P. R. MALLORY & CO. INC.

MALLORY YAXLEY

RADIO SERVICE ENCYCLOPEDIA

17,000 RECEIVERS ANALYZED

AUTOMATIC TUNING

VIBRATORS

ANTENNA DESIGN

RECTIFIERS

AUDIO DISTRIBUTION

TRANSFORMERS

AUTOMATIC FREQUENCY CONTROL

TUBE CHARTS

FORMULAS

AUDIO DEGENERATION

AUDIO FREQUENCY AMPLIFIERS

REACTANCE CHARTS

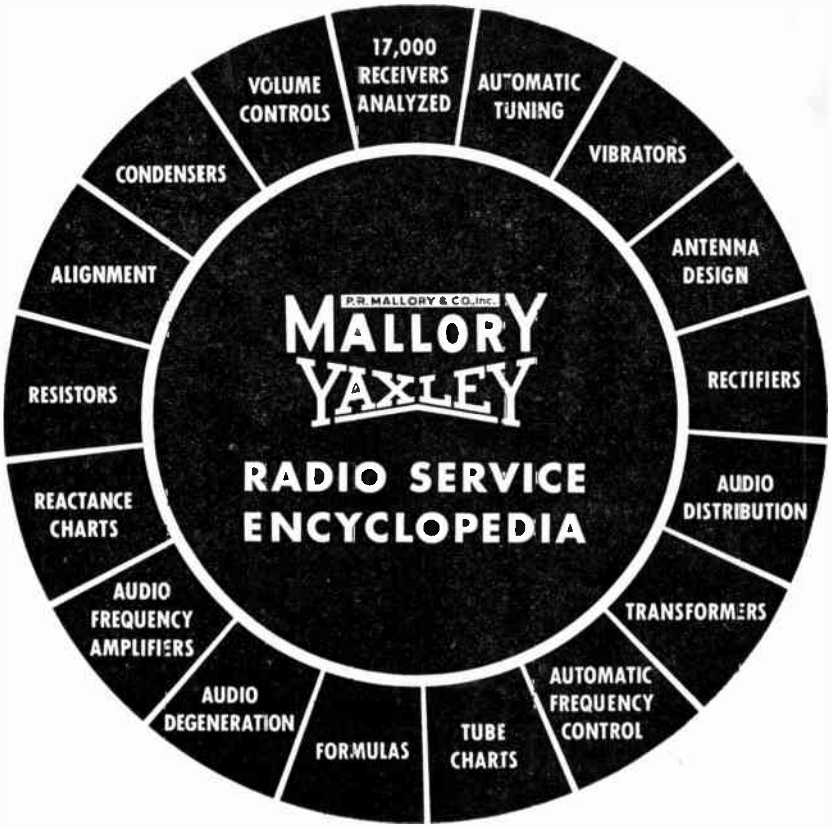
RESISTORS

ALIGNMENT

CONDENSERS

VOLUME CONTROLS

Second EDITION $3.00



Compiled and Published by

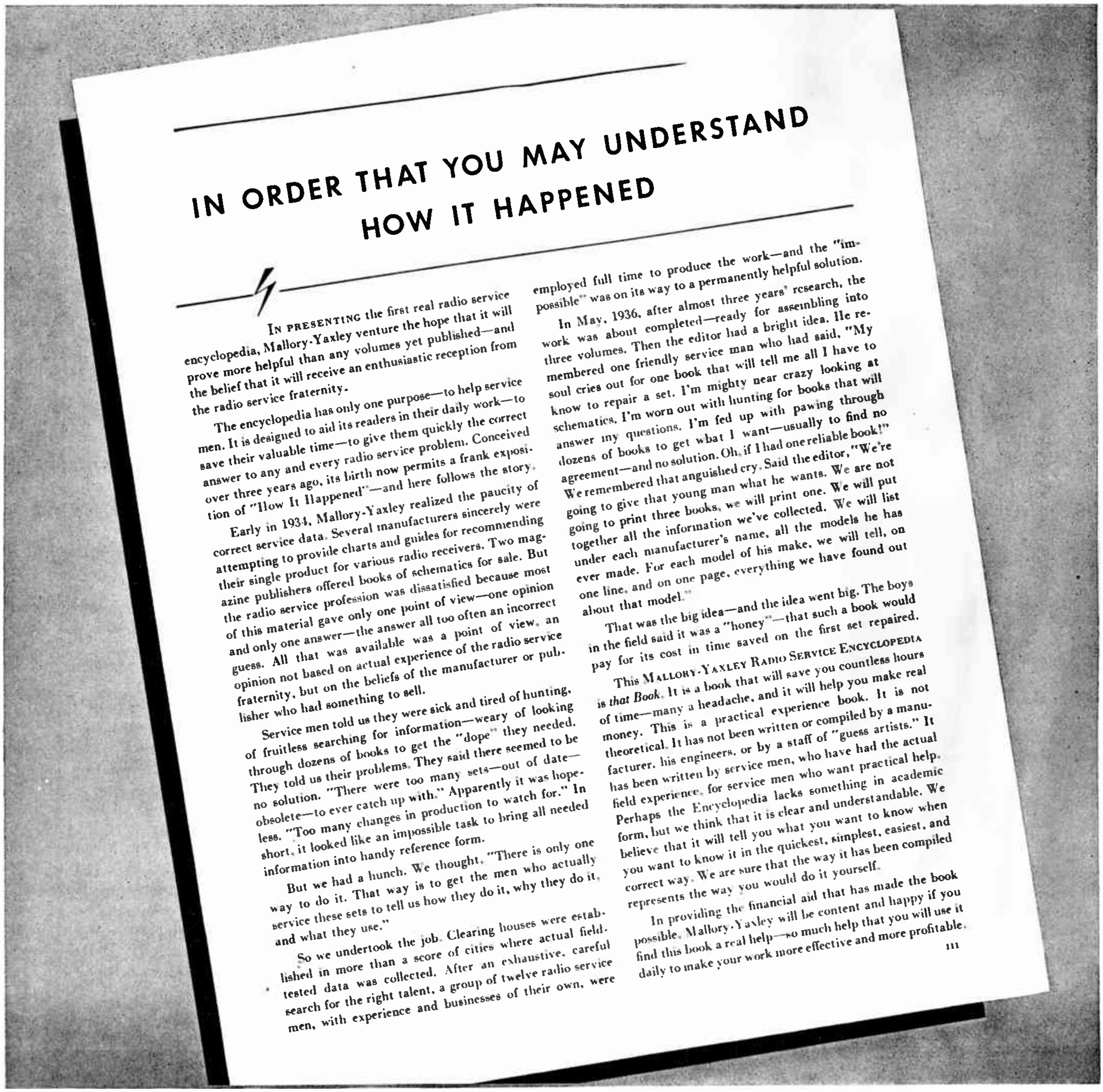
P. R. MALLORY & CO., INC.

INDIANAPOLIS, INDIANA

SECOND EDITION—APRIL, 1938

PRINTED IN U. S. A.

PREFACE *We know of no better way to explain the origin of the Mallory-Yaxley Radio Service Encyclopedia than to reprint the introduction contained in its First Edition, published fifteen months ago. That explanation, given in order that you could understand how the book came into existence, is concise and fully explanatory . . .*



IN ORDER THAT YOU MAY UNDERSTAND HOW IT HAPPENED

In presenting the first real radio service
encyclopedia, Mallory-Yaxley venture the hope that it will
prove more helpful than any volumes yet published—and
the belief that it will receive an enthusiastic reception from
the radio service fraternity.

The encyclopedia has only one purpose—to help service
men. It is designed to aid its readers in their daily work—to
save their valuable time—to give them quickly the correct
answer to any and every radio service problem. Conceived
over three years ago, its birth now permits a frank exposi-
tion of "How It Happened"—and here follows the story.

Early in 1934, Mallory-Yaxley realized the paucity of
correct service data. Several manufacturers sincerely were
attempting to provide charts and guides for recommending
their single product for various radio receivers. Two mag-
azine publishers offered books of schematics for sale. But
the radio service profession was dissatisfied because most
of this material gave only one point of view—one opinion
and only one answer—the answer all too often an incorrect
guess. All that was available was a point of view, an
opinion not based on actual experience of the radio service
fraternity, but on the beliefs of the manufacturer or pub-
lisher who had something to sell.

Service men told us they were sick and tired of hunting,
of fruitless searching for information—weary of looking
through dozens of books to get the "dope" they needed.
They told us their problems. They said there seemed to be
no solution. "There were too many sets—out of date—
obsolete—to ever catch up with." Apparently it was hope-
less. "Too many changes in production to watch for." In
short, it looked like an impossible task to bring all needed
information into handy reference form.

But we had a hunch. We thought, "There is only one
way to do it. That way is to get the men who actually
service these sets to tell us how they do it, why they do it,
and what they use."

So we undertook the job. Clearing houses were estab-
lished in more than a score of cities where actual field-
tested data was collected. After an exhaustive, careful
search for the right talent, a group of twelve radio service
men, with experience and businesses of their own, were
employed full time to produce the work—and the "im-
possible" was on its way to a permanently helpful solution.

In May, 1936, after almost three years' research, the
work was about completed—ready for assembling into
three volumes. Then the editor had a bright idea. He re-
membered one friendly service man who had said, "My
soul cries out for one book that will tell me all I have to
know to repair a set. I'm mighty near crazy looking at
schematics. I'm worn out with hunting for books that will
answer my questions. I'm fed up with pawing through
dozens of books to get what I want—usually to find no
agreement—and no solution. Oh, if I had one reliable book!"
We remembered that anguished cry. Said the editor, "We're
going to give that young man what he wants. We are not
going to print three books, we will print one. We will put
together all the information we've collected. We will list
under each manufacturer's name, all the models he has
ever made. For each model of his make, we will tell, on
one line, and on one page, everything we have found out
about that model."

That was the big idea—and the idea went big. The boys
in the field said it was a "honey"—that such a book would
pay for its cost in time saved on the first set repaired.

This Mallory-Yaxley Radio Service Encyclopedia
is *that Book*. It is a book that will save you countless hours
of time—many a headache, and it will help you make real
money. This is a practical experience book. It is not
theoretical. It has not been written or compiled by a manu-
facturer, his engineers, or by a staff of "guess artists." It
has been written by service men, who have had the actual
field experience, for service men who want practical help.
Perhaps the Encyclopedia lacks something in academic
form, but we think that it is clear and understandable. We
believe that it will tell you what you want to know when
you want to know it in the quickest, simplest, easiest, and
correct way. We are sure that the way it has been compiled
represents the way you would do it yourself.

In providing the financial aid that has made the book
possible, Mallory-Yaxley will be content and happy if you
find this book a real help—so much help that you will use it
daily to make your work more effective and more profitable.

iii

★

Now, after fifteen months, the greatest proof of the value of the Encyclopedia lies in the fact that it is in daily use by tens of thousands of radio service engineers. Their world-wide testimony, evidenced by their enthusiastic letters of commendation, bear witness to this fact. May we again remind you that in providing the financial aid of over $100,000 which has made this service possible, we will be content and happy in rendering a service to you that will make your daily work more effective and more profitable.

Our sincere appreciation to you!

★ *Thus do we acknowledge a special debt of gratitude for generous, spontaneous, willing help, and permission to use articles, charts, and other information without which it would have been impossible to make this Second Edition of the Mallory-Yaxley Radio Service Encyclopedia complete.*

Air-King Products Co., Inc.
Alliance Manufacturing Company
Automatic Radio Manufacturing Co., Inc.
Belmont Radio Corporation
Colonial Radio Corporation
Crosley Radio Corporation
Crowe Name Plate & Manufacturing Co.
Delco Appliance Division, General Motors Sales Corporation
Delco Radio Division, General Motors Corporation
Detrola Corporation
Electrical Research Laboratories, Inc.
Electronics
Emerson Radio & Phonograph Corporation
Fada Radio and Phonograph Corporation
Fairbanks, Morse & Co.
Galvin Manufacturing Corporation
Garod Radio Corporation
General Electric Co.
General Household Utilities Company
General Radio Co.
Gilfillan Bros., Inc.
Gernsback Publications, Inc.
Herbert Horn Radio Co.
Howard Radio Company
Hygrade Sylvania Corporation
Ken-Rad Tube & Lamp Corporation
McGraw-Hill Book Co., Inc.
Mission Bell Radio Mfg. Co., Inc.
Midwest Radio Corp.
Noblitt-Sparks Industries, Incorporated
Operadio Manufacturing Company
Pacific Radio Corporation
Pacific Radio Exchange, Inc.
Packard Bell Radio Company
Peter Pan Radio Corp.
Philadelphia Storage Battery Company
Radio Products Corporation
R C A Manufacturing Company, Inc.
Radio Engineering Handbook, by Keith Henney (Copyright McGraw-Hill Book Co., Inc.)
Radio Amateurs Handbook
Radio News
Radio Retailing
Radio Today
Sears-Roebuck & Co.
The Sparks-Withington Company
Sprague Specialties Company
Stewart-Warner Corporation
Standard Transformer Corporation
Stromberg-Carlson Telephone Manufacturing Company
Thordarson Electric Mfg. Co.
Trav-ler Radio & Television Corporation
Troy Radio Mfg. Co.
United American Bosch Corporation
Utah Radio Products Company
Warwick Manufacturing Co.
Wells-Gardner & Co.
Wholesale Radio Service Co. Inc.
Wilcox-Gay Corporation
Zenith Radio Corporation

For years it has been the Mallory-Yaxley pledge to retain leadership in furnishing constructive, helpful information, and assistance to the radio service fraternity—and to make that information worthy of its confidence. In this, the Second Edition of the Mallory-Yaxley Radio Service Encyclopedia, there is ample evidence of the continuance of this pledge.

To boast of the possession and maintenance of the largest service "morgue" or service library in the world means little. It does mean much; however, to boast of the thousands of friends in the radio service fraternity who, for over four years, have helped to "cut and try"—to reject and finally accept only those improvements which were proven helpful and valuable. Their devotion and loyalty to an ideal—their friendship and their help has made the possession and constant maintenance of this service library possible. To them, we are deeply grateful.

In dedicating the Second Edition of the Encyclopedia to the radio service fraternity, we are also dedicating it to those who have made it possible.

You are always welcome at the Mallory factory, where you may review and witness the continued research and development work—an activity which warrants your 100% confidence.

. . . TO MAKE YOUR WORK MORE EFFECTIVE

AND MORE PROFITABLE . . .

to Help You!

THIS BOOK has one purpose—"*to help you.*" It is designed to aid you in your daily work—to save your valuable time—and to give you quickly the correct answer to any and every radio service problem. *It is divided into three major sections—*

SECTION "A"—Controls
SECTION "B"—Condensers
SECTION "C"—Vibrators

—and supplemented by complete sections covering Tubes, Transformers, Condensers, Volume Controls, Automatic Tuning, Vibrators, Antenna Design, Rectifiers, Audio Distribution, Automatic Frequency Control, Alignment, Resistors, Reactance Charts, Audio Frequency Amplifiers, Audio Degeneration, Formulas, and much other vital information.

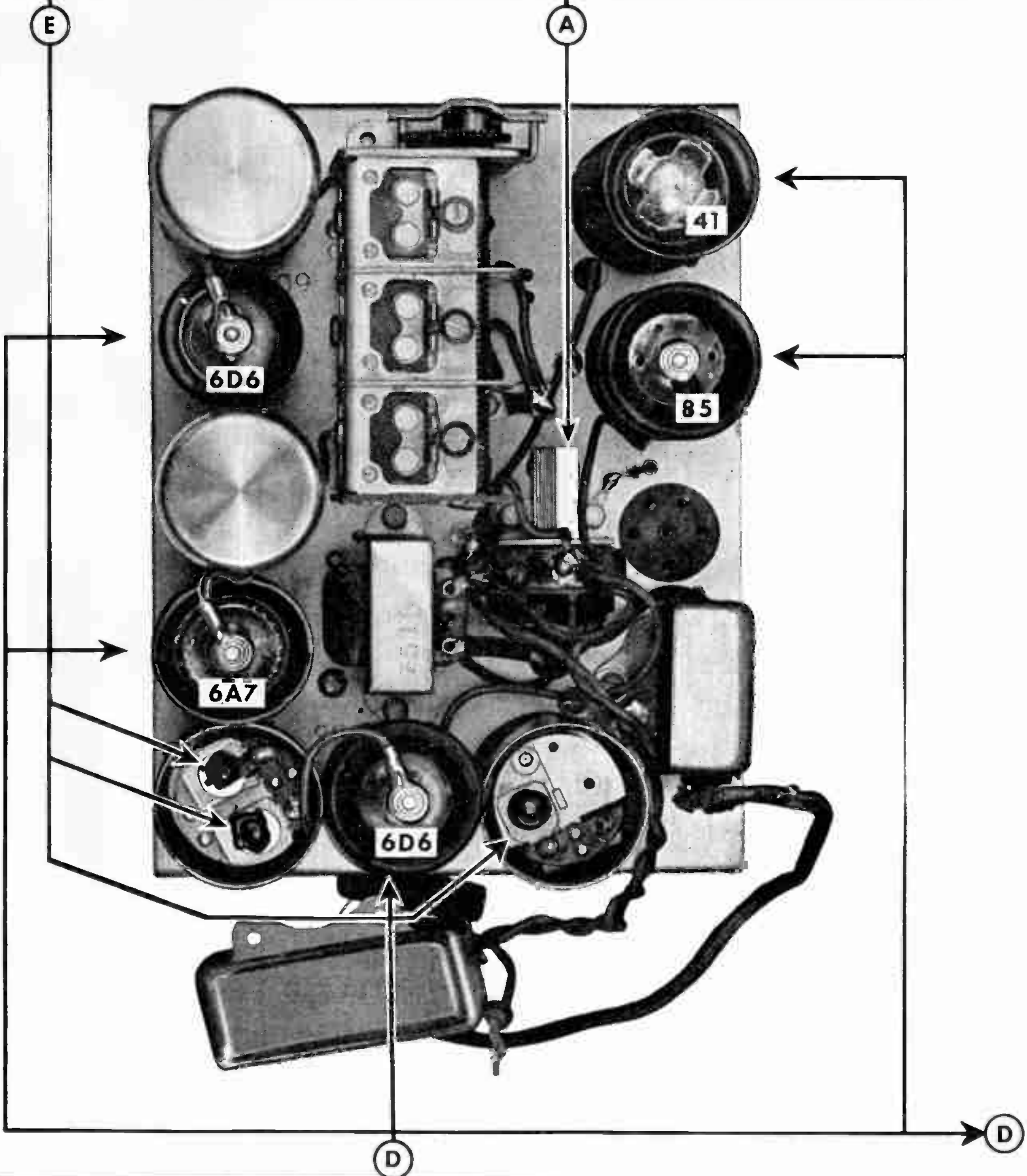
Its use is simple.

But now let's start to save your time. The best way is to show, through an actual case, how the Encyclopedia will help you to repair a set that has gone bad. We are assuming that everything has worn out. The set is in terrible shape. There are many problems. Let's repair it quickly with an expenditure of a minimum amount of your time.

THIS RECEIVER is the Atwater Kent Model 666 auto radio pictured on the following two pages. Here is exactly what you would see if the set were on your service bench. The first view is from directly above the chassis, the second is from underneath the chassis, and the third is of the power supply unit (views are shown with the outer case and power supply case removed). *Now, turn the page and let's actually service the set.*

CONTROLS

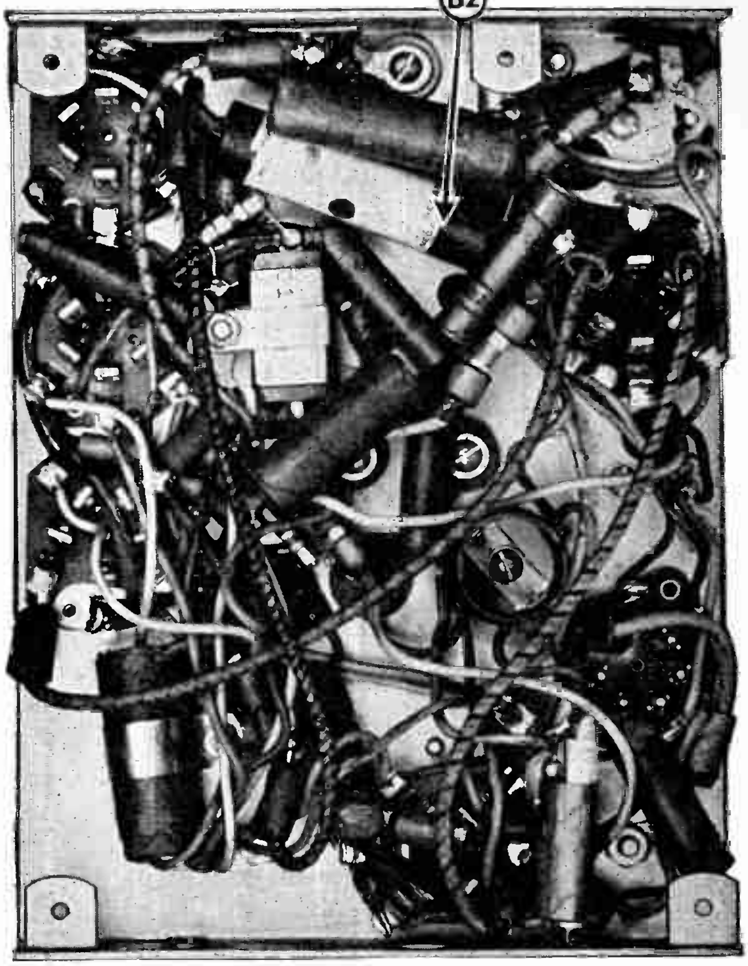
I. F. Peak 264	Use Vol.	Circuit 55	Correct Replacement UC512	SW 6	Bias	Note

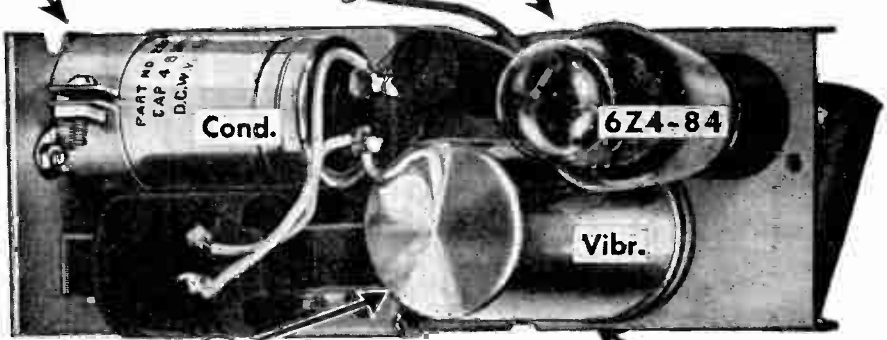


COMPLETE TUBE COMPLEMENT
²6D6, 6A7, 85, 41, 6Z4-84

CONDENSERS			
Original Part	Circuit	Correct Replacement	Note
26995	1	SR605	B23

CONDENSERS			
Original Part	Circuit	Correct Replacement	Note
25397	15	TS101	





VIBRATORS		
Vibr. Conn.	Replacement	Note
37	296	C3

Trans. Circuit 10

Look at page 23. You'll find complete replacement information listed for Atwater Kent Model 666.

MALLORY—YAXLEY RADIO SERVICE ENCYCLOPEDIA

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ATWATER KENT—Continued																
666	Vol.	55	UC512	6			26995 25397 .05-.05	1 15	SR605 TS101 Buffer	B23 B14	37	296	C3	[2]6D6, 6A7, 85, 41 6Z4-84	264	10
667	Vol.	55	N				22538	1	WE847					[1]58, 56, 55, 2A5, 80	264	1

CONTROLS

The volume control is found to be defective. Looking at the chassis from directly above it, the control appears like this in Figure I (indicated by arrow "A" on the complete receiver layout, page 4).

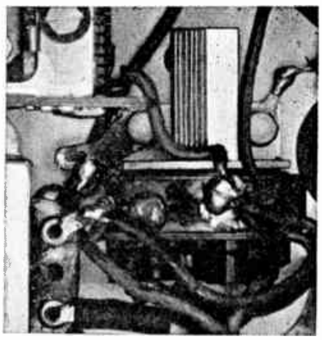
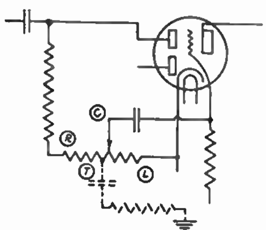


FIGURE I

The circuit in which it is employed looks like this (Circuit 55, page 180).



In a few cases the circuits may be modified to lend themselves to a more universal application. The circuit shown differs from the original in that an RF choke is substituted for the coupling resistor. The majority of models produced by this manufacturer employing circuits of this type, use the coupling resistor method. Since this factor has no direct bearing on the volume control action, it is not necessary to show the variation.

The replacement calls for a 500,000 ohm, left-hand tapered control, with a 5/32" slotted shaft—Type UC512.

Upon further examination of the control you see that a switch is included. The listing shows that it may be replaced by a No. 6 type. The attachable switch is assembled to the control, and the complete unit installed in the receiver in the manner shown in Figure II.

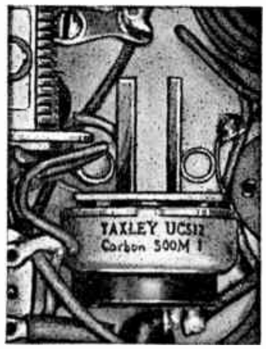


FIGURE II

CONDENSERS

Now let's see what can be done about replacing the electrolytic condensers. The first one we encounter is the filter condenser part number 26995 in the power supply unit proper. It is of the ring clamp mounting type and appears in the lower left hand corner of the power supply. Figure III illustrates it. (See arrow "B-1" in the complete receiver illustration on page 7.)

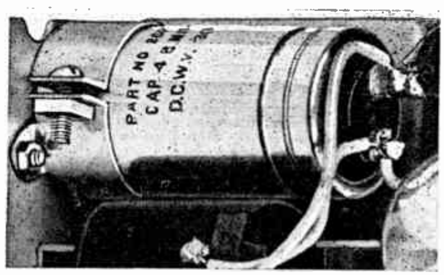
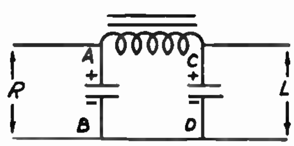


FIGURE III

Here is the filter circuit in which the condenser is used (Circuit 1, page 208).



The correct replacement is an 8-8 mfd., 350 working volt, can type condenser. In this case it is desirable that the replacement unit be equipped with lug terminals and that the can be used for the common negative connection, so an SR605 condenser is specified.

Upon glancing farther across the listing form we see that reference is made to a note B-23. *Be sure* to read this note before attempting to make an installation. Note B23 page 201 reads as follows: "When Mallory stud type condensers such as the SR602, SR605, etc., are recommended to replace condensers of the ring clamp mounting type, the stud may be cut off flush with the top of the can. Be careful not to cut into the can." For replacement in this particular receiver, the stud should be cut off and the condenser installed as pictured in Figure IV.

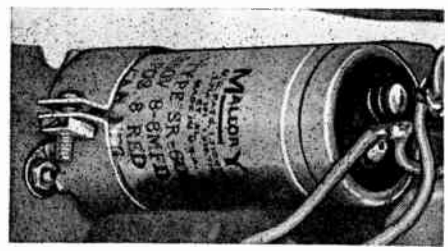
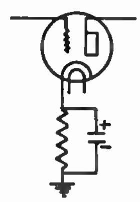


FIGURE IV

A look at the under-side of the receiver chassis reveals another electrolytic condenser, part number 25397 with which we are having trouble. Figure V illustrates it. (Indicated by arrow "B-2" on the receiver layout on page 7.)

FIGURE V

It is used as a cathode bypass condenser on the type 41 output tube. The circuit is shown. (See Circuit 15, page 208).



The correct replacement for this is a 10 mfd. 25-volt tubular—type TS101. This one is really simple. Here's the proof in Figure VI.

FIGURE VI

Since this is a vibrator-powered auto radio our condenser listing includes the correct buffer capacity value for use in this model. The buffer condensers are not visible in the illustrations, but are located directly beneath the rectifier tube socket. If they are not of the specified capacity, or if they have any marked leakage tendency, they should be replaced.

VIBRATORS

Now we can devote our attention to the vibrator problem. The vibrator is plugged in directly above the filter choke and alongside the rectifier tube. Figure VII shows how it looks.

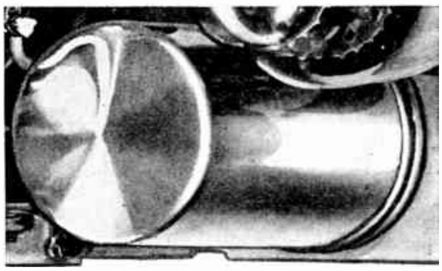
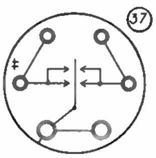


FIGURE VII

The vibrator leads connect into the plug as shown (vibrator connection circuit 37 on page 231).



The correct replacement vibrator must have an equivalent plug arrangement—type 296. Before installing, remember, *read the notes.* Note C3 listed for this replacement appears on page 228 and reads as follows:

C3—When unusual vibrator troubles are experienced a thorough check should be made of all of the power pack parts and the circuit. It is especially important that the secondary buffer condenser, connected across the secondary of the transformer be in good operating condition and within plus or minus 10% of the specified capacity. Be sure to check buffer condenser. In some instances this condenser may be two condensers with the common lead grounded. In certain sets resistors have been used in series with these condensers. If the replacement of a buffer condenser is necessary use the Mallory Oil Filled, high voltage condenser, Type "OT" or "VB" as required. *Never substitute a different value—use only the specified capacity.* The wrong buffer capacity may cause serious damage to the vibrator in a very short time. See Condenser Listing for specified capacity.

This note again warns you of the importance of checking the buffer condensers whenever extensive vibrator trouble is experienced. With the conclusion of this operation the new vibrator is plugged in as illustrated in Figure VIII.

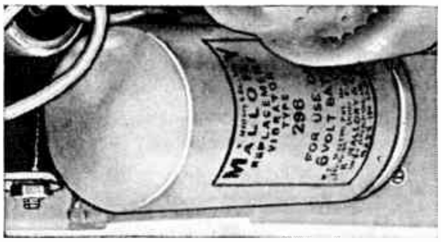


FIGURE VIII

TUBES

The tubes are next. Under the column headed "Complete Tube Complement" you find that the receiver uses 2-6D6, 1-6A7, 1-85, 1-41, and 1-84 or 6Z4. (See arrow "D" on the complete receiver view, pages 6 and 7.) In the first edition of this book all of the types used in the receivers were listed. Since publication we have had requests from servicemen asking that the number of each type used be included. We are happy to be able to comply with that request. If two or more tubes of any type are used, the superior figure indicates the number. The absence of any superior figure means that only one tube of that type is used. Now it is possible for you to carry with you to the job, a stock of tubes that will be able to replace any or all tubes which the set may require. Just ask your customer for the model number of his receiver, select the proper types for replacement from this list, and save yourself time, gas, and mileage. Where there have been tube changes from one type to another during production, they are indicated by a hyphen or the word "or," i.e.: "6Z4-84," or "01A or 12A." On pages 318 to 332 of this book, entirely new and up-to-the-minute tube information is presented. The tube charts, arranged in simple, logical manner, provide authentic characteristic data, operating conditions, and pin arrangement layouts.

Complete Tube Complement
^{2}6D6, 6A7, 85, 41 6Z4-84
^{3}58, 56, 55, 2A5, 80
^{3}78, 37, 75, ^{2}43
^{2}58, 2A6, 2A5, 80
^{3}6D6, 6A7, 6B7, ^{2}76, ^{2}45, 5Z3
^{3}58, 55, ^{2}56, ^{2}2A3, 5Z3
6A8, 6K7, 75, 6F6, 80

ALIGNMENT

Perhaps the number of replacements made, or alterations performed during a previous repair, make it necessary to realign the receiver. The column headed "IF Peak" gives you the frequency at which the IF transformers are to be adjusted. See arrow "E" on page 6.

I. F. Peak
264
264
264 472.5

As shown, the correct frequency for IF alignment in this case is 264 kilocycles. If there is any doubt in your mind as to the proper methods to use in any alignment problem you may encounter, consult the new alignment article on pages 243-245. A really informative article written in a concise and usable manner. Any service engineer desirous of obtaining the best results on re-alignment of the high fidelity or variable fidelity receivers, will, we believe, benefit greatly by studying the portion of the text which explains the use of the oscilloscope and the frequency-modulated test oscillator for this purpose. In addition, wherever the alignment process is further complicated by the presence of Automatic Frequency Control in the receiver, you have a complete discussion of this feature available on pages 246-248. We urge you to use this material, for it is accurate, helpful, and timely.

TRANSFORMERS

Possibly the transformer is defective. Transformer Circuit No. 10 on page 273 shows the number of windings and their arrangement. A real help when you need it. And when you need it, is when it saves you time and makes your profit real. The transformer data and circuits on pages 236-239 will be found most beneficial because they enable the purchase of a correct replacement and the "straightening out" of receivers on which the wiring has been changed. They also facilitate "rebuilding jobs."

Trans. Circuit
10
1

GENERAL INFORMATION

PAPER BY-PASS UNITS

On page 198 you'll find a "honey" of an article headed "Bypass Condenser Circuits" followed by some real information in an article headed "Capacity of Bypass Condensers." These tell you how you can free yourself from depending on general schematics—from failure to find the dope you want—and make you certain of getting the right answer always. Consult the Mallory-Yaxley general catalog for a complete description of the paper dielectric replacement items. There are types available for every replacement use.

RESISTORS

On pages 280-282 there is an excellent article entitled "Resistor Theory and Practice." This discussion answers a long-felt need for really accurate instruction concerning resistor application. Information relative to the type of resistors to choose for power packs, bleeder systems, voltmeter multipliers, etc., is included.

The use of formulae to calculate resistance and wattage values for all of the above applications is fully explained. In addition, you'll find that the resistor wattage chart on page 279, the series condenser-parallel resistor chart on page 275, and the RMA Standard Color Coding explanation on page 278, will save you a lot of time by furnishing a rapid solution to your resistor calculations.

AUTOMATIC TUNING

Here is the only complete, authentic source of information on this newly developed and highly important phase of radio receiver design. It is the only article ever compiled which gives you all the information on *any* type of automatically tuned radio models.

The article, twenty-five pages in length (pages 249-274 inclusive), contains over one hundred illustrations, so that every function of the system is clearly portrayed and easily understandable. Mechanically operated manual types, motor-operated types, and tuned circuit substitution types have been classified and a reference form similar to that of component part replacement listings established. This gives you the information you need with a minimum expenditure of time. Remember, if you are to successfully service receivers which incorporate automatic tuning systems you must know the "how and why" of their operation. Keep abreast of the current designs by a thorough study of this extremely valuable article, so that you will be in a position to offer intelligent service to your customers. This invariably results in increased service activity and prestige.

AUDIO AMPLIFIER DESIGN AND USE

Pages 286-306 are devoted to a discussion of the design and usage of audio frequency amplifying systems. Composed of three major sections it deals with resistance-capacity coupled audio frequency amplifiers, audio degeneration, and audio frequency distribution systems.

The first section concerns the performance characteristics of resistance-capacity coupled amplifiers. It supplies data which will enable you to diagnose the causes of unsatisfactory operation as related to overall response, motorboating, inefficient use of the component parts, etc. It also includes some very useful design tables from which you may select the proper resistor load values and coupling condenser capacity ratings for a given tube application.

The second section covers the design and application of audio degeneration. It shows the derivation of the basic degeneration formulae and includes full instructions for its use. The introduction of degeneration into some of the older receivers employing pentode power output tubes will often times result in a great improvement in the tonal quality of the reproduction.

The subject of audio distribution occupies the third section. This discussion is particularly recommended to those interested in sound systems and similar equipment. The article covers in detail such major subjects as speakers, coupling transformers, impedance matching in all forms of distribution circuits, the use and calculation of the various designs of attenuation networks, either fixed or variable, etc. When you have a problem which concerns any of the above subjects, or any subject which could be classified as relating to audio distribution, refer to this article for an accurate and rapid solution.

USEFUL SERVICING FORMULAS

Pages 312-317 are crammed full of formulas and tables of use in everyday service procedure. Here are simple guides for your calculations concerning many factors which are becoming increasingly more important due to the complexity of modern receiver circuit design. Voltage and resistance network breakdown explanations, frequency conversion table, series or parallel impedance formulas, a full page chart for easy calculation of the inductance of single layer coils (page 317) are only a few examples of the material contained in this reference section. We would also like to call your attention to the reactance charts on pages 282-285. The use of these charts is very simple, and they provide rapid, accurate calculations without resort to complicated mathematical methods.

Now, just to be sure you understand, let's go over the whole arrangement again.

The encyclopedia is divided into three major sections: SECTION "A"—CONTROLS
SECTION "B"—CONDENSERS
SECTION "C"—VIBRATORS

Other important sections such as Antenna Design, Alignment, Automatic Frequency Control, Automatic Tuning, etc., are indexed in both the front and rear of this book.

To use the encyclopedia is simple. Learn to use it, then use it on every job. Using it continually and faithfully will save your time, your labor, and will increase your profits.

Over 17,000 different radio receivers are listed, and still there are some on which no records are available. Whether listed or not, information in the encyclopedia will enable you to effect a quick satisfactory repair.

ENCYCLOPEDIA—LISTINGS

MANUFACTURER AND MODEL
COLIN B. KENNEDY CORP.
5T AC-DC........
Royal............
10...............
20...............
22...............
26...............
30, 32............
34...............
36, 38, 40..........
42 "Coronet"......
42B..............

Receivers are listed either by the manufacturer's name, or the trade-name, according to popular usage. A cross-index in the listings will help you locate the receiver you are looking for.

Model numbers precede chassis numbers, with few exceptions. In these cases, model numbers are in parantheses and follow chassis numbers.

CONTROLS

CONTROLS					
Use	Circuit	Correct Replacement	Switch	Bias	*Note
Vol.					
Vol.					
Tone					
Supp.					
Vol.					
Tone					
Vol.					
Tone					

USE—Controls are listed with an abbreviation of their most common designation; i. e., "Vol." = volume control; "Supp." = Suppressor Control. A complete list of abbreviations is on page 157.

CONTROLS					
Use	Circuit	Correct Replacement	Switch	Bias	*Note
	45				
	17				
	22				
	45				
	44				
	45				
	44				

CIRCUIT—Numbers refer to "A" Control Circuits on pages 178 to 183. These schematic circuits enable you to check the receiver on which you are working to make sure the circuit has not been changed during a previous repair or during that particular model's life in its period of manufacture. Often it is advisable to change a circuit to obtain better performance. Complete instructions are given in Section "A" Controls—pages 158 to 189.

CONTROLS					
Use	Circuit	Correct Replacement	Switch	Bias	*Note
		M........			
		N........			
		SRP258 ...			
		G.........			
		L.........			
		UC508....			
		SRP154....			
		SRP154....			
		SRP154....			
		500M No. 1			See Note A19

CORRECT REPLACEMENT—Here are listed recommended correct replacements. By referring to page 188 an "M" is immediately translated to read "250,000 ohm carbon control with left-hand taper—universal shaft." Where a recommendation reads "500M-No. 1" or is not a definite recommendation, and is followed by a note in the Note Column, it means that the complete or partial value of a control is known. The note referred to gives comprehensive, clear, concise instructions to make a quick satisfactory replacement.

CONTROLS					
Use	Circuit	Correct Replacement	Switch	Bias	*Note
			6		
			6		

SWITCH—The number of the replacement switch which must be used with the recommended control is listed in this column. Referring to page 185, replacement switch numbers are quickly translated; i. e., No. 6 = single pole—single throw.

CONTROLS					
Use	Circuit	Correct Replacement	Switch	Bias	*Note
				EX350	
				EX350	
				EX350	

BIAS—This column tells you that the control is used in a cathode or "bias" circuit. The original control contained a fixed resistance which must be duplicated.

All carbon controls which may possibly be used in "bias" type circuits are provided with a separate adjustable resistor of 500 ohms total resistance. This may be adjusted to the value given in the "Bias" column. "EX350" means that the resistor is to be set at 350 ohms and wired between the right-hand terminal of the control and the cathode circuit. This is accurate and is not to be compared to the haphazard use of an arbitrary value of fixed resistance.

Wire-wound controls contain an adjustable section for this purpose. Where a wire-wound control is specified, the bias column will contain a numeral from 1 to 5 designating the correct setting for this adjustable section.

*NOTE—

		See Note A73		1	See Note B1

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

CONTROLS					
Use	Circuit	Correct Replacement	Switch	Bias	*Note
					See Note A19
					See Note A19
					See Note A5

On pages 176 and 177 there are ninety-six "A" (control) Notes. These are valuable because they tell what to do and how to do it. They tell how to make a quick and easy replacement when information is impossible to obtain. They permit the selection of a proper control either at your distributors, or to tell him by mail the correct resistance and the right taper which, with a sketch of the shaft that you will make, will enable you to receive the right control without delay, loss of time, or customer dissatisfaction.

The "Note" sections ("A" Controls, "B" Condensers, "C" Vibrators) of the encyclopedia are without doubt the finest and most helpful compilation ever printed.

We strongly advise, for your own benefit, that you read these "Note" sections. They will save you time and worry and will make money for you.

CONDENSERS

CONDENSERS			
Original Part	Circuit	Correct Replacement	*Note
8-8-8.....			
8-8........			
8-8........			
8			
8			
8-8			
4-8........			
4-2-4......			

ORIGINAL PART—Under the heading "Original Parts" is listed either the value of the original condensers or the part numbers originally used. Condensers are listed in the order of their importance. First, filter units, second, by-pass units. Filter units are in most instances listed in their respective order of installation, from the rectifier to the load.

8-8-8 means that there is one condenser with three 8 mfd. sections used in the circuit.

8, 8, 8 means that there are three 8 mfd. condensers used in the circuit.

CONDENSERS			
Original Part	Circuit	Correct Replacement	*Note
	1		
	1/13		
	15		
	1		
	13/15		
	13/15		
	1		
	1		
	13		
	15		
	1		
	1/14		
	1		

CIRCUIT—The use of each condenser section is not given because this is clearly shown in the schematics of condensers circuits.

"B" (condenser) Circuits are shown on pages 208 to 211. A double number 1/13 means that sections of the condenser are used in two different circuits; i. e., Circuit No. 1 and Circuit No. 13, both shown on page 208.

CONDENSERS			
Original Part	Circuit	Correct Replacement	*Note
		RN232	
		Buffer	
		CM172	
		TS105	
		Buffer	
		RN232	
		Buffer	
		RN232	
		Buffer	

CORRECT REPLACEMENT—Here are listed recommended correct replacements. By referring to page 218 an RN232 is immediately translated to read—a *dual* 8 mfd. 250 volt round can filter condenser. The word "Buffer" refers to the secondary or buffer condenser which is connected across the secondary of the vibrator power transformer, the value being given in the "original part" column.

***NOTE**—

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

CONDENSERS			
Original Part	Circuit	Correct Replacement	*Note
			B3
			B66

On pages 200 to 207 there are over two hundred and sixty "B" (condenser) NOTES. These are valuable because they tell you what to do and how to do it. They tell how to make a quick and easy replacement when information is impossible to obtain. *They permit the selection of the right condenser without referring to original color coding which may have been obliterated by age, by factory changes during production, or by a previous repair to the receiver. Quick, accurate and wonderfully easy condenser replacements will be effected by reading "B" (condenser) Notes.*

The "Note" sections ("A" Controls, "B" Condensers, "C" Vibrators) of the encyclopedia are without doubt the finest and most helpful compilation ever printed.

We strongly advise, for your own benefit, that you read these "Note" sections. They will save you time and worry and will make money for you.

VIBRATORS

VIBRATORS		
Vibr. Conn.	Replacement	*Note
32	287M	C3
32	G287M	C16
32	287M	C3
32	G287M	C16
24	273	
20	253	C3
20	G253	C16
32	287M	C3
32	G287M	C16
35	294	C3

VIBR. CONN.—Vibrator connections are shown on pages 230 to 231. They're easily understood for they show the appearance and the connections of all replacement units.

REPLACEMENT—Here the correct replacement is listed. No guess work for all have been field-tested just as has every other bit of information in the encyclopedia.

NOTE—Clear instructions for installation, or for the proper selection of a unit, are given in 23 concise notes on pages 228 and 229.

★

P. R. MALLORY & CO., Inc.

MALLORY

GRID BIAS CELL

This exclusive Mallory development is described on page 214. The idea of providing a voltage device, incapable of delivering appreciable current and having an indefinite life, is the invention of Samuel Ruben, as well as the circuit in which the device is used and is covered by U. S. letters Patent 1,920,151 and 2,063,524.

★

WARNING!

Always check the circuit of the receiver upon which you are working to make sure that it does not differ from the circuit listed against the replacement part in the Encyclopedia. In case you should find a difference, read the explanation of circuits given in . . .

Section "A" for Controls

Section "B" for Condensers

Section "C" for Vibrators

You'll find the answer you want every time. Now that an explanation of the encyclopedia has been completed, it is only fair to say that every possible help and advice has been compiled "to help you." Make use of this help. Read, learn and consult the encyclopedia daily. You have everything to gain and nothing to lose.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
A. C. DAYTON																
XL50, XL60, XL61	Vol.	26	UC509											^{5}01A, 12A		
AC63	Vol.	14	L				‡		See Note	B1				^{4}26, 27, 71A, 80		
AC65	Vol.	14	L				‡		See Note	B7				^{4}26, 27, 10, 81		34
AC66	Vol.	14	L				‡		See Note	B7				24, ^{3}26, 27, 50, 81		34
XL 70	Vol.	26	UC509											^{6}01A, 12A		
	Fil.	29	Q													
"Navigator" Series	Vol.	32	SRP274				8-8-8	3	MN275					^{6}27, ^{2}45, 80		1
ACME ELEC. & MFG. CO.																
AC7	Vol.	35	M				2-3	1	See Note	B1				^{4}26, 27, 71A, 80		2
SG88	Vol.	12	A5MP				8-8-8	3	MN275					^{3}24, ^{2}27, ^{2}45, 80		3
AC98	Vol.	7	UC500				8-8-8	3	MN275					^{3}24, ^{2}27, ^{2}45, 80		3
"Moto-Midget"	Vol.	33	N	6	See Note A1									^{2}39, 36, 37, 41		
	Vol.	6	K12		See Note A2											
ACRATEST PRODUCTS																
37	Vol.	‡	100M No. 1		See Note A3		2-8-8	1	See Note	B2				^{2}53, ^{2}56, ^{2}46, 5Z3		1
							10	15	TS101	B6						
38	Vol.	36	100M No. 1		See Note A3		2-8-8-8	‡	See Note	B2				^{4}53, ^{2}50, 80, 83		4
							10	15	TS101	B6						
47	Vol.	23	LL				8	12	See Note	B3				^{2}6A6, ^{2}6B5		MG
							8	13	See Note	B3						
108	Vol.	36	100M No. 1		See Note A3		8-8-1	22	See Note	B3				^{2}57, ^{2}2B6, 83		1
120	Vol.	16	M				6-6	2	See Note	B3				^{2}56, ^{2}45, 80		1
126	Vol.	23	100M No. 1		See Note A3		4-4	1	See Note	B2				^{2}57, ^{2}56, ^{2}50, ^{2}81		5
194	Vol.	6	H7				8-8	1	See Note	B3				^{2}78, 77, 80 or ^{2}6D6,		
							10-10	15	TN111					6C6, 76, 80		1
196, 197	Vol.	15	L				2-8-8-8	‡	See Note	B2				^{2}57, ^{2}56, ^{2}50, 80, 83		4
198, 199	Vol.	15	L				2-8	1	See Note	B2				^{2}57, ^{2}56, ^{2}46, ^{2}80		1
200	Vol.	15	L				8-8	1	See Note	B3				6A6, ^{2}41, 80		1
418	Vol.	23	100M No. 1		See Note A3		1-4	‡	See Note	B4				^{2}57, ^{2}45, ^{2}RK18, RK19,		
														80		4
728							8-8	1	See Note	B3				2B6, 57, 80		1
739							8-8	1	See Note	B3				80		1
770	Vol.	36	250M No. 1		See Note A3		6714	4	CN152					^{2}36, ^{2}37, ^{2}2A3		
1900	Vol.	23	MM				8, 8	1	WE847					^{4}6B5, ^{2}5Z3		1
ACRATONE—Also see Federated Purchaser and Airking.																
L5	Vol.	18	N	6			P474	32	RS211					6L7, 6K7, 6C5, 6H6,		
	Tone	34	L				P160	32	CN151	B81				6F5, 6F6, 5Z4	456	1
							P304	15	TS101							
L6	Vol.	18	N	6			P474	32	RS211					6L7, 6K7, ^{2}6Q7, 6C5,		
	Tone	44	L				P160	32	CN151	B81				^{2}6F6, 5Z4	456	1
							P304	15	TS101							
L7	Vol.	45	N	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{3}30, ^{2}34	456	10
	Tone	‡	L				.01-.01		Buffer	B14						
X6	Vol	45	N	7			P391	1	RN232	B90	14	245C	C3	‡	‡	‡
	Tone	‡	L				.01-.01		Buffer	B14						
Z4	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275	7			P958	1	RN232	B90	14	245C	C3	1C6, 34, ^{2}30, 32, 19	456	10
	Tone	44	L				.01-.01		Buffer	B14						
ADDISON																
N655	Vol.	64	N	7			8-4	1	See Note	B3	31	285XS	C3	1C6, 34, ^{3}30, 19	‡	10
	Tone	22	‡		See Note A5		.01-.01		Buffer	B14						
ADMIRAL—See Continental.																
ADVANCE ELECTRIC CO.																
"A" Auto	Vol.	33	N		See Note A1		10	15	TS101					^{4}36, 41		
Falck "Super B"	Vol.	7	G				6-6	4	See Note	B3				^{2}51, ^{2}24, 27, 47, 80	‡	1
	Tone	22	M													
Falck "E"	Vol.	7	UC509				6-6	4	See Note	B3				51, 24, 47, 80		1
77, 88, 89	Vol.	7	C				6-6	1	See Note	B3				^{3}24, 27, 45, 80		1
	Tone	22	M		See Note A4											
AERO PRODUCTS—See Chas. Hoodwin.																
AETNA																
4T '36	Vol.	6	G12	6	EX125		16-12	23	See Note	B3				6D6, 6C6, 43, 25Z5		
5T '36	Vol.	18	N				16-12	4	See Note	B3				6A7, 6D6, 75, 43,		
	Tone	22	‡		See Note A5									25Z5	465	
252	Vol.	7	MR45	M26	EX120		16-8-5-5	1/15	UR189	B5				6D6, 6C6, 43, 25Z5		
630, 635, 652	Vol.	18	N				8-8	1	See Note	B3				‡	456	1
	Tone	22	K12													
AIRCASTLE																
A31	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
BA41	Vol.	18	N	6		A21	8-8	1	CN152		14	245C	C3	1C6, 34, ^{2}30, 32, 33	456	6
							.01-.01		Buffer	B14						
L5	Vol.	18	N	6			P474	32	RS211					6L7, 6K7, 6C5, 6H6,		
	Tone	34	L				P160	32	CN151	B81				6F5, 6F6, 5Z4	456	1
							P304	15	TS101							
L6	Vol.	18	N	6			P474	32	RS211					6L7, 6K7, ^{2}6Q7, 6C5,		
	Tone	44	L				P160	32	CN151	B81				^{2}6F6, 5Z4	456	1
							P304	15	TS101							
L7	Vol.	45	N	7			P391	1	RN232		14	245C	C3	1C6, 19, ^{3}30, ^{2}34	456	10
	Tone	‡	L				.01-.01		Buffer	B14						
X6	Vol.	45	N	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, 30, 32, 34	456	10
	Tone	‡	L				.01-.01		Buffer	B14						
Z4	Vol.	45	SRP275	7			P391	1	RN232		14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275	7			P958	1	RN232		14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
14-112S	Vol.	18	UM157-SS3				2994	1	^{2}CS133	B85	35	294	C3	^{2}78, 6A7, 75, 42, 84	262	10
	Tone	22	MR36				.0075		Buffer	B14						
	Sen.	7	C1MP													
14-127ES	Vol.	18	N				3375	23	RS216					6A7, 6D6, 75, 76, ^{2}42,		
	Tone	147	P				3351	23	WE847					6G5, 80	456	1
AIRKING																
Dynamic 2 Range	Vol.	6	SRP263				8-8	6	CN142					6D6, 6C6, 43, 25Z5		
							5	15	TS105							
Knave	Vol.	18	N	6			16-8-5-5	1/15	UR189	B3				6A7, ^{2}6D6, 75, 43,		
	Tone	106	N											25Z5	456	
Magnetic	Vol.	6	SRP263				8-8	24	CN142					6D6, 6C6, 38, 76		
							5	15	TS101							
Royalty	Vol.	18	N	6			16	1	CS136					6A7, ^{2}6D6, 75, 76,		
	Tone	21	N				5	15	TS101					^{2}42, 80	456	1
4T "Comet"	Vol.	7	UC509	6	EX300		12-8-5-5	1/15	UR189	B5				78, 77, 43, 25Z5		
Atlas 5T Universal	Vol.	18	MR48	M26			16-8-5-5	6/15	See Note	B5				6A7, 78, 75, 43, 25Z5	456	

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
AIRKING — Continued																
6T TRF-LW	Vol.	6	F7				8, 8	4	RS213					[2]58, 57,[2]47, 80		1
	Tone	21	O													
7T BC "Super"	Vol.	6	G12				8, 8	4	RS213					[2]58,[2]57,[2]47, 80	175	1
	Tone	21	P													
7T TRF-LW	Vol.	6	F7		2		8, 8	4	RS213					[3]58, 57,[2]47, 80		1
	Tone	21	O													
10	Vol.	6	SRP263				8-8	24	CN142					6D6, 6C6, 38, 76		
							5	15	TS101							
11F	Vol.	15	N				16-30	1	See Note	B3				[2]6K7G, 6A8G, 6H6G,		
	Tone	41	N	6			5	15	TS101					6G5, [3]6C5G,		
														[2]6N6G, 5V4G	456	1
21, 22 Series	Vol.	7	J	6			10-10	1	See Note	B3				6D6, 6C6, 38, 76		
							5	15	TS101							
27, 28A	Vol.	18	N				20	6	CS126					6A7, 6D6, 75, 43,		
							10	6	CS125					25Z5	456	
							5	15	TS105							
37, 39	Vol.	6	G	6	2		16-8-6	8/15	See Note	B5				[2]77, 78, 43, 25Z5	456	
40	Vol.	6	UC509				8-8	24	CN142					6D6, 6C6, 38, 37		
							5	15	TS101	B6						
41, 42	Vol.	6	SRP263				8-8	24	CN142					6D6, 6C6, 38, 76		
							5	15	TS101							
47, 48, 57, 58	Vol.	18	N				20	6	CS126					6A7, 6D6, 75, 43,		
							10	6	CS125					25Z5	456	
							5	15	TS105							
50 AC-DC	Vol.	6	UC509				8-8	6	CN142					6D6, 6C6, 43, 25Z5		
							5	15	TS101							
52, 54	Vol.	6	H7	6	3		8-4	1	CN151					[2]57, 58, 47, 80	456	1
66	Vol.	18	N	6			16-8-5-5	6/15	UR189	B5				6A7, 6D6, 75, 43,		
														25Z5	456	
70	Vol.	18	N				16-16	1	See Note	B3				6A7, 6D6, 76, 75,[2]42,		
	Tone	21	N				5	15	TS101	B6				80	456	1
72, 73	Vol.	18	MR48				24-12-4	1/13	See Note	B3				6A7, 6D6, 75, 6G5,		
	Tone	22	N				5	15	TS101					43, 25Z5, 36H	456	
81 Series	Vol.	7	J	6			10-10	1	See Note	B3				6D6, 6C6, 38, 76		
							5	15	TS101							
209	Vol.	45	N				16	1	CS136	B3				6A8, 6K7, 6H6, 6F5,		
	Tone	21	N	6			8	1	CS133	B3				6F6, 5Z4	456	1
							5	15	TS105							
211	Vol.	45	N				24	6	CN145	B8				6A8, 6K7, 6H6, 6F5,		
	Tone	21	N	6			12	6	CS125					43, 25Z5	456	
							10	15	TS106							
213	Vol.	45	N				16	1	See Note	B3				[2]6K7, 6A8, 6H6, 6F5,		
	Tone	21	N											6C5,[2]6F6, 5Z4	456	1
214	Vol.	6	Y				24-10-5	24/15	UR182	B268				6D6, 6C6, 25A7G,		
														80F		
221, 222, 223	Vol.	18	N	6			8	1	CS133	B3				6A7, 6D6, 75, 6F6,		
	Tone	21	N				16	1	CS136	B3				5Z4	456	1
							5	15	TS105							
224, 225	Vol.	45	N				24	6	CN145	B8				6A8, 6K7, 6H6, 6F5,		
	Tone	21	N	6			12	6	CS125					43, 25Z5	456	
							10	15	TS106							
227, 228, 229	Vol.	18	N				8-16	1	CN155					6A8, 6K7, 6H6, 6F5,		
	Tone	57	N	6			5-5	15	TN110					6F6, 5Z4	456	1
250	Vol.	7	F			A14	8-8	1	See Note	B3				6A7, 6D6, 6C6, 43,		
							5	15	TS101					25Z5	456	
260	Vol.	18	MR48				20-10	1	See Note	B3				6A7, 6D6, 75, 43,		
							5	15	TS101					25Z5, 42H	456	
261	Vol.	18	MR48				8-8	1	See Note	B3				6A7, 6D6, 75, 42, 5W4	456	1
							5	15	TS101							
522 Series	Vol.	7	J	6			10-10	1	See Note	B3				6D6, 6C6, 38, 76		
							5	15	TS101							
600	Vol.	18	N				24	6	CN145	B8				6A7, 6D6, 75, 6G5,		
	Tone	22	N				12	6	CS125					43, 25Z5	456	
							5	14	CS121							
							5	15	TS101							
700	Vol.	7	J	6		A14	24-10-5	24/15	UR182	B268				6D6, 6C6, 43, 25Z5,		
														M55HG		
701	Vol.	7	J				24-10-5	24/15	UR182	B268				6D6, 6C6, 43, 25Z5,		
														6E5,[2]M30HG		
705	Vol.	7	J	6		A14	24-10-5	24/15	UR182	B268				6D6, 6C6, 43, 25Z5,		
														M55HG		
710	Vol.	7	F	6			24-10-5	24/15	UR182	B268				6A7, 6D6, 6C6, 43,		
														25Z5, M49HG	456	
715	Vol.	7	F	6			24-10-5	24/15	UR182	B268				6A7, 6D6, 6C6, 43,		
														25Z5, M49HG	456	
725	Vol.	18	MR48	M26			30-10	1	See Note	B3				6A7, 6D6, 75, 6G5,		
	Tone	147	MR48											25N6G, 25Z5,		
														M42HG	456	
730, 731	Vol.	18	MR48	M26										1D7G, 1D5G, 1H6G,		
														1F5G	456	
770	Vol.	18	MR48	M26			24-10-5	1/15	UR182	B269				6A7, 6D6, 75, 43,		
	Tone	147	MR48											25Z5, M49HG	456	
771	Vol.	18	MR48	M26			24-10-5	1/15	UR182	B269				6A7, 6D6, 75, 6G5,		
	Tone	147	MR48											43, 25Z5, M42HG	456	
810	Vol.	18	MR48	M26			16-10	1	See Note	B3				6A7, 6D6, 75, 25L6G,		
														1V	456	‡
822	Vol.	18	MR48	M26			34-10	1	See Note	B3				6A7, 6D6, 75, 25L6G,		
							50	15	TS104					25Z5	456	
823	Vol.	18	MR48	M26			1090	1	RS216					6A7, 6D6, 75, 6V6G,		
														6G5, 80	456	1
824	Vol.	18	MR48				34-10	1	See Note	B3				6A7, 6D6, 76, 6G5,		
	Tone	147	MR48				50	15	TS104					6F5G, 25L6G, 25Z5	456	
828	Vol.	18	MR48	M26			35	1	WE3540					6A7, 6D6, 76, 6G5,		
	Tone	147	MR48				15	1	RS216					6F5G, 6V6G, 80	456	1
							50	15	TS104							
832	Vol.	18	MR48	M26			34-10	1	See Note	B3				6A7, 6D6, 75, 25L6G,		
							50	15	TS104					25Z5	456	
833	Vol.	18	MR48	M26			1090	1	RS216					6A7, 6D6, 75, 6V6G,		
														6G5, 80	456	1
834	Vol.	18	MR48				34-10	1	See Note	B3				6A7, 6D6, 76, 6G5,		
	Tone	147	MR48				50	15	TS104					6F5G, 25L6G, 25Z5	456	
838	Vol.	18	MR48	M26			35	1	WE3540					6A7, 6D6, 6G5, 76,		
	Tone	147	MR48				15	1	RS216					6F5G, 6V6G, 80	456	1
							50	15	TS104							
850	Vol.	18	MR48	M26										1D7G, 1D5G, 1H6G,		
														1F5G, 2BG	456	
1000	Vol.	7	J	6			10-10	24	See Note	B3				6D6, 6C6, 38, 76		
							5	15	TS101							
1001	Vol.	7	J	6		A14	24-10-5	24/15	UR182	B268				6D6, 6C6, 43, 25Z5		
2000	Vol.	7	J	6			10-10	24	See Note	B3				6D6, 6C6, 38, 76		
	Vol.	7	J	6		A14	24-10-5	24/15	UR182	B268				6D6, 6C6, 43, 25Z5		
2001	Vol.	7	J	6		A14	24-10-5	24/15	UR182	B268				6D6, 6C6, 43, 25Z5		

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
AIRLINE—See Montgomery Ward.																
AIR QUEEN—See Airking																
ALLAMERICAN MOHAWK																
D	Vol.	24	DRP169	6			1-1-1.5		See Note	B1				^{3}24, 27,^{2}45, 80		3
							.073		On 60 cy	B9						
							.2		On 25 cy	B9						
DC	Vol.	25	DRP169				8	4	RS213					^{3}22,^{2}12A,^{2}171A		
DC7 110V	Vol.	24	‡			See Note A5	1.5-2	1	See Note	B7				^{3}36,^{2}37,^{2}33	175	
	Tone	22	K12													
DC7 220V	Vol.	24	‡			See Note A5	1.5-2	1	See Note	B7				^{3}36,^{2}37,^{2}33	175	
	Tone	22	‡			See Note A5										
DC65 110V	Vol.	8	G				3.5		See Note	B11				^{2}39, 36, 37,^{2}33	175	
	Tone	22	K12													
DC65 220V	Vol.	8	G	6			1.5-2		See Note	B7				^{2}39, 36, 37,^{2}38	175	
	Tone	22	K12													
H	Vol.	24	DRP169				1-1-1.5	1	See Note	B1				^{4}24, 27,^{2}45, 80	‡	3
							.073		On 60 cy	B9						
							.2 Mfd		On 25 cy	B9						
J	Vol.	6	F7				6900/61366	4	RS213					^{4}24, 45, 80		1
							61278/61356	4	RS216							
K	Vol.	15	N				1-2-4	1	See Note	B1				^{4}24A,^{2}27,^{2}45, 80		3
	Tone	22	K12				.1		See Note	B9						
P	Vol.	6	F7				6900/61366	4	RS213					^{4}24A, 47, 80		1
							61278/61356	4	RS216							
S6	Vol.	8	G				6900	4	RS213					^{2}24, 35, 27, 47, 80	175	1
S7	Vol.	8	G				6900/61366	4	RS213					^{2}24,^{2}35, 27, 47, 80	175	1
	Tone	22	K12				16	4	RS216							
S8	Vol.	8	GG				6900	4	RS213					24,^{2}27,^{2}35,^{2}47, 80	175	1
	Tone	22	Z12				61278	4	RS216							
SW8	Vol.	17	N	6			8-8	1	See Note	B3				^{2}35,^{2}24,^{2}27,^{2}47, 80	485	1
	Tone	22	G12													
S10	Vol.	13	N				6900/61366	3	RS213					^{2}24,^{3}35,^{2}27,^{2}47, 80	175	3
	Tone	41	N													
S40	Vol.	2	Y				8-8	1	See Note	B3				^{2}57, 47, 80	175	1
							10	19	TS101	B6						
S50	Vol.	6	F12	6			8. 8	1	RS213					^{2}57, 58, 47, 80	175	1
	Tone	22	G12				10	19	TS101	B6						
S63	Vol.	42	H				6900	1	RS213					^{2}35, 24, 47, 80	175	1
	Tone	22	G12				10	15	TS101							
SA65	Vol.	15	N	6			8, 8	1	RS213					^{2}58, 57, 55, 47, 80	175	1
	Tone	22	G12				10	16	TS101	B6						
S80	Vol.	8	H	6			8, 8	1	RS213					24,^{2}35,^{2}27,^{2}47, 80	175	1
	Tone	39	M													
SW80	Vol.	15	N				8, 8	1	RS213					^{2}56,^{2}57,^{2}58, 47, 80	485	1
	Tone	22	G12													
SA90	Vol.	18	N	6			8, 8	1	RS213					^{2}24,^{2}35, 55, 27,^{2}47, 80	175	1
	Tone	21	N				10	15	TS101	B10						
	Sen.	‡	F			See Note A4										
SA91	Vol.	15	N				8, 8	1	RS213					55,^{2}57,^{2}58, 56,^{2}47, 80	175	1
	Tone	21	N				10	15	TS101							
	Sen.	‡	F													
SA110	Vol.	18	N				4-8-4-8	1/2	See Note	B3				^{3}56,^{2}57,^{2}58,^{3}46, 83	175	3
	Tone	21	N				10	15	TS101	B6						
	Sen.	‡	C													
SA130	Vol.	15	N	6			8, 8, 8	7	RS213					^{3}56,^{3}57,^{3}58,^{2}47, 82	175	7
	Tone	39	‡			See Note A5	5	15	TS101							
	Sen.	8	H12			See Note A4										
SG 110V DC	Vol.	12	G12				2-2-2	‡	See Note	B11				‡		
U55	Vol.	6	Y				16-5	6	See Note	B5				^{3}44, 43, 25Z5	485	
							10	15	TS101							
							12	6	See Note	B12						
7T 110V DC	Vol.	26	UC513				1-1-1-1-3	‡	See Note	B7				‡		
A10 PWR. PK							2-4-4	3	See Note	B13				BH		9
B7	Vol.	25	DRP239											^{4}32, 33, 30		
B30, 31	Vol.	25	See Note			A5								30,^{2}31,^{3}32		
C6 Studio	Vol.	6	G7				8-8-8	3	MN275					^{3}24, 45, 80		3
60, 61, 62, 65, 66	Vol.	14	SRP170											^{3}26,^{2}27, 71A, 80		
70, 73, 75	Vol.	38	See Note			A6	2-2-3	‡	See Note	B1				^{4}26,^{2}27, 50, 80		8
	Hum	37	HU75				.002		See Note	B9						
77	Vol.	14	M											^{4}26, 27, 71, 80		
B80	Vol.	43	DRP169				8	12	RS203					^{2}34, 32,^{5}30	175	
	Tone	21	M													
80, 83, 84, 85, 86, 88	Vol.	14	SRP170											^{4}26,^{2}27,^{2}71A, 80		
90 Series to 95	Vol.	6	G7				2-2-2	3	See Note	B1				^{7}27,^{2}45, 80		3
	Hum	37	HU20				.1		See Note	B9						
96	Vol.	6	G7				2-2-2-1-1	3	See Note	B1				^{3}24,^{2}27,^{2}45, 80		3
	Hum	37	HU20				.1		See Note	B9						
ALLIED RADIO CORP.																
5T Auto	Vol.	7	G		2	A1								37, 41, 57,^{2}58		
5X	Vol.	18	N				8-4	23	RM261					6A7, 6D6, 75, 41, 80	456	1
6-Tube Auto	Vol.	7	G		2	A1								^{2}58, 57, 37,^{2}41		
6P	Vol.	18	N				‡	1	See Note	B3	14	245C	C3	6D8G, 6S7G, 6T7G,		
	Tone	44	L				.01-.01		Buffer	B14				^{2}30, 19	456	10
6T Dual Wave	Vol.	15	M				9110-0	1	CN151	B15				47, 55, 57,^{2}58, 80	175	1
							5	17	TS101							
6W	Vol.	18	N	6			8-4	23	RM261					6A7, 6D6, 75, 6H5,		
	Tone	34	L											41, 80	456	1
6Y	Vol.	18	N				‡	27	See Note	B3				6A7, 6D6, 75, 25B6G,		
														25Z5	456	
7M	Vol.	139	500M No. 1			See Note A19	4-16	23	RM265	B261				6A7, 6D6, 76, 75,		
	Tone	139	O				10	19	TS101					6U5, 42, 80	456	1
7T	Vol.	7	F				8-8	25	See Note	B3				^{2}24,^{2}35, 47, 27, 80	175	1
	Tone	22	K12													
8T (810)	Vol.	46	See Note	6		A5								^{2}30,^{2}32,^{2}34,^{2}49	‡	
8/9 AC	Vol.	3	D7				4-2-1	3	See Note	B1				^{5}26, 27,^{2}71A, 80		9
12T Class "B" Super	Vol.	45	M				8	3	WE847					^{2}46,^{5}56, 57,^{3}58, 83	177.5	1
	Tone	22	K12				8-8	3	See Note	B3						
80AC	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
118	Vol.	15	N	6			12	34	RS215					^{2}24,^{2}27,^{2}35,^{2}47, 80	175	1
	Tone	44	K12				8	34	RS213							
AC5	Vol.	7	Z				2-1	1	See Note	B1				^{3}24, 45, 80		3
A5-30 (Roamer)	Vol.	7	Z			See Note A1								^{3}24A,^{2}12A		
A9701, A9703, A9702, A9704	Vol.	6	G12				16-12	23	See Note	B3				6D6, 6C6, 43, 25Z5, L49C		
A9705	Vol.	18	N				16-12	27	See Note	B3				6A7, 6D6, 6G5, 75, 25L6, 25Z5	456	

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ALLIED RADIO CORP.—Continued																
A9710, A9711E, A9711, A9712, A9712E	Vol.	45	N				16-12	27	See Note	B3				6A7, 6D6, 76, 6G5,		
	Tone	34	L											6K5, 25L6, 25Z5	465	
A9715, A9717, A9716, A9718	Vol.	6	G12				16-12	23	See Note	B3				6D6, 6C6, 43, 25Z5,		
														L49C		
A9720, A9721, A9722	Vol.	18	N				8-4	23	CM171					[2]6K7, 6A8, 6Q7, 6G5,		
	Tone	34	L											6F6, 5Y3	465	1
A9724, A9725, A9726	Vol.	18	N											6A7, 6D6, 75, 76, [2]48	465	
A9728, A9729, A9730	Vol.	45	N				8-8	1	See Note	B3	43	See Note	C8	6D8, 6S7, [3]6L5, 19	465	10
	Tone	22	M													
A9733, A9734	Vol.	45	2 Meg. No.1		See Note	A19	12-18	1	See Note	B3				[3]6K7, 6A8, [2]6H6, 6G5,		
	Tone	‡	Y1000MP				8	13	CS133					[4]6C5, [2]6F6, [2]5Z3	465	1
							10	15	TS101							
A9735	Vol.	18	N				16-12	27	See Note	B3				6A7, 6D6, 75, 6G5,		
														25L6, 25Z5	456	
A9775	Vol.	18	N				8-4	1	CN152					6A7, 6D6, 75, 42, 80	456	1
A9776, A9777, A9778	Vol.	45	N	7			8-8	1	CN152		14	245C	C3	1C6, 34, [2]30, 32, 19	456	10
	Tone	44	L				.01-.01		Buffer	B14						
A9782, A9783	Vol.	45	UM154			A96	8-6	23	RM262		35	294	C3	6D6, 6A7, 6K7, 6H6,		
	Tone	22	MR44				.0075		Buffer	B14				6C5, 6V6G, 84	175	10
B6-30	Vol.	41	E12		See Note	A1								[3]31, [3]32		
B10500	Vol.	18	MR48				8-4	23	CM171	B3				6A8, 6D6, 6Q7, 6G5,		
	Tone	34	‡	See Note	A3									41, 80	465	1
B10501	Vol.	18	MR48				8-4	23	CM171	B3				6A7, 6D6, 75, 41, 80	465	1
	Tone	34	‡	See Note	A3											
B10502, B10503, B10504, B10505, B10506, B10507	Vol.	6	‡		See Note	A3	16-12	4	See Note	B3				6D6, 6C6, 25L6, 25Z5,		
														L49C		
B10508	Vol.	18	MR48				16-12	4	See Note	B3				6A7, 6D6, 6G5, 25L6,		
														25Z5, L49C	465	
B10509	Vol.	6	‡		See Note	A3	16-12	4	See Note	B3				6D6, 6C6, 25L6,		
														25Z5, L49C		
10515, B10516, B10517, B10518	Vol.	17	TM231-SS1				12-18	1	See Note	B3				[2]6K7, 6A8, 6Q7, 6G5,		
	Tone	34	L											6C5, [2]6F6, 5Y3	465	1
B10520, B10521	Vol.	18	N	7			8-8	1	See Note	B3	48	See Note	C3	1C7, 1D5, 1H6, 1G5	456	10
B10522	Vol.	18	MR48				8-4	23	CM171	B3				6A8, 6D6, 6Q7, 6G5,		
	Tone	34	‡			A3								41, 80	465	1
B10525, B10526	Vol.	‡	Order from Mfr.				P1993	30	WE2545					[4]6K7G, 6L7G, [2]6H6G,		
	Tone	34	M				P1994	30	WE1247					[4]6J5G, 6J7G, [2]6L6G,		
	Bass	15	N				P1992	30	WE2545					[2]5Z3	456	37
							P1997	13/14	CN140							
B10530, B10531	Vol.	18	N	6			‡	4	See Note	B3				6A7, 6D6, 75, 25B6G,		
														25Z5	456	
B10533, B10534	Vol.	18	O	6			P1511	23	RM261					6A7, 6D6, 75, 41, 80	456	1
B10535	Vol.	80	500M No. 1	6	See Note	A19	P1755	23	RM265	B261				6A7, 6D6, 76, 75,		
	Tone	80	O				P304	19	TS101					6U5, 42, 80	456	1
B10536	Vol.	18	N	6			P1591	23	RM261					6A7, 6D6, 75, 41, 80	456	1
B10537, B10538, B10539	Vol.	140	‡	6	See Note	A19	P1937	46	WE2545					6A8, [2]6K7, [4]6J5, 6J7,		
	Tone	140	MR53				P1939	46	RN242					[2]6F6, 5Z3	456	37
B10540, B10541, B10542	Vol.	140	1 Meg. No.1	6	See Note	A19	P1825	46	RN245					6A7, 6D6, [2]76, 75, [2]42,		
	Tone	140	O				P1783	15	TS101					80	456	1
B10543, B10544	Vol.	45	N	6			P1783	19	TS101					1A6, [2]1A4, 30, 1G5G,		
														1B1	456	
B10545, B10546, B10547, B10548, B10549	Vol.	18	N	6			‡	1	See Note	B3	14	245C	C3	6D8G, 6S7G, 6T7G,		
	Tone	44	L											[2]30, 19	456	10
B10562, B10563	Vol.	17	N	6			3041	1	RN241					6A7, 6D6, 75, 6G5,		
	Tone	22	K12											41, 80	465	1
B10565, B10566, B10567, B10568	Vol.	17	2 Meg. No. 1		See Note	A19	3718	1	RN242					6A8G, 6K7G, 6Q7G,		
	Tone	44	K12	6										6G5, 6C5G, [2]6K6G,		
														5Y4G	465	1
B10570	Vol.	18	N	6			3041	1	RN241					6A7, 6D6, 75, 6G5,		
	Tone	22	K12											41, 80	465	1
B10580, B10581, B10582	Vol.	20	TM251-SS16				3167	46	WE2545					[2]6K7, 6A8, 6J7, 6H6,		
							3041	46	RN241					[3]6C5, [2]6F6, 80	465	1
							1693	20	TS101							
							1110	13	CS131							
B10585, B10586	Vol.	15	UM154-SS16				3718	1	RN242					6A7, 6D6, 76, 75, 41,		
	Tone	22	K12	6			1693	15	TS101					80	465	1
B10588, B10589	Vol.	17	N											1C6, 34, 1F6, 33, 5E1	465	
B10590, B10591, B10592, B10593, B10595, B10596	Vol.	17	UM154-SS16				3150	12	RN232	B8				1C6, 34, 1F6, [3]30	465	
	Tone	44	K12	14			1693	19	TS101							
B10600, B10601, B10602, B10603, B10604, B01605	Vol.	15	UM154-SS16				3060	1	RN242		13	245	C3	6D8G, [2]6S7G, 6N5,		
	Tone	22	K12	6			1693	15	TS101					19, [2]6L5G	465	10
							.03		Buffer	B14						
B10612, B10615, B10617	Vol.	17	UM154-SS16											6A7, 6D6, 75, 76, [2]48	465	
	Tone	22	K12	6												
E9830	Vol.	18	M		See Note	A5	8-8	4	See Note	B3				47, [3]56, 57, [2]58, 80	177.5	1
	Tone	22	K12													
E9831	Vol.	18	M		See Note	A5	8-8	4	See Note	B3				[3]56, 57, [3]58, [2]47, 80	177.5	1
	Tone	22	K12													
F9451	Vol.	18	UC512				6-12	1	CN155	B3	34	292	C3	6A7, 6D6, 6B7, 41, 84	456	10
							10	15	TS101							
							.02-.02		Buffer	B14						
F9501	Vol.	6	L		EX400		20-4-5-5	6/15	See Note	B5				78, 44, 77, 43, 25Z5	456	
F9505	Vol.	15	M				4-4	4	See Note	B3				6A7, 42, 75, 78, 80	456	1
	Tone	22	L	7			5-5	15/19	See Note	B3						
F9511	Vol.	9	Y250MP				5	19	TS101					1A6, 19, 30, 32, 34	456	
	Tone	22	L													
F9515	Vol.	15	M				6-10-5-5	1/15	UR189	B5	34	292	C3	6A7, 42, 75, 78, 84	456	10
	Tone	22	L	7			.05-.05		Buffer	B14						
F9521	Vol.	6	G7		2		4-4	4	CM170	B3				42, 77, 78, 80		1
	Tone	22	L	7												
F9525, F9527	Vol.	6	UC510		EX400		20-4-5-5	6/15	UR189	B5				25Z5, 43, 44, 77		
F9531	Vol.	15	N	6			8-4-4	5	See Note	B3				37, [2]42, [3]78, 80, 85	465	1
	Tone	41	L													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ALLIED RADIO CORP.—Continued																
F9541	Vol.	15	UM154	M26	See Note	A96	6-10-5-5 .05-.05	1/15	See Note Buffer	B5 B14	34	292	C3	6A7, 41, 75, ^{2}78, 84	175	10
F9551	Vol.	15	UM147	M26	See Note	A96	8-16 10-10	4 15	See Note See Note	B3 B3	34	292	C3	6A7, 37, 41, ^{2}78, 84, 85	‡	10
F9555	Vol.	7	G		2		6-6 10-10	1 15	RN242 TN111	B16				2A5, 57, ^{2}58, 80		1
F9591	Vol. Tone	15 41	N L	6			8-4-4	5	See Note	B3				37, ^{2}42, ^{3}78, 80, 85	456	1
F9610, F9612, F9613	Vol. Tone	15 22	N G12	 6			8-8 10	1 15	RS213 TS101					2A5, ^{2}56, ^{2}57, ^{2}58, 80	485	1
F9618, F9619	Vol. Suppr. Tone	45 47 21	N F N				8-8 5-5	1 15/17	See Note 2 TS101	B3 B3				^{2}46, ^{5}56, ^{2}57, ^{2}58, ^{2}80	175	1
F9630, F9635	Vol. Tone	45 22	N K12				8-4	4	See Note	B3				^{2}56, ^{2}57, 58, 2A5, 80	456	1
F9640, F9645	Vol. Tone	15 22	N K12				8-8	4	See Note	B3				2A5, ^{3}56, 57, ^{2}58, 80	177.5	1
F9650, F9654	Vol. Tone	15 22	M K12				8-12	4	See Note	B3				^{2}2A5, 55, 56, 57, ^{4}58, 80	‡	1
F9660, F9665	Vol. Tone	45 22	M K12				12 8	4 4	RS215 RS213					^{2}2A5, ^{3}56, 57, ^{3}58, 80	177.5	1
F9670, F9675	Vol. Tone	15 22	M K12				8 12-8	3 3	WE847 See Note	 B3				5Z3, 53, ^{5}56, 57, ^{2}58	‡	1
F9751	Vol. Tone	15 22	M L	 7			4-4 5-5	4 15/19	See Note 2 TS101	B3 B3				6A7, 42, 75, 78, 80	456	1
F9761, F9767	Vol. Tone	15 41	N L	6			8-4-4	26	See Note	B3				37, ^{3}78, 85, ^{2}42, 80	456	1
F9775	Vol. Tone	9 22	Y250MP L	 7			5	19	TS101					1A6, 19, 30, 32, 34	456	
F9777	Vol. Tone	15 22	M L	 7			6-10-5-5 .05-.05	1/15	See Note Buffer	B5 B14	34	F292	C3	6A7, 78, 75, 42, 84	456	10
G9503	Vol.	6	G12	6	EX200		16-12	27	CM165	B3				6C6, 6D6, 12Z3, 43		
G9505	Vol.	7	UC501	6	EX200		8-4	4	See Note	B3				6C6, ^{2}6D6, 42, 80		1
G9511, G9513	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 42, 75, 80	465	1
G9515	Vol.	18	UM154		See Note	A96	6-12 10 .02-.02	1 15	See Note TS101 Buffer	B3 B14	34	292	C3	6A7, 6B7, 6D6, 41, 84	456	10
G9517	Vol.	18	UM154		See Note	A96	6-12 10 .02-.02	1 15	See Note TS101 Buffer	B3 B14	34	292	C3	6A7, ^{2}6D6, 41, 75, 84	175	10
G9527	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 75, 42, 80 6A7, ^{2}6D6, 42, 75, 80	456	1
G9533	Vol. Tone	18 22	N G12				8-8	4	See Note	B3					465	1
G9545, G9547, G9549	Vol. Tone Suppr.	18 22 48	TRP606 Y Y10MP				8-8 8	28 28	RN242 RS213					6A7, 42, 76, ^{3}78, 80, 85	465	1
G9551	Vol. Tone	7 22	G12 L	6 7			4-4	4	See Note	B3				42, 77, 78, 80		1
G9553	Vol.	15	N				8-20-5 5 5	11 15 13	UR182 TS101 CS121	B17				6A7, 6D6, 25Z5, 43, 75	456	
G9557	Vol.	15	N				5-20-8 5	11 15	UR182 TS101	B31				6A7, 6D6, 25Z5, 43, 75	456	
G9561, G9563, G9565, G9567	Vol. Tone	15 22	N L											1C6, ^{2}30, 33, 34	456	
G9561, G9563, G9565, G-9567, (above No. 61700)	Vol. Tone	15 22	No. 1 Taper No. 1 Taper			A5 A5								1C6, 19, 30, 32, 34	465	
G9575 to G9605 Inc.	Vol. Tone	15 22	N L				8-8 8 5	1 14 15	See Note CS123 TS101	B3				^{2}6D6, 6A7, 75, 76, ^{2}42, 80	456	1
G9599	Vol.	17	UM154		See Note	A96	6-10 5-5 .05-.05	1 15	See Note 2 TS101 Buffer	B3 B14	47	See Note	C6	6A7, 41, 75, ^{2}78, 84	465	10
G9611, G9613	Vol.	45	N											1A6, 30, 32, 33, 34	465	
G9615	Vol. Tone	18 22	N Y	 6			1258 1260 9328 .01-.01	1 1 15	RS213 RS211 TN110 Buffer	 B14	20	F253	C3	6A7, 6D6, 75, 38, 84	465	10
G9617, 9619, 9623, 9625, 9627	Vol.	18	N	7			1291	12	RS201					1C6, 34, ^{2}30, 32, 19	465	
G9629, 31, 33, 35, 37, 39	Vol. Tone	18 22	N K12	7			1291	12	RS201					^{3}34, 1C6, ^{5}30	465	
G9643, G9645	Vol. Tone	17 22	N K12	6			1477 1476 8876	1 1 15	RS215 RS216 TS105					^{2}6D6, 6A7, 75, 76, 41, 80	465	1
G9881	Vol.	18	UM154		See Note	A96	6-12 10 .02-.02	1 15	See Note TS101 Buffer	B3 B14	34	292	C3	6A7, 6B7, 6D6, 41, 81	456	10
G9882	Vol.	18	UM154		See Note	A96	6-12 10 .02-.02	1 15	See Note TS101 Buffer	B3 B14	34	292	C3	6A7, ^{2}6D6, 41, 75, 84	175	10
L5	Vol. Tone	18 34	N L	6			P474 P160 P304	32 32 15	RS211 CN151 TS101	 B81				5Z4, 6F5, 6F6, 6H6, 6K7, 6L7	456	1
L6	Vol. Tone	18 44	N L	6			P474 P160 P304	32 32 15	RS211 CN151 TS101	 B81				5Z4, 6C5, ^{2}6F6, 6K7, 6L7, ^{2}6Q7	456	1
L7	Vol. Tone	45 ‡	N L	7			P391 .01-.01	1	RN232 Buffer	B90 B14	14	245C	C3	1C6, 19, ^{3}30, ^{2}34	456	10
P (AC)	Vol. Tone	15 22	N L				4-4 10	4 19	See Note See Note	B3 B3				47, 55, 57, 58, 80	175	1
P (Batt.)	Vol. Tone	9 22	Y10MP L	6			8 10	13 ‡	See Note TS101	B3				^{2}32, 33, ^{2}34,	175	
SG8	Vol.	6	Y	6	See Note	A8	1.8-2.3-2.3	3	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		3
SG9	Vol. Tone	24 41	DRP119 N	6		A9	8, 8, 8	3	RS213					^{4}24, ^{2}27, ^{2}45, 80		3
SG10	Vol.	7	Z			A10	2-2.5-2.5	3	See Note	B1				24, ^{6}27, ^{2}45, 80		3
T (Auto.)	Vol.	17	UM154		See Note	A96	6-10 5-5 .05-.05	1 15	See Note 2 TS101 Buffer	B3 B14	34	292	C3	6A7, 41, 75, ^{2}78, 84	175	10
U	Vol.	7	UC510	6			4-20 5-5	6 15	See Note 2 TS101	B3				25Z5, 43, 44, 77	456	
U6	Vol. Tone	17 22	UC514 MR39	6			P795 G864 .0075	4 15	CM172 TS101 Buffer	 B14	35	294	C3	6D6, 6A7, 6K7, 75, 6F6, 84	175	10
V	Vol.	6	UC510		EX400		20-4 5-5	6 15	See Note 2 TS101	B3				25Z5, 43, 44, 77, 78	‡	

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ALLIED RADIO CORP.—Continued																
W	Vol.	15	N				8-4-4	26	See Note	B3				37, ^{2}42, ^{3}78, 80, 85	456	1
	Tone	41	L													
Z4	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275	7			P958	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
"Knight" 6280	Vol.	45	N				8-4	1	CN151	B3	31	285XS	C3	1C6, 34, ^{3}30, 19	465	10
	Tone	22	‡		See Note	A5	.01-.01		Buffer	B14						
AMERICAN BOSCH—See United American Bosch.																
AMERICAN FOUNDATION FOR THE BLIND																
U	Vol.	6	SRP263	6			8-16	6	CN145	B3				^{2}6C6, 6D6, 43, 25Z5	175	
	Tone	22	K12				2-4	15	TN110							
	Phono.	63	K12													
X	Vol.	6	H12	6	EX200		4-4	4	CM170	B3				^{2}6D6, 6C6, 42, 80		1
	Tone	22	K12				5	15	TS105							
	Phono.	63	Y													
30	Vol.	6	SRP263	6			8-16	6	CN145	B3				^{2}6C6, 6D6, 43, 25Z5	175	
	Tone	22	K12				2-4	15	TN110							
	Phono.	63	K12													
AMERICAN TRAN. CORP.																
25A (A Unit)	Vol.	35	N											^{2}26, 27		
250	Vol.	35	M				2-1-1		See Note	B4				^{3}27, ^{2}50, ^{2}81		
AMRAD																
AC5	Vol.	29				A11	5-60	3	MN272					01A, 81, ^{4}199		1
							D-15-30		MN272							
AC6	Vol.	14	M											^{4}26, 27, 71		
DC6, DC6C	Vol.	29	Q											^{5}01A, 12A or 71A		
	Vol.	29	S													
DC7, DC7C	Vol.	29	‡		See Note	A5								^{6}01A, 71A		
AC7, AC7C	Vol.	10	H12				8-8-8-8	1/14	MN277					^{5}26, 27, 71A, 80		11
70 (Concerto, Nocturn, Opera, Sonata)	Vol.	‡	H12						See Note	B3				^{4}26, 27, 10 or 50, ^{2}81		8
81 (Aria, Minuett, Serenata, Duet, Symphony)	Vol.	12	K12				8-8-18-18	1/22	MN278					^{3}24, ^{2}27, ^{2}45, 80		3
	Hum	75	Y200MP													
	Hum	75	HU20													
84, 84C, 84D	Vol.	15	N				9-9-18	3	MN277	B83				^{4}24, 27, ^{2}45, 80		3
171ABC							8-8-8-8	3/14	MN277					80		18
F516	Vol.	6	G12	6	EX200		W41080	1	RS215					^{2}6D6, 76, 6B5, 80	450	1
							W41081	1	RN232	B8						
F546	Vol.	6	G7		See Note	A11	W36057	1	WE3540		15	246	C3	^{3}15, 6A7, 38	450	10
	Tone	34			See Note	A3	W41195	15	TS101							
							.001		Buffer							
F616	Vol.	18	O				W36055	1	WE3540					6A8G, 6K7G, 6H6G,		
	Tone	34	L	6			W36057	1	WE3540					6F5G, 6N6G,		
														5Z4MG	450	1
F626	Vol.	‡	DRP304				W36055	1	WE3540					6A8G, 6K7G, 6J7G,		
	Tone	34	L	6			W36057	1	WE3540					6C5G, 6N6G,		
							W10325	‡	RS208					5Z4MG	450	1
							W37778	15	TN111							
3500-1	Vol.	31	A400P											^{4}01A		
3500-2	Vol.	14	M											^{4}01A		
7100	Vol.	40	H12											^{4}26, 27		
ANDREA																
D8L, D8S	Vol.	124	MR53				HC99	25	WE1647					^{2}6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G,		
														5Y4G, 6G5	470	1
1D6 (D6L)	Vol.	15	MR53	M26			HC97	4	WE1647					6A7, 78, 76, 77,		
							HC56	13	CS130					6V6G, 80	470	1
1D7 (D7L)	Vol.	124	MR53				HC99	25	WE1647					^{2}6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G, 5Y4G	470	1
1D10 (D10L)	Vol.	124	MR53	M26			HC113	3	WE1247					^{2}6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G, ^{2}6V6G,		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC61	15	TS106							
2D5 (D5)	Vol.	18	MR48	M26			HC121	1/15	RN245/TS101	B193				6A7, 6D6, 75, 41, 80	470	1
2D6 (D6S)	Vol.	15	MR53	M26			HC97	4	WE1647					6A7, 78, 76, 77, 6V6G,		
							HC56	13	CS130					80	470	1
2D7 (D7S)	Vol.	124	MR53				HC99	25	WE1647					^{2}6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G, 5Y4G	470	1
2D10 (D10S)	Vol.	124	MR53	M26			HC113	3	WE1247					^{2}6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G, ^{2}6V6G		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC112	15	TS106							
3D5 (D5L)	Vol.	18	MR48	M26			HC121	1/15	RN245/TS101	B193				6A7, 6D6, 75, 41, 80	470	1
3D7 (D7L)	Vol.	124	MR53				HC99	25	WE1647					^{2}6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G, 5Y4G	470	1
3D10 (D10L)	Vol.	124	MR53	M26			HC113	3	WE1247					^{2}6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G, ^{2}6V6G,		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC61	15	TS106							
4D5 (D5E)	Vol.	18	MR48	M26			HC121	1/15	RN245/TS101	B193				6A7, 6D6, 75, 41, 80	470	1
4D7 (D7S)	Vol.	124	MR53				HC99	25	WE1647					^{2}6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G, 5Y4G	470	1
4D10 (D10S)	Vol.	124	MR53	M26			HC113	3	WE1247					^{2}6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G, ^{2}6V6G		
							HC115	13/14	RN241					6G5, 5U4G	470	1
							HC112	15	TS106							
5D7 (D7L)	Vol.	124	MR53				HC99	25	WE1647					^{2}6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G, 5Y4G	470	1
5D10 (D10L)	Vol.	124	MR53	M26			HC113	3	WE1247					^{2}6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G, ^{2}6V6G,		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC61	15	TS106							
6D7 (D7S)	Vol.	124	MR53				HC99	25	WE1647					^{2}6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G, 5Y4G	470	1
6D10 (D10S)	Vol.	124	MR53				HC113	3	WE1247					^{2}6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G, ^{2}6V6G,		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC112	15	TS106							
7D7 (D7L)	Vol.	124	MR53				HC99	25	WE1647					^{2}6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G, 5Y4G	470	1
7D10 (D10L)	Vol.	124	MR53	M26			HC113	3	WE1247					^{2}6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G, ^{2}6V6G,		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC61	15	TS106							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ANDREA—Continued																
8D7 (D7S)	Vol.	124	MR53				HC99	25	WE1647					[2]6K7G, 6A8G, 6H6G,		
	Tone	57	MR44				HC71	25/13	RN242					6F5G, 6V6G, 5Y4G	470	1
8D10 (D10S)	Vol.	124	MR53	M26			HC113	3	WE1247					[2]6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G,[2]6V6G,		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC112	15	TS106							
9D10 (D10L)	Vol.	124	MR53	M26			HC113	3	WE1247					[2]6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G, 6C5G,[2]6V6G,		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC61	15	TS106							
10D10 (D10S)	Vol.	124	MR53				HC113	3	WE1247					[2]6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC114	3	WE847					6F5G,6C5G,[2]6V6G,		
							HC115	13/14	RN241					5U4G, 6G5	470	1
							HC112	15	TS106							
520 (UD5S), 521 (UD5L)	Vol.	18	MR48	M26			HC96	1/15	RM259	B143				6A7, 6D6, 75, 43,		
														25Z5	470	
616, 617, 618 (D6B)	Vol.	124	MR53				HC77	1	RM257	B59	13	245	C3	[2]6S7G, 6D8G, 6T7G,		
	Tone	57	MR44				HC117	13/14	RN232					6L5G, 6V6G	470	10
							HC119	15	TN111							
							.015-.015		Buffer	B14						
620 (UD6S), 621 (UD6L)	Vol.	17	MR53	M26			HC96	1/15	RM259	B143				6A7, 78, 75, 25L6,		
							HC75	13	CS130					25Z5	470	
1401, 1403, 1405, 1409 (UD14L)	Vol.	124	MR53	M26			HC109	1	RS207					[2]6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC110	1	RS208					6F5G, 6C5G,		
							HC116	13	RN232	B8				[2]25L6G, [2]25Z6G,		
							HC61	15	TS106					6G5	470	
							HC111	1	RM259							
1402, 1404, 1406, 1408, 1410, (UD14S)	Vol.	124	MR53	M26			HC109	1	RS207					[2]6K7G, 6A8G, 6H6G,		
	Tone	22	MR48				HC110	1	RS208					6F5G, 6C5G,		
							HC116	13	RN232	B8				[2]25L6G, [2]25Z6G,		
							HC61	15	TS106					6G5	470	
							HC111	1	RM259							
ANSLEY RADIO LABS																
B1	Vol.	12	M			A27	10	19	TS101	B20				1A6, 1A4, 32, 33 or		
	Tone	71	O			A4								1A6, 1A4, 1F4, 1B4	456	
DC	Vol.	26	UC510				2-2-1		See Note	B4				[5]01A, 71A		
D1	Vol.	50	L				32-8-8	1	See Note	B3				25Z5,[2]48, 76		
	Hum	51	A3MP													
D1 (Rev.)	Vol.	63	M				48	‡	See Note	B3				[2]6C6,[2]48,[2]25Z5		
	Tone	41	N													
	Hum	‡	A3MP													
D1, D1A (3rd type)	Vol.	‡	LL				80	12	Order from	Mfr.				[2]6C6,[2]25L6,[2]25Z5		
	Tone	41	N													
	Hum	‡	Y500MP													
D3, D4, D6	Vol.	6	SRP263		EX100		16-8	1	CN145	B8				25Z5, 43,[2]77, 78	175	
							2-4	15	TN110							
D9, D10	Vol.	17	MR53	M26			32-24-12	8	Order from	Mfr.				6A8G, 6K7, 6Q7G,		
	Tone	57	MR48				10-10	15	TN111					25A6G or 25L6,		
														[2]25Z6G	456	
D12	Vol.	63	N				48-16-8	46	See Note	B3				[2]76,[2]48,[2]25Z5		
	Tone	44	N				10	15	TS106							
	Hum	‡	A3MP													
D16	Vol.	63	M				48	‡	See Note	B3				[2]6C6,[2]48,[2]25Z5		
	Tone	41	N													
	Hum	‡	A3MP													
D16 (Rev.)	Vol.	‡	LL				80	12	Order from	Mfr.				[2]6C6,[2]25L6,[2]25Z5		
	Tone	41	N													
	Hum	‡	Y500MP													
D17, D18	Vol.	17	MR53	M26			32-24-12	8	Order from	Mfr.				6A8G, 6K7, 6Q7G,		
	Tone	57	MR48				10-10	15	TN111					25A6G or 25L6,		
														[2]25Z6G	456	
D20	Vol.	‡	LL				80	12	Order from	Mfr.				[2]6C6,[2]25L6,[2]25Z5		
	Tone	41	N													
	Hum	‡	Y500MP													
D24, D25 (7152)	Vol.	80	MR53				32-24-12	6/12	Order from	Mfr.				[3]6K7, 6L7, 6Q7, 6G5,		
	Tone	80	MR48	M26			80	12	Order from	Mfr.				6C5,[4]25L6,[4]25Z5	456	
	Sen.	7	Order from	Mfr.			10	15	TS101							
D26	Vol.	‡	N	6			32-24-12	1/13	Order from	Mfr.				6C5, 25L6, 25Z6		
MD1	Vol.	12	G12				3		CN142	B11				30,[3]32, 71A		
U1 AC-DC	Vol.	12	Y				4-8-2	3	CN155					[4]24, 27,[2]45, 80		‡
	Tone	21	M													
U2 AC-DC	Vol.	8	K				4-8-2		MN275					[3]36, 37, 38, 80		1
	Tone	22	M	6			10	15	TS101							
U3	Vol.	7	H	6	2		8-8-2	3		B3				[2]37,[2]38,[3]39, 80	175	1
	Tone	39	M				4	15	TS101							
U8	Vol.	12	M	6			4-4	1	See Note	B3				37,[3]39, 80, 85,[2]89	‡	1
	Tone	39	M				10-10-2	15	See Note	B3						
U10	Vol.	6	E	2			16-16-16	1	See Note	B77				6A7, 6C6, 6D6, 12Z3		
	Phono.	50	L				10-10	15	See Note	B77				43, 25Z5	456	
U10, U11 (Late)	Vol.	17	MR53	M26			32-24-12	8	Order from	Mfr.				6A8G, 6K7, 6Q7G,		
	Tone	57	MR48				10-10	15	TN111					25A6G or 25L6,		
														[2]25Z6G	456	
APEX—See U. S. Radio & Tel.																
APPEL HENDERSON																
AC	Vol.	6	G7	6	4		8-4-4	3	See Note	B3				24, 27, 47,[2]51, 80	‡	1
	Tone	22	G12													
DC Comb.	Vol.	6	H7	6	5		.5-1	‡	See Note	B4				33,[5]36,[2]37		
	Tone	22	G12													
4 Tube	Vol.	29	T											[2]32, 33, 36		
5 Tube Batt.	Vol.	40	See Note			A5								[2]32, 36,[2]38		
5 Tube AC	Vol.	6	G7	6	4		4-8	1	See Note	B3				‡		3
	Tone	22	G12													
ARBORPHONE																
45	Vol.	10	E12				2-2-2-2	1/14	See Note	B1				[4]26, 27,[2]71, 80		11
ARCADIA—See Wells Gardner.																
ARGUS																
B125	Vol.	‡	‡		See Note	A5	8-8-8	3	MN275					12,[5]99, BH		1
B195	Vol.	16	M				‡	‡	See Note	B3				[5]99, 10,[2]81		5
	Sen.	‡			See Note	A5										
ARIEL RADIO																3
101	Vol.	3	Y				15-5	6	MN273					[2]24,[2]27,[2]45, 80		

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ARKAY—See R. K. Radio Lab's.																
ARVIN—See Noblitt-Sparks																
ATCHISON RADIO MFG. CO.																
5AC	Vol.	6	G7		5		‡	‡	See Note	B3				24, ^{4}27, 15, 80		3
5 Tube (DC Speaker)	Vol.	6	G7		5		‡	‡	See Note	B3				24, ^{4}27, 45, 80		3
6AC	Vol.	6	G7				‡	‡	See Note	B3				24, ^{5}27, ^{2}45, 80		3
ATWATER KENT																
37, 37C, 37F	Vol.	5	SRP239			See Note A12	1.5-1	2	See Note	B1				^{4}26, 27, 71A, 80		11
38	Vol.	5	SRP239			A12	1.5-1	2	See Note	B1				^{5}26, 27, 71A, 80		11
40, 40F	Vol.	5	SRP239			See Note A12	1-1.5-1	3	See Note	B1				^{4}26, 27, 71A, 80		11
41DC	Vol.	5	SRP239			See Note A12								^{5}12A, ^{2}71A		
42, 42F	Vol.	5	SRP239			See Note A12	1-1.5-1	3	See Note	B1				^{4}26, 27, 71A, 80		11
43	Vol.	5	SRP239			See Note A12	‡	3	See Note	B1				^{4}26, 27, ^{2}12A, 80		11
44, 44F, 45	Vol.	5	SRP239			See Note A12	1-1-1.5	3	See Note	B1				^{5}26, 27, 71A, 80		11
46, 47	Vol.	5	SRP239			See Note A12	‡	3	See Note	B1				^{4}26, 27, ^{2}71A, 80		11
52	Vol.	5	SRP239			See Note A12	‡	3	See Note	B1				^{4}26, 27, 71A, 80		11
53	Vol.	5	SRP239			See Note A12	‡	‡	See Note	B1				^{4}26, 27, 71, 80		11
55, 55C (Early)	Vol.	12	SRP241			See Note A30	2-2.3-2.3	30	See Note	B1				^{2}24, ^{2}27, ^{2}45, 80		3
55, 55C (Late)	Vol.	25	DRP301				2-2.3-2.3	30	See Note	B1				^{2}24, ^{2}27, ^{2}45, 80		1
55F, 55FC (Early)	Vol.	12	SRP241			See Note A30	1.7-4-1	30	See Note	B1				^{2}24, ^{2}27, ^{2}45, 80		3
55F, 55FC (Late)	Vol.	25	DRP301				1.7-4-1	30	See Note	B1				^{2}24, ^{2}27, ^{2}45, 80		3
56, 57	Vol.	5	SRP239			See Note A12	‡	2	See Note	B1				^{4}26, 27, 71A, 80		11
60, 60C (Early)	Vol.	12	SRP241			See Note A30	2-2.5-2.5	30	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		1
60, 60C (Late)	Vol.	52	DRP301				2-2.3-2.3	30	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		1
60, 60C (3rd Type)	Vol.	25	DRP301				.1-2-1	30	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		1
61, 61C (DC)	Vol.	12	SRP241			See Note A30	4-2	2	See Note	B11				^{3}22, ^{2}12A, ^{2}71A		
66	Vol.	52	DRP301				2.1-2.3-2.3	3	See Note	B2				^{3}24, ^{2}27, ^{2}50, ^{2}81		4
67, 67C	Vol.	12	L											^{3}22, ^{2}12A, ^{2}71A		
D1 (70, 74, 76)	Vol.	25	DRP301				.5-4-2-1	2	See Note	B11				^{3}22, ^{2}12A, ^{2}71A		
D2 (70, 74, 76)	Vol.	25	DRP301				4-2-1-.5	2	See Note	B11				^{3}22, ^{2}12A, ^{2}71A		
F (70, 74, 76)	Vol.	25	DRP301				4-1-.5	2	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		1
L1 (70, 74, 76)	Vol.	25	DRP301				1-2-1-.5	31	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		1
L2 (70, 74, 76)	Vol.	25	DRP301				2-1-1-.5	3	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		1
							.225		See Note	B9						
P (75)	Vol.	25	DRP301				2-1-1-.5	‡	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		1
	Phono.	‡	A				.225		See Note	B9						
H1, H2 (72)	Vol.	53	DRP302				1-2-1	3	See Note	B1				^{3}24, ^{3}27, ^{2}45, 80	130	1
							.225		See Note	B9						
Q (70, 76)	Vol.	25	DRP303											^{2}01A, ^{3}22, ^{2}71A		
80, 80F	Vol.	8	E	6			23146	4	WE847					24, ^{2}35, 47, 80	130	1
							22538	4	WE847							
81, 81 (2nd), 81B, 81C	Vol.	54	UC503				22538	12	WE847					^{3}36, ^{2}37, ^{2}38		
82	Vol.	7	A550P	6			23146/22538	4	WE847					^{2}24, ^{2}35, 47, 80	130	1
82D	Vol.	15	N	6			20049	12	RN235	B8				^{3}36, ^{2}37, 33	130	
82F	Vol.	7	A550P	6			22538	4	WE847					^{2}24, 27, ^{2}35, 47, 80	130	1
							23146	4	WE847							
82Q (1st Type)	Vol.	15	N	6			23146/22538	12	WE847					^{2}30, ^{4}32, 33	130	
82Q (2nd Type)	Vol.	15	L	6			22538									
							23146	12	WE847					^{2}30, ^{4}32, 33	130	
83, 83F	Vol.	8	E	6			22538	4	WE847					24, ^{2}35, 27, 47, 80	130	1
							23146	4	WE847							
							3-4	‡	CN150	B21						
84	Vol.	15	N				22538	4	WE847					^{3}24, 27, 47, 80	130	1
							23146	4	WE847							
84 (Late)	Vol.	7	SRP254	6			22538	4	WE847					24, 27, ^{2}35, 47, 80	130	1
							23146	4	WE847							
84D	Vol.	15	N				20049	12	RN235	B8				33, ^{3}36, ^{2}37	130	
84F	Vol.	15	N				22538	4	WE847					^{3}24, 27, 47, 80	130	1
							23149	4	WE847							
84F (Late)	Vol.	7	SRP254	6			22538	4	WE847					24, 27, ^{2}35, 47, 80	130	1
							23149	4	WE847							
84Q	Vol.	15	N				22538	12	WE847					^{2}30, ^{4}32, 33	130	
85, 85F (Early Late)	Vol.	8	A550P			See Note A4	22538	4	WE847					^{2}24, ^{2}35, 47, 80	130	1
	Vol.	8	Y500MP			See Note A27	3-4	4	CM170	B21						
85Q (1st Type)	Vol.	15	L				22538	12	WE847					^{2}30, ^{4}32, 33	130	
85Q (2nd Type)	Vol.	15	M				22538	12	WE847					^{2}30, ^{4}32, 33	130	
86, 86F	Vol.	8	A550P				22538	4	WE847					^{2}24, 27, ^{3}35, 47, 80	130	1
							3-4	4	CM170	B21						
87	Vol.	8	SRP254	6			2-2.3-2.3	3	See Note	B1				^{2}27, ^{3}35, ^{2}47, 80	130	3
							.25		See Note	B9						
87D	Vol.	25	DRP301				20049	12	RS207					^{2}33, ^{4}36, 37, 38	130	
89, 89F, 89P	Vol.	15	N	6			2-2.3-2.3	3	See Note	B1				24, ^{3}27, ^{3}35, ^{2}47, 80	130	3
							.25		See Note	B9						
90, 90F	Vol.	8	E	6			22538	4	WE847					24, 27, ^{3}35, 47, 80	130	1
							23146	4	WE847							
91, 91B, 91C	Vol.	54	N				22472	12	CS123					^{3}36, ^{4}37, ^{2}38	260	
92	Vol.	13	N	6			22538	4	WE847					^{2}24, ^{3}35, 47, 80	130	1
							23146	4	WE847							
92F	Vol.	13	N				22538	4	WE847					24, ^{2}27, ^{3}35, 47, 80	130	1
							23146	4	WE847							
							22397	4	CS133							
93 (SW Converter)							22538	1	WE847					24, ^{2}27, 80	1000	1
							19728	1	WE847							
94, 94F	Vol.	7	SRP254				19728	4	WE847					^{3}35, 24, 47, 80	130	1
							3-4	4	CS133	B21						
96 (1st Type)	Vol.	13	N	6			19060	4	WE847					24, ^{2}27, ^{3}35, 47, 80	130	1
							1-2-1-.5	‡	See Note	B1						
							.225		See Note	B9						
96 (2nd Type)	Vol.	13	N				19060	4	WE847					24, ^{2}27, ^{3}35, 47, 80	130	1
	Tunlgt.	‡	K				1-2-1-.5	‡	See Note	B1						
							.225		See Note	B9						
96 (3rd Type)	Vol.	13	N				19060	4	WE847					24, ^{2}27, ^{3}35, 47, 80	130	1
	ToneB'm	‡	M10MP				1-2-1-.5	‡	See Note	B1						
							.225		See Note	B9						
96F	Vol.	13	N	6			19060	4	WE847					24, ^{2}27, ^{3}35, 47, 80	130	1
	Tunlgt.	‡	Y50MP				2-2-1-1-.5	‡	See Note	B1						
99 (Types 1 and 2)	Vol.	15	N				2-2.3-2.3	‡	See Note	B1				24, ^{3}27, ^{3}35, ^{2}47, 80	130	3
	Tunlgt.	‡	Y50MP				.25	‡	See Note	B9						
99 (3rd Type), 99F	Vol.	15	N				2-2.3-2.3	‡	See Note	B1				24, ^{2}27, ^{3}35, ^{2}47, 80	130	3
	Tunlgt.	‡	H				.25	‡	See Note	B9						
99P	Vol.	15	N	8			2-2.3-2.3	‡	See Note	B1				24, ^{3}27, ^{3}35, ^{2}47, 80	130	3
	Tunlgt.	‡	H				.25	‡	See Note	B9						
112	Vol.	20	TRP606	6			28031	28	WE847					^{2}2A3, 2B7, 5Z3, ^{3}56,		
							27583	28	RS216					57, ^{5}58	472.5	3
							25385	12	RS203							
							25384	12	CS133							
							25379	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
ATWATER KENT—	Continued															
126	Vol.	17	UC512		See Note A1		32136	4	CM172	B25	35	294	C3	6A8, 6F6, ^{2}6K7, 6Q7, 6X5	264	10
							25379	15	TS101							
							.003		Buffer	B14						
135Z	Vol.	19	N	6			26995	1	SR605	B23	38	F297	C3	6A7, 43, 75, 78, 84	264	10
							22538	12	WE847							
							25379	15	TS101							
							.05-.05		Buffer	B14						
136	Vol.	17	UC512				32136	4	CM172	B25	35	294	C3	^{2}6K7, 6A8, 6Q7, 6F6, 6X5	264	10
							25379	15	TS101							
							.003		Buffer	B14						
137	Vol.	18	N	6			22538	4	WE847					^{3}58, 55, 56, 47, 80	125	1
145	Vol.	18	N	6			19060	1	WE847					2A7, 58, 2A6, 2A5, 80	264	1
							27585	1	RS213							
							10	15	TS101							
E145, E145X	Vol.	18	N	6			28031	1	WE847					2A7, 58, 2A6, 2A5, 80	125	1
							27585	1	RS213							
							25379	15	TS101							
155	Vol.	60	N				24602	9	CM165	B22				77, 44, 75, 43, 25Z5	262.5	
							25167	15	TS101							
155 (2nd Type)	Vol.	60	N				24602	29	CM162	B33				77, 44, 45, 43, 25Z5	262.5	
							21939	29	CS123	B33						
							24955	29	CM165	B51						
155 (3rd Type)	Vol.	60	N	6			P24955	29	CM165	B32				77, 44, 75, 43, 25Z5	262.5	
165	Vol.	60	N	6			25168	1	WE847					57, 58, 2A6, 2A5, 80	262.5	1
							25167	15	TS101							
165 (2nd Type)	Vol.	55	N	6			25168	1	WE847					57, 58, 2A6, 2A5, 80	264	1
							25167	15	TS101							
165Q	Vol.	27	UC513	7		A95	22472	12	CS123					1A6, 34, 32, 30, 19	264	3
168	Vol.	18	N	6			22538	3	WE847					^{3}58, 55,^{2}47, 80	125	3
184	Vol.	‡	A20MP	‡			28031	‡	WE847					^{2}6C6, 42, 80	450	1
							27583	‡	RN242							
185	Vol.	55	N	6			25168	1	WE847					57, 58, 2A6, 2A5, 80	264	1
							25167	15	TS101							
185A	Vol.	55	N				25168	1	WE847					2A7, 58, 2A6, 2A5, 80	264	1
							25379	15	TS101							
188, 188F	Vol.	13	N	6			22538	25	WE847					^{3}58, 57, 47,^{2}56, 80	130	3
188, 188F (2nd Type)	Vol.	13	N	6			22538	25	WE847					56,^{3}58, 55, 57, 47, 80	130	3
	Sil.	12	A20MP													
206	Vol.	17	N				27592	1/15	RN245					2A7,^{3}58, 2A6, 2A5, 80	472.5	1
							22538	1	WE847							
206D	Vol.	18	N				28403	39	RN232	B11				^{2}78, 6A7, 85,^{2}43	472½	
E208	Vol.	18	N	6			29691	1	RS216					^{3}6K7, 6A8, 6R7,^{2}6F6, 5Z4	472½	1
							27583	1	RS216							
							25379	15	TS101							
215Z	Vol.	19	N	6			26995	1	SR605	B23	38	F297	C3	6A7, 78, 75, 43, 84	264	10
							22538	1	WE847							
							.05-.05		Buffer	B14						
P216	Vol.	18	N	6			28031	1	WE847					^{2}6D6, 6A7, 75, 42, 80	472½	1
							27592	1/14/15	RN245							
217	Vol.	55	N	6			22538/25168	1	WE847					^{3}58, 55, 56, 2A5, 80	264	1
							25379	15	TS101							
217D	Vol.	55	N	6			23981	39	UR190					^{3}78, 75,^{2}43, 37	264	
228	Vol.	13	N	6			22538	4	WE847					27, 24,^{3}35, 47, 80	130	1
228D	Vol	13	N	6			20049	12	RS207					^{3}36,^{2}37, 33	130	
228F	Vol.	13	N	6			22538	4	WE847					^{3}35, 24,^{2}27, 47, 80	130	1
							22397	4	CS133							
228Q	Vol.	15	L				19728	12	WE847					^{4}32,^{2}30, 33	130	
							23146	12	WE847							
							22538	12	WE847							
236	Vol.	18	N	6			26381	1	RS213					^{2}58, 56, 2A6, 2A5, 80	125	1
							25379	15	TS101							
237Q	Vol.	18	N	6			31552	1	SR605	B23	35	294	C3	1C6,^{2}34, 1B5, 30, 19 6Z4	472.5	10
							31551		On order							
							29529	13	RS203							
							.015-.015		Buffer	B14						
246	Vol.	55	N	6			24099	1	RN241	B22				56, 57, 58, 55, 47, 80	262.5	1
255	Vol.	19	TRP611				22538	25	WE847					6A8, 6K7, 75, 6F6, 80	450	1
							27583	25	RS216							
260, 260F (Types 1 and 2)	Vol.	15	N	6			22538	2	WE847					^{4}58,^{3}56,^{2}47, 80	130	3
	ToneB'm	‡	M15MP													
260, 260F (3rd Type)	Vol.	18	N	6			22538	2	WE847					57,^{4}58, 55, 56,^{2}47, 80	130	3
	ToneB'm	‡	M15MP													
	Sil.	12	A20MP													
266	Vol.	18	N	6			22538	1	WE847					57, 58, 55, 56, 47, 80	262.5	1
273D	Vol.	15	N	6			8-8	39	See Note	B11				1A6,^{2}34	‡	
275	Vol.	55	N	6			26158	29	UR190	B72				6A7, 44, 75, 43, 25Z5	264	
285Q	Vol.	45	N	13		A13	29529	12	RS203					1C6, 34, 32, 33, 30	450	
286	Vol.	18	N	6			28031	1	WE847					^{2}58, 2A7, 2A6, 2A5, 80	472.5	1
							27592	1/14/15	RN241/TS101	B24						
305Z	Vol.	18	N	6			26995	1	SR605	B23	38	F297	C3	6A7, 78, 75, 43, 6Z4-84	264	10
							25379	15	TS101							
							.05-.05		Buffer	B14						
310	Vol.	45	N	6			22538	3	WE847					^{3}58,^{3}56,^{2}2A5, 80	130	1
	Sil.	7	H													
312, E312	Vol.	15	N				28031	1	WE847					^{3}6D6, 6A7, ^{5}76, ^{2}2A3, 5Z3	472½	3
							27583	1	RS216							
							29961	13	RS216							
							25384	13	RS213							
							29962	14	RN231							
							25379	15	TS101							
317	Vol.	18	N	6			28031	1	WE847					^{2}6K7, 6A8, 6F5, 6F6, 5Z4	472.5	1
							27592	1/14/15	RN241/TS101	B24						
318	Vol.	55	N				28031	1	WE847					^{3}58, 2A7, 55,^{2}2A5, 80	472.5	1
325	Vol.	18	N	6			19060	1	WE847					2A7, 58, 2A6, 2A5, 80	264	1
							27585	1	RS213							
							10	15	TS101							
328 (Early)	Vol.	18	N	6			29691	1	WE1647					^{3}6K7, 6A8, 6H6, 6F5, 6F6, 5Z4	472.5	1
							27592	1/14/15	RN241/TS101	B24						
328 (Late)	Vol.	18	N	6			31702	1/14/15	RN241/TS101	B24				^{3}6K7, 6A8, 6H6, 6F5, 6F6, 5Z4	472.5	1
							28031	1	WE847							
P336	Vol.	18	N	6			27592	1/14/15	RN241/TS101					^{2}6D6, 6A7, 75, 42, 80	472½	1
							28031	1	WE847							
337	Vol.	18	N	6			27592	1/14/15	RN241/TS101	B24				^{2}6K7, 6A8, 6H6, 6F5, 6F6, 5Z4	472.5	1
							28031	1	WE847							
356	Vol.	18	N	6			27592	1/14/15	RN241/TS101	B24				^{2}58, 2A7, 2A6, 2A5, 80	472.5	1
							28031	1	WE847							
376	Vol.	18	N	6			27592	1/14/15	RN241/TS101	B24				^{2}58, 2A7, 2A6, 2A5, 80	472.5	1
							22538	1	WE847							
376D	Vol.	18	N				28403	39	RN232	B11				^{2}78, 6A7, 85,^{2}43	472½	
385Q	Vol.	27	UC513	13			22472	12	CS123					1C6, 34, 32, 30, 19	264	
387	Vol.	12	N	7		A95	22472	12	CS123					^{2}34, 1A6, 32,^{3}30	264	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Cir-cuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replace-ment	*Note	Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
ATWATER KENT—	Continued															
E412, E412X, P412, P412X	Vol.	15	N				29691	46	RS216					^{3}6K7, 6A8, 6H6, ^{4}6C5,		
							27583	46	RS216					^{2}2A3, 5Z3	472½	14
							25384	14	CS133							
							29962	14	RN231							
							29964	15	TN111							
415Q	Vol.	45	N	13			29529	12	RS203					1C6, 34, 32, 33, 30	450	
416	Vol.	17	UC512				32136	4	CM172	B25	35	294	C3	^{2}6K7, 6A8, 6Q7, 6F6,		
							25379	15	TS101					6X5	264	10
							.003		Buffer	B14						
424	Vol.	55	N				25385	1	RS203		9	226	C3	77, 44, 75, 41	264	
							24379	15	TS101							
							25384	1	CS133							
							.01-.01		Buffer	B14						
425	Vol.	55	N	6			25168	1	WE847					57, 58, 2A6, 2A5, 80	264	1
							25379	15	TS101							
							26381	1	RS213							
427	Vol.	55	N	6			25168	1	RS213					^{3}58, 55, 2A5, 80	264	1
							25397	15	TS101							
427D	Vol.	55	N	6			23981	39	CM164	B11				^{3}78, 75, 37, ^{2}43	264	
427Q	Vol.	12	N	7			22472	12	CS123					1A6, ^{2}34, 32, ^{3}30	264	
435	Vol.	18	N				28031	25	WE847					6A8, 6K7, 75, 6F6, 80	450	1
							27585	25	RS213							
							25379	15	TS101							
435 (2nd Type)	Vol.	18	N	6			8	28	WE847					6A8, 6K7, 75, 6F6, 80	450	1
							16	28	RS216							
446	Vol.	17	UC512				32136	4	CM172	B25	35	294	C3	^{2}6K7, 6A8, 6Q7, 6F6,		
							25379	15	TS101					6X5	264	10
							.003		Buffer	B14						
447	Vol.	55	N	6			28031	1	WE847					^{3}58, 2A7, 55, 2A5, 80	472.5	1
448	Vol.	55	N	6			22538	3	WE847					^{3}58, 55, ^{2}47, 56, 80	130	3
	Sil.	7	E													
465Q	Vol.	27	UC513	7		A95	22472	12	CS123					1C6, 34, 32, 30, 19	264	
467Q	Vol.	18	N	6			31552	1	SR605	B23	35	294	C3	1C6, ^{2}34, 1B5, 30, 19,		
							31551		On order					6Z4	472.5	10
							29529	1	RS203							
							.015-.015		Buffer	B14						
469	Vol.	13	N	6			22538	1	WE847					^{3}58, ^{3}56, ^{2}47, 80	130	3
	ToneB'm	‡	SRP267													
469 (2nd Type)	Vol.	18	N	6			22538	1	WE847					56, 57, ^{3}58, 55, ^{2}47, 80	130	3
	Sil.	12	Y													
	ToneB'm	‡	M20MP													
469D	Vol.	55	N	6			23981	39	CM164	B11				^{3}39, 36, 37, 85, ^{2}48	130	
	Sil.	12	A20MP													
469F	Vol.	13	N	6			22538	3	WE847					^{3}58, ^{3}56, ^{2}47, 80	130	3
	ToneB'm	‡	SRP267													
469F (2nd Type)	Vol.	55	N	6			22538	1	WE847					^{3}58, 56, 57, 55, ^{2}47, 80	130	3
	Sil.	12	Y													
	ToneB'm	‡	M20MP													
469Q	Vol.	55	N				22472	12	CS123					^{3}34, ^{2}32, ^{4}30	130	
475	Vol.	18	N	6			28031	1	WE847					2A7, 58, 2A6, 2A5, 80	264	1
							27585	1	RS213							
							25379	15	TS101							
480	Vol.	13	N	6			22538	1	WE847					^{4}58, ^{2}56, ^{2}47, 80	472.5	3
	ToneB'm	‡	SRP267													
485Q	Vol.	18	N	7			29529	12	RS203					1C6, ^{2}1A4, 1B5, 33	450–	
							28031	12	RS203						472.5	
487	Vol.	18	N	6			28031	1	WE847					^{3}58, 2A7, 2A6, 2A5,		
							27592	1/14/15	RN241/TS101					80	472½	1
509	Vol.	64	N				22538	3	WE847					^{3}58, 2A7, 56, 55, ^{2}2A5,		
														80	472½	1
510	Vol.	45	N	6			22538	1	WE847					^{3}58, ^{3}56, ^{2}2A5, 80	130	1
	Sil.	7	H													
511	Vol.	55	TRP606				22538	1	WE847					^{3}58, 2A7, 2B7, ^{3}56, ^{2}2A3,		
							25385	12	RS203					5Z3	472.5	3
							27911	24	WE1647							
							25384	24	CS133							
							25379	15	TS101							
515Q	Vol.	18	N	7			28031	12	RS203					1C6, ^{2}1A4, 1B5, 33	450	
							29529	12	RS203							
525	Vol.	55	N	6			25168	1	WE847					57, 58, 2A6, 2A5, 80	264	1
							25167	15	TS101							
							26381	1	RS213							
525Q	Vol.	27	UC513	7		A95	22472	12	CS123					1A6, 34, 32, 30, 19	264	
534	Vol.	55	N				25385	1	RS203		9	226	C3	77, 44, 75, 41	450	
							24379	15	TS101							
							25384	1	CS133							
							.01-.01		Buffer	B14						
545	Vol.	18	N	6			22538	1	WE847					6A7, 6D6, 75, 42, 80	472.5	
							25384	1	RS203						or 450	1
555	Vol.	55	N	6			24403	1	RN241	B26				47, 55, 57, 58, 80	262.5	1
555 (2nd Type)	Vol.	18	N	6			22538	1	WE847					57, 58, 55, 47, 80	262.5	1
							25184	1	CS131							
556	Vol.	17	UC512				32273	1	CN152		35	294	C3	^{2}6K7G, 6A8G, 6Q7G,		
							25379	15	TS101					6X5G, 6F6G	264	10
							.01-.01		Buffer	B14						
557	Vol.	‡	N				28031	‡	WE847					^{3}58, 2A7, 55, ^{2}2A5, 80	472.5	
558	Vol.	55	N	6			22538	4	WE847					^{3}58, 55, 56, 57, 47, 80	130	1
	Sil.	12	A20MP													
558D	Vol.	55	N	6			23981	39	CM164	B11				^{3}39, 37, 36, 85, ^{2}48	130	
	Sil.	12	A20MP													
558Q	Vol.	55	N				22472	12	CS123					^{4}30, ^{2}32, ^{3}34	130	
559	Vol.	55	N	6			22538	3	WE847					^{3}58, 55, ^{2}2A5, 80	472.5	1
565Z	Vol.	18	N	6			26995	1	SR605	B23	38	F297	C3	6A7, 78, 75, 43, 6Z4-		
							25379	15	TS101					84	264	10
							.05-.05		Buffer	B14						
567, 567F	Vol.	8	E	6			22538	4	WE847					^{3}35, 24, 47, 27, 80	130	1
E608	Vol.	18	N	6			29961	1	RS216					^{3}6D6, 6A7, 85, ^{2}42, 80	472½	1
612	Vol.	55	N	6			22538	1	WE847					^{4}58, 56, 57, 55, ^{3}46, 83	130	12
	ToneB'm	‡	M20MP				23498	1	WE447							
	Sil.	12	A20MP				23179	15	TS107							
625Q	Vol.	27	UC513	13			22172	12	CS123					1C6, 34, 32, 30, 19	264	
627	Vol.	55	N	6			22538	4	WE847					^{3}58, 56, 55, 47, 80	130	1
636	Vol.	55	N				24298	1	CS123					^{2}39, 36, 85, ^{2}41	262.5	
E648	Vol.	18	N	6			29961	1	RS216					^{3}6D6, 6A7, 85, ^{2}42, 80	472½	1
649	Vol.	17	N	6			29691	1	WE1647					^{3}6K7, 6A8, 6H6, 6C5,		
							25379	15	TS101					^{2}6F6, 5Z4	472.5	1
655Q	Vol.	27	UC513	7		A95	22472	12	CS123					1C6, 34, 32, 30, 19	264	
657Q	Vol.	18	N	7			31552	24	RN232					1C6, ^{2}34, 1B5, ^{3}30	472.5	
665	Vol.	55	N	6			25168	1	WE847					57, 58, 2A6, 2A5, 80	264	1
							26381	1	RS213							
							25379	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ATWATER KENT—	Continued															
666	Vol.	55	UC512	6			26995	1	SR605	B23	37	296	C3	[2]6D6, 6A7, 85, 41		
							25397	15	TS101					6Z4-84	264	10
							.05-.05		Buffer	B14						
667	Vol.	55	N				22538	1	WE847					[3]58, 56, 55, 2A5, 80	264	1
							25397	15	TS101							
667D	Vol.	55	N				23981	39	CM164	B11				[3]78, 37, 75,[2]43	264	
708	Vol.	55	N	6			22538	1	WE847					[5]58, 2A6, 2A5, 80	472.5	1
							25167	15	TS101							
710	Vol.	18	N				28031	1	WE847					[5]6D6, 6A7, 6B7, [2]76,		
							27583	14	RS216					[2]45, 5Z3	472½	14
							25384	14	CS133							
							29964	15	TN111							
711	Vol.	55	N	6			22538	28	WE847					[5]58, 55,[2]56,[2]2A3, 5Z3	472.5	3
	Sil.	7	H				25384	24	CS133						450	1
							25385	24	RS213							
725, 725X	Vol.	18	N	6			28031	25	WE847					6A8, 6K7, 75, 6F6, 80	450	1
							27585	25	RS213							
							25379	15	TS101							
735	Vol.	18	N	6			28031	1	WE847					2A7, 58, 2A6, 2A5, 80	264	1
							27585	1	RS213							
							25379	15	TS101							
747Q	Vol.	18	N	7			31552	24	RN232					1C6,[2]34, 1B5,[3]30	472.5	
P755	Vol.	18	N	6			28031	1	WE847					6A7, 6D6, 75, 42, 80	264	1
							27583	1	RS216							
							25379	15	TS101							
756, 756B	Vol.	55	MR48				24298	1	CS123					[2]39, 36, 85,[2]41	262.5	
E765	Vol.	18	N	6			28031	1	WE847					6A7, 6D6, 75, 12, 80	472½	1
							27592	1/14/15	RN241/TS101							
768Q	Vol.	18	N	7			22472	12	CS123					1C6,[2]34,[4]30,32	472.5	
776	Vol.	55	UC512	6			26995	1	SR605	B23	37	296	C3	6A7,[2]6D6, 41, 84, 85	264	10
							25379	15	TS101							
							.05-.05		Buffer	B14						
788	Vol.	55	N	6			22538	1	WE847					[5]58, 2A6, 2A5, 80	472.5	1
	Sil.	7	H				23579	15	TS101							
808	Vol.	55	N	6			22538	1	WE847					[5]58, 2A6, 2A5, 80	472.5	1
							25379	15	TS101							
808A	Vol.	55	N				22538	1	WE847					[5]58, 2A6, 2A5, 80	472.5	1
							25379	15	TS101							
810	Vol.	19	TRP606	6			22538	1	WE847					[5]6K7, 6A8, 6H6, 6C5,		
							27583	1	WE1647					[5]6F6, 5Z4	472.5	1
							29964	15	TN111							
812	Vol.	55	N	6			22538	1	WE847					[4]58, 56, 57, 55,[3]46, 83	130	12
	ToneB'm	‡	M20MP				23498	1	WE447							
	Sil.	12	Y				23181	1	WE1217							
							23479	16	TS107							
816	Vol.	55	UC512	6			26062	1	SR611	B30	9	226	C3	[2]39, 6A7, 85,[2]41	264	10
							.05-.05		Buffer	B14						
825 AC-DC	Vol.	55	N	6			26158	29	UR190	B72				6A7, 44, 75, 43, 25Z5	264	
854	Vol.	2	Y	6			22538	1	WE847					[2]57, 2A5, 80	450	1
							27584	1	RS211							
856	Vol.	18	N	6			28031	1	WE847					6A8, 6K7, 6H6, 6F5,		
							27585	1	RS213	B27				6F6, 5Z4	264	1
							27583	1	RN242	B27						
P875	Vol.	18	N	6			28031	1	WE847					6A7, 6D6, 75, 42, 80	264	1
							27583	1	RS216							
							25379	15	TS101							
926	Vol.	55	UC512	6			26864	12	CS133					[2]39, 6A7, 85,[2]41	264	MG
936	Vol.	55	UC512	6			26864	12	CS133					[2]39, 6A7, 85,[2]41	264	MG
944	Vol.	2	Y	6			22538	25	WE847					[2]57, 2A5, 80	450	1
							27584	25	RS211							
976	Vol.	18	N	6			28031	25	WE847					6A8, 6K7, 6H6, 6F5,		
							27585	25	RS213	B27				6F6, 5Z4	264	1
							27583	1	RN242	B27						
978Q	Vol.	55	N	7			22472	12	CS123					1C6,[2]34,[4]30, 32	472.5	
AUDIOLA—Also see	Fairbanks-Morse.															
Jr.	Vol.	6	G7	6		A14	1-2	1	See Note	B1				[3]24, 45, 80		3
	Tone	22	G12													
Jr. No. 1	Vol.	6	G7	6		A14	8, 8	1	RS213	B3				[3]24, 27, 45, 80		3
	Tone	22	G12													
Jr. No. 2, 6 Tube	Vol.	6	G7	6		A14	8-8	1	RS213	B3				[3]24, 27, 45, 80		3
	Tone	22	G12													
4 Tube Pent. 1931	Vol.	6	G7	6		A14	4-4	1	See Note	B3				35, 24, 47, 80		3
4 Tube, '32	Vol.	6	G7			A14	6-4	4	See Note	B3				35, 24, 47, 80		1
13T5	Vol.	6	G7	6		A14	4-4	1	CN150	B3				[2]35, 24, 47, 80		3
	Tone	22	M													
6 Tube Pent. '31	Vol.	6	G7	6		A14	8-8	1	See Note	B3				[2]35, 24, 27, 47, 80		3
	Tone	22	G12													
7 Tube Sup. Pent.'31	Vol.	6	G7	6			8-8	1	See Note	B3				[2]35,[2]24, 27, 47, 80	177.5	3
	Tone	22	M													
8 Tube Sup. Pent.'31	Vol.	6	G7		3	A14	8-8	1	See Note	B3				[2]35,[2]27,[2]24, 47, 80	177.5	3
	Tone	22	M													
9 Tube Sup. Pent.'31	Vol.	6	G7	6		A14	8-8		See Note	B3				[2]35-[3]51,[2]27,[3]24, 47, 80	177.5	3
10 Tube Sup. '31	Vol.	6	G7		3	A14	8-8	1	See Note	B3				[5]24,[2]27,[2]45, 80	177.5	3
	Tone	41	O													
B6	Vol.	18	UC512				8-8	25	CM172		38	297	C3	[2]6D6, 6A7, 75, 41, 84,	177.5	10
							.02		Buffer	B14						
9T45	Vol.	6	G7	6	3		8, 8	1	RS213					[2]35,[2]27[3]24, 45, 80	177.5	3
	Tone	41	O													
13S6	Vol.	6	G12			A14	8, 8	1	RS213					[2]24, 27, 35, 47, 80	‡	3
	Tone	22	See Note			A5										
13S9	Vol.	6	G7				8-4-4	3	See Note	B28				[2]35, 24,[2]27,[2]47, 80	177.5	3
	Tone	22	M													
13T5	Vol.	6	G7	6			4-4	1	See Note	B3				[2]35, 24, 47, 80		3
	Tone	22	M													
23S7 Auto	Vol.	15	L				8-8	1	CN152	B42	44	312T	C1	[2]39, 36, 85-Wunder-		
							20	15	TS102		34	292	C1	lich, 79, BR	177.5	
							.05		Buffer	B43						
23S8	Vol.	15	N				8, 8	4	RS213					[2]58,[3]56, 57, 47, 80	177.5	1
	Tone	22	K12													
23S8Q	Vol.	15	L	6			8, 8	1	RS213					[2]35,[2]27, 24, Wunder-		
	Tone	22	See Note			A5	5	17	TS101					lich, 47, 80	177.5	3
23S10	Vol.	45	M	6			8, 8	4	RS213					[3]38,[3]56, 57,[2]47, 80	177.5	1
	Tone	22	K12													
23S10 (2nd)	Vol.	45	M	6			12	4	RS215					[3]38, 57,[3]56,[2]2A5, 80	177.5	1
	Tone	22	K12				8	4	RS213							
							.5	4	See Note	B7						
23S12	Vol.	45	M	6			8	3	WE847					[3]58,[5]56, 57,[2]46, 83	177.5	1
	Tone	22	K12				8-8	3	RS213	B3						
23S12 (Revised)	Vol.	45	M	6			8	3	WE847					[3]58,[5]56, 57,[2]59, 5Z3	177.5	1
	Tone	22	K12				12	3	RS215							
							8	3	RS213							

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
AUDIOLA—Continued																
23T5	Vol.	6	G7	6		A14	4-4	1	See Note	B3				^{2}35, 24, 47, 80		3
23T5 SW	Vol.	6	G12	6	EX300		6-4	4	See Note	B3				^{2}35, 24, 47, 80		1
30B	Vol.	12	D12				1-3-3	3	See Note	B1				^{3}24, 27,^{2}45, 80		3
31 Series	Vol.	6	G7			A11	8-8-8	3	See Note	B3				^{3}24, 27,^{2}45, 80		3
	Tone	41	O		See Note	A4										
31 Super	Vol.	6	G7				8-8-8	3	MN275					^{4}24,^{2}27,^{2}45, 80	175	3
	Tone	41	O													
	Tone	22	M		See Note	A4										
32S11	Vol.	48	N				8-8-8	25	RS213	B3				^{3}35,^{4}27, 24,^{2}47, 80	‡	3
	Tone	22	K12													
33A6	Vol.	15	L			A15	8-8	1	CN152	B42	8	225	C3	^{2}6D6, Wunderlich, 37,		
							5	15	TS101					89	177.5	10
							.02		Buffer	B14						
33S5	Vol.	6	K12	6			16-8	6	See Note	B3				^{2}6D6-78, 6C6-77, 43,		
							5	15	TS101					25Z5	456	
33S5 (Rev.)	Vol.	6	K12	6			8	4	RS213					^{2}58, 57, 2A5, 80	456	1
33S6	Vol.	15	L	6			8-8	1	CN152	B12	41	312T	C1	^{2}39, 36, Wunderlich,		
							20	15	TS102		8	225	C4	89, BR	177.5	
33S6B	Vol.	6	K12											32,^{2}34, 30, 19	450	
33S7	Vol.	45	N	6			8-4	4	See Note	B3				^{2}58, 57,^{2}56, 2A5, 80	456	1
	Tone	22	K12													
33S7 Auto	Vol.	15	L				8, 8	1	CN152	B42	41	312T	C1	6C6,^{2}6D6, 37, 79, 85		
											34	292	C1	BR-84	177.5	
33S8 32V	Vol.	15	N				8-8	1	CN152	B42	41	F312	C2	^{3}39, ^{2}37, 85, 77, 84-BR	‡	
	Tone	22	K12				5	15	TS101			See Note	C2			
							.005		See Note	B44						
							.04		See Note	B44						
33S10 SW	Vol.	15	M				12-8	4	See Note	B3				^{4}58, 57, 55, 56,^{2}2A5, 80	456	1
	Tone	22	K12	6			.25		See Note	B7						
33T4	Vol.	6	K12	6			4-4	1	CN140	B3				6D6-78, 6C6-77, 38-		
							5	15	TS101					89, 12Z3-37		
34C5 (AC-DC)	Vol.	17	N	6			16-8	6	See Note	B3				6A7, 6D6, 75, 43,		
							5	15	TS101					12Z3	456	
34S5	Vol.	17	M	6			8, 8	4	RS213	B3				2A7, 58, 2A6, 2A5, 80	456	1
							5	15	TS101							
34S5 LW	Vol.	6	K12	6			8-8	4	RS213	B3				2A7, 58, 57, 2A5, 80	456	1
							.25	4	See Note	B7						
51, 52	Vol.	17	N				8, 8	4	RS213					2A7, 58, 2A6, 2A5, 80	456	1
	Tone	22	K12				5	15	TS101							
53	Vol.	18	N				8, 8	4	RS213					2A7, 58, 2A6, 2A5, 80	456	1
	Tone	22	K12													
346	Vol.	17	UC512	6			8-8	25	CM172		38	297	C3	^{2}6D6, 6A7, 75, 41, 84	177.5	10
	Tone	22	K12				.02		Buffer	B14						
347	Vol.	17	N	6			8-8	25	See Note	B3	38	297	C3	^{2}6D6, 6A7, 85,^{2}41, 81	177.5	10
	Tone	44	K12				.02		Buffer	B14						
516 (2-volt bat. set)	Vol.	134	K12											32,^{2}34, 30, 19	177.5	
889	Vol.	4	A				1-.5-2-2-2		See Note	B1				^{4}26, 27,^{2}71, 80		11
7330	Vol.	12	D				1-3-3		See Note	B1				^{3}24, 27,^{2}45, 80		3
8430	Vol.	7	Z				1-3-3-.5		See Note	B1				^{2}27,^{2}45, 80		3
	Tone	22	M													
AUSTIN																
A	Vol.	6	F7	6		A11	8, 8	1	RS213					^{3}24, 45, 80		3
J	Vol.	6	E7	6			8-8	1	RN242					^{4}24, 45, 80		3
	Tone	22	H12													
S	Vol.	6	F7	6			8, 8	1	RS213					^{3}24,^{2}27,^{2}45, 80	175	3
	Tone	39	G12													
SP	Vol.	6	F7	6		A11	8, 8	1	See Note	B3				^{2}51,^{2}27, 24,^{2}47, 80	175	3
	Tone	39	G12													
AUTOCRAT																
Jr. 4	Vol.	6	G12	6			8-4	25	See Note	B3				^{2}57, 47, 80		1
4SA	Vol.	17	G12	6	See Note	A11	12-12	1	See Note	B5				6D6, 6C6, 43, 25Z5		
							10-10	15	See Note	B5						
4LW	Vol.	6	J	6	EX300		8-4-4	8	See Note	B3				6D6, 6C6, 43, 25Z5		
5	Vol.	17	UM154		See Note	A96	8-8	4	See Note	B3	34	292	C3	6A7, 6D6, 6B7, 41, 84	456	10
							10	15	TS101							
							.008-.008		See Note	B14						
5SA (55SA)	Vol.	17	N	6			10-5-25	11	UR182					6A7, 6D6, 75, 43,		
							10	15	TS101					25Z5	456	
6	Vol.	17	N	6			4-4	1	See Note	B3				57, 58, 55, 56, 2A5, 80	175	1
	Tone	22	N													
6 (Revised)	Vol.	56	N				7-4	1	See Note	B3				2A7, 58, 2B7, 2A5, 80	175	1
	Tone	22	N				10	15	TS101							
6D32	Vol.	18	N				8-4	4	See Note	B3	‡	See Note	C7	6A7, 6D6, 75, 41, 84	175	‡
	Tone	22	K12													
57C	Vol.	6	G12	6	EX300		4-4	25	CM170					58, 57, 47, 80		1
80	Vol.	6	G12		See Note	A11	4-4	25	See Note	B3				^{2}58, 57, 47, 80		1
90SL	Vol.	15	N				8-8	1	See Note	B3				57,^{2}58, 2B7,^{2}56,^{2}2A5,		
	Tone	21	N											80	175	1
406	Vol.	7	‡		See Note	A5								6D6, 6C6, 38, 12Z3		
505	Vol.	18	UM154	M26		A96	505F	1	CN152	B3	35	294	C3	6A7, 6D6, 75, 41, 84	456	10
							5	15	TS105							
							.03		Buffer	B14						
518, 618	Vol.	17	UM154			A96	4-8	4	CM171		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	456	10
							4	15	TS105							
							.0075		Buffer	B14						
AUTOMATIC																
A1	Vol.	17	N				AC511	4	CM172		45	503	C3	6A7, 6D6, 75, 41,		
														6E5, 84		10
A5	Vol.	18	UM154		See Note	A96	4-8	4	CM171		45	503	C3	6A7, 6D6, 75, 41, 84	480	10
							.02		Buffer	B14						
B10, B10P, B10LW, B15	Vol.	88	O	6	EX200		16-16-8-5-5	24/15	UR189/CS126	B256				6D6, 6C6, 43, 25Z5		
B30 Series I	Vol.	18	N	6			CE15	1/15	UR192/TN110					6A7, 6D6, 75, 43,		
														25Z5	456	
B30 Series II	Vol.	18	M	6			CE20	23	UR192					6A7, 6D6, 6Q7, 25L6,		
														25Z5	456	
B37, B38	Vol.	18	M	6			CE20	23	UR192					6A7, 6D6, 6Q7G,		
														25L6G, 6E5, 25Z5	456	
B40 Series II	Vol.	18	M	6			CE16	1/15	CM164/TN110					6A7, 6D6, 6Q7, 25L6,		
														25Z5	456	
B70, B80, B85, B85LW	Vol.	18	M	6			8-30-16	1/13	See Note	B3				6A7, 6D6, 37, 6E5,		
														6C6, 25B6, 25Z5	456	
B100	Vol.	18	M	6			CE21	23	UR192					6A7, 6D6, 76, 75,		
														25L6G, 25Z5	456	
C4	Vol.	7	J	6	EX300		5-20-8	24/15	UR182					6D6, 6C6, 25A8		
D5	Vol.	88	O	6	EX200		16-16-8-5-5	24/15	UR189/CS126	B256				6D6, 6C6, 43, 25Z5		
J50	Vol.	17	UM154			A96	4-8	4	CM171		45	503	C3	6A7, 78, 75, 41, 84	480	10
	Tone	21	MR48				.02		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
AUTOMATIC—Cont'd																
J60	Vol. Tone	17 21	UM154 MR48			A96	4-8 .02	4	CM171 Buffer	 B14	45	503	C3	6A7, 78, 75, 41, 6E5, 84	480	10
J80	Vol. Tone	17 22	UM161 MR44	M26		A96	1082010 .02	1	CN151 Buffer	 B14	45	503	C3	^{2}78, 6A7, 75, 76,^{2}41, 84	456	10
M10	Vol.	18	MR48	M26			CE30 .007	40	CM175 Buffer	B270 B14	35	294	C3	6A7, 6D6, 75, 41, 84	456	10
M20	Vol. Tone	18 21	MR48 MR48	M26			CE30 .007	40	CM175 Buffer	B370 B14	35	294	C3	6A7, 6D6, 75, 41, 6X5	456	10
M60	Vol. Sen.	17 7	N D	6			CE12 .007	4	RM265 Buffer	B257 B14	35	294	C3	^{2}6D6, 6A7, 6Q7G, 41, 84	456	10
M70	Vol. Tone	18 22	UM154 MR34	M26		A96	12-12 8 5 .007	23 13 15	See Note CS123 TS105 Buffer	B3 B14	35	294	C3	^{2}6D6, 6A7, 6Q7G, 41, 6X5	456	10
M80	Vol. Tone Sen.	18 21 48	UM154 MR34 C100P	M26		A96	12-12 8 .008	23 13	See Note CS123 Buffer	B3 B14	35	294	C3	^{2}6D6, 6A7, 6Q7G, ^{2}76, ^{2}6B5, 0Z4	456	10
P25	Vol.	12	K12	6			8-8	4	See Note	B3				35, 24, 47, 80		1
P35, 34	Vol.	12	K12				8-8	4	See Note	B3				^{3}24, 47, 80		1
P224 (Midget Tom Thumb)	Vol.	12	Y				8-8	4	See Note	B3				^{4}24, 45, 80		3
R6, R61, R63	Vol.	17	N				20-16-5-5	1/15	UR192/TN110					6A7, 6D6, 75, 25B6, 25Z5	456	
S6	Vol.	7	F	6	2		20-8-5-5	6/15	UR189	B36				6A7, 6D6, 75, 43, 25Z5	456	
44, V45, V46, C45, P46	Vol.	7	A5MP				8-8	4	See Note	B3				^{4}24, 47, 80		1
850	Vol.	18	M	6			CE20	23	UR192					6A7, 6D6, 6Q7G, 6E5, 25L6G, 25Z5	456	
855	Vol.	18	M	6			40-5-20	4/19	See Note	B3				6A7, 6D6, 76, 6Q7G, 25L6G, 25Z5	456	
860	Vol.	18	M	6			CE21	23	UR192					6A7, 6D6, 76, 75, 25L6G, 25Z5	456	
878	Vol. Tone	18 22	M N	6			CE22 5	4 20	Order from TS105	Mfr.				6A7, 6D6, ^{2}76, 6U5, 6C6, 25B6G, 25Z5	456	
892	Vol. Tone Sen.	18 41 7	M N F	6		 A14	40-20-20 5	24 15	Order from TS105	Mfr.				6A7, 6D6, ^{2}76, 6G5, 75, ^{2}25L6G, ^{2}25Z5	456	
JR (AR224)	Vol.	15	UM154			A96	E1365GL .02	1	UR189 Buffer	B29 B14	34	292	C3	^{2}6D6, 37, 6C6, 41, 84		10
SG4 (Tom Thumb)	Vol.	31	A400P											22,^{3}99		
Tom Thumb (Steering Post)	Vol.	7	G		See Note A1									^{2}78, 77, 41		
AZTEC RADIO CO.																
Aztec	Vol.	6	G12				8-8	1	See Note	B3				^{3}24, 47, 80		3
BAIRD—See Gen. Electronics Corp.																
BALDWIN																
45	Vol.	6	H12				2-4	4	See Note	B3				^{2}24, 45, 80		1
47	Vol.	6	Y				2-8	4	See Note	B3				35, 24, 47, 80		1
54	Vol.	18	UM154		See Note A96		6-10 .02	4	See Note Buffer	B3 B14	35	294	C3	6A7, 6D6, 75, 42, 84	‡	10
64	Vol.	18	UM154		See Note A96		6-10 .02	4	See Note Buffer	B3 B14	35	294	C3	^{2}6D6, 6A7, 75, 42, 84	‡	10
80	Vol. Sen.	6 7	H12 M1MP				2-2	1	See Note	B1				^{4}24, 27,^{2}45, 80		1
BALKEIT																
A3, A5, A7	Vol.	27	K12		See Note A5		‡	3	See Note	B1				^{5}27,^{2}12A, 80		3
B7, B9	Vol.	3	F12				2-3-4	3	See Note	B7				^{5}01A, 50,^{2}81, 10		5
C	Vol. Sen.	6 7	H12 M2MP				2-2-2	3	See Note	B1				^{6}27,^{2}45, 80		3
D5	Vol.	7	K	6		A10	4-4	4	CM170					^{2}58, 56, 47, 80		1
E	Vol. Tone	6 22	H12 G12				8-4-4	3	See Note	B3				^{3}24, 27, 45, 80		3
F	Vol.	6	H12				8-8-8	3	MN275					^{4}27, 24,^{2}45, 80		3
G16A, G19B	Vol. Tone	18 34	N ‡		 See Note A5		4 8-4	32 32	WE447 See Note	 B3				6A7, 6K7, 6H6, 6F5, 6F6, 80	456	1
G20	Vol.	18	N				4 8-4	32 32	WE447 See Note	 B3				6A8, 6K7, 6H6, 6A6, ^{2}6F6, 80	456	1
G200X	Vol.	18	N				4 8-4	32 32	WE447 See Note	 B3				6A8, 6K7, 6H6, 6A6, ^{2}6F6, 80	456	1
GT16A	Vol.	18	UC509		EX300		4-8-12 10-10	8 15	See Note TN111	B3				6C6, 6D6, 75, 43, 25Z5	456	
GT33	Vol.	18	N				18-6 5-5	6 15	See Note See Note	B3 B5				6A7, 6D6, 75, ^{2}43, 25Z5	456	
GT156BA	Vol.	48	N	7			8-8 .01-.01	1	CN152 Buffer	 B14	14	245C	C3	1C6, 34,^{2}30, 32, 33	456	6
KP	Vol. Tone	6 22	H12 O				8-8	4	See Note	B3				^{3}24, 47, 80		1
L5	Vol. Tone	18 34	N L	6			P474 P160 P304	32 32 15	RS211 CN151 TS101	 B81				5Z4, 6F5, 6F6, 6H6, 6K7, 6L7	456	1
L6	Vol. Tone	18 44	N L	6			P474 P160 P304	32 32 15	RS211 CN151 TS101	 B81				5Z4, 6C5,^{2}6F6, 6K7, 6L7,^{2}6Q7	456	1
L7 ('36)	Vol. Tone	45 ‡	N L	7			P391 .01-.01	1	RN232 Buffer	 B14	14	245C	C3	1C6, 19,^{3}30,^{2}34	456	10
L7 ('31)	Vol. Tone	6 21	H12 O				8-8	4	RS213	B3				27,^{2}51,^{2}24, 47, 80	175	1
L8	Vol. Tone	7 41	H O	6			4-4-4	3	CM173					^{3}51,^{2}27,^{2}47, 80	175	3
M	Vol. Tone	6 22	H12 O		EX300		8-8	4	RS213	B3				^{2}24, 47, 80		1
ML1, ML2	Vol.	18	SRP275				4 8-4	7 7	RS213 CN151					6A7, 6K7, 6H6, 6F5, 6F6, 80	456	1
SG6	Vol. Tone	6 22	H12 G12				8-4-4	3	See Note	B3				^{3}24, 27, 45, 80		3
Z4	Vol. Tone	45 44	SRP275 L	7			P391 .01-.01	1	RN232 Buffer	 B14	14	245C	C3	1C6, 19,^{2}30, 32, 34	456	10
Z5	Vol. Tone	45 44	SRP275 L	7			P958 .01-.01	1	RN232 Buffer	 B14	14	215C	C3	1C6, 19,^{2}30, 32, 34	456	10
38	Vol.	7	M	6	EX250		8-8 10	1 15	CN142 TS101	B3				6D6, 6C6, 38, 12Z3		
41A	Vol.	6	UC509		EX250		8-4	1	See Note	B3				6A7, 6D6, 6H6, 6F5, 80	456	1
42E, 42G	Vol.	6	G12		EX200		4-4	25	CM170	B3				58, 57, 47, 80		1
45	Vol.	6	UC509		EX250		12-8 10	6 15	See Note See Note	B3 B5				6D6, 6C6, 43, 25Z5		

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
BALKEIT—Continued																
48	Vol.	6	UC509		EX250		16-12	1	See Note	B3				6D6, 6C6, 38, 25Z5		
							10-10	15	TN111	B6						
52-1	Vol.	6	H12				4-4	4	CM170	B3				58, 57, 47, 80		1
	Tone	22	O													
54	Vol.	18	UM154		See Note	A96	6-10	4	See Note	B3	35	294	C3	6A7, 6D6, 75, 42, 84	‡	10
							.02		Buffer	B14						
55	Vol.	6	H12				4-4	4	CM170	B3				^{2}57, 58, 47, 80		1
59	Vol.	6	G12	6	EX200		20-20	6	See Note	B3				6A7, 6D6, 75, 43,		
							10-10	15	TN111					25Z5	456	
60	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
64	Vol.	18	UM154		See Note	A96	6-10	4	See Note	B3	35	294	C3	6A7,^{2}6D6, 75, 41, 84	‡	10
							.02		Buffer	B14						
69	Vol.	6	G7	6	2		20-20	6	See Note	B3				6A7, 6D6, 85, ^{2}43,		
							3	13	See Note	B3				25Z5	456	
							10		TS101							
70	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
100	Vol.	17	O				4-4-4	3	See Note	B3				^{3}58, 55,^{3}56,^{2}45, 82	175	1
	Tone	42	O				20	15	TS102							
BARKER BROS.																
L	Vol.	15	N	6			4	3	UR185	B3				^{3}58, 57, 55,^{2}56,^{2}46, 82	262	1
							8-4	3	See Note	B3						
M	Vol.	15	N	6			8-8	1	See Note	B3				^{2}57,^{2}58,^{2}56, 55,^{2}59, 82	262	1
	Tone	22	UC502				4	15	See Note	B3						
	Sil.	‡	See Note			A5										
P(2 Types)	Vol.	15	N	6			8-4	1	See Note	B3				57,^{2}58, 56, 55, 59, 82	262	1
	Tone	22	UC502				8-8	1	See Note	B10						
							10	15	TS101							
BEL CANTO—See Amrad.																
BELL TONE—See Airking																
BELMONT RADIO CORP.																
40AC	Vol.	7	G		2		4-4	4	See Note	B3				35, 24, 47, 80		1
40A, 41A, 42A	Vol.	7	G				8	4	RS213					58, 57, 47, 80		1
							4	4	RS211							
40DC, 45, 46	Vol.	6	G12				1		See Note	B7				^{2}36, 37, 38		
50	Vol.	7	G				6-6	4	RS213					^{2}51, 24, 47, 80		1
	Tone	22	G12													
50A, 51A, 52A, 53A, 54A	Vol.	7	G				4-4	4	See Note	B3				^{2}35, 24, 47, 80		1
50B, 51B, 52B, 53B, 54B	Vol.	6	G12		See Note	A14	6	4	RS213					^{2}24, 35, 47, 80	175	1
							4	4	RS211							
50C, 51C, 52C, 53C, 54C	Vol.	6	G12				8	4	RS213					^{2}57, 58, 47, 80	175	1
	Tone	22	K12				4	4	RS211							
							25	17	TS102							
50F, 55F	Vol.	7	Z		See Note	A14	4-8	1	CM161					^{2}39, 36, 38		
							5-5	15	TN110							
53	Vol.	20	N	6			C525	11	UR182	B31				6A7, 6D6, 75, 42,		
														25Z5	456	
60, 61, 62, 63, 64	Vol.	6	G12				6	4	RS213					^{2}24, 27, 35, 47, 80	175	1
	Tone	22	K12													
65, 66	Vol.	6	G12				4	1	See Note	B11				^{3}36, 37,^{2}38		
	Tone	41	N													
70	Vol.	7	G				6	4	RS213					^{3}51,^{2}27, 47, 80	175	1
	Tone	22	K12													
70A, 71A, 72A, 73A, 74A	Vol.	17	O				8	4	RS213					^{2}58, 57, 56, 55, 47, 80	175	3
	Tone	22	K12				4	4	RS211							
	Supp.	7	K				10	17	TS101							
71C	Vol.	56	O				P1047	1/15	CS131/TS101					^{2}58, 57, 56, 55, 2A5, 80	175	1
	Supp.	7	K				P1048	1	WE847							
	Tone	22	K12	6												
100, 101, 102, 103, 104	Vol.	45	O				8-4-8	5	See Note	B3				^{2}58, 57,^{4}56, ^{2}59, 83	175	1
	Tone	22	K12	6												
	Supp.	6	K													
110	Vol.	62	O				4-4-4	26	See Note	B3				^{4}35,^{4}27,^{2}47, 80	175	3
	Tone	22	L	6												
401	Vol.	8	UC501				P119-10	1/15	CN145	B34				58, 57, 2A5, 80		1
401 Series B	Vol.	8	UC501				P119-10	1/15	CN145	B34				6K7, 6J7, 6F6, 5Z4		
														or 5Y3		1
404	Vol.	6	TRP601											1A6,^{2}32, 33	465	
	Fil.	29	M4R													
415 Series A	Vol.	56	MR53	M27			119-28	1	RN232		15	246	C3	1A6, 1A4, 1F6, 1F4	465	10
	Tone	21	MR53				.005		Buffer	B14						
	Fil.	29	C6R													
415 Series B	Vol.	18	MR53	M27			119-28	1	RN232		15	246	C3	6D8G, 6S7G, 6T7G,		
	Tone	22	MR44				.005		Buffer	B14				1F5G	465	10
420	Vol.	7	Z	6	EX100	A10	8-8-8	1	See Note	B35				6D6, 76, 38, 12Z3		
							8	15	See Note	B35						
425	Vol.	7	Z	6	EX100		C538	11	UR182	B31				6E7, 6D7, 43, 25Z5	456	
430	Vol.	7	Z	6	EX100		8-16-5-5	6/15	UR189	B36				6D6, 76, 12A5, 12Z3		
440	Vol.	7	Z	6	EX100	A10	P103-1	11	Order from	Mfr.				6D6, 6C6, 43, 25Z5	456	
444EX	Vol.	8	UC501	6	EX100		10-8	1	CN152					6D6, 6C6, 43, 12Z3		
							4	15	TS101							
489 Series A	Vol.	18	O	7			119-28B	1	RN232		15	246	C3	6D8G, 6S7G, 6T7G,		
							.005		Buffer	B14				6K6G	465	10
504 Series A	Vol.	18	O	7			119-28	1	RN232		15	246	C3	6D8G, 6S7G, 6T7G,		
	Tone	22	MR44				.005		Buffer	B14				1F5G, 6N5	465	10
505 Series A	Vol.	18	O	7			119-24B	4	SR633		35	294	C3	6D8G, 6S7G, 6T7G,		
							119-22	15	TS101					6K6G, 6ZY5G	465	‡
							.008		Buffer	B14						
522	Vol.	62	O	6			10	19	TS101					1A6, 34, 30, 32, 950	465	
	Batt.	29	M6R													
523	Vol.	15	MR53	M26			119-22	20	TS101					1A6,^{2}1A4, 30, 950	465	
523B	Vol.	‡	MR53	M26			119-22	20	TS101					1A6, ^{2}1A4, 30, 1G5G	465	
525	Vol.	17	N	6			C525	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	456	
530	Vol.	17	N	6			C525/C538	11	UR182	B31				6A7, 6D6, 75, 43,		
														25Z5	456	
540	Vol.	17	N	6			C525C/C525D	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	456	
541	Vol.	82	TRP609	6			P119-7	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	456	
544, 545	Vol.	82	TRP609				P103-9	1/15	RN232/TS101					6A7, 6D6, 6B7, 43,		
	Tone	22	K12	6										12Z3	465	
550	Vol.	17	N	6			P1003	4	RM262					2A7, 58, 2A6, 2A5, 80	456	1
555	Vol.	82	TRP609	6			P103-6	4	RS213					6A7, 6D6, 6B7, 42, 80	456	1
							P103-7	4	RS213							
556 (Export)	Vol.	62	TRP609	6			P103-6	4	RS213					6A7, 6D6, 6B7, 42, 80	465	1
							P103-7	4	RS213							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
BELMONT RADIO CORP.—Continued																
566	Vol.	18	UM154-SS13	M26			119-20	4	CM171	B93	35	294	C3	6A8, 6K7, 75, 84-		
							.01		Buffer	B14				6Z4, 41	465	10
567A	Vol.	17	UM154-SS13	M26			119-33	4	RN241		35	294	C3	6A8, 6K7, 6Q7, 6F6,		
							.005		Buffer	B14				6X5	465	10
575	Vol.	6	Z12	6	EX100		P119-6	4	RM262	B37				58, ^{2}57, 2A5, 80	175	1
578	Vol.	56	O				P103-6	4	RS213					6A7, 6D6, 6B7, 42, 80	456	1
							P103-7	4	RS213							
580	Vol.	17	N	6			P119-15	4	CM160		35	294	C3	6D6, 6A7, 75, 42, 84	175	10
							.01		Buffer	B14						
580 (Revised)	Vol.	17	N	6			P119-15	4	CM171	B3	37	296	C3	6A7, 6D6, 75, 42, 84	175	10
							.01		Buffer	B14						
582	Vol.	18	MR53	M26			119-47	23	CM172					6A8G, 6K7, 6Q7G,		
														6K6G, 5Y3G	465	1
585 Series A	Vol.	18	N	6			P119-11	1/15	CM173	B75				6F7, 6D6, 75, 42, 80	370	1
585 Series B and C	Vol.	18	N	6			P103-6	4	RS213					6F7, 6D6, 75, 42, 80	370	
							P103-7	4	RS213						465	1
585 Series D	Vol.	18	N	6			103-6	4	RS213					6F7, 6K7, 75, 6F6, 80	465	1
							103-7	4	RS213							
586 Series A	Vol.	18	O	6			103-6	42	RS213					6A7, 78, 75, 41, 80	465	1
							103-7	42	RS213							
587 Series A	Vol.	18	O	6			103-6	23	RS213					6A8, 6K7, 6Q7, 6F6,		
							103-7	23	RS213					5Y3	465	1
588 Series A	Vol.	18	MR53	M26			119-38	23	RM252					6A8, 6K7, 6Q7, 6F6,		
														5Y3	465	1
589	Vol.	18	MR53	M26			119-38	4	RM252					6A8, 6K7, 6Q7, 6K6,		
														5Y3	465	1
600	Vol.	17	N	6			16-16-8-14-2	9/15	Order from	Mfr.				^{2}78, 6A7, 6B7, 43,		
														25Z5	175	
601 Series A & B	Vol.	18	MR53	M26			119-25	11	RM257	B260				6A7, 78, 75, 43, 25Z5	465	
	Tone	22	MR53				119-29	4	RM259	B64						
601 Series C	Vol.	18	MR48	M26			119-29	4	RM259					6A7, 78, 75, 43, 25Z5,		
	Tone	22	MR53											L49B	465	
602	Vol.	18	MR53	M26			119-39	1	RM259	B271				6A8, 6K7, 6R7, 25L6,		
														25Z6	465	
602B	Vol.	18	MR53	M26			119-42	4	RM257					6A8, 6K7, 6R7, 25L6,		
														25Z6, L49B	470	
602C	Vol.	18	MR53	M26			119-42	4	RM255					6A8, 6K7, 6R7, 25L6,		
														25Z6, L49B	470	
625	Vol.	17	N	6			C525	11	UR182	B31				^{2}78, 6A7, 75, 43, 25Z5	175	
							C525B	11	UR182	B31						
							C525C	11	See Note	B38						
							C525D	11	See Note	B38						
640EX	Vol.	82	TRP609	6			P103-3	4	WE1847					57, 27, 58, 2A6, 2A5,		
							P103-4	4	WE1647					80	370	1
650	Vol.	17	N	6			C525C	11	See Note	B31				^{2}6D6, 6A7, 75, 43,		
							C525D	11	UR182	B31				25Z5	175	
660	Vol.	17	N	6			C550	4	CM172		3	220B	C3	^{2}6D6, 6A7, 75, 89, 6Z4	175	10
661	Vol.	18	UM154-SS13				119-37	4	RM262		35	294	C3	^{2}6K7, 6A8, 6Q7, 41,		
							.005		Buffer	B14				6X5	465	10
666 "A"-"B"	Vol.	18	UC512				119-21	1	CN151	B92	35	294	C3	^{2}6K7, 6A8, 6Q7, 6N6,		
							.01		Buffer	B14				84-6X5	465	
667	Vol.	17	UM147-SS13	M26			119-34	4	RN261		35	294	C3	^{2}6K7, 6A8, 6Q7, 6F6,		
	Tone	22	MR53				.01		Buffer	B14				6X5	262.5	10
670	Vol.	17	N	6			P103-2	4	RM262		37	296	C3	6D6, 6C6, 78, 75, 42,		
							20	15	TS102					84	175	10
							.02		Buffer	B14						
670A	Vol.	17	N	6		A1	P119-4	4	CM172		37	296	C3	^{2}6D6, 6C6, 75, 42, 84	175	10
							.015		Buffer	B14						
675	Vol.	18	N	6			P103-4	4	WE1647					57, 27, 58, 2A6, 2A5,		
							P103-3	4	WE1847					80	370	1
680	Vol.	61	UC511				P119-17	4	CM162		37	296	C3	^{2}6D6, 6A7, 6B7, 42, 84	175	10
							.01		Buffer	B14						
685 "A," 686 "A," "B"	Vol.	18	O	6			103-6	42	RS213					6L7, 6K7, 6Q7, 6F6,		
	Tone	22	K12				103-7	42	RS213					6C5, 5Y3	465	1
690	Vol.	18	UC511				119-17	4	CM172		37	296	C3	^{2}6D6, 6A7, 6B7, 42, 84		
							.01		Buffer	B14						
691	Vol.	18	MR53	M26			119-45	23	RM262					6L7, 6K7, 6Q7, 6C5,		
	Tone	22	K12											6F6, 5Y3	465	1
740	Vol.	18	O	6			103-6	4	RS213					6A8, 6K7, 6Q7, 6C5,		
	Tone	22	M				103-14	4	RS216					^{2}6F6, 5Y3	465	1
746 Series A (Ex)	Vol.	18	O	6			103-6	23	RS213					6L7, 6C5, 6K7, 6Q7,		
	Tone	22	K12				103-7	23	RS213					6G5, 6F6, 5Y3	465	1
750	Vol.	18	N				8-8	4	WE847					^{2}58, 2A7, 55, ^{2}45, 80	175	1
	Tone	21	M				5	14	See Note	B3						
755EX	Vol.	82	TRP609	6			P103-8	4	WE847					^{2}6D6, 6C6, 76, 6B7,		
	Tone	21	M				P103-4	4	RS216					42, 80	465	1
770 "A"	Vol.	56	TRP611	6			103-8	43	RS216					^{2}6K7, 6C6, 6C5, 6B7,		
	Tone	21	M				103-4	43	RS216					42, 80	465	1
775	Vol.	18	N	6			P103-4	4	WE1647					^{3}58, 2A7, 55, 2A5, 80	370	1
	Tone	21	N				P103-5	4	RS213							
777 Series A	Vol.	18	O	6			P103-4	4	WE1647					^{2}6D6, 6C6, 76, 75, 42,		
	Tone	21	M				P103-3	4	WE1847					80	465	1
777 Series B	Vol.	56	O	6			P103-8	4	WE1647					^{2}6D6, 6C6, 76, 6B7,		
	Tone	62	M				P103-4	4	WE1647					42, 80	465	1
777 Series C	Vol.	56	O	6			103-8	4	RS216					^{2}6K7, 6C6, 6C5, 6B7,		
	Tone	57	M				103-4	4	RS216					42, 80	465	1
778 "A"	Vol.	124	1 Meg. No. 1		See Note	A19	103-8	25	RS216					^{2}6K7, 6J7, 6C5, 6Q7,		
	Tone	21	UM180-SS1	M28			103-6	25	RS213					6F6, 5Y3-5W4	465	1
778 Series B	Vol.	18	1 Meg. No. 1		See Note	A19	103-8	25	RS216					^{2}6K7, 6J7, 6Q7, 6C5,		
	Tone	21	UM180-SS1	M28			103-6	25	RS213					6F6, 5Y3	465	1
786 "A"	Vol.	18	O	6			103-6	42	RS213					6L7, 6K7, 6Q7, 6C5,		
	Tone	22	K12				103-7	42	RS213					6F6, 5Y3, 6G5	465	1
787 Series A	Vol.	18	MR53	M26			103-6	23	RS213					6L7, 6C5, 6K7, 6Q7,		
	Tone	22	K12				103-7	23	RS213					6G5, 6F6, 5W4	465	1
804	Vol.	18	MR48	M27			119-32	1	RN232		15	246	C3	^{2}6S7G, 6D8G, ^{2}6L5G,		
	Tone	22	MR39				.005		Buffer	B14				6T7G, 6N5, 19	465	10
822	Vol.	62	MR44	M26			103-11	12	RS203					1A6, 1A4, ^{3}30, ^{2}34, 19	465	
	Tone	21	MR44													
	Fil.	29	Q													
823 Series A (Ex)	Vol.	62	MR44	M27			103-11	24	CS133	15	15	246	C3	1A6, 1A4, ^{3}30, ^{2}34, 19	465	10
	Tone	21	MR44				103-26	24	RS213							
							.01		Buffer	B14						
840	Vol.	18	MR53	M26			103-6	4	RS213					6A8, 6K7, 6Q7, 6G5,		
	Tone	22	MR44				103-14	4	RS216					6C5, ^{2}6F6, 5Y3	465	1
842 (Ex)	Vol.	18	MR53	M26			103-6	4	RS213					6A8G, 6K7, 6Q7G,		
	Tone	22	MR44				103-14	4	RS216					6G5, 6C5, ^{2}6F6G,		
														5Y3	465	1
845 Series A (Ex)	Vol.	18	O	6			119-30	23	Order from	Mfr.				6L7, 6C5, 6K7, 6Q7,		
	Tone	44	M											6G5, ^{2}25A6, 25Z6	465	
848, 849 (Ex)	Vol.	18	MR53	M26			119-30	4	Order from	Mfr.				6L7, 6C5, 6K7, 6Q7,		
	Tone	22	MR44											6G5, ^{2}25L6, 25Z6	465	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
BELMONT RADIO CORP.—Continued																
856 Series A (Ex)	Vol.	17	1 Meg. No. 1	M26	See Note	A19	103-8	25	RS216					^{2}6K7, 6J7, 6Q7, 6G5,		
	Tone	21	UM180-SS1	M28			103-6	25	RS213					6F6, 5Y3	465	1
860 Series A	Vol.	18	MR53				103-6	4	RS213					6A8, 6K7, 6Q7, 6C5,		
	Tone	22	MR11	M26			103-14	4	WE1647					^{2}6F6,^{2}6U5, 5Y3	465	1
878 Series A & B	Vol.	124	1 Meg. No. 1	M26	See Note	A19	103-8	25	RS216					^{2}6K7, 6J7, 6C5, 6Q7,		
	Tone	21	UM180-SS1	M28			103-6	25	RS213					6G5, 6F6, 5Y3	465	1
879 Series A	Vol.	124	1 Meg. No. 1		See Note	A19	103-8	25	RS216					^{2}6K7, 6J7, 6C5, 6G5,		
	Tone	21	UM180-SS1	M28			103-6	25	RS213					6F6, 5Y3	465	1
880 (A and B)	Vol.	18	UC511	6			P119-16	1	CN152		37	296	C3	^{2}6D6, 6A7, 85, ^{2}76,		
							.01		Buffer	B14				6A6, 84	175	10
880 Series C	Vol.	15	UC511				P119-16	1	CN152		37	296	C3	^{2}6D6, 6A7, 85, ^{2}76,		
	Tone	22	MR39				.01		Buffer	B14				6A6, 84	465	10
881	Vol.	18	UM150-SS17				119-13	4	RM265		35	294	C3	^{2}6K7, 6A8, 6R7, 6C5,		
	Tone	22	Order from Mfr.				.003		Buffer	B14				^{2}6V6, 0Z4	262.5	10
888, 889	Vol.	18	MR48	M26			103-12	25	RS213					^{2}6K7, 6J7, 6C5, 6Q7,		
	Tone	22	K12				103-13	25	RS213					6F6, 6G5, 5Y3	465	1
890 Series A (Ex)	Vol.	18	MR48	M26			103-12	25	RS213					^{2}6K7, 6J7, 6C5, 6Q7,		
	Tone	22	K12				103-13	25	RS213					6G5, 6F6, 5Y3	465	1
1050	Vol.	15	N				P1048	26	WE847					^{2}58, 2A7,^{4}56,^{2}45, 80	175	1
	Tone	‡	L	6	See Note	A5	P1038	26	WE847							
	Supp.	12	F7		See Note	A5										
1070 "A"	Vol.	20	1 Meg. No. 1	6	See Note	A19	103-10	1	WE3540					^{2}6K7, 6L7,^{2}6C5,^{3}6F6,		
	Tone	22	SRP287				103-8	1	WE1647					5Z4, 6H6	465	1
							119-19	15	2 TS102							
1070 Series B	Vol.	20	‡		See Note	A19	103-10	1	WE3510					^{2}6K7, 6L7, ^{2}6C5, 6H6,		
	Tone	22	SRP287	8			103-8	1	RS216					^{3}6F6, 5Z4, 6G5	465	1
							119-23	15	TS103							
							119-19	15	^{2}TS102							
1170	Vol.	20	1 Meg. No. 1		See Note	A19	103-10	25	WE3540					^{2}6K7, 6J7, 6C5, 6H6,		
	Tone	22	SRP287	8			103-8	25	RS216					6G5, 6F5, ^{3}6F6, 5Z4	465	1
1170B, 1170C	Vol.	20	‡		See Note	A19	103-10	1	WE3540					^{2}6K7, 6J7, 6C5, 6H6,		
	Tone	22	SRP287	8			103-8	1	RS216					6G5, 6F5, ^{3}6F6, 5Z3	465	1
1171	Vol.	20	TRP610	6			103-10	25	WE3540					^{2}6K7, 6J7, 6C5, 6H6,		
	Tone	22	SRP287	8			103-8	25	RS216					6G5, 6F5, ^{3}6F6, 5Z4	465	1
1172	Vol.	20	1 Meg. No. 1		See Note	A19	103-10	25	WE3540					^{2}6K7, 6J7, 6C5, 6H6,		
	Tone	22	SRP287	8			103-8	25	RS216					6G5, 6F5, ^{3}6F6, 5Z4	465	1
1174	Vol.	20	‡		See Note	A19	103-5	30	RS213					^{2}6K7, 6J7, 6C5, 6H6,		
	Tone	22	SRP287	8			103-10	30	WE3540					6G5,^{3}6F6, 5Z3	465	1
							103-8	30	RS216							
BLACKHAWK																
6U	Vol.	18	UC511	6			81028	1	CN152		20	253	C3	^{2}78, 77, 75, 41, 84	262.5	10
	Tone	22	UC502				81021C	15	TN111							
							.01	2	Buffer	B14						
BOND RADIO CO.																
34-33, 6TA	Vol.	18	N				8-4	1	See Note	B3				2A7, 58, 2A6,^{2}2A5, 80	456	1
B. O. P.—See United Motors Service.																
BOSCH—See United American Bosch.																
BRANDES																
A1	Vol.	40	Y				2-2	1	See Note	B1				^{3}24,^{2}27,^{2}45, 80		3
B10	Vol.	40	Y				1-.5-.5-.5	1	See Note	B1				^{5}27, 71A, 80		2
B11, B12	Vol.	40	Y				2-1	1	See Note	B1				^{5}27, 71A, 80		2
B15, B16	Vol.	40	Y				2-1-.5	3	See Note	B1				^{5}27,^{2}71A-45, 80		2
K48	Vol.	40	Y				2-4	1	CN150	B1				^{3}24,^{2}27, 45, 80		3
	Sen.	58	UC500													
K60, K62	Vol.	8	E				8, 8	4	RS213					^{2}35,^{2}24, 47, 27, 80	175	1
K70, K72	Vol.	59	H12				8, 8, 8	4	RS213					^{2}35,^{3}24, 27, 45, 80	175	1
K80, K82	Vol.	59	H12				8, 8, 8	4	RS213					^{2}35,^{2}27,^{2}24,^{2}47, 80	175	1
K90, K92	Vol.	59	H12				8, 8, 8	4	RS213					^{3}35,^{2}27,^{2}24,^{2}47, 80	175	1
K110, K112, K120	Vol.	15	N				7337	26	CM175					^{3}58,^{3}56, 47, 80	175	1
K114	Vol.	15	N				8	12	CS123	B3				^{3}34,^{6}30	175	
K130, K132	Vol.	59	H12				7240		CM175	B39				^{3}58,^{3}56,^{2}47, 80	175	1
K133, K143	Vol.	15	N				4	4	See Note	B11				^{3}39,^{3}37,^{4}38	175	
							4	15	TS101							
BREMER TULLY																
Counterphase 8	Vol.	13	N						See Note	B1				^{4}26, 27, 71A		
6-40, 6-41	Vol.	‡	See Notes		No. 1	3/5	1-2-2	3	See Note	B1				^{4}26, 27, 71A, 80		11
7-10	Vol.	6	H12				1-2-2	3	See Note	B1				^{3}26,^{2}27,^{2}71A, 80		
8-20, 8-20A, 8-21, 8-22	Vol.	‡	E12	6				4	See Note	B7				^{4}26,^{2}27,^{2}10, 81		8
80	Vol.	29	R	6										^{5}01A, 12A		
81, 82	Vol.	7	J	6			1-1.5	2	See Note	B1				^{5}27,^{2}45, 80		3
S81, S82	Vol.	12	A3MP				1-1	1	See Note	B1				^{4}24, 27,^{2}45, 80, D110,		
	Hum	37	HU30				.275		See Note	B9				D126, 25CY		3
	Hum	30	SRP265				1-2		25 Cycle	B1						
							1		25 Cycle	B9						
83A	Vol.	8	A3MP				2-1-2	3	See Note	B1				^{4}24, 27,^{2}45, 80, D126		3
BRETING																
12	Vol.	18	N				16	25	RN242	B8				^{2}6B7, ^{5}6D6, 6C6, ^{3}42,		
	M. Vol.	7	J				8	25	RS213					5Z3	432	1
	Tone	22	UC502				25	19	TS102	B40						
	Meter		CIMP													
14	Vol.	83	N				16	25	WE1647					^{4}6K7, ^{3}6J7, 6L7, 6H6,		
	Tone	22	UC502	6			18	25	WE1847					6B8,^{3}6F6, 5Z3	432	1
	Sil.	7	J				25	44	TS107							
BRONSWICK RADIO																
Bronswick	Vol.	6	D12				8-4	4	See Note	B3				^{3}58, 57, 47, 80		1
BROWNING DRAKE																
JR	Vol.	8	G	6	See Note	A14	8-8	4	See Note	B3				35, 24, 47, 80		1
20	Vol.	7	H	6	1		8, 8	4	RS213					^{4}24, 47, 80		1
	Tone	22	K12		RS241	A21										
MB30	Vol.	12	K12				8-8-8	3	See Note	B3				^{4}24,^{2}27,^{2}45, 80		3
34, 36, 38	Vol.	60	B				8-8-8	3	MN275					^{5}26, 27, 71A, 80		11
40	Vol.	7	H	6	2		8, 8	4	RS213	B3				^{2}35,^{2}24, 47, 80	175	1
	Tone	22	G12													
54	Vol.	8	Y10MP				8	1	RS213	B3				^{2}24,^{4}27,^{2}45, 80		3
							8-8-8	14	MN275	B3						
69	Vol.	12	G12	6			8, 8	4	RS213	B3				^{3}24,^{3}27,^{2}45, 80		3
70, 71	Vol.	61	M	6			‡	4	See Note	B3				^{4}24,^{2}27,^{2}45, 80		
80	Vol.	7	H	6	2		8, 8	4	RS213	B3				^{2}35,^{2}24, 47, 80	175	1
	Tone	22	K12													
100	Vol.	43	Y50MP		See Note	A5								^{4}32, 33		
	Tone	22	K12		See Note	A5										

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
BRUNSWICK RADIO CORP.																
B17 (For PR17-8																
2nd Type)	Vol.	1	SRP145				4-4	4	See Note	B1				^{4}26, 27, 71, 80		11
PR6							3.5-3.5	1	See Note	B1				80, 71A		1
R1	Vol.	1	SRP144				1-1	2	See Note	B1				^{4}26, 27, 71A, 80		11
3KR0, 3KR6	Vol.	1	SRP144				1-1	2	See Note	B1				^{4}26, 27, 71, 80		
	Phono.	‡	V													
3KR8	Vol.	1	SRP144				1-1	2	See Note	B1				^{3}26, 27		
	Phono.	‡	V													
3NW8	Vol.	59	SRP141				4-4	4	See Note	B7				^{8}27, 50, ^{2}81	180	
	Sen.	1	D12													
5KR, 5KR0, 5KR6,																
2KR0	Vol.	1	SRP144				1-1	2	See Note	B1				^{4}26, 27, 71, 80		
	Phono.	63	V													
5NC8	Vol.	‡	SRP138				2-2	2	See Note	B1				^{7}27, 71A, 80	180	
5N0	Vol.		SRP138				2-2	2	See Note	B1				^{7}27, 71A, 80	180	
10	Vol.	8	A5MP	6	1		1-4	25	See Note	B1				^{2}51, 24, 47, 80		1
							.055		See Note	B9						
							2		See Note	B9						
11, 12, 16, 33, "D"																
Chassis Below No.																
25000	Vol.	7	SRP255				7	1	See Note	B3				^{2}51, ^{3}24, 47, 80		1
							6	1	See Note	B3						
11A, 12A, 16A, 18,																
33A, "D" Chassis,																
Above No. 25000	Vol.	15	SRP273				7	1	See Note	B3				^{2}51, ^{2}24, 27, 47, 80	175	1
							6	1	See Note	B3						
14, 21, 31 DC	Vol.	11	A5MP	6				‡	See Note	B7				^{5}01A, ^{4}71A		
S14, S21, S31, S81,																
S82C	Vol.	12	A3MP	6			1-1-1	3	See Note	B1				^{4}24, 27, ^{2}45, 80		3
	Hum	37	HU20				.275		See Note	B9						
S14, S21, S81, S82																
(25 Cycle)	Vol.	12	A3MP				2-1-2	3	See Note	B1				^{4}24, 27, ^{2}45, 80		3
	Hum	37	HU20				1		See Note	B9						
	Hum	30	SRP265													
15B	Tone	22	K12											^{4}32, 30, ^{2}31		
15, 22, 32, 42 (AC)	Tone	22	E12				2-2	1	See Note	B1				^{4}24, ^{2}45, 80		
	Phono.	63	See Note			A5	4		See Note	B12						
							.14		See Note	B9						
							.25		See Note	B12						
15DC, 22DC, 32DC,																
42DC	Tone	22	K12											^{4}32, 30, ^{4}71A		
	Phono.	63	See Note			A5										
17, 24, 25, AC	Vol.	9	SRP273				4.5-6	4	See Note	B1				^{2}51, 27, ^{3}24, ^{2}47, 80	175	3
BUCKINGHAM																
80	Vol.	3	C12				2-1-3	3	See Note	B1				^{4}26, 27, ^{2}71A, 80		11
BUICK MOTOR—See United Motors Service.																
BULOVA WATCH																
M501	Vol.	8	A5MP				1-4-2	28	See Note	B1				^{2}51, 24, 47, 80		1
							.055		See Note	B9						
600, 601, 605, 610	Vol.	8	A5MP		2		1-2-1	3	See Note	B1				^{2}51, ^{2}24, 47, 80	175	1
							.06/.25		See Note	B9						
							.03		See Note	B9						
M701	Vol.	7	G	6			2-2-2.5	28	See Note	B1				^{3}51, 24, 27, 47, 80	175	1
	Tone	22	K12				.055		See Note	B9						
C751	Vol.	58	F				8, 8	34	RS213					^{2}35, 27, ^{2}24, 47, 80	175	1
	Tone	22	K12													
G781	Vol.	7	G	6			2-2-2.5	28	See Note	B1				^{3}51, 24, 47, 27, 80	175	1
	Tone	22	K12				.055		See Note	B9						
BUSH AND LANE																
10	Vol.	26	A10MP		See Note A18		8-8-8	3	RN245	B11				^{5}27, ^{2}45, 80		3
12	Vol.	12	A10MP		See Note A18		8-8-8	3	RN245	B11				^{2}27, ^{3}24, ^{2}45, 80		3
C R C																
24-27	Vol.	6	G7	6			4-4	1	See Note	B3				^{2}24, 45, 27		13
24-45	Vol.	6	G7				4-4	1	See Note	B3				35, 24, 45, 80		1
24-47	Vol.	6	G7				4-4	23	See Note	B3				35, 24, 47, 80		1
58-47	Vol.	6	H7				4-4	23	See Note	B3				58, 57, 47, 80		1
CABLE-NELSON—See Howard.																
CADILLAC																
06W	Vol.	18	N	6			P80939	2	CN155		2	210	C5	^{2}78, 77, 85, ^{2}41	262	10
	Tone	44	UC502				P80965	14	CS121	B3	12	237	C5			
							.01		Buffer	B14						
5X	Vol.	56	200M No. 1		See Note A19		10-8	1	RN242		18	248	C3	^{2}6K7, 6J7, 6B7, 6B5	175	10
	Tone	22	MR53				.0055		Buffer	B14						
6KB	Vol.	56	200M No. 1		See Note A19		10-8-12	1/15	RN242/TS101		18	248	C3	^{2}6K7, 6J7, 6B7, 41,		
	Tone	22	MR53				.0055		Buffer	B14				6A6	175	10
6Q	Vol.	56	UM154	M26		A96	P45X208	4	CM172					^{2}6D6, 6C6, 6B7, 41,		
	Tone	34	UC502											6A6	175	MG
6R	Vol.	17	UM161		See Note A96		4-5-8	4/15	CM172/TS101		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	34	UC502				.0075		Buffer	B14						
6S	Vol.	17	N	6			45X204	1	CN152		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	M				45X203	15	TN111							
							.01		Buffer	B14						
6T	Vol.	17	‡		See Note A3									^{2}6D6, 6C6, 6B7, ^{2}42	262.5	MG
	Tone	44	L													
6U2	Vol.	18	UM150		See Note A96		10-10	1	See Note	B3	35	294	C3	^{2}78, 77, 75, 41, 84	262.5	10
	Tone	22	UC502				.01		Buffer	B14						
2029, 2029A, 2030	Vol.	‡	G											^{3}36, ^{3}37, ^{2}47	175	
2721 (072)	Vol.	18	N				P80902	13/15	See Note	B45	‡	‡		^{3}39, 36, 37, ^{2}38	262	
	Tone	44	UC502													
2722 (072A)	Vol.	18	N				P80902D	15/13	See Note	B45	2	211		^{3}39, 37, 36, ^{2}41	262	
	Tone	44	UC502													
56V1	Vol.	17	N		See Note A3		4-4-.5	13/15	See Note	B16	4	221	C3	^{2}78, 77, 6B7, ^{2}41	262	
	Tone	44	UC502													
CALVERT																
A50A	Vol.	6	G12		EX400		8-8	1	See Note	B3				^{3}24, 47, 80		3
A51A, A52A	Vol.	8	UC501				8-8	1	See Note	B3				^{2}35, 24, 47, 80		3
CAPEHART																
CK	Vol.	13	L				8, 8, 8,	1	RS213	B3				^{3}58, 57, ^{4}56, ^{2}47, 80	175	3
	Tone	41	L													
	Phono.	87	M													
	Sil.	8	UC501													

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS: Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Cir-cuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replace-ment	*Note	Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
CAPEHART—Continued																
103, 104 (Cosmopolitan) Chassis Z	Vol.	33	See Note			A5	8-8-6	3	See Note	B3				^{3}78, 6A7, 75, 77, ^{2}37,		
	Tone	22	See Note			A5	8-8	14	See Note	B3				^{2}2A5, 80	175	3
202	Vol.	15	N				8-8	1	CN152	B3				^{3}6K7, 6A8, 6H6, 6C5,		
	Tone	41	M				4	13/14	CS131					^{2}6F6, 5Z4	465	1
							5	15	TS105							
203 Tuner	Vol.	17	N				4	13	CS131	B3				^{3}6K7, 6A8, 6H6	465	
	Tone	44	N													
203 (Amplifier)							8-8-4-2	3/14	See Note	B4				^{2}6F5, ^{2}6F6, 5Z3		16
400A	Vol.	15	M				8-8-4-2-2	37	See Note	B3				^{4}58, ^{2}56, 57, 55, ^{4}47, ^{2}80	180	3
	Tone	41	O				40	15	SR608	B3						
400B	Vol.	33	M				8-8-4-2-2	3	See Note	B3				^{6}58, ^{3}56, 57, 55, ^{4}2A5,		
	Tone	‡	M				40	15	SR608	B3				^{2}5Z3	180	7
	Supp.	44	UC501													
400, 401, 402	Vol.	8/87	See Note			A5								^{4}51, ^{3}27, ^{4}47, ^{2}80	180	3
	Tone	41	See Note			A5										
400B, 402B, 404B, Tuner	Vol.	33	M				8-8-4-2-2	3	See Note	B3				^{4}58, 2A7, ^{2}57, 55, ^{3}56,		
	Tone	44	M				40	15	SR608	B3				^{4}2A5, ^{2}5Z3	180	
	Supp.	8	UC501													
400B, 402B, 404B, All-Wave	Vol.	15	M				8-8-4-2-2	3	See Note	B3				^{3}58, ^{2}57, ^{4}56, 2A7, ^{4}2A5,		
	Tone	44	M				40	15	SR608	B3				^{2}5Z3	465	7
	Supp.	8	UC501		See Note	A5										
400D Tuner	Vol.	146	M				8-8	13	CN152					^{4}6K7, 6L7, ^{3}6C5, 6H6	465	
	B.Tone	146	M				25	15	TS103							
	T.Tone	146	M													
	Sen.	8	K													
400D Treb. Amp.							8-8	1	See Note	B4				6F5, ^{2}6F6, 5Z3		1
400D Bass Amp.							8-8-4-2-2	3	See Note	B4				^{2}6F5, ^{4}6F6, ^{2}5Z3		‡
Standard Amp.							8-8-4-2	3	See Note	B3				^{3}56, ^{2}2A5, 5Z3		3
							40	15	SR608	B3						
CASE—Also see U. S. Radio & Tel.																
601 (Chassis 16SM)	Vol.	18	N	6			A15313	25	RS216					6D6, 6A7, 6K7, 75,		
	Tone	34	UC502				A15237-2	25	WE1247					6F6, 80	262.5	1
701 (Chassis 16SME)	Vol.	18	N	6			A15313	25	RS216					6D6, 6A7, 6K7, 75,		
	Tone	34	UC502				A15237-2	25	WE1247					6G5, 6F6, 80	262.5	1
801-802 (Chassis 27SME)	Vol.	18	M	6			A15313	25	RS216					6K7, 6L7, 76, 6D6,		
	Tone	34	UC502				A15427	25	RS216					75, 6G5, 42, 80	262.5	1
							A15237-2	25	WE2147							
1001 (Chassis 19RSME)	Vol.	15	P	6			A15236	25	WE2545					^{3}6K7, 6L7, 6H6, 6G5,		
							A15237	25	WE1247					6C5, ^{2}6F6, 5Y3	262.5	1
							A15258	13/15	CS131/TS105							
1050	Vol.	17	TRP618	6			B16554-2	1	WE3540					^{2}6K7G, 6L7G, 6C5G,		
	Tone	22	UC502				B15427	1	WE1647					6Q7G, 6G5, ^{3}6F6G,		
							B16551-3	15	TN111					5Z3	456	1
1101, 1102 (Chassis 110RSME)	Vol.	45	N	6			A15100	56	WE2545					^{2}6K7, 6L7, ^{2}6C5, 6H6,		
							A15101	56	WE2545					6E5, ^{2}6F6, 5Z3	262.5	1
							A15102	14	TS106							
							A15178	13/14	TN111/CS132							
1250	Vol.	140	TRP610				B16613-2	1	UR191					^{3}6K7G, 6L7G, ^{2}6C5G,		
	Tone	140	P				B16614-3	13/15	CS123/TS101					6H6G, 6G5, 6F5G,		
														^{2}6L6G, 5Z3	456	1
CAVALCADE																
54	Vol.	18	UM154		See Note	A96	6-10	4	See Note	B3	35	294	C3	6A7, 6D6, 75, 42, 84	‡	10
							.02		Buffer	B14						
64	Vol.	18	UM154		See Note	A96	6-10	4	See Note	B3	35	294	C3	^{2}6D6, 6A7, 75, 42, 84	‡	10
							.02		Buffer	B14						
357	Vol.	18	N	6			8-8	4	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
359	Vol.	18	UM154		See Note	A96	6-10-.05	4	See Note	B3	35	294	C3	^{2}6D6, 6A7, 75, 42, 84	456	10
							.02		Buffer	B14.						
3511	Vol.	45	M	6			8-8	1	CN152	B3	14	245C	C3	1C6, 34, 32, 33, ^{2}30	456	6
							.01-.01		Buffer	B14						
CENTURY																
4-47	Vol.	6	G12	6	EX200	A5	8-8	1	See Note	B3				35, 24, 47, 89		1
4-78	Vol.	6	See Note	6		A5	8-8	1	See Note	B3				58, 57, 47, 89		1
5-38	Vol.	6	See Note	6		A5								36, ^{2}38, ^{2}39		
5-47	Vol.	6	G12	6	EX200	A5		1	See Note	B3				^{3}24, 47, 80		1
7-38 Auto Radio	Vol.	64	N		See Note	A5								^{2}37, ^{2}38, ^{3}39		
"Ace"	Vol.	18	N				16-8-8	3	See Note	B3				^{4}58, ^{3}56, 46, ^{2}47, 80	175	3
	Tone	22	K12													
	Supp.	7	G		2											
"Queen"	Vol.	6	Y	6	EX200		8-4	1	See Note	B3				^{2}57, 58, 47, 80	175	1
	Tone	22	K12		See Note	A4	10	17	TS101							
CHAMPION																
4T AC-DC	Vol.	6	H12				16-12	23	See Note	B3				6D6, 6C6, 43, 25Z5		
5T (3 band)	Vol.	18	N				8-4	23	See Note	B3				2A7, 78, 2A6, 2A5, 80,		
														or 6A7, 6D6, 75, 41,		
														80	465	1
6T (3 band)	Vol.	45	N				8-4	23	See Note	B3				6A8, 6K7, 6H6, 6F5,		
														6F6, 5Z4	465	1
40R, 40RM, 40DW, 40DWM	Vol.	6	H12				8-4	23	See Note	B3				6D6, 6C6, 42, 80, or		
														6K7, 6J7, 6F6, 5Z4		1
42	Vol.	6	H12				4-4	1	See Note	B3				6D6, 6C6, 42, 80 or		
							5	15	TS106					58, 57, 2A5, 80		1
52 (Early)	Vol.	6	H12				4-4	1	See Note	B3				^{2}58, 57, 47, 80 or ^{2}6D6,		
							5	17	TS105					6C6, 42, 80	456	1
52 (Late)	Vol.	6	H12				4-4	1	See Note	B3				6A7, 6D6, 6C6, 42, 80	456	1
							5	15	TS105							
52DWG	Vol.	18	N				16-12	4	See Note	B3				6A7, 6D6, 75, 43,		
														25Z5	465	
500	Vol.	18	‡		See Note	A3	8-8	1	See Note	B3	35	294	C3	6A7, 6D6, 6B7, 41,		
							10	15	TS101					84 or 6A7, 6D6, 75,		
							.02-.02		Buffer	B14				41, 84	456	10
501	Vol.	18	UM154			A96	8-8	4	See Note	B3	35	294	C3	6A7, 6D6, 75, 41, 0Z4	456	10
							5	18	TS105							
							.01-.01		Buffer	B14						
558	Vol.	6	H12				4-4	1	See Note	B3				^{2}57, 58, 47, 80	456	1
							5	17	TS105							
600	Vol.	18	UM154			A96	6-12	1	See Note	B3	35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
							10	15	TS101							
							.01-.01		Buffer	B14						
601	Vol.	18	UM154			A96	8-8	4	See Note	B3	35	294	C3	^{2}6K7, 6A8, 6Q7, 6F6,		
	Tone	22	G12				.01		Buffer	B14				0Z4	175	10

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Cir-cuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replace-ment	*Note	Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
CHEVROLET—See United Motors Service.																
CLAGO																
Radiochron "B"	Vol. Tone	6 22	G12 G12				1-2	1	See Note	B1				[4]24, 45, 80		3
CLARION—Also see Transformer Corp.																
11A (52.3)	Vol. Tone	18 21	MR48 MR48	 M26			18-102	1/15	RN245	B34				6A7, 6D6, 75, 6G5, 41, 80	456	1
29, 35 (537)	Vol.	18	MR48	M27			16-100	19	TS101					1D7G, 1D5G, 1H6G, 1G5G, NB1	456	
31, 37 (453)	Vol.	18	MR53	M26			1845 .008	1	CN142 Buffer	 B14	14	245C	C3	6D8G, 6S7G, 6T7G, 6N5, 1F5G	456	10
55A, 57A (645)	Vol. Tone	18 21	MR48 MR48	 M26			18-102	1/15	RN245	B34				6A7, 6D6, 75, 6G5, 41, 80	456	1
58B (735)	Vol. Tone	18 21	MR48 MR48	 M26			18-202 18-201	25 25	RS215 WE1247					6A7, 76, 6D6, 6Q7G, 6G5, 6V6G, 80	456	1
60, 61 series (646)	Vol. Tone	18 21	UM157 MR48			A96	18-203 .005	74/19	CM175 Buffer	 B14	35	294	C3	6K7, 6A8, 6D6, 75, 41, 84	262	10
70, 71 Series (746)	Vol. Tone	18 22	UM157 Order from	 Mfr.		A96	18-204 .008	24/15	CN155 Buffer	 B14	35	294	C3	6K7, 6A8, 6K7G, 6Q7G, 6J5G, 6N7G, 0Z4	262	10
70X (715A)	Vol.	17	MR53	M26			30-8	1	See Note	B3				6A7, 6D6, 6Q7G, 6G5, 25B5, 25Z5, L21B	456	
80, 81 (846)	Vol. Tone	18 22	UM157 Order from	 Mfr.		A96	18-204 .008	24/15	CN155 Buffer	 B14	35	294	C3	[2]6K7, 6A8, 6K7G, 6J5G, 6N7G, 0Z4	262	10
88X, 89X	Vol. Tone	148 41	‡ ‡		See Note See Note	A5 A5	18-202 18-201	1 1	RS215 WE1247					6A7, 6D6, 6H6G, 6G5, 6Y7G, [2]6V6G, 80	456	1
93 (885)	Vol. Tone	148 41	‡ ‡		See Note See Note	A5 A5	18-202 18-201	1 1	RS215 WE1247					6A7, 6D6, 6H6G, 6G5, 6Y7G, [2]6V6G, 80	456	1
Chassis 562	Vol. Tone	18 21	MR48 ‡		 See Note	 A5	1845 .01-.01	1	CN142 Buffer	 B14	15	246	C3	1C6, 1A4, 6T7G, 6N5, 41	456	10
700, 701 (710)	Vol.	17	MR53	M26			30-8	1	See Note	B3				6A7, 6D6, 6Q7G, 6G5, 25B5, 25Z5, L42B	456	
Chassis 1102	Vol. Tone	148 44	 Order from	 Mfr.	See Note	A5	18-214 18-215 18-216	1 1 13	RS216 RS215 CS123					[2]6C5G, 6A8G, 6K7G, 6H6G, 6G5, [2]6J7G, [2]6V6G, 80	456	1
Chassis 1105	Vol. Tone	148 44	‡ Order from	 Mfr.	See Note	A5	18-214 18-215 18-216	1 1 13	RS216 RS215 CS123					[2]6C5G, 6A8G, 6K7G, 6H6G, 6G5, [2]6J7G, [2]6V6G, 80	456	1
CLEARTONE																
110 (Compact)	Vol. Clr'ty	16 26	N K				3-3-2	3	See Note	B1				[5]Kellog, 80		1
112	Vol.	14	N				2-2	1	See Note	B7				[4]26, 27, 50, 81		9
CLIMAX																
4 tube AC-DC	Vol.	6	G12	6	EX300		20-4-10	1/15	See Note	B3				6D6, 6C6, 43, 12Z3		
4 tube Battery	Vol.	135	Y10MP				10	12	CS125	B3				[2]34, 32, 33		
5 tube AC-DC	Vol.	6	G12		EX300		12-4-8-10	11	See Note	B3				6D6, 6C6, 43, 37, 12Z3		
6 tube Battery	Vol.	45	N	6			10	12	CS125	B3				1C6, [2]34, [2]30, 33	456	
AA, AAX	Vol.	6	G12	6	EX300		8-12-4-10	11/15	See Note	B3				6K7, 6J7, 43, 25Z5		
AB, ABX	Vol.	6	G12		EX300		4-8-12-5	11	See Note	B3				6A8, 6K7, 6J7, 43MG, 25Z5MG	458	
ABX (late)	Vol.	17	N	6			4-30-10	11/15	See Note	B3				6A8, 6K7, 6B6, 43MG, 25Z5MG	456	
AC 60	Vol.	45	N	6			317	4	RS213					6A7, 6D6, 76, 6G5, 6F6G, 42, 80	456	1
AC 61	Vol.	45	N	6			317	4	RS213					6A7, 6D6, 76, 6F5G, 42, 80	456	1
AC 64, AC 64B	Vol.	45	N	6			317	4	RS213					6A7, 6D6, 76, 6G5, 6F5G, 42, 80	456	1
AC 65	Vol.	45	N	6			317	4	RS213					6A7, 6D6, 76, 6F5G, 42, 80	456	1
AD	Vol.	18	N	6			317	4	RS213					6A7, 6D6, 75, 42, 80	456	1
AD6	Vol.	45	N	6			317	4	RS213					6A7, 6D6, 76, 6F5G, 6G5, 42, 80	456	1
AH	Vol.	18	N	6			311 314	27 27	RS207 RS205					6A7, 6D6, 75, 43, 25Z5, L49C	456	
AHE	Vol.	18	N	6			311 314	27 27	RS207 RS205					6A7, 6D6, 75, 6G5, 43, 25Z5, L42C	456	
AJ	Vol.	18	N	6										1C6, 1A4, 1B5, 30, 19	‡	
AKE	Vol.	18	N	6			324 304 .01	1 15	RS203 TS101 Buffer	 B14	18	See Note	C8	6A7, 6S7G, 6T7G, 6G5, 41	‡	10
AL	Vol.	6	G12	6	EX400		20 10	4 4	See Note See Note	B3 B3				6D6, 6C6, 26L6, 25Z5, L55B		
AR	Vol.	6	Y	6	EX300		20 10	4 4	See Note See Note	B3 B3				6K7, 6J7, 25L6, 25Z5		
ASE	Vol. Tone	45 22	N ‡	6	 See Note	 A5	311 314	4 4	RS207 RS205					6A7, 6D6, [2]76, 6G5, 25L6, L73B, L80B	‡	
ATE	Vol. Tone	45 22	N ‡	6	 See Note	 A5	311 314	4 4	RS207 RS205					6A7, 6D6, [2]76, 6G5, 25L6, 25Z5, L73B, L80B	‡	
AX	Vol. Tone	45 22	N ‡	6	 See Note	 A5	317	4	RS213					6A7, 6D6, 76, 6F5G, 42, 80	‡	1
A4	Vol.	6	G12	6	EX300		20-4 10-10	1 15	See Note TN111	B3				39, 44, 77, 43, 12Z3		
Diamond	Vol.	6	G12	6	EX500		5-10-25	40/15	UR182	B3				6D6, 6C6, 43, 25Z5		
Duke	Vol.	6	G12	6	EX300		4-5-8-11	‡	See Note	B3				6D6, 6C6, 43, 25Z5, L55B		
E	Vol.	6	G12	6	EX275		316	8	UR193/TS101					6D6, 6C6, 43, 25Z5		
E20	Vol.	6	G12	6	EX300		316	‡	UR193/TS101					6D6, 6C6, 43, 25Z5		
F	Vol.	6	G12	6	EX275		311 314	23 23	RS207 RS205					6D6, 6C6, 43, 25Z5		
G	Vol.	6	G12	6	EX275		311 314	27 27	RS207 RS205					6A7, 6F7, 43, 25Z5	456	
HE	Vol.	18	N	6			311 314	27 27	RS207 RS205					6A7, 6D6, 6Q7G, 25B5, 25Z5, 6G5	456	
JE	Vol.	18	N	6			311 314	27 27	RS207 RS205					6A7, 6D6, 6Q7G, 25B5, 25Z5	456	
JEBT	Vol.	18	N	6			311 314	27 27	RS207 RS205					6A7, 6D6, 6Q7G, 6G5, 25B5, 25Z5	456	
JL	Vol. Tone	83 22	N Z12	 6			317 301	1 15	RS213 TS101					6A7, 6D6, [4]76, 6G5, 6F5G, 42, [2]80	456	1
KSW4	Vol.	6	G12	6	EX300		8-4	4	See Note	B3				58, 57, 47, 80		1
LEE SW5	Vol.	6	G12	6	EX300		8-4	4	See Note	B3				[2]58, 57, 47, 80		1
M (early)	Vol.	18	N	6			8-4-10	1/15	See Note	B3				6A7, 6D6, 75, 42, 80	456	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
CLIMAX—Continued																
M and ME (late)	Vol.	45	N				317	1	RS213					6A7, ^{2}76, 6D6, 6F5G,		
	Tone	34	Z12	6			304	15	TS101					6G5, 42, 80	456	1
MEBT	Vol.	45	N				317	1	RS213					6A7, ^{2}76, 6D6, 6G5,		
	Tone	34	Z12	6			304	15	TS101					6F5G, 42, 80	456	1
M4	Vol.	6	G12	6	EX300		8-4	24	See Note	B3				39/44, 36, 38, 37		
							10-10	15	TN111							
OPAL	Vol.	6	G12	6	EX300		5-8-10	24/15	See Note	B3				6D6, 6C6, 38, 76		
Q69	Vol.	6	G12	6	EX100		316	‡	UR193/TS101					6D6, 6C6, 43, 25Z5,		
														L55B		
R	Vol.	6	G12	6	EX275		316	8	UR193/TS101					6D6, 6C6, 43, 25Z5		
RBT	Vol.	6	G12	6	EX250		316	‡	UR193/TS101					6D6, 6C6, 43, 25Z5		
SBT	Vol.	45	N	6			311	27	RS207					6A7, 76, 6D6, 6H6G,		
														6Q7G, 25B5, 25Z5	456	
T	Vol.	6	G12	6	EX275		11-8-10	40/15	See Note	B3				6D6, 6C6, 43, 25Z5		
U series, UE	Vol.	18	N	6			311	27	RS207					6A7, 6D6, 75, 6G5, 43,		
							314	27	RS205					25Z5, L42C or 6A7,		
														6D6, 75, 43, 25Z5,		
														L49C	‡	
Z55	Vol.	6	G12	6	EX400		4-5-8-14	‡	See Note	B3				6D6, 6C6, 43, 25Z5,		
														L55B		
7	Vol.	6	G12	6	EX300		14-8-10	24/25	See Note	B3				6D6, 6C6, 38, 76		
7B	Vol.	6	G7	6	EX300		8-14-5	24/25	See Note	B3				6D6, 6C6, 38, 76		
10, 12, 14, 19	Vol.	6	G12	6	EX300		5-14-8	6/15	See Note	B3				6D6, 6C6, 43, 25Z5		
30-34	Vol.	6	G12	6	EX300		10-10-20	6/15	See Note	B3				6D6, 6C6, 43, 25Z5		
35	Vol.	17	N				311	23	RS207					6A7, 6D6, 75, 43, 6G5,		
							10	23	See Note	B3				25Z5	456	
50, 56, 59	Vol.	17	N	6			20-10-10	6/14	See Note	B3				6A7, 6D6, 75, 43,		
														25Z5, L55S2	456	
66	Vol.	17	UM154			A96	8-4	1	See Note	B3	35	294	C3	6A7, 6D6, 76, 75, 41,		
							5	15	TS101					84	456	10
							.01		Buffer	B14						
90, 91, 93	Vol.	45	N	6			10-10-4	1/15	See Note	B3				6A7, 6D6, 76, 75, 6E5,		
	Tone	34	Z12											42, 80	456	1
90B, 96B, 99B	Vol.	45	N	6			6-10-10	1/15	See Note	B3				6A7, 6D6, 76, 75, 42,		
	Tone	34	Z12											80, 6G5	456	1
424	Vol.	6	G12		EX200		4-4	1	See Note	B3				^{2}24, 47, 80		1
457	Vol.	6	G12	6	EX300		5-5	4	See Note	B3				58, 57, 47, 80		1
557	Vol.	6	G12	6	EX300		5-5	4	See Note	B3				^{2}58, 57, 47, 80		1
CLINTON																
6V6	Vol.	45	MR48	M27			C220	1	CN142		13	245	C3	6D8G, 1E5G, ^{2}1H4G,		
	Tone	34	MR39				.005		Buffer	B14				6T7G, 1J6G	456	10
19B (194, 195)	Vol.	6	SRP263	6			8-20-8	8	UR182					6D6, 6C6, 43, 25Z5		
51	Vol.	6	SRP263	6			6-20-3	8	UR182					6D6, 6C6, 43, 25Z5,		
														L55B		
56P	Vol.	6	SRP263	6			8-20-8	6	UR182					6D6, 6C6, 43, 25Z5,		
														L55B		
57PG, 58PG, 59PG	Vol.	6	SRP263	6			8-20-8	8	UR182					6D6, 6C6, 43, 25Z5		
C625Q	Vol.	18	MR48	M26			16-20	27	UR182					6A7, 6D6, 75, 43,		
														25Z5		
C71XF	Vol.	18	MR48	M26			8-8	4	RM262					6A7, 6D6, 76, 75, 42,		
	Tone	21	MR18											6G5, 80	456	1
C83	Vol.	18	MR48				8	3	RS213					^{2}6D6, ^{2}76, 75, 6U5,		
	Tone	106	MR18				8-4	3	RN241					6B5, 80	456	1
C93	Vol.	106	MR48				8	1	WE847					^{2}6D6, ^{2}76, 75, ^{2}42, 6G5,		
	Tone	106	MR39				8	1	CS133					80	456	1
							10	15	TS101							
C113XF	Vol.	106	MR18				8	1	WE847					^{2}6D6, ^{3}76, ^{2}6C6, ^{2}42,		
	Tone	106	MR48				8-8	1	RN242					6U5, 80	456	1
C123	Vol.	106	MR48				8	1	WE847					^{3}6C6, 6D6, ^{4}76, ^{2}42,		
	Tone	106	MR39				8-8	1	RN242					6G5, 80	456	1
							10	15	TS101							
152, 153	Vol.	6	SRP263	6			8-20-8	8	UR182					6D6, 6C6, 43, 25Z5		
300	Vol.	17	MR48	M26			40-12	6	UR182					6A7, 6D6, 6Q7G,		
	Tone	21	MR14				10	15	TS101					25B5, 25Z5	465	
610SP, 611SP	Vol.	7	MR19	M26			8-20-8	8	UR182					76, 6D6, 6C6, 43,		
							5	15	TS105					25Z5, 65R4	456	
612SP	Vol.	18	MR18	M26			6-20-8	8	UR182					6A7, 6D6, 75, 43,		
							5	15	TS105					25Z5, L49B	456	
615SQ	Vol.	18	MR48	M26			16-20	27	UR192					6A7, 6D6, 75, 43,		
														25Z5		
620XP	Vol.	7	G	6			8-14	4	CM175					6A7, 6D6, 76, 43,		
														25Z5, 65R4	456	‡
622XF	Vol.	62	MR48	M26			8-8-8	4/13	CM175					6A7, 6D6, ^{2}76, 6AB6G,		
	Tone	22	L											6G5, 80	456	1
630P	Vol.	6	SRP263	6			8-20-8	8	UR182					6D6, 6C6, 43, 25Z5,		
							5	15	TS105					L80B		
716SQ	Vol.	18	MR48	M26			6-20-8	8	UR182					6A7, 6D6, 75, 43, 6U5,		
							5	15	TS105					25Z5, 140R8	456	
717SF	Vol.	18	MR18	M26			20	8	RS207					6A7, 6D6, 75, 43, 6U5,		
							12	8	CS126					25Z5, 140R8	456	
							8	8	CS123							
							5	15	TS105							
723XF	Vol.	62	MR18	M26			8-8-8	4/13	CM175					6A7, 6D6, ^{2}76, 6AB6G,		
	Tone	22	L											6G5, 80	456	1
803, 1935, 1936	Vol.	‡	‡		See Note A5		8-8	‡	CM172		35	294	C3	‡	‡	‡
							‡		Buffer	B14						
818SF	Vol.	45	MR48				40	6	UR182					6A7, 6D6, 76, 6Q7G,		
	Tone	22	L				16	6	CS126					25B5, 25Z5, 6G5	456	
							8	13	CS123							
824XF	Vol.	18	MR48	M26			8-8	4	CM172					6A7, 6D6, 75, 76, ^{2}42,		
	Tone	106	MR39				10	15	TS101					80, 6U5	456	1
831SP	Vol.	18	MR48	M26			6-20-8	8	UR182					6A7, 6D6, 75, 43,		
							5	15	TS105					25Z5, 6U5, L80B	456	
1501	Vol.	15	MR48				8	3	RS213					6L7, ^{2}6K7, ^{6}6C5,		
	Tone	41	N				20	3	RS216					^{2}6H6, ^{2}6V6, 5V4, 6G5	456	1
							10	15	TS106							
							20	15	TS102							
							8	13	CS123							
COAST TO COAST																
A14	Vol.		NN				3	3	See Note	B7				^{2}37, ^{4}42, 82		1
							8-8	3	RS213	B3						
83	Vol.	15	N				8-8-8		See Note	B3				^{2}56, 46, 83		3
							10	15	TS101							
							4-4-4	14	See Note	B3						
51-2'59-2'81	Vol.	15	N				2-2-4	3	See Note	B7				^{2}59, ^{2}50, ^{2}81, 56		5
	Tone	41	M													
525	Vol.	7	E				8-8-8	3	CN155	B3				^{2}35, ^{2}24, ^{2}27, ^{2}47, 80		3
	Tone	41	L													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
COAST TO COAST—	Continued															
D3008	Vol.		N				16-4	24	See Note	B3				^{3}37, ^{2}2A3, ^{2}82-83		
							4	13	See Note	B3						
							4-4	1	See Note	B3						
							5	15	TS101							
D3031	Vol.	16	N				12-12	9	See Note	B3				37, ^{2}43, ^{2}25Z5		
	Tone	65	N				8-4	14	See Note	B3						
							5	15	TS106							
4978	Vol.	15	M				2-2-2	3	See Note	B7				24, 45, ^{2}50, ^{2}81		8
	Tone	41	M													
COLONIAL—Also See Sears Roebuck.																
16-5	Fil.	29	Q											^{5}01A		
16-6	Fil.	29	Q											^{6}01A		
17-5	Fil.	29	Q											^{5}01A		
25	Vol.	15	N				2-2-2	3	See Note	B7				^{2}01A, ^{5}99, 10, ^{2}81		1
	Primary		M30R				.085		See Note	B9						
26	Vol.	29	T											^{4}01A, 71		
	Fil.	29	HU20		See Note	A33										
31AC	Hum	37	C30P				8-8-8	3	MN275					^{2}26, ^{2}27, ^{2}71A, 80		9
31DC	Fil.	‡	M20R											^{5}26, ^{2}71A		
32AC	Vol.	24	GK				1445P	3	MN275					^{4}24, 27, ^{2}45, 80		1
Cavalier, Picadilly,																
Moderne 32 DC.	Vol.	24	GK											^{4}24, 27, ^{2}45		
33, 34, 35							8-8	1	MN272					^{3}24, 27, ^{2}45, 80		7
36	Hum	66	SRP266				D4758P	1	RS213					^{3}24, ^{2}45, 80		3
36P							D4758P	1	RS213					^{3}24, ^{2}45, 80		3
37							R5734A	4	RN242					^{3}35, 24, ^{2}45, 80		3
37P							R5734A	4	RN242					^{3}35, ^{2}24, 45, 80		3
38	Hum	66	SRP266				D4758P	1	RS213					^{3}24, ^{2}45, 80		3
39							4758P	4	RS213					^{3}24, 45, 80		1
41, 42							R5734A	4	RN242					^{2}35, 24, ^{2}45, 80		1
41P							R5734A	1	RN242					^{2}35, 24, ^{2}45, 80		1
44	Vol.	6	H7		1		4758P	4	RS213					^{2}24, 35, 47, 27, 80	175	1
46 (Midget)	Vol.	7	H				R6122	1	CN152					35, 24, 47, 80		1
47, 48	Vol.	6	H7		1		D4758P	4	RS213					^{3}35, 24, 27, ^{2}47, 80	175	3
49 (Midget)							4758P	4	RS213					^{2}35, 24, 47, 80		1
50 (AVC)	Vol.	7	H				D4758P	4	RS213					^{4}35, 27, 24, ^{3}47, 80	175	7
51	Tone	21	N	6			D4758P	25	RS213					^{3}35, 24, ^{2}27, 47, 80	175	3
52	Vol.	6	H		1		D4758P	4	RS213					^{3}35, 27, 24, 47, 80	175	3
	Tone	21	N													
55							R6645	1	RS211					24, 27, 35, 80	1000	1
56	Vol.	15	N				8	12	CS123					^{3}32, ^{3}30, 33	175	
	Tone	57	N				5	17	TS101							
62	Vol.	6	H7	6			8	1	RS213					57, ^{2}58, 24, 47, 80	175	3
	Tone	57	N				4	13	See Note	B3						
65	Vol.	29	U	6										^{2}34-32, 32, 33, Bal.		
69	Tone	22	N				8	12	See Note	B3				^{4}32, ^{2}30, 33, Bal.	175	
							20	19	TS102							
71	Supp.	7	W	6			D4758P	2	WE847					^{3}58, ^{3}57, ^{4}46, 83	175	7
	Tone	66	N													
73	Vol.	6	H7	6	1		D4758P	23	RS213					57, 58, ^{2}24, 47, 80	175	1
76	Vol.	6	H12	6			14	4	WE1647					^{2}57, 58, 56, ^{3}46, ^{2}80	175	3
	Tone	22	N				D4758P	4	RS213							
	Hum	37	HU20				16	13	See Note	B3						
106B	Vol.	17	N				UE115	1	CS123		4	221	C3	^{2}36, 39, 85, ^{2}41, 84	175	
	Tone	44	N				R7917	17	TS102							
							.02		Buffer	B14						
114	Hum	66	SRP266				8	1	RS213					^{2}35, 24, ^{2}45, 80		3
117	Hum	66	SRP266				D4758P	1	RS213					^{3}24, ^{2}45, 80		3
125							4758P	4	RS213					^{3}24, 45, 80		1
136	Vol.	6	H12	6			R9150	29	CM165	B47				78, 77, 43, 25Z5		
							5	15	TS101							
150	Vol.	18	N	6			R8837	1	CN152		24	271	C3	6A7, 78, 75, 41	480	10
							R9144	15	TS101							
164	Vol.	17	SRP252	6			R9743	1	CN152		3	220B	C3	^{2}78, 6A7, 6B7, 41, 84	175	10
	Tone	22	N				R9144	15	TS101							
							.01-.01		Buffer	B14						
164B	Vol.	18	SRP252				R9743	1	CN152		37	296	C3	78, 6A7, 6B7, 41, 84	175	10
	Tone	22	N				R9144	15	TS101							
							.01-.01		Buffer	B14						
182	Vol.	17	SRP252	6			R9780	4	RM262	B48				78, 6A7, 6F7, 6B7, ^{2}41	175	
	Tone	44	N					15	TS101							
250	Vol.	68	D12				R8053	9	CM165	B49				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
250AC	Vol.	68	D12				R8247	23	RM262	B50				6A7, 6B7, 77, 41, 84	175	1
250AC (Ex. Range)	Vol.	18	N	6			R8719	23	CS133					6A7, 78, 75, 41, 84	175	1
							R8748	23	CS123							
250-300 AC-DC	Vol.	18	N	6			R8053	29	CM165	B51				6A7, 78, 75, 43, 25Z5	175	
279 (A)	Vol.	68	D12				R8053	9	CM165	B49				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
279AC	Vol.	68	D12				R8247	23	RM262	B50				6A7, 6B7, 77, 41, 84	175	1
279 (B)	Vol.	68	D12				R8053	29	CM165	B51				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
300 (A)	Vol.	68	D12				R8053	9	CM165	B49				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
300 (B)	Vol.	68	D12				R8053	29	CM165	B51				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
300AC, 301AC	Vol.	68	D12				R8247	23	RM262	B50				6A7, 6B7, 77, 41, 84	175	1
300 (Ex. Range)	Vol.	18	N	6			R8719	23	CS133					6A7, 78, 75, 41	175	1
							R8748	23	CS123							
301 (A)	Vol.	68	D12				R8053	9	CM165	B49				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
301 (B)	Vol.	68	D12				R8053	29	CM165	B51				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
T345, C399	Vol.	6	H12				D4758P	23	RS213					39, ^{2}36, ^{2}89, 80	175	1
	Tone	21	N													
T397	Vol.	6	H12				D4758P	23	RS213					^{2}58, ^{2}24A, 47, 80	175	1
	Tone	21	N													
400	Vol.	19	1 Meg.		See Note	A19	R8624	23	RS213					^{2}78, 6A7, 85, 41, 84	175	1
	Tone	21	O													
	Power	7	A550P		See Note	A14										
C495	Vol.	6	H12				D4758P	23	RS213					^{2}58, ^{2}24A, 47, 80	175	1
	Tone	21	N													
500 (A)	Vol.	68	D12				R8053	9	CM165	B49				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
500 (B)	Vol.	68	D12				R8053	29	CM165	B51				6A7, 6B7, 77, 43,		
							R8058	15	TS101					25Z5	175	
501	Vol.	18	N	6			R8053	29	CM165	B51				6A7, 78, 75, 43, 25Z5	175	
	Tone	21	N				R9229	29	CS123	B52						
501AC	Vol.	18	N	6			R9345	23	CS133					6A7, 78, 75, 41, 84	175	1
	Tone	21	N				R9344	23	CS123							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
COLONIAL—Continued																
C595	Vol.	15	O				R8624	4	RS213					^{4}58, 56, 27, 47, 80	175	3
	Tone	21	N	6												
600, 600A	Vol.	18	UC503				R7236	23	WE1647					^{2}78, 6A7, 85, 41, 80	175	1
	Tone	22	N				D4758P	23	RS213							
601	Vol.	18	N				R7236	23	WE1647					^{2}78, 6A7, 75,^{4}45, 83	175	14
	Power	7	UC500				D4758P	23	RS213							
							R9237	13	CS131							
602	Vol.	15	N				R7236	23	WE1647					6A7, ^{2}78, ^{2}6B7, ^{3}37,		
	Tone	22	N				R9344	13	CS133					^{2}2A3, 83	175	15
	Sen.	7	H				R8748	13	CS123							
603	Vol.	18	N				D4758P	23	RS213					^{2}78, 41, 75, 42, 80	480	1
	Tone	‡	N													
604	Vol.	18	N				R7236	23	WE1647					^{2}78, 6A7, 75,^{2}47, 80	445	14
	Tone	‡	O				R8488	23	RS213							
							R9237	13	CS121							
605	Vol.	18	N	6			8-8	23	RS213					^{2}78, 41, 37, 75, 47, 80	175	14
	Tone	22	N													
650	Vol.	18	N	6			R4758P	23	RS213					6A7, 78, 75, 41, 80	175	1
	Tone	‡	N				R7236	23	WE1647							
651	Vol.	18	N	6			R8744	23	CS133					6A7, 78, 75, 41, 84	480	1
							R8748	23	CS123							
652	Vol.	18	N	6			R8624	23	RS213					6A7, 78, 75, 42, 80	480	1
							8	13	CS133	B3						
653	Vol.	6	D7				D4758P	23	RS213					6A7, 78, 37, 41, 80	480	1
654	Vol.	7	D	6			R10689	24	CN142					6A7, 78, 37, 38, 1V	480	
655	Vol.	18	N	6			8-8	23	RS213					^{2}78,^{2}41, 75, 84	480	1
656	Vol.	18	N				D4758P	23	RS213					^{2}78, 41, 75, 42, 80	175	16
	Tone	‡	N	6												
657	Vol.	18	N	6			R10601	29	UR190	B53				6A7, 78, 75, 43, 25Z5	480	
658	Vol.	18	N	6			D4758P	23	RS213					^{2}78,^{2}41, 75, 80	480	1
	Tone	‡	N				8	23	RS213							
659	Vol.	29	U				R10673	13/19	CN142/TS102					^{2}951, 30, 32, 33, 30,		
	Tone	34	N											Bal.	480	
662	Vol.	18	N	6			R9204	23	RS213					6A7, 78, 51, 41, 84	480	1
							R8748	23	RS213							
C695	Vol.	18	O				D4758P	23	RS213					^{4}58,^{2}56, 27,^{2}47, 80	175	3
	Tone	21	N													
700, 701, 702	Vol.	18	N	6			R9397	29	RS203					6A7, 78, 75, 43, 25Z5	175	
700AC, 701AC, 702AC	Vol.	18	N				R8624	23	RS213					6A7, 78, 75, 41, 84	175	1
							R9204	23	RS203							
C995	Tone	22	N				R7236	7	WE1647					^{5}58, 24,^{2}57,^{4}46,^{2}82	175	17
							8	7	RS213							
1580	Vol.	6	H7				8-8	25	RS213					57,^{2}58, 56, 57-24, 47,		
	Tone	21	N											80	175	3
COLUMBIA PHONO. CO.																
C1, C2, C3, C4	Vol.	14	L				2-2-2	3	See Note	B1				^{4}26, 27, 71A, 80		11
C5 (205)	Vol.	14	L				3-2-2	3	See Note	B1				^{5}26, 27, 50, 81		8
C5 (310)	Vol.	14	L				3-4-4	3	See Note	B1				^{5}26, 27, 10,^{2}81		8
C6, C7	Vol.	14	L				‡	‡	See Note	B1				01A, 71A		
31, 33	Vol.	7	A5MP	6			1-4-2	25	See Note	B1				^{2}51, 24, 47, 80		1
							.055		See Note	B9						
C33, C34	Vol.	7	G				2-2	25	See Note	B1				^{2}51, 24, 27, 47, 80		1
							8	25	RS213	B3						
							.08		See Note	B9						
C80A	Vol.	15	M				8-8-10	25/15	CM172/TS101	B6				^{4}58S, 56, 4-S, 47, 82	175	1
	Tone	22	K12	6												
C80B	Vol.	15	M				8-8-10	25/15	CM172/TS101	B6				^{4}58S, 56, 4-S, 47, 82	175	1
	Tone	22	K12	6												
C90, A, B	Vol.	15	M				7489	2	CN152	B8				^{4}58S, 56,^{2}57S,^{2}47, 82	175	3
	Supp.	12	Y				7278	13/14	CM162	B54						
	Tone	22	M	6			7402	15	TS101	B54						
	Hum	37	HU20				7784	15	TS102	B54						
C100	Vol.	15	SRP226				8-8-8	3	MN275					^{4}24, 27,^{2}45, 80		3
120B	Vol.	43	GG											30,^{4}32, 33	175	
C800	Vol.	15	M				8-8-10	25/15	CM172/TS101	B6				^{4}58S, 56, 4-S, 47, 82	175	1
	Tone	22	K12	6												
900, 901	Vol.	87	‡			See Note A5	3-4	1	See Note	B7				26, 10,^{2}81, 876		8
902	Vol.	63	‡			See Note A5	3-4	1	See Note	B7				^{2}27,^{2}50,^{2}81		5
920, 930	Hum	37	HU20				2-2-.5	3	See Note	B7				27,^{2}45, 80		3
930-300	Vol.	63	‡			See Note A5	3-4	1	See Note	B7				26, 10,^{2}81		5
931	Vol.	63	‡			See Note A5	3-2	1	See Note	B7				26, 50, 81		5
940	Vol.	40	Y				2-1-.5	3	See Note	B1				26,^{5}27,^{2}45, 80		2
950, 961	Vol.	40	G12				3-2-2	3	See Note	B7				^{4}26, 27, 50, 81		8
	Phono.	63	‡			See Note A5										
980	Vol.	14	L				1-1-1	3	See Note	B1				Radio ^{4}26,^{3}27, 80		
	Phono.	63	‡			See Note A5	3-4	1	See Note	B7				Phono 27,^{2}50,^{2}81		11/5
990	Hum	37	HU20				2-2-5	3	See Note	B1				27,^{2}45, 80		3
COLUMBIA RADIO CORP.																
SG5 ('30)	Vol.	7	Z				2-1	1	See Note	B1				^{3}24, 45, 80		3
SG8	Vol.	69	Y	8		A8	2-2-2	3	See Note	B1				^{4}24,^{2}27,^{2}45, 80		3
SG9	Vol.	25	G12	6		A20	8-8-8	3	See Note	B3				^{4}24,^{2}27,^{2}45, 80		3
	Tone	41	N													
SG10	Vol.	7	Z			See Note A10	2-2.5-2.5	3	See Note	B1				^{6}24,^{6}27,^{2}45, 80		3
COMMONWEALTH																
150	Vol.	17	N				5-18-7	11	UR182	B31				6A7, 6D6, 75, 43, 25Z5	456	
CONSOMELLO																
8 in line	Vol.	10	D7				‡	3	See Note	B3				^{5}26, 27, 71A, 80		11
CONTINENTAL																
(Slagle) 9 ('71A)							2-4-2	3	See Note	B1				^{7}27,^{2}71A, 80		2
(Slagle) 10, A, B, ('71A)							2-4-2	3	See Note	B1				^{8}27,^{2}71A, 80		2
29A, 29B							2-4-2	3	See Note	B7				^{8}27,^{2}50,^{2}81		2
(Slagle) 29C ('71)	Phono.	63	K12			See Note A3	2-4-2	3	See Note	B7				^{8}27,^{2}71A, 80		2
29C, 29B ('50)	Phono.	63	K12			See Note A3	2-4-2	3	See Note	B7				^{9}27,^{2}50,^{2}81		5
"Star Raider" R20, R30, R40							2-4-1-2	37	See Note	B7				^{7}484,^{2}585,^{2}81, VR		5
A31	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
"Admiral" L5	Vol.	18	N	6			P474	32	RS211					5Z4, 6F5, 6F6, 6H6,		
	Tone	34	L				P160	32	CN151	B81				6K7, 6L7, 6C5	456	1
							P304	15	TS101							
"Admiral" L6	Vol.	18	N	6			P474	32	RS211	B81				5Z4, 6C5, ^{2}6F6, 6K7,		
	Tone	44	L				P160	32	CN151					6L7,^{2}6Q7	456	1
							P304	15	TS101							

‡ Data not substantiated.

*IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
CONTINENTAL—Continued																
"Admiral" L7	Vol.	45	N	7			P391	1	CN152		14	245C	C3	1C6, 19, ^{3}30, ^{2}34	456	10
	Tone	‡	L				.01-.01		Buffer	B14						
M1	Vol.	18	O	6			P160	1	CN151					6A8, ^{2}6K7, 6Q7, 6F6,		
	Tone	34	L											5Y3	456	1
"Admiral" U6	Vol.	17	UC514				P759	4	CM172		35	294	C3	6D6, 6A7, 6K7, 75,		10
	Tone	22	MR39				G864	15	TS101					6F6, 84		
X8	Vol.	18	N	6			P160	1	CN151					6A7, 6D6, 75, 42, 80	456	1
X641, X741	Vol.	45	N				8-8	1	See Note	B3	14	245C	C3	1C6, 34, ^{2}30, 32, 33	456	10
							.01-.01		Buffer	B14						
Z2	Vol.	45	N	6			P160	1	CN151					6A7, 6D6, 6H6, 6F5,		
	Tone	34	L											42, 80	456	1
"Admiral" Z4	Vol.	45	SRP275	7			P391	1	CN152		14	245C	C3	1C6, 34, ^{2}30, 32, 19	456	10
	Tone	44	L				.01-.01		Buffer	B14						
"Admiral" Z5	Vol.	45	SRP275	7			P958	1	CN152		14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
5M	Vol.	18	N	6			P1591	23	RM261					6A7, 6D6, 75, 41, 80	456	1
5X	Vol.	18	N				8-4	23	RM261					6A7, 6D6, 75, 41, 80	456	1
5Z	Vol.	18	MR53	M26			P1511	23	RM262					6A7, 6D6, 75, 41, 80	456	1
6H	Vol.	18	N				‡	23	See Note	B3				6A7, 6D6, 75, 25B6G,		
														25Z5	456	
6L	Vol.	18	N	6			‡	4	See Note	B3				6A7, 6D6, 75, 25B6G,		
														25Z5	456	
6P	Vol.	18	N				‡	1	See Note	B3	14	245C	C3	6D8G, 6S7G, 6T7G,		
	Tone	44	L				.01-.01		Buffer	B14				^{2}30, 19	456	10
6Q	Vol.	62	O				10	19	TS101					1A6, ^{2}1A4, 30, 1G5G,		
	Tone	22	L											1B1	‡	
6W	Vol.	18	N	6			8-4	23	RM261					6A7, 6D6, 75, 6H5,		
	Tone	34	L											41, 80	456	1
6Y	Vol.	18	N				‡	27	See Note	B3				6A7, 6D6, 75, 25B6G,		
														25Z5, L49BJ	456	
7M	Vol.	139	500M No. 1			See Note A19	4-16	23	RM265	B261				6A7, 6D6, 76, 75,		
	Tone	139	O				10	19	TS101					6U5, 42, 80	456	1
7MU	Vol.	139	500M No. 1			See Note A19	16-4	23	RM265					6A7, 6D6, 76, 75,		
	Tone	139	O				10	19	TS106					6U5, 42, 80	456	1
8K	Vol.	140	1 Meg. No. 1			See Note A19	P1825	1/13	RN245					6A7, 6D6, 75, ^{2}76,		
	Tone	140	MR48				P1873	15	TS101					^{2}42, 80	456	1
8KU	Vol.	140	1 Meg. No. 1			See Note A19	6-6-2	46	RN245					6A7, 6D6, ^{2}76, 75,		
	Tone	140	O				10	15	TS101					^{2}42, 80	456	1
8T	Vol.	140	1 Meg. No. 1			See Note A19	20-25	1	See Note	B3				6A7, 6D6, 75, 76, ^{2}43,		
	Tone	140	O				10	15	TS101					25Z5, 17AJ	‡	
9G	Vol.	140	1 Meg. No. 1			See Note A19	6-12	1	See Note	B3				6A7, 6D6, ^{3}76, 75, ^{2}42,		
	Tone	140	O				10	15	TS101					80	456	37
11S	Vol.	140	1 Meg. No. 1			See Note A19	P1937	1	WE2545					6A8, ^{2}6K7, 6J7, ^{4}6J5,		
	Tone	140	MR53				P1939	1/13	RN242					^{2}6F6, 5Z3	456	37
16R	Vol.		Order from	Mfr.			25	30	WE2545					^{4}6K7G, 6L7G, ^{2}6H6G,		
	Tone	34	M				12	30	WE1247					^{4}6J5G, 6J7G, ^{2}6L6G,		
	Bass	15	N				25	30	WE2545					^{2}5Z3	456	37
							4-4	13/11	CN140							
61	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
77	Vol.	45	UM154			A96	8-6	23	RM262		35	294	C3	6D6, 6A7, 6K7, 6H6,		
	Tone	22	‡			See Note A3								6C5, 6V6G, 84	175	10
770	Vol.	45	UM154			A96	8-6	23	RM262		35	294	C3	6D6, 6A7, 6K7, 6H6,		
	Tone	22	‡			See Note A3								6C5, 6V6G, 84	175	10
L2	Vol.	18	SRP275				4	7	RS213					6A7, 6K7, 6H6, 6F5,		
	Tone	34	O	6			8-4	7	CN151	B81				6F6, 80	456	1
L4, ML4	Vol.	18	SRP275				4	7	RS211					6A8, 6K7, 6H6, 6A6,		
	Tone	44	L	6			8-4	7	CN151	B81				^{2}6F6, 80	456	1
							5	15	TS101							
ML156, ML266	Vol.	18	SRP275				4	7	RS211					6A7, 6K7, 6H6, 6F5,		
	Tone	34	O	6			8-4	7	CN151	B81				6F6, 80	456	1
137X, 150X, 171X	Vol.	18	N			See Note A21	8-4	23	See Note	B3				6A7, 6D6, 75, ^{2}42, 80	456	1
X541	Vol.	18	N				18-6	6	See Note	B3				6A7, 6D6, 75, ^{2}43,		
							5	15	TS101					25Z5	456	
CORONA																
110	Vol.	18	M				12-4	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
	Tone	34	K12													
212	Vol.	45	MR48	M26			8-8	1	See Note	B3	43		See Note C8	1C6, 1A4, ^{2}30, 1B4,		
														19	‡	10
214	Vol.	45	MR48	M26			8-8	1	See Note	B3	43		See Note C8	1C6, 1A4, ^{2}30, 1B4,		
														19	‡	10
406	Vol.	98	‡			See Note A5	‡	24	See Note	B3				6D6, 6C6, 38, 12Z3		
							5	15	TS101							
CORONADO—See Gamble-Skogmo																
"CRANE" (American Radiator Co.)																
23T8 LW	Vol.	15	N				8-8	4	See Note	B3				^{2}58, ^{3}56, 57, 47, 80	177.5	1
	Tone	22	K12													
CROSLEY																
Buddy, Chum	Vol.	7	A400P				W4943	24	MN272					^{2}24, ^{2}71A, 80		2
AC7, AC7C	Vol.	29	A550P				15-15-5	3	MN275					^{4}99, 12A, BH		1
A155	Vol.	18	UC514	6			W32759	1	RS213		15	247	C3	^{2}78, 6F7, 6B7, 42	181.5	10
							W32802	1/15	SR605	B23						
							.005		Buffer	B14						
A156	Vol.	56	UM162-SS14				W37020	4	CM171		35	294	C3	6A7, 6B7, 6D6, 42	262.5	10
							.005		Buffer	B14						
A157	Vol.	18	MR53	M26			W50160	23	RM261		35	294	C3	6A8G, 6U7G, 6Q7G,		
							.01		Buffer	B14				6K6G, 6X5G	455	10
A166	Vol.	17	UM162-SS14				W38427	1/15	RN242/TS101	B6	25	273C		6D6, 6A7, 6B7, 76, ^{2}41	262	10
							W32904	‡	TS102							
							W38430	‡	TS101							
A167	Vol.	45	TM222-SS1				W50045A	1	RN242		35	294	C3	^{2}6K7G, 6A8G, 6B8G,		
							.005		Buffer	B14				6N6G, 6X5G	262	10
A177	Vol.	17	TM252-SS1				W50076A	1/15	RN245		35	294	C3	^{2}6K7G, 6A8G, 6R7G,		
							W38430	15	TS105					^{2}6V6G, 6W5G	262	10
							.006		Buffer	B14						
A255	Vol.	17	UM162-SS14				W38473	1	RN242		25	273C		6D6, 6A7, 6B7, 76,		
														6B5	450	10
A266	Vol.	15	UM147-SS14				W38786	4	RM262	B73	35	294	C3	^{2}6D6, 6A7, 6B7, 42, 84	262	10
							.005		Buffer	B14						
A267	Vol.	124	TM222-SS1				W50194	23	RM262		35	294	C3	^{2}6K7G, 6A8G, 6Q7G,		
							.01-.01		Buffer	B14				6K6G, 0Z4	262	10
A355	Vol.	17	UM162-SS14				W38473	1	RN242		25	273C		6D6, 6A7, 6B7, 76,		
														6B5	450	10
A366	Vol.	20	TM242-SS14				W38427	1/15	RN242/TS101		25	273C		6D6, 6A7, 6B7, 76, ^{2}41	262.5	10
	Tone	39	MR44				W38430	15	TS101							
A455, A555	Vol.	18	UM162-SS14				W38473	1	RN242		25	273C		^{2}6D6, 6A7, 6B7, 6B5	450	10
2C1 (Sampler)	Vol.	6	‡	6		See Note A3	W34704A	24/15	CM164/TS101					6F7, 12A7		

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
CROSLEY — Continued																
4A1	Vol.	18	UC512	6			W32759	1	RS213		16	247	C3	6F7, 6B7, 6D6, 42	456	10
							W30419A	13/15	RN242							
							.005		Buffer	B14						
4B1 Batt. (Forty)	Vol.	70	Y10MP	13		See Note A13								^{2}1A6, 34, 33	456	
5A1	Vol.	18	UC512	6			W31631B	1	CS135	B3	6	223	C3	^{3}78, 6B7, 41	181.5	10
							W30419A	1/15	RN242							
							.01		Buffer	B14						
5A3 (Roamio)	Vol.	18	UC514	7		See Note A31	W32759	1	RS213		16	247	C3	^{2}78, 6F7, 6B7, 42	181.5	10
							W32802	1/15	SR605	B23						
							.005		See Note	B14						
5B3 (Batt. Fiver)	Vol.	70	Y10MP	13		See Note A14								1A6, 34, 33	456	
5M3 (Fiver Jr.)	Vol.	6	E7	6		See Note A14	W29150B	1/15	SR615					^{2}6D6, 76, 42, 80	456	1
5V1 (Deluxe Fiver)	Vol.	17	N	6			W30059C	4/14	SR616					6A7, 6D6, 6B7, 42, 80	181.5	1
5V2 (Fiver Deluxe)	Vol.	17	O	6			W30059C	4/14	SR616					6A7, 6D6, 6B7, 42, 80	181.5	1
6B1 (Batt. Six)	Vol.	45	O				W34898	1	RS213		16	247	C3	^{3}15, 6A7, 30, 38	456	10
	Tone	22	Z	6			W34899	13	RS203							
							W34896	1/13	RM257							
							.005		Buffer	B14						
6H2 (61, 61LB)	Vol.	17	UC504				W26194B	4	WE1247					6A7, 6D6, 6B7, 76, 42, 80	456	1
	Tone	22	Z	6			W29097C	4/14	SR615							
6H3	Vol.	17	UC504				W26194B	4	WE1247					6D6, 6A7, 6B7, 76, 42, 80	456	1
	Tone	22	Z	6			W27097D	4/14	SR615							
6V2 (Dual Sixty)	Vol.	56	O				B30059B	4/13	SR616					^{2}58, 2A7, 55, 2A5, 80	181.5	1
	Tone	22	Z	6												
7H2 (72, 72LB)	Vol.	56	O				W29097C	4/13	SR615					^{3}58, 2A7, 2B7, 2A5, 80	456	1
	Tone	22	Z	6			W26191B	4	WE1247							
7H3 (72, 72LB)	Vol.	56	O				W26194B	4	WE1247					^{2}6D6, 6A7, 6B7, 6F7, 42, 80	456	1
	Tone	34	Z	6			W29097C	4/14	SR615							
7V2 (Dual Seventy)	Vol.	17	UC504				W26194B	1	WE1247					^{3}58,^{2}56, 2A5, 80	181.5	1
	Tone	22	Z	6			W29150B	15/24	SR615							
8B3	Vol.	45	O				W33990	12/13	RN232					^{3}34, 1C6,^{2}30, 31, 19	456	
	Tone	22	Z	14												
8H1 (80, 80LB)	Vol.	56	O				W26194B	1	WE1247					^{2}6D6, 6A7, 6B7, 6F7, ^{2}42, 80	456	1
	Tone	44	Z	6			W29097C	3	SR615							
7 (Converter)							W23701	1	RS213					^{3}24, 27, 80		1
10							W27676	1	CN140					77,^{2}37		
20, 21, 22	Vol.	6	T			See Note A22								^{3}22,^{2}01A, 71A		
26	Vol.	12	L											^{3}22, 01A,^{4}12A		
27, 28	Vol.	4	SRP263											^{3}32,^{3}31		
30S, 31S, 33S, 34S	Vol.	7	SRP188				W5253	3	MN275					^{2}24,^{2}27,^{2}45, 80		3
38 (Field Supply)							W29806A	1	RM257	B59				^{2}25Z5		
40S, 41S, 42S	Vol.	89	DRP305	1st type			W5253	3	MN275					^{3}24,^{2}27,^{2}45, 80		3
	Vol.	90	DRP305	2nd type												
	Vol.	91	SRP188	3rd type												
41, 41A, 42	Vol.	3	SRP185				W4943	1	MN272					^{4}26, 27,^{2}71, 80		11
48	Vol.	6	SRP263				W21459	1	RS213					^{3}24, 45, 80		1
50, 50LB (5H1)	Vol.	18	UC504				W26194B	4	WE1247					6A7, 6F7, 6B7, 42, 80	456	1
	Tone	22	Z	6			W29097C	4/14	SR615							
51 (5C2)	Vol.	56	UC503	6			W31992	11/15	RM259/TS101	B56				78, 6F7, 6B7, 43, 25Z5	181.5	
53, 54	Vol.	6	SRP263				W4943	1	MN272					^{3}24, 45, 80		3
55	Vol.	2	L				W20156	39	RM257	B63				^{3}32, 12A, 71A		
							W21292	15	TS102							
56	Vol.	2	SRP263				W20156	39	RM257	B63				^{3}32, 12A, 71A		
							W21292	15	TS102							
57, 58	Vol.	6	SRP263				W4943	1	MN272					^{3}24, 45, 80		3
59AC	Vol.	6	E7			See Note A14	W23705	4	RS215					^{2}35, 24, 47, 80		1
							W23791	4	RS213							
60S, 61S, 62S, 63S	Vol.	12	SRP188				W5253	3	MN275					^{4}22,^{2}12A,^{2}71A		
76	Vol.	15	SRP226				W20156	1	RM257	B63				^{3}24,^{3}71A		
							W21292A	‡	TS102							
77-1	Vol.	6	SRP263				W20341A	3	MN277	B60				^{3}24, 27,^{2}45, 80		3
77A, 77B, 77L	Vol.	15	SRP226				W20341A	3	MN277	B60				^{3}24, 27,^{2}45, 80		3
82S	Vol.	89	DRP305	1st type			W5253	3	MN275					^{3}24,^{2}27,^{2}45, 80		3
	Vol.	90	DRP305	2nd type												
	Vol.	91	SRP188	3rd type												
84	Vol.	15	M				W20341	3	MN277	B6				^{4}24, 27,^{2}45, 80		3
84C, 84D	Vol.	15	SRP226				W20341	3	MN277	B60				^{4}24, 27,^{2}45, 80		3
90 (Roamio)	Vol.	26	K12											^{2}24, 27,^{2}12A		
91 (Roamio)	Vol.	15	M				W21292A	16	TS102					^{3}24,^{2}12A		
92 (Roamio)	Vol.	15	L				W21292B	19	TS102					^{4}36, 37, 71A		
95 (Roamio)	Vol.	15	UC504				W25857B	12/15	UR180					^{2}36, 39,^{2}37, 41	181.5	
96 (Roamio)	Vol.	17	UC504	6			W25857B	12/15	UR180					36,^{3}39, 85, 89	181.5	
98	Vol.	17	UC504	6			W28068	1	CS135		6	223	C3	^{2}78, 77, 75, 89	181.5	10
	Supp.	7	J				W25857B	12/15	UR180							
							W28406	‡	TS101							
							W26870A	15	TS101							
							.01		Buffer	B14						
99	Vol.	17	UC504	6		See Note A1	W28068	1	CS135		6	223	C3	77,^{2}78, 79, 89	181.5	10
	Supp.	56	J				W25857B	15/14	UR180							
	Tone	44	Z				W28406	‡	TS101							
							W26870A	15	TS101							
							.01		Buffer	B14						
102	Vol.	‡	UC512				W29808	1	RS205		6	223	C3	^{3}78, 6B7, 41	181.5	10
							W29809	12/15	UR180							
103	Vol.	17	UC514	6			W29808	1	RS205		6	223	C3	^{3}78, 6B7, 41	181.5	10
							W30419	1/15	RN232	B61						
							.02		Buffer	B14						
104, 104R, 105, 105R, 106 (Pwr. Packs)							10-10-10	3	MN275					80		11
119	Vol.	15	UC504				W28978B	1	RS205		6	F223	C3	^{2}78, 6B7, 75, 37, 43	181.5	10
	Tone	22	Z	6			W30568A	13/15	RN235/TS101	B62						
							.01		Buffer	B14						
120	Vol.	6	G7				W20341A	3	MN277	B60				^{4}24, 27,^{2}45, 80	175	3
	Tone	22	SRP226													
121 Series "A"	Vol.	8	SRP264				W23701	1	RS213					^{2}35,^{2}24,^{3}27,^{2}47, 80	175	3
	Tone	41	M				W23705	1	RS215							
121 Series "B"	Vol.	15	SRP226	6			W23701	3	RS213					^{3}51,^{2}24,^{2}27,^{2}47, 80	175	1
	Tone	41	M				W23705	3	RS215							
122	Vol.	6	D7				W22363	4	RS211					^{2}35,^{3}24, 47, 80	175	1
	Tone	22	K12				W21159	4	RS213							
123	Vol.	6	SRP264				W23701	1	RS213					^{2}35,^{2}24, 47, 80,^{2}27	175	1
	Tone	34	K12													
124	Vol.	6	E7	6	2		W23801	1	CN152					^{2}35, 24,^{2}27,^{2}47, 80	175	1
	Tone	34	K12													
124-1	Vol.	6	E7		2		W24342	1	RS213					^{2}35, 24,^{2}27,^{2}47, 80	175	1
	Tone	44	Z				W23701	1	RS213							
125	Vol.	6	E7	6	2		W23801	1	CN152					35,^{2}24, 47, 80	175	1
	Tone	22	K12													
126	Vol.	92	SRP264				W20156	1	RM257	B63				^{4}36, 37,^{2}71A	175	
	Tone	44	L				W21292B	‡	TS102							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
CROSLEY — Continued																
126-1	Vol.	92	SRP264	8			W20156	1	RM257	B63				^{4}36, 37, ^{2}71A	175	
	Tone	34	M				W24282	‡	TS102							
127	Vol.	15	M				W23701	3	RS213					^{3}35, 24, ^{3}27, ^{2}47, 80	175	1
	Tone	41	M				W23705	3	RS215							
127-1	Vol.	15	M				W23701	3	RS213					^{3}35, 24, ^{3}27, ^{2}47, 80	175	1
	Tone	44	Z	6			W23705	3	RS215							
128	Vol.	71	SRP262	14	5		W24282	19	TS102					^{3}32, ^{3}30, ^{2}31	175	
	Tone	44	M													
129	Vol.	6	E7		4		W25542	1	CN151					24, 58, 57, ^{2}42, 80	181.5	14
	Tone	41	Z	6			W24779	13	CS133	B3						
129-1	Vol.	6	SRP262		2		W26118	1	CN152					24, 58, 57, ^{2}42, 80	181.5	14
	Tone	44	Z	6			W26119	13	UR180							
130	Vol.	23	DRP232				W25462	1	See Note	B3				^{3}58, 57, ^{2}56, ^{2}42, 80	181.5	14
	Tone	44	Z	6			W26119	24	UR180							
130-1	Vol.	23	DRP232				8-8	1	See Note	B3				^{3}58, 57, ^{2}56, ^{2}42, 80	181.5	14
	Tone	41	Z	6			W26119	13	UR180							
131	Vol.	6	SRP262	6	4		W25462	1	RS213					24, 35, 47, 80	175	1
							W23701	1	RS213							
							W25303	16	TS101							
132-1	Vol.	23	DRP232				W26194B	3	WE1247					^{4}58, ^{3}56, ^{2}42, ^{2}46, 82	181.5	19
	Tone	44	Z	6			W26118	3	CN152							
	Sil.	‡	Y500MP				W26119	24	UR180							
133	Vol.	6	E7		2		W25542	1	CN151					^{3}35, 24, 27, 47, 80	181.5	1
	Tone	72	N	6			W25503	19	TS101							
134	Vol.	15	UC504				W25542	1	CN151					^{2}35, 24, ^{2}27, 47, 80	181.5	1
	Tone	72	N	6			W25857	15/24	UR180							
134-1	Vol.	15	UC504				W23701	1	RS213					^{2}35, 24, ^{3}27, 47, 80	181.5	1
	Tone	72	N	6			W25676	2/16	2-8-5	B3						
135	Vol.	6	E7		3		W25542	1	CN151					^{2}24, 35, 47, 80	181.5	1
	Tone	72	N	6			W25303	16	TS101							
136-1	Vol.	23	DRP232				W26118	1	CN152					^{4}56, ^{3}58, ^{2}42, 80	181.5	14
	Tone	44	Z	6			W26119A	2	UR180							
137	Vol.	6	SRP262	6	1		W25542	1	CN151					24, 35, 47, 80	181.5	1
							W25303	16	TS101							
141	Vol.	6	E7	6			W25542A	1	CN151					24, 58, 57, 47, 80	181.5	1
							W25303	16	TS101							
143	Vol.	9	Y10MP	14			W24779	13	CS123					^{5}34, ^{2}30, 19	181.5	
	Tone	57	UC504				W28869	‡	CS121	B3						
146	Vol.	15	UC504				W26194	2	WE1247					^{3}58, 56, 57, 80, ^{2}46, 82	181.5	19
	Tone	67	Z	6			W26896	2/15	CN152							
	Sen.	7	Y500MP													
146-1	Vol.	17	UC504				W26194	2	WE1247					^{3}58, 57, 55, 80, ^{2}46, 82	181.5	19
	Tone	67	Z	6			W25542	1	CN151							
	Sen.	7	E7		3		W25857B	15	UR180							
147	Vol.	6	E7	6	2		W27676	1	CN140					39, 36, 38, 37, KR		
							W27677A	15	TN111							
148	Vol.	6	E7	6	2		W23701	1	RS213					^{2}58, 57, 42, 80	456	1
							W27488	15	UR180							
150	Vol.	15	M				W25542A	1	CN151					^{2}58, 57, 55, 42, 80	181.5	14
	Tone	67	Z	6			W26870A	15	TS101							
154	Vol.	2	G12	6			W23701	1	RS213					58, 57, 42, 80	456	14
							W25857B	15	UR180							
155	Vol.	6	E7	8	3		W27789	1	CS123					36, 39, 37, 48	456	
							W26870A	15	TS101							
156	Vol.	9	G12	13	EX1500									30, ^{2}34, 32, 33	456	
157, 158	Vol.	15	UC504				W26118A	1	CN152					^{2}58, 57, ^{4}56, ^{2}42, 80	181.5	14
	Tone	67	Z	6			W25857	14/15	UR180							
159	Vol.	6	E7	6	2		W28978	1	RS205		6	F223	C3	^{3}78, 77, 43	456	
							W28976	1	CS123							
							W26870A	15	TS101							
							W29012	Order	from Mfr.							
							.01		Buffer	B14						
160	Vol.	17	UC504				M28468	1	RN245					^{4}58, ^{5}56, ^{2}59, 80	181.5	1
	Tone	67	Z12	6			W25857B	14/15	UR180							
							W28340	1	RN245							
163	Vol.	6	E12	6	EX200		W28068	6	CS135					^{2}78, 77, 38, 12Z3	456	
							W25857B	6/15	UR180							
							W26870A	15	TS101							
164	Vol.	45	UC504				W23705	3	RS215					^{2}58, 57, ^{3}56, ^{2}2A5, 80	456	1
	Tone	44	Z	6			W29097C	3/14	SR615							
166	Vol.	6	E12	6	EX200		W29264A	6/15	SR617					78, 6F7, 38, 12Z3	456	
167	Vol.	6	E7	6	2		W23701B	1	RS213					^{2}58, 57, 42, 80	456	1
							W27488	1/15	UR180							
167 Series 2	Vol.	6	E7	6	2		W29150A	1/15	SR615					^{3}58, 2A5, 80	456	1
168	Vol.	17	UC504				W23701B	1	RS213					^{3}58, 2A5, 56, 80	181.5	1
	Tone	34	Z	6			W27677A	15	TN111							
169	Vol.	6	SRP262	6	3		W23701	1	RS213					58, 2B7, 42, 80	456	14
							W25857B	1/15	UR180							
169 (Revised)	Vol.	6	E7	6	2		W29150A	1/15	SR615					58, 2B7, 42, 80	456	14
170	Vol.	15	UC504				W23705A	3	RS215					^{4}56, ^{3}58, ^{2}2A5, 80	181.5	1
	Tone	44	Z	6			W29097A	3/14	SR615							
171	Vol.	15	UC504				W23705A	3	RS215					^{3}58, ^{5}56, 2B7, ^{2}2A5, 80	181.5	1
	Tone	44	Z	6			W29097	3/24	SR615							
	Supp.	98	A5MP													
172	Vol.	6	E12	6	EX200		W29264A	6/15	SR617					78, 6F7, 38, 12Z3	456	
173, 173-5	Vol.	73	N	6			W30124	8	RM259	B67				^{3}78, 6B7, 43, 25Z5	456	
							W27677A	15	TN111							
174	Vol.	6	E12	6	EX200		W29804A	11	RM259	B68				78, 6F7, 43, 25Z5	456	
175	Vol.	15	UC504				W26194B	28	WE1247					^{5}58, 55, ^{3}56, ^{4}45, 5Z3	181.5	1
	Supp.	58	A5MP				B30059	28/13	SR616							
	Tone	‡	‡	6	See Note	A19										
176	Vol.	6	E12	6	EX200		W28068	1	CS135					^{2}78, 36, 38, 12Z3	456	
							W25857B	1/15	UR180							
							W26870A	15	TS101							
178	Vol.	9	Y10MP	13	EX2M									^{2}34, 1A6, 33	456	
179	Vol.	15	UC504				W26194B	1	WE1247					^{3}58, ^{2}56, 2A5, 80	181.5	1
	Tone	22	Z	6			W29150A	15/24	SR615							
180	Vol.	15	UC504				W26194B	28	WE1247					^{3}58, ^{4}56, ^{2}2A5, 80	181.5	1
	Tone	44	Z	6			B30059A	28/13	SR616							
181	Vol.	45	O				W30059	4/14	SR616					2A7, ^{2}58, 56, 2A5, 80	456	1
	Tone	34	Z	6												
182	Vol.	56	O	6			W30962	11	UR190	B71				6A7, 78, 6B7, 43,		
							W30963	11	CS126	B71				25Z5	456	
							W26870A	15	TS101							
184	Vol.	6	E7	6	2		W29150A	1/15	SR615					58, 6F7, 2A5, 80	456	14
415	Vol.	54	Y10MP	13										^{2}1A6, 34, 33	450	
416	Vol.	6	E7	6	3		W34896	1/15	RM257		15	246	C3	6A7, ^{2}15, 38	450	10
							.001		Buffer	B14						
425	Vol.	6	E7	6	2		W29804A	11	RM259	B68				78, 6F7, 43, 25Z5	450	
435	Vol.	6	E7	6	3		W34896	1/15	RM257	B76	15	246	C3	6A7, ^{2}15, 38	450	10
							.001		Buffer	B14						
505	Vol.	17	UC504	6			W35750	1/15	RN242/TS101	B57				6A7, 6D6, 75, 41, 80	450	1

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
CROSLEY—Continued																
506 (C-516)	Vol.	18	O				W43280	49	RS207					6A7, 75, 43, 25Z5	450	
515 (Fiver)	Vol.	6	G12	6	EX200		W36719	1	RN242	B57				^{2}6D6, 6B5, 76, 80	450	1
516	Vol.	6	G12	6	EX200		W41080	1	RS215	B57				^{2}6D6, 76, 6B5, 80	450	1
							W41081	1	RS216							
517	Vol.	18	O	6			W41081	4	RS216					6A8G, 6U7G, 6Q7G,		
							W43150	4	RS216					6K6G, 5Y3	455	1
525	Vol.	17	UC504				W35750	1/15	RN242/TS101	B57				6A7, 6D6, 75, 41, 80	450	1
526	Vol.	‡	DRP304				W36055	1	WE3540					6A8G, 6K7G, 6J7G,		
	Tone	22	MR40	M26			W36057	1	WE3540					6N6G, 5Z4MG	450	1
534	Vol.	18	O	6			B30059C	4/14	SR616					6A7, 6D6, 75, 42, 80	456	1
535	Vol.	6	Order from	Mfr.										^{2}34, 1A6, 1B5, 33	450	
536	Vol.	6	E7	6	2		W29804A	11	RM259	B78				^{2}6K7G, 6J7G, 25A6G,		
														25Z6G	450	
537	Vol.	18	O	6			W41081	23	RS216					6A8G, 6U7G, 6Q7G,		
							W43150	23	RS216					6K6G, 5Y3	455	1
545	Vol.	6	E7	6	2		W31992	11/15	RM259/TS101	B58				^{2}6D6, 6B7, 43, 25Z5	450	
546	Vol.	6	G7		See Note A11		W36057	1	WE3540		15	246	C3	6A7, ^{3}15, 38	450	10
	Tone	34	‡	6	See Note A5		W41195	15	TS101							
							.001		Buffer	B14						
547	Vol.	18	O	6			W41081	4	RS216					6A8G, 6U7G, 6Q7G,		
							W43150	4	RS216					6K6G, 5Y3	455	1
555	Vol.	‡	DRP304	6			W36055	1	WE3540					6A8, 6K7, 6J7, 6F6,		
							W36057	1	WE3540					5Z4	450	1
							W36931	15	TS101							
556	Vol.	54	Order from	Mfr.										1A6, ^{2}34, 1B5, 33	450	
557	Vol.	18	Order from	Mfr.			W44012	13	RN232	B8	15	W245	C3	1C7G, 1D5G, 1F7G,		
							W44217	1	RN232	B8				1H4G, 1F5G	455	10
							W44131	1	RS207							
							.01		Buffer	B14						
566	Vol.	‡	Order from	Mfr.			W41081	13	RN232	B8				1C6, 34, 1B5, 30, 950	450	
567	Vol.	18	O	6			W44012	23	RS216					6A8G, 6U7G, 6Q7G,		
							W44013	23	RN232	B8				6K7G, 5Y3	455	1
577	Vol.	18	O	6			W43280	4	RS207					6A8G, 6U7G, 6Q7G,		
														25A6G, 25Z6G	455	
586 (B637)	Vol.	15	Order from	Mfr.										^{2}34, 1A6, 1B5 or 25S,		
														950	262	
596 (C526)	Vol.	18	N	6			W42439	4	RS207					6A8G, 6K7G, 6Q7G,		
							W41953	15	RS200					25A6G, 25Z6G	450	
602 (Band Box)	Vol.	4	SRP185				10-10-10	3	MN275					^{4}26, 27, 71A, 80		
605	Vol.	33	O											^{2}34, 1A6, 1B5, 30, 19	450	
	Sen.	54	Order from	Mfr.												
608 (Gembox)	Vol.	3	SRP185				W4943	1	MN272					^{3}26, 27, 71A, 80		11
609 (Gemchest), 610																
(Gembox)	Vol.	3	SRP185				W4943	1	MN272					^{4}26, 27, 71A, 80		11
614	Vol.	17	UC504				W26194B	4	WE1247					6D6, 6A7, 6B7, 76,		
	Tone	22	Z	6			W27097D	4/14	SR615					42, 80	456	1
615	Vol.	56	N	6			W31992	11/15	RM259/TS101	B56				6A7, ^{2}6D6, 6B7, 43,		
														25Z5	450	
616	Vol.	18	O				W36055	1	WE3540					6A8G, 6K7G, 6H6G,		
	Tone	34	MR40	M26			W36057	1	WE3540					6F5G, 6N6G, 5Z4MG	450	1
617	Vol.	18	O				W44138	1	RS208					6A8G, 6U7G, 6Q7G,		
	Tone	44	‡	M26	See Note A5		W44912	1	RS216					^{2}6K6G, 5Y3G	455	1
626	Vol.	‡	DRP304				W36055	1	WE3540					6A8G, 6K7G, 6J7G,		
	Tone	34	MR40	M26			W36057	1	WE3540					6C5G, 6N6G, 5Z4MG	450	1
							W40325	13	RS208							
							W37778	15	TN111							
629 (666)	Vol.	15/15	DRP304	6	See Note A87		W36055	1	WE3540					6A7, 6D6, 76, 75, 6B5,		
							W36057	1	WE3540					5Y3	450	1
634 (656)	Vol.	15/15	DRP304		See Note A87		W36055	1	WE3540					6A8, 6K7, 6H6, 6F5,		
	Tone	34	MR40	M26			W36057	1	WE3540					6N6, 5Z4MG	450	1
635 (Buccaneer)	Vol.	45	O	6			B30059C	4/13	SR616					6A7, ^{2}6D6, 76, 42, 80	450	1
636	Vol.	18	O				W36057	1	WE3540		15	246	C3	6A7, 6B7, ^{3}15, 19	450	10
	Tone	34	Z	6			W37778	15	TN111							
							.001		Buffer	B14						
637	Vol.	18	O	6			W36057	23	WE3540					6A8G, 6U7G, 6Q7G,		
							W41081	23	RS216					^{2}6K6G, 5Y3G	455	1
644 (5666)	Vol.	‡	DRP304	6	See Note A87		W36055	1	WE3540					6A7, 6D6, 76, 75, 6B5,		
							W36057	1	WE3540					5Y3	450	1
645	Vol.	17	UC504	6										^{2}6D6, 6A7, 85, ^{2}48	450	
	Sen.	6	E7													
646	Vol.	18	O				W37628	12	RS207					1C6, ^{2}34, 1B5, 30, 19	450	
	Tone	34	Order from	Mfr.												
647	Vol.	18	O	6			W40325	29	RS208					6A8G, 6U7G, 6Q7G,		
							W36057	29	WE3540					25A6G, 25Z6G	455	
							W41081	13	RN232	B8						
649 (5656)	Vol.	‡	DRP304				W36055	1	WE3540					6A8, 6K7, 6H6, 6F5,		
	Tone	34	MR40	M26			W36057	1	WE3540					6N6, 5Z4MG	450	1
655	Vol.	18	O	6			B30059C	4/14	SR616					6A8, ^{2}6K7, 6H6, 6F6,		
														5Z4	450	10
676 (C629)	Vol.	18	MR48	M26			W40325	29	RS208					6A8G, 6Q7G, 25A6G,		
							W36057	29	WE3540					25Z6G	450	
							W41081	13	RN232	B8						
704 (Showbox)																
(Jewelbox)	Vol.	3	SRP185			A23	W5253	1/24	MN275					^{4}26, 27, 71A, 80		11
704A (Jewelbox)	Vol.	3	SRP185			A23	W4736	1	MN272					^{4}26, 27, 71A, 80		11
704B	Vol.	3	SRP185			A23	W5253	1/12	MN275					^{4}26, 27, ^{2}71A, 80		11
705 (Showbox DC)	Vol.	1	SRP185			A23	W4929	1	MN272					^{5}01A, ^{3}71A		
706 (Showbox)	Vol.	3	SRP185			A23	W4943	1	MN272					^{4}26, 27, ^{2}71A, 80		11
714	Vol.	18	O				W26194B	4	WE1247					^{2}6D6, 6A7, 6B7, 6F7,		
	Tone	34	Z	6			W29097D	4/13	SR615					42, 80	456	1
715 (Corsair)	Vol.	15	O				W36055	4	WE3540					6D6, 6A7, 6B7, ^{2}76,		
	Tone	22	Z	6			W36056	4/24	RN245					42, 80	450	1
725	Vol.	15	O				W36056	1/24	RN245					6D6, 6A7, 6B7, ^{2}76,		
	Tone	22	Z	6			W36055	1	WE3540					42, 80	450	1
744, 745 (716)	Vol.	18	O				W36055	1	WE3540					6A8, 6C5, 6K7, 6H6,		
	Tone	34	MR40	M26			W36057	1	WE3540					6F5, 6N6, 5Z4MG	450	1
759 (736)	Vol.	45	O				W36055	1	WE3540					6A8, ^{2}6K7, 6H6, 6C5,		
	Tone	34	MR40	M26			W36057	1	WE3540					6N6, 5Z4	450	1
769 (726)	Vol.	20	TM257-SS1				W36055	1	WE3540					^{2}6K7, 6A8, 6H6, 6F5,		
							W36057	1	WE3540					6N6, 5Z4MG	450	1
							W41081	13	RS216							
804 (Jewel Box)	Vol.	7	A1MP		See Note A24		W5684	3	MN277					^{5}27, ^{2}71A, 80		2
814	Vol.	17	‡		See Note A5		W26194B	3	WE1247					6A7, 6D6, 6F7, 6B7,		
	Tone	44	Z	6			W29097D	3	SR615					42, 80	456	1
							W32258	14	RS213							
815	Vol.	45	O				W33990	24	RN232					^{3}30, ^{3}34, 1C6, 19	450	
	Tone	22	Z	14												
816	Vol.	19	TRP615				W36055	1	WE3540					6A8G, ^{2}6K7G, 6R7G,		
	Tone	34	Z	6			W41080	1	RS215					^{2}6N6, 5Z4MG	450	1
							W41081	24	RN232							
							W41598	15	RS200							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
CROSLEY—Continued																
817	Vol.	18	MR53				W44054	23	WE3540					6A8G,^{3}6K6G, ^{2}6U7G,		
	Tone	44	MR40	M26			W36057	23	WE3540					6Q7G, 5Y3G	456	1
855	Vol.	17	O				W36055	4	WE3540					^{2}6K7, 6A8,^{2}6H6, 6C5,		
	Tone	22	Z	6			W36056	24	RN245					6F6, 5Z4	450	1
865	Vol.	17	O				W36055	4	WE3540					^{2}6K7, 6A8,^{2}6H6, 6C5,		
	Tone	22	Z	6			W36056	24	RN245					6F6, 5Z4	450	1
915	Vol.	18	O				W36055	‡	WE3540					6D6, 6A7, 6B7, ^{2}76,		
	Tone	44	Z	6			W36057	‡	WE3540					^{3}42, 5Z3	450	‡
							W36548	‡	TS102							
916	Vol.	93	DRP304				W36055	1	WE3540					^{2}6K7, 6A8, 6R7, 6C5,		
	Tone	34	Z	6			W36057	1	WE3540					^{2}6N6, 5Z4MG	450	1
							W37778	15	BN225							
955	Vol.	93	DRP304				W36055	1	WE3540					^{2}6K7,^{2}6C5, 6L6, 6Q7,		
	Tone	34	Z	6			W36057	14	WE3540					^{2}6F6, 5Z4	450	1
							W37778	15	BN225							
989 (926)	Vol.	20	TRP615				W36055	1	WE3540					^{2}6K7, 6A8, 6H6, 6C5,		
							W41080	1	RS215					^{2}6N6, 5Z4	450	1
							W41081	14	RN232	B8						
							W41598	15	RS200							
1014 (Centurion)	Vol.	17	O				W26194B	7	WE1247					^{4}6D6, 6A7, 6F7, ^{3}76,		
	Tone	44	Z	6			W34596	7/24	RN245	B57				^{2}42, 80	456	1
1016	Vol.	93	DRP304				W36055	1	WE3540					^{2}6K7, ^{2}6C5, 6A8, 6R7,		
	Tone	44	Z	6			W36057	1	WE3540					^{2}6N6, 5Z4MG	450	1
							W37778	15	BN225							
1026	Vol.	‡	DRP304				W36055	1	WE3540					^{2}6K7, 6A8, ^{2}6C5, 6R7,		
	Tone	34	Z	6			W36057	1/13	WE3540					^{2}6N6, 5Z4	450	1
							W37778	15	BN225							
1055	Vol.	18	O				W36055	30	WE3540					^{2}6K7, 6A8, ^{2}6C5, ^{2}6F6,		
	Tone	44	Z	6			W36057	30	WE3540					6H6, 5Z4	450	1
							W36548	15	BN225	B8						
1117	Vol.	45	MR53				W41054	23	WE3540					6A8G, ^{2}6U7G, ^{2}6C5G,		
	Tone	44	MR40	M26			W36057	23	WE3540					^{3}6K6G, 5Y3G, 6G5.	455	1
1127	Vol.	45	TRP608				W44054	23	WE3540					6A8G, ^{2}6U7G, ^{2}6C5G,		
	Tone	34	MR39	M26			W36057	23	WE3540					6K5G, ^{3}6K6G,		
							W41598	15	RS200					5Y3G, 6T5	455	1
1137	Vol.	45	TRP608				W44054	23	WE3540					6A8G, ^{2}6U7G, ^{3}6C5G,		
	Tone	34	MR39	M26			W36057	23	WE3540					6K5G, ^{3}6K6G,		
							W41598	15	RS200					5Y4G	455	39
1155	Vol.	93	DRP304				W36055	1	WE3540					^{2}6K7, 6L7, 6C5, 6H6,		
	Tone	44	Z	6			W36057	1	WE3540					6Q7,^{2}6F6, 5Z4	450	1
							37632	15	BN225/TS102	B79						
1199 (1126)	Vol.	20	TRP615				W36055	1	WE3540					^{2}6K7G, 6A8, 6J7, 6H6,		
							W42386	1/14	WE2545					6R7,^{2}6N6, 5Z4	450	1
							W41598	15	RS200							
1211 (1216)	Vol.	‡	Order from	Mfr.			W36055	1	WE3540					^{2}6K7, 6A8, 6J7, 6H6,		
							W42386	1/14	WE2545					6R7, 6C5,^{2}6N6, 5Z4	450	1
							W37778	15	BN225							
1313 (1336)	Vol.	‡	Order from	Mfr.			W36055	1	WE3540					^{2}6K7, 6A8, 6J7, 6H6,		
							W36057	1/14	WE3540					6R7, ^{2}6C5, ^{2}6N6,		
							W41598	15	RS200					5Z4MG	450	1
1316	Vol.	93	Order from	Mfr.			W36055	1	WE3540					^{3}6K7, 6A8, 6R7, 6J7,		
	Fidlty.	‡	UC504	6			W36057	1	WE3540					6H6, 6C5, ^{2}6N6,		
							W36057	13	WE3540					^{2}5Z4MG	450	1
							W37632	15	BN225/TS102	B79						
1516	Vol.	‡	Order from	Mfr.			W36055	1	WE3540					^{3}6K7, 6A8, 6J7, 6H6,		
							W36057	1/13	WE3540					6R7, ^{2}6C5, ^{2}6N6,		
							W41598	15	RS200					^{2}5Z4	450	1
5515 (Fiver)	Vol.	6	G12	6	EX200		W36719	1	RN242	B57				^{2}6D6, 76, 6B5, 80	450	1
5516	Vol.	6	G12	6	EX200		W41080	1	RS215	B57				^{2}6D6, 76, 6B5, 80	450	1
							W41081	1	RS216							
5517	Vol.	18	O	6			W44012	23	RS216					6A8G, 6U7G, 6Q7G,		
							W43450	23	RS216					6K6G, 5Y3G	455	1
5526	Vol.	‡	DRP304				W36055	1	WE3540					6A8G, 6K7G, 6J7G,		
	Tone	44	MR40	M26			W36057	1	WE3540					6N6G, 5Z4MG	450	1
5536	Vol.	6	E7	6	2		W29804A	11	RM259	B78				^{2}6K7G, 6J7G, 25A6G,		
														25Z6G	450	
5555	Vol.	‡	DRP304	6			W36055	1	WE3540					6A8, 6K7, 6J7, 6F6,		
							W36057	1	WE3540					5Z4	450	1
							W36931	15	TS101							
6516	Vol.	6	G12	6	EX200		W41080	1	RS215	B57				^{2}6D6, 76, 6B5, 80	450	1
							W41081	1	RS216							
6615	Vol.	17	O				W36057	1	WE3540		15	246	C3	^{2}15, 6A7, 6B7, 31, 38	450	10
	Tone	34	Z	6			W34896	1/24	RM257	B80						
							.001		Buffer	B14						
6625	Vol.	‡	DRP304				W36055	1	WE3540					6A7, 6D6, 6C6, 76,		
	Tone	34	MR40	M26			W36057	1	WE3540					6B5, 80	450	1
							W40325	13	RS208							
							W37778	15	BN225							
CROYDON—See Airking.																
DELCO—Also see United Motors Service.																
RA-B, RB-B	Vol.	9	Y25MP	6										^{4}32, 30,^{2}31		
	Tone	41	‡		See Note A5											
RA3, RB3	Vol.	7	K											^{4}36,^{2}38		
	Tone	22	L													
RB1, RC1	Vol.	6	‡		See Note A5		4-4	7	See Note	B3				24,^{2}27,^{2}35, 47, 80	175	1
	Tone	22	‡		See Note A5		8	7	See Note	B3						
3002	Vol.	26	UC513	6										^{3}24, 27, 12A		
3026	Vol.	48	‡		See Note A5									^{3}36,^{3}37,^{2}47	175	
DELTA																
"Class B Amp."	Vol.	16	N											^{2}56,^{2}VT1,^{2}VT2		
	Mic.	74	M600P													
DETROLA																
4 Tube TRF '32	Vol.	6	Y				941	4	CM170					35, 24, 47, 80		1
"Road Chief"	Vol.	6	G12		See Note A1									^{2}39, 36, 37, 41		
"Road Master"	Vol.	56	N											^{2}36, 39, 85, 41	175	
"Warwick"	Vol.	15	L	6			8-4	4	See Note	B3				57, 58, 55, 47, 80	175	1
	Tone	21	N				10	17	TS101							
4C	Vol.	6	G12		See Note A14		4-16-8	11	UR182	B3				77, 78, 43, 25Z5		
4D	Vol.	6	G12		See Note A14		4-4	1	See Note	B3				78, 77, 42, 80		1
							10	15	TS101							
4F	Vol.	6	G12	6	See Note A14		4-20-8	11	UR182	B31				77, 78, 43, 25Z5		
4H	Vol.	6	G12	6	See Note A14		8-4	40	CN141					36, 37, 38, 39		
4J	Vol.	6	G12	6	See Note A14		4-4	1	CN150					77, 78, 42, 80		1
							10	15	TS101							
4W	Vol.	6	G12	6	See Note A14		4-20-8	11	UR182	B31				6D6, 6C6, 43, 25Z5		
4Y	Vol.	6	K12	6			4-20-8	11	UR182	B31				6D6, 6C6, 43, 25Z5		
5B	Vol.	17	O				1398	1	RN242					6A7, 78, 75, 42, 80	370	1
	Tone	22	M	6			578	15	TS101							

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
DETROLA—Continued																
5D	Vol.	18	O				1014	1	RN242					78, 6F7, 75, 42, 80	455	1
	Tone	22	M	6			595	19	TS101							
5L	Vol.	6	G12	6		See Note A14	1460	11	UR182	B31				77, 78, 43, 25Z5		
5T (Super Midget)	Vol.	6	K12				16-8	11	See Note	B3				78, 44, 77, 43, 25Z5	459	
5W	Vol.	17	O				1624	1	CN152					6A7, 6D6, 75, 42, 80	370	1
	Tone	34	M	6			10	14	TS101							
5WG	Vol.	18	MR53				4-20-8	11	UR182	B3				6A7, 78, 75, 43, 25Z5	370	
5X	Vol.	17	O				1624	1	CN152					6A7, 78, 75, 42, 80	370	1
	Tone	34	M	6			578	14	TS101							
5Y	Vol.	6	Y	6		See Note A14	1460	11	UR182	B31				6D6, ^{2}76, 43, 25Z5		
6A	Vol.	17	UC512			See Note A25	8-8	1	See Note	B3	3	220B	C3	^{2}78, 6F7, 75, 42, 84	262	10
							10	15	TS101							
							.02		Buffer	B14						
6M, 6R	Vol.	17	UC512			See Note A25	1882	1	CN155		35	294	C3	^{2}6D6, 6A7, 75, 42, 84	262	10
	Tone	22	L				5-5	15	TN110							
							.0075		Buffer	B14						
6W	Vol.	17	O				1624A	1	CN152					6A7, ^{2}78, 75, 42, 80	370	1
	Tone	34	M	6			578	14	TS101							
6X	Vol.	17	O	6			1678	1/15	UR189	B84				6A7, ^{2}78, 75, 43, 25Z5	370	
	Tone	34	M	6												
6ZM	Vol.	17	O				8-8	1	See Note	B3				^{2}6K7, 6A8G, 75, 6F6G,		
	Tone	34	L				10	15/19	TS106					5Y3	370	1
7A	Vol.	17	O				1014	28	RN242					^{3}78, 37, 75, 42, 80	262	1
	Tone	22	M	6			1085	28	RS213							
7ZM	Vol.	15	O				8-8	1	See Note	B3				^{2}6K7, 6A8, 6H6, 6F5,		
	Tone	34	L				10	15/19	TS106					6F6, 5Y3	370	1
10ZM	Vol.	15	O				12-12	1	See Note	B3				^{3}6K7, 6A8, 6H6, 6F5,		
	Tone	41	L				10	15/19	TS106					6C5, ^{2}6F6, 5Y3	456	1
14-129	Vol.	18	N	7			3575	1	CS123		13	245	C3	6D8G, 6S7G, 6T7G,		
	Tone	147	P				3574	13	RN235	B255				33	456	10
							.01		Buffer	B14						
14-142ES	Vol.	18	N	6			3375	25	RS216					78, 6A7, 6D6, 75, 6G5,		
	Tone	147	P				3351	25	WE847					42, 80	456	1
48	Vol.	6	G12	6		See Note A14	784	24	CM161					37, 38, 77, 78		
100	Vol.	45	N	6			2591	23	CS126					6A7, 6D6, 76, 6C6,		
							2594	23	RS207					43, 25Z5	456	
101, 101A	Vol.	6	H12	6			2591	4	CS126					6A7, 6F7, 43, 25Z5	456	
							2594	4	RS207							
102	Vol.	18	N	6			2732	29	CM162					6A7, 6D6, ^{2}76, 6C6,		
	Tone	147	P				8	29	RS203					43, 25Z5	456	
							2594	29	RS207							
103	Vol.	136	N	7			2698	12	RN232	B8				1C6, 1A4, 1A6, 950,		
														1B1	480	
104	Vol.	7	H	6			3229	23	RM255					6D6, 6C6, 43, 25Z5		
106, 106E	Vol.	18	N	6			2767	23	RS213					6A7, 6D6, 75, 41, 1V,		
	Tone	147	P				2766	23	WE1647					6G5	456	35
107	Vol.	18	N	6			3375	23	RS216					6A7, 6D6, 75, 76, ^{2}42,		
	Tone	147	P				3351	23	WE847					80	456	1
108	Vol.	18	N	6			2767	23	RS213					^{2}6D6, 6A7, 75, 41, 84	456	35
	Tone	147	P				2766	23	WE1647							
109	Vol.	18	MR48	M26			16	25	RN232	B8				6A7, 6D6, 75, 43, 1V		36
							8	25	RS203							
110	Vol.	18	N	6			2879	25	RN232	B8				6A7, 6D6, 75, 76, ^{2}43,		
	Tone	147	P											25Z5	456	36
111	Vol.	18	UC512				2994	1	2 CS133	B85	35	294	C3	78, 6A7, 75, 6B5, 0Z4	262	10
	Tone	22	MR36				.0075		Buffer	B14						
	Sen.	7	C1MP													
112	Vol.	18	UM157-SS17				2994	1	^{2}CS133	B85	35	294	C3	^{2}78, 6A7, 75, 42, 84	262	10
	Tone	22	MR36				578	15	TS101							
	Sen.	7	C1MP				.0075		Buffer	B14						
114	Vol.	18	N	6			2698	71	RN232	B8				6A7, 6D6, 76, 6C6,		
	Tone	147	P				2594	71	RS207					43, 25Z5	456	
116	Vol.	18	MR48	M26			16-24	27	See Note	B3				6A7, 6D6, 75, 43,		
														25Z5	456	
116X	Vol.	18	N	6			2591	4	CS126					6A7, 6D6, 75, 25B6G,		
							2594	4	RS207					25Z5	456	
117	Vol.	31	N	7			2698	12	RN232	B8				1C6, 1A4, 1B5, 1F4,		
														1B1	480	
120	Vol.	7	H	6			16	23	RN232	B8				6D6, 6C6, 43, 25Z5		
							8	23	RS203							
121	Vol.	7	H	6			2698	23	RN232	B8				6D6, 6C6, ^{2}43, 25Z5		
							2594	23	RS207							
125	Vol.	18	N	6			3285	3	RS216					6A7, 6D6, 75, 76, ^{2}43,		
	Tone	147	P				4234	3	CM172					25Z5	456	
127	Vol.	18	N	6			3375	23	RS216					6A7, 6D6, 75, 76, ^{2}42,		
	Tone	147	P				3351	23	WE847					80	456	1
130	Vol.	7	H	6			3229	23	RM255					6D6, 6C6, 43, 25Z5,		
														BK55B		
134A, 134AZ,																
134AB, 134X	Vol.	58	H	6			3229	23	RM255					6A7, 6C6, 43, 25Z5	456	
135, 135E	Vol.	18	N	6			2698	23	RN232	B8				6A7, 6D6, 75, 43,		
							2594	23	RS207					25Z5, 6G5	456	
136, 136T	Vol.	18	N	6			2767	25	RS216					6A7, 6D6, 75, 41, 1V	456	35
							3351	25	WE847							
137	Vol.	18	N	6			2698	23	RN232	B8				6A7, 6D6, 75, 43,		
							2594	23	RS207					25Z5	456	
139	Vol.	18	N	6			2767	23	RS213					6A7, 6D6, 75, 41, 1V	456	35
	Tone	147	P				2766	23	WE1647							
140	Vol.	18	N	6			2698	71	RN232	B8				6A7, 6D6, 76, 6C6,		
	Tone	147	P				2594	71	RS207					43, 25Z5	456	
141, 141A	Vol.	6	H12	6			3397	21/15	UR189	B189				6D6, 6C6, 38, 76		
144, 144B, 144C	Vol.	18	N	7			3417	1	CS123		13	245	C3	6D8G, 6S7G, 6T7G,		
	Tone	147	P				2594	13	RS207					^{2}1F5G	456	10
							.015		Buffer	B14						
145B, 145CR	Vol.	18	N	7			8	1	See Note	B3	13	245	C3	6D8G, 6S7G, 6T7G,		
	Tone	147	P				16	1	RS205					^{2}33, 1H4G	456	‡
							8	13	CS123							
							.01		Buffer	B14						
147, 147E, 147ECR	Vol.	18	N	6			3375	23	RS216					6A7, 6D6, 75, 76, ^{2}42,		
	Tone	147	P				3351	23	WE847					80, 6G5	456	1
148	Vol.	45	MR48	M26			8-8	29	CM162					6A7, 6D6, 76, 6C6,		
	Tone	147	MR55				8	29	RS203					43, 25Z5	456	
							24	29	RS207							
149, 149E	Vol.	18	N	6			2767	25	RS216					6A7, 6D6, 75, 41, 1V	456	35
							3351	25	WE847							
150	Vol.	18	N	6			3285	3	RS216					6A7, 6D6, 75, 76, ^{2}43,		
	Tone	147	P				4234	3	CM172					25Z5	456	
151	Vol.	18	N	6			3638	23	RM262					6A7, 6D6, 75, 43,		
														25Z5	456	36
152	Vol.	18	N	6			2767	25	RS216					6A7, 6D6, 75, 41, 1V	456	35
							3351	25	WE847							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
DETROLA—Continued																
153	Vol.	7	H	6			3229	23	RM255					6D6, 6C6, 25B6G, 25Z5, BK55B		
154E	Vol.	18	N	6			3877	23	CN152					6A7, 6D6, 75, 6G5, 41, 84	456	35
155	Vol. Tone Sen.	124 147 48	TRP621 UM181-SS1 A2MP	 M28			3111 3112 3113 3136	72 72 72 72	HD683 RS216 WE1647 TS102					^{2}6K7, 6A7, 6H6, 6G5, 6C5,^{2}76,^{2}42, 80	456	1
157A	Vol.	7	H				16-6	23	RM255					6D6, 6C6, 43, 25Z5		
159	Vol.	18	N	6			3638	23	RM262					6A7, 6D6, 75, 43, 25Z5	456	36
162	Vol.	7	H	6			3229	23	RM255					6D6, 6C6, 43, 25Z5		
163	Vol. Tone Sen.	124 147 48	TRP621 UM181-SS1 A2MP	 M28			3111 3112 4062 3079 4071	72 72 72 14 72/15	HD683 RS216 WE3540 CS123 2-TS107					^{3}6K7G, 6A7, 6H6G, ^{4}76,^{4}42, 5Z3	456	1
164, 165	Vol. Tone Sen.	124 147 105	TRP621 UM181-SS1 A2MP	 M28			3111 3112 3113 3136	72 72 72 72	HD683 RS216 WE1647 TS102					^{3}6D6, 6A7, 75, 76, 6G5, ^{2}42, 80	456	1
166	Vol.	18	UM157-SS17				4165 .007	1/15	RN241/TS101 Buffer	 B14	35	294	C3	6D6, 78, 75, 42, 84	456	10
167	Vol.	18	N	6			2698 2594	23 23	RN232 RS207	B8				6A7, 6D6, 75, 43, 25Z5	456	
168	Vol.	7	H	6			3229	23	RM255					6D6, 6C6, 25B6G, 25Z5, BK55B		
169	Vol. Tone	18 147	N P	6			4297 4298	73 73/15	RS207 RM 259/TS101					6A7, 6D6, 6Q7G, 6G5, 76,^{2}43, 25Z5	456	
172	Vol.	58	H	6			3229	23	RM255					6A7, 6C6, 43, 25Z5	456	
173	Vol. Tone	18 147	N P	6			3375 3351	23 23	RS216 WE847					6A7, 6D6, 75, 76,^{2}42, 80	456	1
174	Vol. Tone	18 147	N P	6			4297 4298	73 73/15	RS207 RM 259/TS101					6A7, 6D6, 6Q7G, 6G5, 76,^{2}43, 25Z5	456	
175	Vol. Tone	18 147	N P	6			3375 3351	23 23	RS216 WE847					6A7, 6D6, 75, 6G5, 76,^{2}42, 80	456	16
177	Vol.	18	N	6			2698 2594	23 23	RN232 RS207	B8				6A7, 6D6, 75, 43, 25Z5	456	
179	Vol.	58	H	6			3229	23	RM255					6A7, 6C6, 43, 25Z5	456	
180	Vol.	18	N	7			4459 .03	24	RM259 Buffer	 B14	13	245	C3	6D8G, 6S7G, 6T7G, 1D5G	456	10
182	Vol.	58	H	6			3229	23	RM255					6A7, 6C6, 43, 25Z5	456	
183	Vol. Tone	18 147	N P	6			3375 4062 4528	23 23 13	RS216 WE3540 CS121					6A7, 6D6, 6Q7G, ^{2}76, ^{4}42, 80	456	16
184	Vol.	18	N	7			4459 .03	24	RM259 Buffer	 B14	13	245	C3	6D8G, 6S7G, 6T7G, 1D5G	456	10
185	Vol. Tone	18 147	N P	6			3375 3351	23 23	RS216 WE847					6A7, 6D6, 75, 6G5, 76,^{2}42, 80	456	16
191	Vol. Tone	18 147	MR48 MR55	M26			3375 4062 4528	23 23 14	RS216 WE3540 CS121					6A7, 6D6, 6Q7G, 6G5, ^{2}76,^{4}42, 80	456	37
192	Vol. Tone	20 ‡	‡ MR55			See Note A19	4649 4062 3079	4 4 13	WE2545 WE3540 RS203					^{4}6D6, 6A7, 6H6G, 6G5,^{2}76,^{4}42, 80	456	37
193	Vol. Tone	18 147	MR48 MR55	M26			3375 3351	23 23	RS216 RS213					6A7, 6D6, 6Q7G, 6G5, ^{2}76,^{2}42, 80	456	37
503	Vol. Tone	6 22	K K12				8-4 10	1 17	CN151 TS101					^{2}58, 57, 47, 80	456	1
1000	Vol.	7	K	6			4-4-21	11	UR182	B31				6D7, 6E7, 43, 25Z5		
1200	Vol. Tone Supp.	15 44 7	TRP623 K12 J	6			50-8-8-10	64	2-UR182	B226				^{3}6D6,^{2}37, 85,^{4}43,^{2}25Z5	175	
DEWALD																
AC-LW15-6	Vol.	6	E7	6	3		2062	4	See Note	B3				^{2}35, 24, 27, 47, 80		1
B-A-C	Vol.	6	F7	6	5		2095	4	RM261					58, 57, 47, 82		1
B-A-G	Vol.	6	F7	6	5		2062 2063	4 4	CS133 CS131					^{2}24, 27, 35, 47, 80	175	1
B-A-H	Vol.	6	F7	6	4		2063 2062	4 4	CS131 CS133					58,^{2}56, 35,^{2}57, 47, 82	175	1
B-A-H-9	Vol.	6	F7	6	4		2062 2063	4 4	CS133 CS131					58, 35,^{2}56,^{2}57,^{2}47, 82	175	1
B-A-M	Vol. Tone	15 44	K12 Y				8-8	4	CM172					^{2}58,^{2}35, 27,^{2}56,^{2}47, 82	465	1
B. L. G.	Vol.	6	F7		4		4-8	4	See Note	B3				^{3}58, 56, 57, 47, 82	115	1
K. A. D.	Vol.	6	H12	6	EX700									39, 36, 201A, 71A		
K. A. F.	Vol.	6	H12	6	EX800									^{2}36, 39, 37,^{2}33	175	
K. R. E.	Vol.	6	H12		EX700									^{2}39, 37,^{2}33		
AC14-45	Vol.	7	E12				3-3-1.5	2	See Note	B1				24,^{4}27, 45, 80		3
AC24-45	Vol.	6	E12				1.5-3-1.5	2	See Note	B3				24,^{4}27,^{2}45, 80		1
40	Vol.	6	F7	6	5		4-4	4	See Note	B3				58, 57, 47, 82		1
41	Vol.	6	G7	6	5		8-5 10-10	1 15	CN141 TN111	B3				78, 77, 38, 25Z5		
42, 42R	Vol.	6	F7	6	5		2170 10-10	1 15	CN141 TN111	B87				78, 36, 38, 12Z3		
50	Vol.	6	F7	6	5		2103	4	RM261	B86				24, 58, 57, 47, 82	175	1
51	Vol.	6	F7	6	5		8-4	4	See Note	B3				24, 58, 57, 47, 82	175	1
52	Vol.	15	N				‡ 10	‡ 15	See Note TS101	B3	4	221	C3	^{2}36, 85, 37, 89	175	
53	Vol.	6	H12	6	EX800									^{3}36,^{2}33		
54	Vol.	7	UC501	6	EX200		2128B 2129A	1 15	CN141 TN111	B87				36,^{2}37, 38, 39		
55	Vol.	6	G7		2		2134B 5	27 15	CM165 TS101	B88 B6				78, 44, 77, 43, 25Z5	456	
55R, 55X	Vol.	6	G7	6	2		2171 10-10	6 15	UR190 TS101	B89				^{2}78, 77, 43, 12Z3	‡	
56	Vol.	6	G7		2		12-7 5	4 15	See Note TS101	B3				6A7, 44, 77, 43, 25Z5	456	
58	Vol.	6	‡			See Note A5	12-12 4-4	1 15	See Note TN110	B3				^{2}6D6, 6C6, 43, 12Z3	455	
58L, 59	Vol.	6	J	6			12-12 4-4	27 15	See Note TN110	B3				6A7, 6D6, 6C6, 43, 12Z3	456	
60	Vol.	6	G7		1		14-8 5	4 15	CN145 TS101					^{2}39, 37,^{2}43, 25Z5		
60EX	Vol.	6	J	6			7-12 10-10	4 15	See Note TN111	B3				^{2}78, 77, 37, 43, 25Z5	Early, 455 Late, 175	
61	Vol.	56	UM154			See Note A96	2147 2133 .025	1 15	CS133 TS101 Buffer	 B14	34	292	C3	6A7, 78, 85, 37, 41	456	10

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
	Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	Original Part	Cir-cuit	Correct Replacement	*Note	Vibr. Conn.	Replace-ment	*Note			
DEWALD—Continued																
62 Batt.	Vol.	54	O											1A6, 34, 32, 30, ^{2}49	175	
80	Vol.	15	N				8-8	1	See Note	B3				6A7, ^{3}78, 37, ^{2}42, 80	456	1
							10-10	15	TN111							
81	Vol.	15	N	6			8-8	1	See Note	B3				6A7, ^{3}78, 37, ^{2}42, 80	456	1
	TunLgt.	‡	C15MP				10-10	15	TN111							
81R	Vol.	15	N	6			8-8	1	See Note	B3				6A7, ^{4}6D6, 37, 42, 80	456	1
	TunLgt.	‡	C15MP				10-10	15	TN111							
	Tone	22	UC502													
90	Vol.	‡	‡		See Note	A5	2179	‡	CN152					^{3}58, ^{2}56, 55, ^{2}45, 80	262.5	‡
							2180	‡	CS130							
							2181	‡	CS121							
100	Vol.	15	N				8-8	1	See Note	B3				6A7, ^{3}78, ^{3}37, ^{2}42, 80	456	1
							10-10	15	TN111							
AC145	Vol.	10	C12				2-1-2	37	See Note	B1				^{3}26, ^{2}27, 45, 80		18
AC171-2	Vol.	10	‡		See Note	A5	1-3-1	5	See Note	B1				^{4}26, 27, ^{2}71A, 80		18
DC173-4	Vol.	10	C12				2-1	2/12	See Note	B1				^{5}12A, ^{2}71A		
AC245	Vol.	10	‡		See Note	A5	2-2-2	3	See Note	B1				^{3}26, ^{2}27, ^{2}45, 80		18
DC273	Vol.	10	C12				2-1	2	See Note	B1				^{5}12A, ^{2}71A		
400	Vol.	6	J		See Note	A14	10-10	1	See Note	B3				6D6, 6C6, 25B5, 25Z5		
							5	15	TS101							
402	Vol.	6	Y		EX500		10-10	6	CN152					6D6, 6C6, 43, 25Z5		
							5-5	15	TN110							
403-4	Vol.	6	G7				2283	1/15	See Note	B5				6D6, 6C6, 43, 12Z3		
403-4 Type 2	Vol.	6	SRP263				2283	24/15	See Note	B5				6D6, 6C6, 38, 1V		
405	Vol.	6	J		See Note	A14	10-10	1	See Note	B3				6D6, 6C6, 25B5 25Z5		
							5	15	TS101							
425R	Vol.	6	SRP263				10-12	6	See Note	B3				6D6, 6C6, 43, 12Z3		
							4-4	15	TN110							
430	Vol.	6	Y			A14	4-8	24	CN141	B3				6D6, 6C6, 38, 12Z3		
							4	15	TS101							
440	Vol.	6	SRP263				10-12	6	See Note	B3				6D6, 6C6, 43, 12Z3		
							4-4	15	TN110							
AC447M	Vol.	7	A20MP	6	EX250		2-2	4	See Note	B1				35, 24, 47, 80		1
500A	Vol.	6	G7	6	4		16-16	6	See Note	B3				6A7, 6D6, 6C6, 43,		
							4-4	15	TN110					12Z3	130	
501	Vol.	6	G7	6	4		8-8	6	CN142					6A7, 6D6, 6C6, 43,		
							4-4	15	TN110					12Z3	456	
503-4	Vol.	6	‡		See Note	A5	8-4	1	See Note	B3				2A7, 58, 57, 2A5, 80	456	1
	Tone	22	K12				5	15	TS101							
505	Vol.	6	Y		See Note	A14	8-8	6	See Note	B3				6A7, 6D6, 75, 43,		
							5	15	TS101					25Z5	456	
505F	Vol.	6	SRP263		EX800		12-20	27	See Note	B3				6A7, 6D6, 75, 43,		
							5	15	TS101					25Z5	456	
505R	Vol.	6	SRP263		EX800		2272	6/15	UR189					6A7, 6D6, 75, 43,		
														25Z5	456	
506	Vol.	7	UC509		See Note	A14	10-10	1	See Note	B3				6D6, ^{2}76, 43, 12Z3		
							5-5-5	15	See Note	B3						
506R	Vol.	6	SRP263		See Note	A14	2279	27/15	UR189	B94				6D6, 6C6, 43, 25Z5,		
														185-Bal.		
510	Vol.	6	‡	6	See Note	A5	2292	4	CM172					6A7, 6D6, 6C6, 42, 80	456	1
515	Vol.	6	Y				10-10	1	CN142	B3				6D6, 6C6, 43, 25Z5,		
							4	15	TS101					L55B		
517	Vol.	17	MR48	M26			8-8	1	See Note	B3	35	294	C3	6A7, 6D6, 75, 41, 0Z4	456	10
	Tone	22	MR36				5	15	TS101							
							.01-.01		Buffer	B14						
517R	Vol.	17	MR48	M26			8-8	1	CN152		35	294	C3	6A7, 6D6, 75, 41, 84	456	10
	Tone	22	MR36				5	15	TS101							
							.01		Buffer	B14						
518	Vol.	6	Y				10-10	1	CN142	B3				6D6, 6C6, 43, 25Z5,		
							4	15	TS101					L55B		
520	Vol.	6	E12				8-8	4	See Note	B3				6A7, 6D6, 76, 42, 80	456	1
522	Vol.	18	MR48											1A6, 1A4, 1B5, 30, 33	456	
AC524	Vol.	40	G12				8	4	RS213					^{3}24, 45, 80		1
527	Vol.	18	MR48	M26			8-8	23	See Note	B3	35	294	C3	6A7, 6D6, 75, 41, 84	456	10
	Tone	22	Z12				.01		Buffer	B14						
528, 528LW	Vol.	6	‡		See Note	A5	10-10	1	See Note	B3				6D6, 6C6, 25L6G,		
							5	15	TS101					25Z5, M55F		
529, 529LW	Vol.	18	N				5-5	23	See Note	B3				6A7, 6D6, 75, 41, 84	456	1
532-3	Vol.	6	E7	6	3		.25-2	1	See Note	B7				^{3}36, ^{2}33		
	Tone	21	O													
535-6	Vol.	6	E7	6	4		8-4	4	See Note	B3				^{2}35, 24, 47, 80		1
547	Vol.	6	E7	6	5		4-4	4	See Note	B3				^{2}35, 24, 47, 80		1
547A	Vol.	6	E7	6	3		4-4	4	See Note	B3				^{2}35, 24, 47, 80		1
553-4S	Vol.	6	G7	6	2		12-12	6	See Note	B3				^{2}6D6, 6C6, 43, 12Z3	456	
							4-4	15	TN110							
555	Vol.	6	Y	6	EX250		1 5-4.5	1	See Note	B3				58, 57, 27, 2A5, 80		1
570	Vol.	6	J	6	EX1000		8-4	1	See Note	B3				2A7, 57, 58, 2A5, 80	455	1
	Tone	22	K12				5	15	TS101							
600	Vol.	6	J	6	EX500		16-16	27	2-CS126					6A7, 78, 37, 6C6, 43,		
	Tone	22	K12				4-4	15	TN110					25Z5	456	
605	Vol.	17	UM154	M26	See Note	A96	8-8	1	See Note	B3	22	253Y	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
							5-5	15	TN110							
							.025-.025		Buffer	B14						
606	Vol.	17	UM154			A96	2269	1	CN152		35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
	Tone	22			See Note	A3	2270	15	TN110							
							.025-.025		Buffer	B14						
607	Vol.	17	UM154	M26	See Note	A96	8-8	1	See Note	B3	35	294	C3	^{2}6D6, 6A7, 75, 41, 84	456	10
							5-5	15	TN110							
							.0075		Buffer	B14						
609	Vol.	6	‡	6	See Note	A5	2294	27/15	UR182	B95				6A7, 6K7, 6J7, 43,		
														25Z5	456	
609 Revised	Vol.	6	‡		See Note	A5	20-12	4	See Note	B3				6A7, 6K7, 6J7, 43,		
							5	15	TS101					25Z5	456	
610, 610LW	Vol.	17	‡	6	See Note	A5	2292	4	CM172					6A8, 6K7, 6H6, 6F5,		
														6F6, 80	456	1
611, 611LW	Vol.	6	‡	6	See Note	A5	20-12	27	UR182	B95				6A8, 6K7, 6H6, 6F5,		
	Tone	21	‡		See Note	A5	5	15	TS101					43, 25Z5	456	
612, 612LW, 615,																
615LW	Vol.	6	‡		See Note	A5	2301	27/15	UR182	B95				6A8, 6K7, 75, 43,		
														25Z5	456	
616	Vol.	6	C12				20-12	27	See Note	B3				6A7, 6D6, 76, 43,		
							5	15	TS101					25Z5, M49B	456	
617	Vol.	17	UM154	M26		A96	2269	1	CN152		35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
	Tone	22	‡		See Note	A3	2270	15	TN110							
							.025-.025		Buffer	B14						
618	Vol.	18	‡		See Note	A5	16-16	27	CM164	B3				6A7, 6D6, 75, 43,		
	Tone	21	‡		See Note	A5								25Z5, L49C	456	
619	Vol.	6	C12				20-12	27	See Note	B3				6A7, 6D6, 76, 43,		
							5	15	TS101					25Z5, L49C	456	
620, 620LW	Vol.	18	‡		See Note	A5	8-8	1	See Note	B3				6A7, 6D6, 75, 6G5,		
	Tone	147	‡		See Note	A5								42, 80	456	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
DEWALD—Continued																
621, 621LW	Vol.	17	‡			A5	20-12	27	See Note	B3				6A7, 6D6, 75, 43,		
	Tone	147	‡			A5								25Z5, L49C	456	
AC624	Vol.	7	E				8-5	4	See Note	B3				^{4}24, 45, 80		1
	Tone	21	M													
629, 629LW	Vol.	18	N				16-16	1	CM164	B3				6A7, 6D6, 75, 25L6G,		
							5	15	TS101					6G5, 25Z5	456	
630	Vol.	6	H7		5		16-16-8	11	See Note	B96				^{2}78, 6A7, 77, 43, 25Z5	456	
	Tone	22	K12				5	15	TS101	B96						
DC632	Vol.	40	G12	6										30, ^{2}31, ^{3}32		
637-8	Vol.	6	Y											^{3}36, 37, ^{2}38		
640	Vol.	17	N				2210	1	CN152		Order	from Mfr.		^{2}6D6, 6A7, 75, 41, 84	175	10
							5-5	15	TN110							
							.025-.025		Buffer	B14						
700, 700LW	Vol.	18	N				16-16	27	CM164	B3				6A7, 6D6, 75, 6G5,		
	Tone	21	‡		See Note	A5								25Z5, L42C, 43	456	
700A, 700A-LW	Vol.	17	N				20-20	6	See Note	B3				6A7, 6D6, 75, 25L6G,		
	Tone	22	L				5	15	TS101					25Z5, L42C	455	
702	Vol.	18	UM154	M26		A96	8-8	23	See Note	B3	35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
	Tone	22	Z12				.01		Buffer	B14						
703, 703LW	Vol.	18	N				16-16	1	CM164	B3				6A7, 6D6, 75, 25L6G,		
							5	15	TS101					6G5, 25Z5	456	
AC724	Vol.	40	‡		See Note	A5	1.5-3-1	3	See Note	B1				^{3}24, 27, ^{2}45, 80		3
724-1	Vol.	6	F12	6			12-8	1	See Note	B3				^{3}24, 27, ^{2}45, 80		3
	Tone	41	‡		See Note	A5										
DC727	Vol.	40	‡		See Note	A5								^{3}24, ^{2}27, ^{2}45		
746-7M	Vol.	6	E7	6			8-8	4	See Note	B3				^{2}35, ^{2}27, ^{2}24, 47, 80	175	1
802, 803	Vol.	17	N				8-8-8	5	See Note	B3				^{2}58, 2A7, 2A6, 2A5,		
	Tone	21	O				4-4	15	TN110					^{2}45, 80	456	1
804, 805	Vol.	76	N	6			2282	26	CS133					^{2}58, 2A7, 2A6, 2A5,		
	Tone	76	N				2286	26	RM262					^{2}45, 80	456	1
							2259	15	TN111							
804S, 805A, 805C	Vol.	76	N	6			2282	26	CS133					^{2}58, 2A7, 2A6, 2A5,		
	Tone	76	N				2286	26	RM262					^{2}45, 80	456	1
							2259	15	TS101							
811A	Vol.	45	N				8-8	1	See Note	B3				^{4}6D6, 6A7, 37, 42, 80	456	1
	Tone	22	H12				10-10	15	TN111							
1100 (Early)	Vol.	114	N				20-12	4	See Note	B3				6A8, 6K7, 6H6, 6C5,		
	Tone	114	O				5	15	TS101					^{3}43, ^{2}25Z5, 2600,		
														2601	456	
1100 (Late)	Vol.	114	N				20-12	4	See Note	B3				6A8, ^{2}6K7, 85, ^{3}43,		
	Tone	114	O				8	‡	CS123	B3				^{2}25Z5	456	
							5	13	CS121	B3						
							5	15	TS101							
1200	Vol.	15	MR48				16-16	1	CM164	B3				6A7, 6D6, ^{2}76, 75,		
							5	15	TS101					25L6G, ^{2}25Z5	456	
EARL																
21, 22AC	Vol.	13/10	DRP240				1-2-4-1	3	See Note	B1				^{3}26, ^{2}27, ^{2}71A, 80		11
21DC, 22DC, 24DC,																
31DC, 32DC	Vol.	7	M											^{5}01A, ^{4}71A		
31AC, 32AC	Vol.	7	K		See Note	A10	1-1-2-1	3	See Note	B1				^{5}27, ^{2}45, 80		3
33S-AC	Vol.	1/7	DRP308				1-1-4	3	See Note	B1				^{4}24, 27, ^{2}45, 80		3
41AC, 42AC	Vol.	7	K				1-1-2-1	3	See Note	B1				^{6}27, ^{2}45, 80		3
ECHOPHONE																
F	Vol.	6	Y				8	4	RS213					^{3}24, ^{2}45, 80		1
	Tone	44	H12													
S3	Vol.	6	C12				2-1	25	See Note	B1				^{3}24, 45, 80		3
4	Vol.	6	Y				6790B	4	RM261	B86				58, 57, 47, 80		1
S4	Vol.	3	D12				1-2	25	See Note	B1				^{3}24, 27, 45, 80		1
5	Vol.	77	N				8, 8	4	RS213					55, 57, ^{2}58, 47, 80	175	1
	Tone	22	Y													
S5 (Dynatron)	Vol.	6	H7				8	4	RS213					^{4}24, ^{2}45, 80	175	1
	Tone	44	H12													
S5 (Rev.)	Vol.	6	Y				8	4	RS213					^{4}24, 27, ^{2}45, 80	175	1
10	Vol.	77	N				8, 8	1	RS213					^{3}58, 55, 57, ^{2}47, 80	175	1
	Tone	44	M													
12	Vol.	6	G7	6	2		8	4	See Note	B3				^{2}57, 58, 47, 80	175	1
							4	4	See Note	B5						
14	Vol.	77	N				8, 8	4	RS213					55, 57, ^{2}58, 47, 80	175	1
	Tone	22	Y													
15	Vol.	77	N				8, 8	1	RS213					^{3}58, 57, 55, ^{2}47, 80	175	1
	Tone	44	Y													
16, 17, 18	Vol.	77	N				8, 8	1	RS213					55, 56, 57, ^{2}58, ^{2}47, 80	175	1
	Tone	22	Y													
20	Vol.	77	N				8, 8	4	RS213					^{3}58, 57, 55, ^{2}47, 80	175	1
	Tone	44	Y													
35, 36	Vol.	15	UM154		See Note	A96	8, 8	1	RS213	B3				55, ^{2}56, 57, ^{4}58, ^{2}46, 80	175	7
	Tone	22	N				8	12	RS213	B3						
	Sen.	‡	M100P													
38	Vol.	6	G7		2		8-4	4	See Note	B3				^{2}57, 58, 47, 80	175	1
40 Echoette	Vol.	6	Y	6	EX300		8-4	4	See Note	B3				24, 35, 47, 80		1
44	Vol.	6	Y		EX300		6790B	4	RM261	B86				58, 57, 47, 80		1
50	Vol.	6	H7				8, 8	4	RS213					24, 27, ^{2}35, 47, 80	175	1
	Tone	22	Y													
60	Vol.	6	Y	6	EX200		8, 8	4	RS213					24, 27, ^{3}35, 47, 80	175	1
	Tone	22	Y													
70DC	Vol.	6	Y	6	EX200		6	1	See Note	B11				^{3}37, ^{3}39, ^{2}71A	175	
	Tone	22	Y													
80	Vol.	6	Y	6	EX200		8	1	RS213					24, 27, ^{3}35, ^{2}47, 80	175	1
	Tone	22	Y				4	1	RS211							
81	Vol.	15	N	6			8-8	4	RS213	B66				24, ^{2}27, ^{3}35, 47, 80	175	1
	Tone	22	Y													
90	Vol.	6	Y	6	EX200		8	1	RS213					24, 27, ^{3}35, ^{2}47, 80	175	1
	Tone	22	Y				12	1	RS215							
90 (Rev.)	Vol.	6	H7		2		12	1	RS215					24, 27, ^{3}35, ^{2}47, 80	175	1
	Tone	22	Y				8	1	RS213							
110	Vol.	7	UC509	6			12-5	24	CN145					78, 77, 38, 12Z3		
							10	15	TS101							
111	Vol.	7	UC509		EX350		12-5	24	CN142					78, 77, 38, 12Z3		
							10-10	15	TN111							
119	Vol.	18	N	‡			8-4	1	See Note	B3				2A7, 58, 2A6, 2A5, 80	456	1
	Tone	22	K12	‡			307	15	TS101							
124	Vol.	18	N				8-4	1	See Note	B3				56, 57, ^{2}58, 2A6, 2A5,		
	Tone	22	K12				10	15	TS106					80	456	1
126	Vol.	18	N	‡			8-4	1	See Note	B3				2A7, 58, 2A6, 2A5, 80	456	1
128	Vol.	7	UC509		See Note	A14	5-12-5	8	UR182					78, 77, 43, 25Z5		
							5	15	TS101							
139, 139C	Vol.	18	N				8-8	1	See Note	B3				6A7, 6D6, 75, ^{2}42, 80	456	1
	Tone	22	‡		See Note	A5	10	15	TS106							
143	Vol.	18	N	6			156	1	CN151					2A7, 58, 2A6, 2A5, 80	456	1
							307	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ECHOPHONE—Continued																
180	Vol. Tone	‡ 22	N K12	6			16. 8.	11 11	CS126 CS123					‡	‡	
1731	Vol.	18	N				8-4	1	See Note	B3				58, 2A7, 2A6, 2A5, 80	456	1
1734, 1734A	Vol.	18	N				8-4 10.	1 15	See Note TS101	B3				2A7, 58, 2A6, 2A5, 80	456	1
1800	Vol.	6	SRP263		See Note	A11	8-4 10.	1 15	CN151 TS101					58, 57, 2A5, 80		1
7110	Vol.	7	UC509		See Note	A11	12-5 10-10	24 15	CN142 TN111					77, 78, 38, 12Z3		
7114	Vol.	6	SRP263		See Note	A14	5-16-5	11	UR182	B31				6A7, 6D6, 75, 43, 25Z5	456	
7124	Vol. Tone	18 22	N K12				8-4 10.	1 15	CN151 TS106					^{2}58, 57, 56, 2A6, 2A5, 80	456	1
7126	Vol.	7	UC509		See Note	A11	5-12-10-10	24/15	See Note	B5				77, 78, 38, 12Z3		
7127	Vol. Tone	18 22	N K12	‡ ‡			8-4 10.	1 15	See Note TS106	B3				58, 2A7, 2A6, 2A5, 80	456	1
EDISON-BELL																
36	Vol. Tone	42 22	G K12	6			8-8	4	See Note	B3				24A, ^{2}58, ^{2}47, 80		1
53	Vol.	6	K12	6	EX200		16-8 4-4	6 15	See Note TN110	B3				^{2}6C6, 6D6, 43, 25Z5	175	
53LW	Vol.	6	K12	6	EX200		16-8 2-4	6 15	CN145 TN110					6A7, ^{2}6D6, 6C6, 43, 25Z5	115	
55AW	Vol.	17	N	6			16-16-4-4-2	8/15	See Note	B3				6A7, 6D6, 75, 43, 25Z5	456	
63	Vol.	56	N	6			16-16 4-4	1 1/15	See Note See Note	B3 B3				37, 6A7, 6D6, 75, 43, 25Z5	175	
63LW	Vol.	18	N	6			16-16 4-4	8 8/15	See Note See Note	B3 B3				^{2}6D6, 6A7, 75, 43, 25Z5	115	
66AW	Vol.	17	N	6			16-16-8-4-4	11	See Note	B3				^{2}6D6, 6A7, 75, 43, 25Z5	456	
THOMAS A. EDISON																
"Abbey" Battery	Vol.	14	SRP278											^{5}01A, 71A		
(Splitdorf) "Abbey" Jr	Vol.	14	SRP278				4-6	1	See Note	B1				^{4}26, 27, 71A, 80		11
C1 (SC)	Vol. Regen.	10 10	SRP277 SRP276		(Rear) (Front)	A35 A35	2.5-2.5-2.5	28	See Note	B2				^{4}26, 27, ^{2}50, ^{2}81		23
C2, R1, R2 (Jr., Jc, 25 Cy.)	Vol. Regen.	10 10	SRP277 SRP276		(Rear) (Front)	A35 A35	2-1	3	See Note	B1				^{4}26, 27, 50, 81		8
C2, R1, R2, (Jr., Jc, 60 Cy.)	Vol. Regen.	10 10	SRP277 SRP276		(Rear) (Front)	A35 A35	2-1	4	See Note	B2				^{4}26, 27, 50, 81		22
C4, R4, R5 (Chassis 7-R)	Vol.	24	DRP306				2-2-1	3	See Note	B1				^{5}27, ^{2}45, 80		7
R4, R5, (DC)	Vol.	24	DRP306				1-2-2	1	See Note	B11				^{5}27, ^{4}71A		
R6, R7	Vol.	20	TRP607				1.5-1-1.5	3	See Note	B1				^{3}24, ^{3}27, ^{2}45, 80		7
(Splitdorf) M5	Vol. Regen.	10 10	SRP277 SRP276		(Rear) (Front)	A35 A35	2-1	4	See Note	B1				^{4}26, 27, 50, 81		22
(Splitdorf) M6	Vol. Regen.	10 10	SRP277 SRP276		(Rear) (Front)	A35 A35	2.5-2.5-2.5	28	See Note	B2				^{4}26, 27, ^{2}50, ^{2}81		23
(Splitdorf) E-175	Vol.	10	‡		See Note	A36	‡	1	See Note	B1				^{4}26, 27, 71A, 80		11
Splitdorf PAD4	Vol.	10	‡		See Note	A36	2-1	4	See Note	B2				^{4}26, 27, 50, 81		22
EILEN RADIO LABS.																
5 Tube	Reg. Sen.	12 7	L D		5		8-8	4	See Note	B3				6D6, 6C6, 76, 42, 84		1
ELEC. AUTO LITE																
No. 11	Vol.	7	UC510											35, ^{2}24, 27, ^{2}71A		
062A, 3622A	Vol. Tone	45 21	N L				4.	15	TS105		1	206	C3	^{3}39, 36, 37, 41	262	
072A, 3722A	Vol. Tone	18 41	N L				4. 4.	12 15	CS123 TS105		2	211		^{3}39, 36, 37, ^{2}41	262	
E & A (Electric & Automotive Products Co.)																
4M	Vol.	6	SRP263	6			8-8 5-5	1 15	See Note TN110	B3				78, 77, 38, 12Z3		
IL-5	Vol.	6	SRP263		EX500		16-10 5-5	1 15	See Note TN110	B3				6A7, 78, 77, 43, 25Z5	125	
6AW	Vol.	17	N				8-8 5-5	1 15	See Note TN110	B3				^{2}78, 6A7, 75, 42, 80	456	1
SW-6	Vol.	18	N				10. 5.	1 15	See Note TS105	B3				2A7, ^{2}58, 2A6, 2A5, 80	456	1
25AW	Vol.	17	N				8-8 5-5	1 15	CN152 TN110					6A7, 78, 75, 42, 80	456	1
30AW	Vol.	17	N				10-25 5-5	1 15	See Note TN110	B3				^{2}78, 6A7, 75, 43, 25Z5	456	
35AW	Vol.	17	N				8-8 5-5	1 15	See Note TN110	B3				^{2}78, 6A7, 75, 42, 80	456	1
IL55LW	Vol.	6	SRP263		EX500		25-10 5-5	6 15	UR182 TN110					6A7, 78, 77, 43, 25Z5	125	
303	Vol.	6	SRP263		EX500		10. 5-5	1 15	CS124 TN110					6A7, 6F7, 12A7	456	
303LW	Vol.	6	SRP263		EX500		10. 5-5	1 15	CS124 TN110					6A7, 6F7, 12A7	456	
303SW	Vol.	6	SRP263		EX500		10. 5-5	1 15	CS124 TN110					6A7, 6F7, 12A7	456	
405	Vol.	6	SRP263		EX500		16-10 5-5	1 15	See Note TN110	B3				6A7, 6F7, 43, 12Z3	456	
405LW	Vol.	6	SRP263		EX500		16-10 5-5	6 15	See Note TN110	B3				6A7, 6F7, 43, 12Z3	456	
ELECTRICAL RESEARCH LABS.			—See "Erla"													
ELECTRONIC																
331							8-8-20 .02-.02	1	UR190 Buffer	B97 B14	34	292	C3	84		
332 32V							8-8-25 .02-.02	1/19	UR190 Buffer	B97 B14	34	F292	C3	25Z5		
EL-REY																
4 Tube Midget	Vol. Tone	6 22	J Y	6	EX200		4-4	23	CM170					58, 57, 47, 80		I
7 Tube AW	Vol. Sen. Tone	56 7 22	M C Y	6			8-8 10.	1 15	See Note TS101	B3				55, 56, 57, ^{2}58, 2A5, 80	465	I
10, 15	Vol. Tone	6 22	SRP263 Y		EX300 See Note	 A4	4-4	23	CM170					58, 57, 47, 80		1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
EL-REY—Continued																
20	Vol. Tone	17 22	M Y	6			1-8 25	4 15	See Note TS102	B3				57, 58, 59, 55, 80, 56	465	1
644	Vol. Tone	18 22	N Y	6			8-8	23	See Note	B3				6A7, ^{2}6D6, 75, 42, 80	465	1
845	Vol. Tone	17 44	N Y				8-8	1	See Note	B3				55, 56, 57, ^{2}58, ^{2}2A5, 80	465	1
ELEC. SPEC. EXPORT CORP, "Stratfield"																
R502	Vol.	6	G12	6	2		20-20 10-10	6 15	UR190 TN111	B3				6A7, 6D6, 75, 43, 25Z5	456	
38	Vol.	6	UC509	6	EX250		8 10	24 15	CS123 TS101					6D6, 6C6, 38, 12Z3		
45	Vol.	6	M				8-12-10-10	1/15	See Note	B5				6D6, 6C6, 43, 25Z5		
48	Vol.	6	M		EX250		16-12-10-10	1/15	See Note	B5				6D6, 6C6, 38, 25Z5		
69	Vol.	6	G12	6	EX200		20-20 10	1 15	UR190 TS101	B3				6A7, 6D6, 85, ^{2}43, 25Z5	456	
EMERSON																
A130, A132 (type 1) up to 799, 301	Vol.	6	E12	6	EX500		3CC261 KKC145	6 15	RS207 TN110					6A7, 6D6, 76, 43, 25Z5	456	
A130, A132 (type 2) 799, 301 to 819, 200	Vol.	6	E12	6	EX500		3CC261 KKC145	6 15	RS207 TN110					6A7, 6D6, 75, 43, 25Z5	456	
A130, A132 (type 3) 819, 201 up	Vol.	18	MR48	M26			3CC261 KKC145	6 15	RS207 TN110					6A7, 6D6, 75, 43, 25Z5	456	
AA131 (chassis AA) below 1,266,501	Vol.	18	MR44	M26			3CC261 YC98A	25 13	RS207 CS121					6A7, 6D6, 75, 43, 25Z5	456	
AA131 (chassis AA) above 1,266,501	Vol.	18	MR44	M26			3CC261 3CC337	1 1	RS207 RS208					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AB178 (below 1,373,394)	Vol. Tone	18 ‡	500M No. 1 N	 6	See Note A19		3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6C5, ^{2}6F6, ^{2}80	456	1
AB178 (above 1,373,394)	Vol. Tone	18 ‡	500M No. 1 N	 6	See Note A19		3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6J5, ^{2}6F6, ^{2}80	456	1
AB182 & AB183 (below 1,373,394)	Vol. Tone	18 ‡	500M No. 1 N	 6	See Note A19		3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6C5, ^{2}6F6, ^{2}80	456	1
AB182 & AB183 (above 1,373,394)	Vol. Tone	18 ‡	500M No. 1 N	 6	See Note A19		3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6J5, ^{2}6F6, ^{2}80	456	1
AC130	Vol.	18	MR44	M26			3RC318A	23	CM171					6A7, 6D6, 6Q7, 41, 80	456	1
AC149	Vol.	18	MR44	M26			3RC318Z	23	CM171					6A7, 6D6, 6Q7, 41, 80	456	1
AC168	Vol.	18	MR44	M26			3RC-318A	23	CM171					6A7, 6D6, 6Q7, 41, 80	456	1
AD108	Vol.	18	MR48	M26			4DC345	1	UR194					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AD110	Vol.	18	MR48	M26			4DC345	1	UR194					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AD125	Vol.	18	MR48	M26			4DC345	1	UR194					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AE163 (chassis AE)	Vol.	18	MR48	M26			3CC261	1	RS207					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AF171, AF173, AF176, AF179, AF180, AF185	Vol.	18	MR48	M23			VVC221	12	CS123					^{3}1A4, 1C6, 1B5, 1F4, 1E1	456	
AG151 (chassis AG)	Vol. Tone	18 44	MR44 L				3MC290 3MC291 3MC292 KKC145	1 1 13 15	RS208 RS208 RS203 TN110					6K7, 6A8, 6D6, 6Q7G, 6C5, ^{2}25L6, ^{2}25Z5	456	
AH162 (AH)	Vol.	18	MR48	M26			HHC348 IC43A	1 15	UR192 TS101					6A7, 6D6, 6Q7G, 25L6, 25Z5	456	
AJ130, AJ137, AJ149	Vol.	18	MR48	M27			VVC221A	13	CS123					1C6, 1A4, 1B5, 30, 1F4	456	
AL130, AL132, AL149	Vol.	18	MR48	M26			3CC261	1	RS207					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AL164	Vol. Tone	18 ‡	N	6	 See Note A5		3CC261	1	RS207					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AL168	Vol.	18	MR48	M26			3CC261	1	RS207					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
ALLW130, ALLW132, ALW149, ALLW168	Vol.	18	MR48	M26			3CC261 IC43A	1 15	RS207 TS101					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AM131, AM169, AM187	Vol.	18	MR44	M26			3CC261 3CC337	1 1	RS207 RS208					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AP171, AP173, AP174, AP176, AP180, AP185, (chassis AP)	Vol.	18	MR44	M26			3CC261 3CC337	1 1	RS207 RS208					6A7, 6D6, 6Q7, 25L6, 25Z5	456	
AR165 (below 1,326,200)	Vol.	45	MR48	M26			3LC314 3ZC341	23 23	RS215 RN245	 B8				6A7, 6D6, ^{2}76, 41, 80	456	1
AR165 (above 1,326,200)	Vol.	18	MR48	M26			3LC314 3ZC341	25 25	RS215 RN245	 B8				6A7, 6D6, 6Q7, ^{2}41, 80	456	1
AR166 (below 1,326,200)	Vol.	45	MR48	M26			2NC246 2NC247	23 23	RS216 WE1647					6A7, 6D6, ^{2}76, 41, 80	456	1
AR166 (above 1,326,200)	Vol.	18	MR48	M26			2NC246 2NC247	25 25	RS216 WE1647					6A7, 6D6, 6Q7, ^{2}41, 80	456	1
AR177 (below 1,326,200)	Vol.	45	MR48	M26			2NC246 2NC247	23 23	RS216 WE1647					6A7, 6D6, ^{2}76, 41, 80	456	1
AR177 (above 1,326,200)	Vol.	18	MR48	M26			2NC246 2NC247	25 25	RS216 WE1647					6A7, 6D6, 6Q7, ^{2}41, 80	456	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
EMERSON—Continued																
AS179	Vol.	18	MR48	M26			4SC355 .02-.02	1	CN145 Buffer	 B14	48	See Note	C8	6D8G, [2]6S7G, 6Q7, 41	456	10
B-AC-10	Vol. Tone Supp.	18 44 3	N Y E12	6			12-8	1	See Note	B3				[3]58, 55, 56, 57, [3]46, 82	175	3
B131	Vol.	18	MR44	M26			3CC261 YC98A	25 13	RS207 CS121					6A7, 6D6, 75, 43, 25Z5	456	
CS	Vol.	6	‡		See Note A5		A-404	4	CS131	B3				[2]24, 35, 47, 80	175	1
C134, C136, C139, C140, C142	Vol. Tone	18 ‡	MR48 MR18				3BC282 3BC289 3BC281	4 4 14	RS215 WE4045 CS123					[2]6K7, 6A8, 6R7, 6G5, 6C5-6J7, 6F6-6L6, 5W4	456	1
DC4	Vol.	7	‡	6	See Note A5		1-1	1	See Note	B7				[2]39, 36, 33		
D5	Vol.	6	Y		EX300		UC-93	4	CM172					[2]58, 57, 47, 80	456	1
D134, D136, D138, D139, D140, D142, D146	Vol. Tone	20 22	TM230-SS1 MR48	M26			3AC255 3AC277 IC43B 3AC256	3 3 15 15	WE847 WE1647 TS101 TS105					[2]6K7, 6A8, 6H6, 6G5, 6F5, 6C5, [2]6F6, 5Z3	456	1
E128, F122, F133, F135, F141, G127	Vol.	45	UM157		See Note A96		QQC169C .0075	1/15	CN152/TN111 Buffer	 B14	35	294	C3	78, 6A7, 6B7, 76, 41, 84	172.5	10
F	Vol.	6	H12				8-8-8	3	RS213	B66				[4]27, 24, [2]45, 80		3
F117	Vol.	18	MR44	M26			3EC288 YC98A	25 13	RS207 CS121					6A7, 6D6, 75, 43, 25Z5	456	
G4	Vol.	7	M				4-4 5-5	1 15	CN140 TN110					39, 36, 38, 37		
H5	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				[2]78, 77, 43, 25Z5	172.5	
H5L	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				6A7, 78, 77, 43, 25Z5	132	
H130, H137	Vol.	17	MR48	M27			VVC221A	12	CS123					[2]1A4, 1A6, 1B5, 1F4, 1B1	456	
J	Vol.	6	‡	‡	See Note A5		A404	4	CS131					[2]24A, 35, 47, 80		1
JS	Vol.	6	‡		See Note A5		A404	4	CS131					[2]24, 35, 47, 80	175	1
J106	Vol.	17	MR48	M26			12-12 5	6 15	See Note TS101	B3				6A7, 6D6, 75, 43, 25Z5	456	
KS	Vol. Tone	7 22	G G12	6	1		A3 4	4 13	CS133 See Note	 B3				[2]35, [3]24, 27, 47, 80	175	1
K116, K121, K123	Vol.	6	E12	6	2		6-8-12	1/15	See Note	B3				[2]6D6, 76, 41, 80	456	1
LA (Early)	Vol.	7	Y		EX300		8-4 5	4 15	CM161 TS101					78, 77, 38, 1V		
LA (Revised)	Vol.	7	Y		EX300		8-4 5	4 15	CM161 TS101					6D6, 6C6, 38, 1V		
LAC4	Vol.	6	‡		See Note A5		4-4	4	See Note	B3				58, 57, 47, 80		1
LAC5	Vol.	6	‡		See Note A5		8 4	4 4	See Note See Note	B3 B3				[2]58, 57, 47, 80		1
L117 (early)	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 41, 80	456	1
L117 (late)	Vol.	18	MR44	M26			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 75, 41, 80	456	1
L117LW	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 42, 80	456	1
L122 (early)	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 41, 80	456	1
L122 (late)	Vol.	18	MR44	M26			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 75, 41, 80	456	1
L122LW, L133 (early)	Vol.	56	MR44	M26			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 42, 80	456	1
L133 (late)	Vol.	18	MR44	M26			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 75, 41, 80	456	1
L133LW	Vol.	56	MR44	M26			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 42, 80	456	1
L135 (early)	Vol.	56	MR44	M26			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 41, 80	456	1
L135 (late)	Vol.	18	MR44	M26			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 75, 41, 80	456	1
L135LW	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 42, 80	456	1
L141 (early)	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 41, 80	456	1
L141 (late)	Vol.	18	MR44	M26			2NC246 2NC247 IC43A	1 L 15	RS216 WE1647 TS101					6A7, 6D6, 75, 41, 80	456	1
L141LW	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 42, 80	456	1
L143 (early)	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 85, 41, 80	456	1
L143 (late)	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	RS216 WE1647 TS101					6A7, 6D6, 75, 41, 80	456	1
L150	Vol.	18	MR44	M26			12 8 IC43A	1 1 14	RS216 RS213 TS101					6A7, 6D6, 75, 41, 80	456	1
MAC7	Vol. Tone	6 34	E7 Y	6	2		BC9	4	CM172	B3				[3]58, 55, 47, 80	175	1
M134, M136, M138, M139, M140, M142, M146	Vol. Tone	18 22	MR39 MR44				3MC290 3MC291 3MC292 3AC256	27 27 13 15	RS208 RS208 RS203 TS105					6K7, 6A8, 6D6, 85, 6G5, 6C5, [2]43, [2]25Z5	456	
P117, P135	Vol.	18	MR44				8-8 3PC310	1 15	See Note TS102	B3	Order	from Mfr.		[2]1A4, 1A6, 1B5-25S, 30, 1E7G	456	10
Q157	Vol.	6	Z12				3QC338	1	CM164					6D6, 6C6, 25L6, 25Z5		
R152 (R), R156, R158	Vol.	18	MR48	M26			3RC318	23	CM171					6A7, 6D6, 75, 41, 80	456	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
EMERSON—Continued																
S7	Vol.	6	E7	6			IC42 IC43	4 20	CM172 TS101	B3				^{4}58, 57, 59, 80	465	1
S50	Vol.	6	E7	6			IC42 IC43	4 20	CM172 TS101	B3				^{4}58, 57, 59, 80	465	1
S147, S151	Vol. Tone	18 34	MR48 L				3SC303 3BC289 IC43A	1 1 15	WE4015 WE4015 TS101					^{2}6K7, 6A8, 6Q7, 6F6, 5W4-5Z3	456	1
T	Vol.	6	G7	6	3		A403 A404	4 4	See Note CS131	B3				35, 24, 47, 80		1
TS	Vol.	6	G7	6	3		A310 A404	4 4	See Note CS131	B3				35, 24, 47, 80		1
U154	Vol.	45	UM162			See Note A96	3VC320C IC43A .0075	1/15 15	CN152/TS102 TS101 Buffer	 B14	35	294	C3	6A7, ^{2}6D6, 76, 41, 84	262	10
V4 (Early)	Vol.	7	Y		EX300		8-4 5	4 15	CM171 TS101					78, 77, 38, 1V		
V4 (Revised)	Vol.	7	Y		EX300		8-4 5	4 15	CM171 TS101					6D6, 6C6, 38, 1V		
V155	Vol. Tone	15 44	UM162 K12			See Note A96	3VC320	1/15	CN152/TS102		35	294	C3	6D6, 6A7, 6B7, ^{2}76, ^{2}41, 84	262.5	10
X146	Vol. Tone	18 ‡	500M No. 1 N	 6		See Note A19	3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6C5, 6G5, ^{2}6F6, ^{2}80	456	1
X146 (above 1,328,650)	Vol. Tone	18 ‡	500M No. 1 N	 6		See Note A19	3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6J5, 6G5, ^{2}6F6, ^{2}80	456	1
X178 (below 1,328,650)	Vol. Tone	18 ‡	500M No. 1 N	 6		See Note A19	3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6C5, 6G5, ^{2}6F6, ^{2}80	456	1
X178 (above 1,328,650)	Vol. Tone	18 ‡	500M No. 1 N	 6		See Note A19	3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6J5, 6G5, ^{2}6F6, ^{2}80	456	1
X183 (below 1,328,650)	Vol. Tone	18 ‡	500M No. 1 N	 6		See Note A19	3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6C5, 6G5, ^{2}6F6, ^{2}80	456	1
X183 (above 1,328,650)	Vol. Tone	18 ‡	500M No. 1 N	 6		See Note A19	3XC329 YC98A IC43A	1 13 15	WE3540 CS121 TS101					^{2}6K7, 6A8, ^{7}6J5, 6G5, ^{2}6F6, ^{2}80	456	1
Z117, Z122, Z133	Vol.	45	N	6			2NC216 2NC247	23 23	RS216 WE1647					6A7, 6D6, ^{2}76, 41, 80	456	1
Z135, Z141	Vol.	45	MR43	M26			2NC216 2NC247	23 23	RS216 WE1647					6A7, 6D6, ^{2}76, 41, 80	456	1
Z150 (early)	Vol.	45	MR44	M26			12 8 8	23 23 13	RS215 RS213 CS123					6A7, 6D6, ^{2}76, 41, 80	456	1
Z150 (late)	Vol.	45	MR44	M26			12 24 8	23 23 13	RS215 RN245 CS123	 B8				6A7, 6D6, ^{2}76, 41, 80	456	1
Z159, Z160	Vol.	45	MR48				2NC216 2NC247	23 23	RS216 WE1647					6A7, 6D6, ^{2}76, 41, 80	456	1
3LW	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				6A7, 78, 77, 43, 25Z5	132	
5A	Vol.	17	UM154			See Note A96	8-8 10-10	1 15	See Note TN111	B3	29	277S		^{2}78, 6A7, 85, 42	172.5	10
6A	Vol.	17	UM154			See Note A96	8-8 10-10 .003	1 15	See Note TN111 Buffer	B3 B14	22	253Y	C3	^{2}78, 6A7, 85, 41, 84	172.5	10
19 (UV4)	Vol.	6	Y		EX300		KKC143 KKC145	6 15	CM164 TN110					6A7, 6F7, 43, 25Z5	456	
20A	Vol.	6	UC509	6	EX200		HC31 HC32	1 15	CN140 TN113					36, 37, 38, 39		
23 (4B)	Vol.	6	Z12	6	EX200		UC93	4	CM172					6A7, 77, 42, 80	456	1
25A	Vol.	6	UC509	6	EX300		HC31 HC32	1 15	CN140 TN113					36, 37, 38, 39		
26 (DAC5)	Vol.	6	Y	6	EX500		8-8	4	See Note	B3				^{2}58, 57, 47, 80	456	1
28 (5J)	Vol.	6	Y	6	EX300		UC93 IC43	4 15	CM172 TS101					^{2}6D6, 6C6, 42, 80	456	1
30	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				^{2}78, 77, 43, 25Z5	172.5	
30AW	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				25Z5, 43, 77, ^{2}78	456	
30LW	Vol.	6	Y	6			KC68	11	UR193	B264				6A7, 78, 77, 43, 25Z5	132	
32 (U5S)	Vol.	17	N				GGC137	6/15	UR189	B98				6A7, 6D6, 75, 43, 25Z5	456	
33AW	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				25Z5, 43, 77, ^{2}78	456	
33LW	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				6A7, 78, 77, 43, 25Z5	132	
34C (C6-D6)	Vol. Tone	55 22	M M	 6			8-8	4	See Note	B3				6A8, ^{2}6K7, 75, 6F6, 80	456	1
34F7	Vol. Tone	55 22	MR48 MR44	M26			6-10 2KC249 2KC234	1 13 15	See Note CS123 TN110	B3	5	222		6A7, ^{2}15, 85, 76, 19	456	10
35 (T6)	Vol.	17	N	6			12-12-8 5	11 15	See Note TS101	B3				^{3}78, 75, 43, 25Z5	172.5	
36 (B5)	Vol.	6	E12		EX150		8-6 12	1 15	See Note TS101	B3				^{2}6D6, 76, 42, 80	456	11
38 (U6)	Vol. Tone	17 22	N Y				CCC125 HC32	6/13 15	UR190 TN110					6A7, ^{2}6D6, 25Z5, 43, 75	456	
38 (U6D)	Vol.	6	Z12	6	EX200		CCC125 HC32	6/13 15	UR190 TN110					6A7, ^{2}6D6, 25Z5, 43, 75	456	
39 (D-S5)	Vol.	‡	MN	6			8-8 4 5	4 13 15	CM172 CS121 TS101					2A7, 2B7, 47, 58, 80	456	11
40	Vol.	17	O	6			PC83	11	UR182	B31				6B7, 25Z5, 43, ^{3}78	175	
41	Vol.	6	Y		EX500		8-8	4	See Note	B3				^{2}58, 57, 47, 80	456	
42 (U6)	Vol. Tone	17 22	N Y			 See Note A4	CCC125 HC32	6/13 15	UR190 TN110					6A7, ^{2}6D6, 25Z5, 43, 75	456	
42 (U6D)	Vol.	6	Z12	6	EX200		CCC125 HC32	6/13 15	UR190 TN110					6A7, ^{2}6D6, 25Z5, 43, 75	456	
45 (6BD)	Vol.	6	E7	6	4		8-4 8 5	4 12 15	See Note See Note TS101	B3 B3				^{2}6D6, 6A7, 75, 42, 80	456	1
49 (U6)	Vol. Tone	17 22	N Y			 See Note A4	CCC125 HC32	6/13 15	UR190 TN110					6A7, ^{2}6D6, 25Z5, 43, 75	456	
49 (U6D)	Vol.	6	Z12	6	EX200		CCC125 HC32	6/13 15	UR190 TN110					6A7, ^{2}6D6, 25Z5, 43, 75	456	
50L	Vol. Tone	6 34	E7 Y	6			IC42 IC43	4 20	CM172 TS101	B3				55, 56, ^{3}58, 59, 80	115	1
50M	Vol. Tone	6 34	E7 Y				BC9	4	CM172	B3				47, 55, 56, ^{3}58, 80	175	1
AW55	Vol.	7	H		2		8-4	4	See Note	B3				^{2}24, 47, 56, 58, 80	445	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
EMERSON—Continued																
59 (DS5)	Vol.	‡	MN	6			8-8	4	See Note	B3				2A7, 2B7, 47, 58, 80	456	1
							4	13	See Note	B3						
							5	15	TS101							
65	Vol.	7	UC500				2-1-1	1	See Note	B1				[3]24, [2]27, [2]45, 80, 99		24
71 (AW7)	Vol.	17	O	6			8-8	1	See Note	B3				[2]6D6, 6A7, 75, [2]42, 80	456	1
	Tone	41	Y				4	13	CS121							
77	Vol.	17	O				8-8	4	See Note	B3				2A6, 47, 56, [3]58, 80	172.5	1
	Tone	34	Y													
101 (C6-D6)	Vol.	18	M				8-8	4	See Note	B3				6A8, [2]6K7, 75, 6F6, 80	456	1
	Tone	22	M	6												
101F7	Vol.	55	MR48	M26			6-10	1	See Note	B3	5	222		6A7, [2]15, 85, 76, 19	456	10
	Tone	22	MR44				2KC249	13	CS123							
							2KC234	15	TN110							
101U	Vol.	55	MR48				ZZC192A	11/13	UR193	B265				6A8, [2]6K7, 75, 43,		
	Tone	22	MR44	M26			YC98	11	CS121					25Z5	456	
102	Vol.	17	TRP611				8-8	1	See Note	B3				[2]6K7, 6A8, 75, 6E5,		
	Tone	22	N				IC43	15	TS101					6C5, [2]6F6, 80	456	1
							NNC226	‡	CS133							
102LW (B8)	Vol.	18	TRP611				2HC217	1	CN152					[2]6K7, 6A8, 75, 6C5,		
	Tone	22	N				NNC226	1	CS133					[2]6F6, 80	456	1
							IC43	15	TS101							
103 (F5)	Vol.	17	N	7										1C6, 34, 25S, 30, 33,		
														LLL25	456	
104	Vol.	17	TRP611				8-8	1	See Note	B3				[2]6K7, 6A8, 75, 6E5,		
	Tone	22	N				IC43	15	TS101					6C5, [2]6F6, 80	456	1
							NNC226	‡	CS133							
104LW (B8)	Vol.	17	TRP611				2HC217	1	CN152					[2]6K7, 6A8, 75, 6C5,		
	Tone	22	N				NNC226	1	CS133					[2]6F6, 80	456	1
							IC43	15	TS101							
105 (A11)	Vol.	20	‡		See Note	A19	2AC-209A	30	UR191	B3				5Z3, 6A8, 6C5, [3]6F6,		
	Tone	22	N	6			IC43	19	TS101					6H6, [4]6K7	456	1
106 (U6B)	Vol.	18	N	6			2CC-194	27	CM165					6A7, 6D6, 6H6, 6F5,		
														43, 25Z5	456	
107 (U6A)	Vol.	55	N	6			ZZC-192A	11/27	UR193	B99				6A8, [2]6K7, 75, 43,		
	Tone	22	M				YC98A	11	CS121	B99				25Z5	456	
107 (U6F)	Vol.	45	MR48				16-8-4	6/13	RM257					6A7, 6K7, 6H6, 6F5,		
							4	13	CS121					43, 25Z5	456	
107AC	Vol.	18	MR44	M26			2NC246A	1	RS216					6A7, 78, 75, 41, 1V	456	38
							2NC246B	1	RS216							
							IC43A	15	TS101							
107LW (U6C)	Vol.	45	MR48	M26			4-8-16	25/13	See Note	B3				6A7, 6K7, 6H6, 6F5,		
	Tone	22	MR44											43, 25Z5	456	
108-110	Vol.	18	MR48	M26			2DC-203	27	CM164	B100				6A7, 6D6, 75, 43,		
														25Z5	456	
108LW (U5B)	Vol.	18	MR48	M26			2DC203	27	CM164					6A7, 6D6, 75, 43,		
														25Z5	132	
109 (U4A)	Vol.	6	Z12	6	See Note	A14	KKC143	6	CM164					6A7, 6F7, 43, 25Z5	456	
							KKC145	15	TN110							
110LW	Vol.	18	MR48	M26			2DC203	27	CM164					6A7, 6D6, 75, 43,		
														25Z5	132	
111 (U6A)	Vol.	18	MR48	M26			ZZC-192A	11	UR193	B99				6A8, [2]6K7, 75, 43,		
	Tone	22	MR44				YC-98A	11	CS121	B99				25Z5	456	
111 (U6F)	Vol.	45	MR48	M28			16-8	6	See Note	B3				6A7, 6K7, 6H6, 6F5,		
							4-4	13	See Note	B3				43, 25Z5	456	
111LW (U6C)	Vol.	45	MR48	M26			4-8-16	25/13	UR193	B3				6A7, 6K7, 6H6, 6F5,		
	Tone	22	MR44											43, 25Z5	456	
112	Vol.	17	TRP611				8-8	1	See Note	B3				[2]6K7, 6A8, 75, 6E5,		
	Tone	22	N				IC43	15	TS101					6C5, [2]6F6, 80	456	1
							NNC226	‡	CS133							
114	Vol.	18	MR44	M26			2NC246A	1	RS216					6A7, 78, 75, 41, 1V	456	38
							2NC246B	1	RS216							
							IC43A	15	TS101							
116	Vol.	6	E12	6	See Note	A14	6-8-12	1/15	See Note	B3				[2]6D6, 76, 42, 80	456	1
117	Vol.	56	MR44	M26			2NC246	1	RS216					6A7, 6D6, 85, 42, 30	456	1
							2NC247	1	WE1647							
							IC43A	15	TS101							
117LW	Vol.	56	M	6			2NC246	1	RS216					6A7, 6D6, 85, 42, 80	456	1
							2NC247	1	WE1647							
							IC43A	15	TS101							
118	Vol.	6	Z12	6			GGC137	6/15	UR189	B98				6D6, 6C6, 43, 25Z5		
119 (U6A Rev)	Vol.	55	MR48	M26			ZZC192A	11	UR193	B99				6A8, [2]6K7, 75, 43,		
	Tone	22	MR44				YC98A	11	CS121					25Z5	456	
							VVC221	11	CS123							
120	Vol.	6	Z12	6			GGC137	6/15	UR189	B98				6D6, 6C6, 43, 25Z5		
121	Vol.	6	E12	6	See Note	A14	6-8-12	1/15	See Note	B3				[2]6D6, 76, 42, 80	456	1
126	Vol.	6	Z12	6			GGC137	6/15	UR189	B98				6D6, 6C6, 43, 25Z5		
138	Vol.	18	MR18				3BC282	4	RS215					[2]6K7, 6A8, 6R7, 6G5,		
	Tone	‡	MR48				3BC289	4	WE4045					6C5-6J7, 6F6-6L6,		
							3BC281	14	CS123					5W4	456	1
250	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				[2]78, 77, 43, 25Z5	172.5	
250AW	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				25Z5, 43, 77, [2]78	456	
250LW	Vol.	6	Y	6			KC68	11	UR193	B264				6A7, 78, 77, 43, 25Z5	132	
280 (F6D)	Vol.	17/15	Order from	Mfr.										1C6, 34, 1A6, 33,		
														LLL25	456	
300	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				[2]78, 77, 43, 25Z5	172.5	
321AW, 330AW, 350AW	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				25Z5, 43, 77, [2]78	456	
321LW, 350LW	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				6A7, 78, 77, 43, 25Z5	132	
375	Vol.	17	O	6			PC83	11	UR182	B264				6B7, 25Z5, 43, [3]78	175	
375LW	Vol.	13	O	6			KC68	11	UR193	B264				78, 6A7, 6B7, 77, 43,		
														25Z5	125	
409, 410, 411 (A4)	Vol.	6	Y	6	EX300		RC84	1	CN141					78, 6F7, 38, 1V		
							RC85	15	TN110							
409, 410. 411 (U4C)	Vol.	6	Z12	6			2WC239	6	CS123/TN110					6D6, 6C6, 43, 25Z5		
							2WC240	6	CS126							
415, 416	Vol.	6	Y	6	EX300		8-4	4	CM161	B3				78, 77, 38, 1V		
415, 416 (Revised)	Vol.	6	Y	6	EX300		8-4	4	See Note	B3				1V, 6C6, 6D6, 38		
							8	15	TS101							
420 (V4)	Vol.	6	Y	6	EX300		QC78	4	CM160	B3				78, 77, 38, 1V		
456	Vol.	6	Y	6	EX300		KC68	11	UR193	B264				77, [2]78, 43, 25Z5	456	
667	Vol.	17	UM161	M26	See Note	A96	6-10	1	See Note	B3	37	296	C3	6A7, [2]41, 75, [2]78, 84	172.5	10
							5	15	TS101							
							.015		Buffer	B14						
678 Type 1	Vol.	‡	See Note			A19	4-8	1	See Note	B3	5	222	C3	78, 6A7, 6B7, [2]41	172.5	10
	Tone	39	H12				4-8	13	See Note	B3						
	Supp.	‡	C1MP		See Note	A33	5	15	TS101	B6						
							.02		Buffer	B14						
678 Type 2	Vol.	‡	UM147-SS3	M26			4-8	1	CN152	B3	5	222		78, 6A7, 6B7, [2]41	172.5	10
	Tone	39	H12				4-8	13	See Note	B3						
	Supp.	‡	C1MP		See Note	A33	5	15	TS101	B6						
L755	Vol.	6	E7	6	2		IC42	4	CM172	B3				55, 56, [3]58, 59, 80	115	1
	Tone	34	Y				IC43	20	TS101							

‡ Data not substantiated.

* IMPORTANT; Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
EMERSON—Continued																
M755	Vol. Tone	6 34	E7 Y		2		BC9	4	CM172	B3				47, 55, 56, ^{3}58, 80	175	1
S755	Vol.	6	E7	6	2		IC42 IC43	4 19	CM172 TS101	B3				^{4}58, 59, 80, 57	465	1
770 (AW7)	Vol. Tone	17 41	O Y	6			8-8 4	1 13	See Note CS121	B3				6A7, ^{2}6D6, ^{2}42, 75, 80	456	1
965	Vol.	17	UM161		See Note	A96	ZC100 IC43 .02	1 15	See Note TS101 Buffer	B3 B14	37	296	C3	6A7, 41, 75, 78, 84	172.5	10
EMPIRE																
10	Vol.	7	UC509	6	EX300		16-8 2-4	6 15	CM165 TN110	B3 B6				25Z5, 36, 39, 43		
20	Vol.	7	UC509	6	EX300		16-8 2-4	6 15	CM165 TN110	B3 B6				39, 36, 37, 43, 25Z5		
30	Vol.	6	SRP263	6			16-8 2-4	6 15	CM165 TN110	B3				^{2}77, 78, 43, 25Z5	175	
40	Vol.	18	N	6			16-16 4-4	1 18/15	CM164 See Note	B3 B3				6A7, 78, 75, 43, 37, 25Z5	175	
40SW	Vol.	18	N	6			4-16-16-8-4	8/14	See Note	B101				6A7, ^{2}6D6, 75, 43, 25Z5	456	
51	Vol.	17	N	6			12-8	4	See Note	B3				2A7, 58, 2A6, 2A5, 80	175	1
60	Vol.	17	N	6			8-4 2-4 10-10 .02	1 15 ‡	See Note TN110 TN111 Buffer	B3 B6 B14	47	See Note	C6	^{2}78, 6A7, 75, 41, 84	175	10
71	Vol.	18	N	6			16-8	23	See Note	B3				2A5, 2A6, 2A7, ^{3}58, 80	175	1
74	Vol.	6	G12	6			8-8	4	See Note	B3				^{4}58, 57, 2A5, 80	462.5	1
400AC	Vol.	8	G				6-6	4	See Note	B3				57, 58, 47, 80		1
400DC	Vol.	3	G12		EX200									^{2}39, 36, 33		
450A	Vol.	17	N	6			16-4-16-4-2	8/13/15	See Note	B102				6A7, 6D6, 75, 43, 25Z5	456	
460B	Vol.	17	N	6			16-4-16-8-4	8/15	See Note	B101				^{2}6D6, 6A7, 75, 43, 25Z5	456	
470C	Vol.	17	N	6			8-16 2 4-4	1 13 15	See Note See Note TN110	B3 B3				^{2}58, 2A7, 2B7, 2A6, 2A5, 80	456	1
480C	Vol.	17	N				16-4-16-8-4 6	8/15 13	See Note See Note	B101 B3				^{2}6D6, 6A7, 75, ^{2}43, ^{2}25Z5	456	
500AC	Vol. Tone	8 22	G K12				8-8	4	See Note	B3				^{2}58, 57, 47, 80		1
500DC	Vol.	6	G12											^{2}36, 37, ^{2}33		
550AC	Vol. Tone	6 22	G12 K12	6	EX300		6-6	4	See Note	B3				^{2}58, 47, 80		1
575	Vol. Tone	6 22	G7 K12	6			8-8	4	See Note	B3				57, 58, 55, 47, 80	175	1
600AC	Vol. Tone	7 44	G K12	6			8-8	4	See Note	B3				^{2}58, 24, ^{2}47, 80		1
700DC	Vol. Tone	6 44	G7 K12	6	EX200									^{2}39, ^{3}37, ^{2}48		
ERLA (ERLA-SENTINEL) Also see Sentinel																
R1 (Power Pack "A")	Vol.	13	M				2-1-2	3	See Note	B2				^{5}26, 27, ^{2}50, ^{2}81		8
R2 (Power Pack "A" 2)	Vol.	40	G12				1-2-2	3	See Note	B1				^{4}26, 27, ^{2}71A, 80		11
10M	Vol.	17	UM154	M26		A96	8-8 8876 .02	1 15	CN152 TS101 Buffer	B3 B14	35	294	C3	6A7, 6D6, 6B7, 41, 84	370	10
11M	Vol. Tone	18 34	UM154 M	M26	See Note	A96	8-8 .02	4	CM172 Buffer	B3 B14	35	294	C3	^{2}6D6, 6A7, 75, 41, 84	465	10
14A	Vol. Tone	7/18 44	DRP314 M	6			12 16	1 1	RS215 RS216					^{3}6D6, ^{2}76, 75, 41, 80	465	1
19A	Vol. Tone	18 34	N K12	6			1476 1477 1110	25 25 13	RS215 RS216 CS131					6A7, 6D6, 75, ^{2}42, 80	465	1
20A	Vol. Tone	18 22	N K12	6			1476 1477	25 25	RS215 RS216					6A7, 6D6, 75, 42, 80	465	1
22U	Vol. Tone	18 22	N K12	6			12-20-8	11	UR182	B3				6A7, 6K7, 75, 43, 25Z5	465	
25A	Vol. Tone	18 44	N K12				1476 1477	25 25	RS215 RS216					6A7, 6D6, 75, 76, ^{2}41, 80	465	1
27A	Vol. Tone	7/18 44	DRP314 M	6			1476 1477 1693	1 1 15	RS215 RS216 TS101					^{3}6D6, ^{2}76, 75, ^{2}41, 80	465	1
30 (248)	Vol. Tone	7 22	J ‡	6	See Note	A5	8-8	1	See Note	B3				^{2}24, 27, ^{2}35, 47, 80		3
30A	Vol.	6	Y	6			2158 1260 8876	25 25 15	RS213 RS213 TS101					6D6, 6C6, 42, 80		1
31, 32, 33 (A3, R3)	Vol.	6	G7				2-2-1 .05	3	See Note See Note	B3 B9				^{5}27, ^{2}45, 80		3
31B	Vol. Tone	18 22	N K12	7			2272 .02	1	CM164 Buffer	 B14	30	285	C3	1C6, ^{2}34, ^{2}30, 19	465	10
32B	Vol.	18	MR48											1C6, 34, 1B5, 33	465	
33B	Vol. Tone	18 22	N K12	14										1C6, 34, 1B5, 30, 19	465	
34B	Vol. Tone	18 57	MR48 MR48	M27			2272 .02	1	CM164 Buffer	 B14	30	285	C3	1C6, 34, 1B5, 38	465	10
35, 37, 38, 39 (230)	Vol. Tone	15 41	M O				6638-0	3	RS213					^{3}24, ^{3}27, ^{2}45, 80		3
35B	Vol. Tone	18 22	MR48 MR53	M24			2289	12	CS121					1C6, ^{2}34, ^{2}30, 19	465	
36L	Vol. Tone	18 44	N K12	6										6A7, 6D6, 75, 76, ^{2}48	465	
37B	Vol.	18	MR48											1C6, 34, 1B5, 33, 5E1	465	
38B	Vol. Tone	18 22	N K12	14			2289	13	CS121					1C6, 34, 1B5, 30, 19	465	
39B	Vol. Tone	18 22	MR48 MR33	M24			2289	13	CS121					1C6, ^{2}34, ^{2}30, 19	465	
40A, 40B	Vol. Tone	18 34	MR48 K12				1476 1477	25 25	RS215 RS216					6A7, 6D6, 6H6, 6F5, 42, 80	465	1
47AE	Vol. Tone	18 22	500M No. 1 K12	6	See Note	A19	3167 1476 3170 8876 1110	25 25 19 15 13	WE2545 RS216 TS106 TS101 CS131					^{2}6K7, 6L7, 6J7, 6H6, 6G5, ^{2}6C5, ^{2}6F6, 5Z3	465	1
48A	Vol. Tone	7 22	E K12	6	3		2627	1/15	CN151/TS101					6A7 6D6, 76, 41, 80	465	1
49B	Vol. Tone	18 22	MR48 K12	7			2272 .02	1	CM164 Buffer	 B14	30	285	C3	1C6, 34, 6B7, 30, 19	465	10
50B	Vol. Tone	45 22	N K12	7			2272 .02	1	CM164 Buffer	 B14	30	285	C3	1C6, ^{2}34, ^{3}30, 19	465	10

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
ERLA—Continued																
54A	Vol.	18	MR48				2627	1/15	CN151/TS101					6A7, 6D6, 75, 41, 80	465	1
	Tone	22	K12													
55U	Vol.	18	N	6			12-20	27	See Note	B3				6A7, 6D6, 75, 43, 25Z5	465	
60B	Vol.	18	MR48											1C6, 34, 1F6, 33, 5E1	465	
61, 62, 63 (250)	Vol.	8	UC501				8-2	1	See Note	B3				[2]24, 27, 35, 47, 80	175	1
							7850-0	1	CS131							
63B	Vol.	18	MR48				3060	1	RN242		30	285	C3	[2]15, 75, 41	465	10
	Tone	22	N				1693	15	TS101							
							.01		Buffer	B14						
65B	Vol.	18	N				3150	13	RN232	B8				1C6, 34, 1F6, 30, 19	465	
	Tone	22	MR33	M24												
66B, 66BE	Vol.	45	2 Meg. No. 1		See Note A19		3060	1	RN242		30	285	C3	[3]15, 6S7, [2]76, 6G5, 19	465	10
	Tone	44	MR33	M26			8876	15	TS101							
							.02		Buffer	B14						
67L	Vol.	18	MR48											6A7, 6D6, 75, 76, [2]48	465	
	Tone	22	K12	6												
68B, 68BE	Vol.	45	MR48				3060	1	RN242		30	285	C3	6A7, [2]15, [2]76, 6G5, 19	465	10
	Tone	22	K12	6			1693	15	TS101							
							.01-.01		Buffer	B14				6D6, 6C6, 43, 25Z5		
69U	Vol.	6	H12	6	EX200		20-12	27	See Note	B3						
70A	Vol.	7	E	6	3		3041	1	RN241					6A7, 6D6, 76, 41, 80	465	1
71U	Vol.	17	N	6			20-12	27	See Note	B3				6A7, 6D6, 75, 43, 25Z5	465	
72A, 72AE	Vol.	17	N	6			3041	1	RN241					6A7, 6D6, 75, 41, 80	465	1
	Tone	22	MR33													
73B	Vol.	17	N				3060	1	RN242		13	245	C3	6D8G, [2]6S7G, 6L5G,		
	Tone	22	MR33				1693	15	TS101					41	465	10
							.03		Buffer	B14						
74, 76 (210)	Vol.	‡	‡		See Note A38									[3]30, [2]32, [2]71A		
76A	Vol.	20	TM251-SS16				3167	25	WE2545					[2]6K7, 6A8, 6J7, 6H6,		
							3041	25/15	RN241					[3]6C5, [2]6F6, 80	465	1
							1110	13	CS131							
							1693	20	TS101							
75, 77 (231)	Vol.	12	Z12	6										[2]30, [3]32, [2]71A		
78B	Vol.	17	UM154-SS16				3060	1	RN242		13	245	C3	6D8G, [2]6S7G, [2]6L5G,		
	Tone	22	MR33	M26			1693	15	TS101					6N5, 19	465	10
							.03		Buffer	B14						
80B	Vol.	17	MR48											1C6, 34, 1F6, 33, 5E1	465	
81, 82 (245)	Vol.	7	G	6			6638-0	1	RS213					[3]24, [2]27, [2]45, 80	175	3
	Tone	41	O													
81P, 82P (248)	Vol.	7	UC501	6			6638-0	1	RS213					[2]24, 27, [3]35, 47, 80	175	3
	Tone	22	‡		See Note A5											
82A, 82AE	Vol.	17	UM154-SS16				3718	1	RN242					6A7, 6D6, 76, 75,		
	Tone	22	MR33				1693	15	TS101					6G5, 41, 80	465	1
85U, 85UE	Vol.	17	MR48	M26			3638	27	CM161					6A7, 6D6, 75, 43,		
	Tone	22	MR33											6G5, 25Z5, M49B-M42G	465	
86AE	Vol.	17	‡		See Note A19		3718	1	RN242					6A8G, 6K7G, 6Q7G,		
	Tone	44	K12	6			1108	20	CS130					6G5, 6C5G, [2]6K6G, 5Y4G	465	1
90B	Vol.	17	MR48											1C6, 34, 1F6, 33, 5E1	465	
93L	Vol.	17	UM154-SS16											6A7, 6D6, 75, 76, [2]48	465	
	Tone	22	MR33	M26												
95B	Vol.	17	UM154-SS16				3150	12	RN232	B8				1C6, 34, 1F6, [3]30		
	Tone	44	MR33	M24			1693	15	TS101					(4-1)	465	
96BE	Vol.	17	MR48	M26			3060	1	RN242		13	245	C3	6D8G, [2]6S7G, 6L5G,		
	Tone	22	MR33				1693	15	TS101					6M5, 41	465	10
							.03		Buffer	B14						
107AE	Vol.	17	MR48				3718	1	RN242					6A7, 6D6, 75, 6G5,		
	Tone	22	K12	6										41, 80	465	1
224AC	Vol.	12	F7	6			1-2-2-3	3	See Note	B1				[3]24, [2]27, [2]45, 80		3
224B	Vol.	12	F7	6			3-2-1-1	3	See Note	B1				[3]24, [2]27, [2]45, 80		3
225	Vol.	25	DRP192				6638-0	1	RS213					[3]24, [2]27, [2]45, 80		3
	Tone	41	O													
271A	Vol.	25	DRP192				6552-0	1	RS213					[2]24, [2]27, 45, 80		3
	Tone	57	N													
335	Vol.	7	UC501	6	See Note A10		6958-0	1	RS213	B3				35, 24, 45, 80		1
							6938-0	1	RS211							
336	Vol.	6	G12	6			4-4	1	See Note	B11				[2]36, [2]38		
570X	Vol.	6	K12	6	EX250		4-20-8	11	UR182	B31				6A7, 78, 75, 43, 25Z5	262	465
599	Vol.	6	H12	6	EX250		4-20-8	11	UR182	B31				6A7, 78, 75, 43, 25Z5	262	465
603	Vol.	17	N	6			1247	1	CN152	B3	34	292	C3	[2]78, 6A7, 75, 41, 84	265	10
							9328	15	TN110							
							.005		Buffer	B14						
620, 622, 623	Vol.	17	M	6			8-8	1	RN242					[2]57, 58, 2A6, 2A5, 80	465	1
	Tone	22	K12				5	15	TS101							
630, 634, 635	Vol.	17	M	6			9659	1	RN242					[2]57, 58, 2A6, 2A5, 80	465	1
	Tone	22	K12				8876	15	TS101							
5001, 5002	Vol.	6	H12		EX250		9925	12	CS133					[2]78, 37, 77, 38	465	
							5-5	15	TN110							
5700, 5721	Vol.	18	N	6			9659	1	RN242					2A7, 58, 2A6, 2A5, 80	465	1
							1108	12	CS130							
6100	Vol.	6	H12	6	EX250		9925	12	CS133		49	F292	C3	[2]78, 77, 38, 25Z5, or 84	465	10
							8705	1	CS133							
							9328	15	TN110							
							.02-.02		Buffer	B14						
6300, 6315, 6317, 6323	Vol.	17	M	6			9659	1	RN242					2A7, [2]58, 2A6, 2A5, 80	465	1
	Tone	22	K12				1110	13	CS131							
							8876	15	TS101							
6900	Vol.	18	N	6										6A7, 6D6, 75, 76, [2]48	465	
7700, 7732, 7741	Vol.	18	N	6			1291	12	RS201					1C6, 34, [2]30, 19	465	
ESPEY																
675	Vol.	17	MR53				20	12	See Note	B3				6A7, 6D6, 6R7, [2]43,		
	Tone	41	MR48				12-30	6	See Note	B3				[2]25Z5	456	
							5	13	CS123							
							10	15	TS101							
5111	Vol.	18	N				16-30	1	See Note	B3				6A7, 6K7, 6R7, [2]43,		
	Tone	41	N				16	18	See Note	B3				[2]25Z5	456	
							20	12	See Note	B3						
7111	Vol.	15	MR53				5.117	1	RS216					[3]6K7, 6L7, 6H6, 6E5,		
	Tone	39	MR48	M26			5.117A	1	WE3540					6F5, 6C5, [2]6L6, 5Z3	456	1
	Sen.	7	Order from	Mfr.			678	15	TN111							
7151, 7153	Vol.	80	MR53				32-24-12	6/13	Order from	Mfr.				[3]6K7, 6L7, 6Q7, 6G5,		
	Tone	80	MR48	M26			80	12	Order from	Mfr.				6C5, [4]25L6, [4]25Z5	456	
	Sen.	7	Order from	Mfr.			10	15	TS101							
EVEREADY—See National Carbon.																
EVERETTE PIANO—See "Orgatron"																

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
FADA																
KA60	Vol.	15	O				2-2-2-1-1	66/13	See Note	B1				^{3}24A, ^{3}27, ^{2}45, 80		3
KB (81, 82, 84, 86)	Vol.	15	O				2.5-2-1-2	3	See Note	B7				^{3}24, ^{3}27, ^{6}71A		
	Sen.	12	E12													
KE (122)	Vol.	12	Y	13										^{2}30, ^{2}31, ^{3}32		
KF (43) KG (761, 762, 764, 766)	Vol.	24	DRP119				2-2-1-1	30/14	See Note	B1				^{3}24, 27, ^{2}45, 80		3
KO (51) KOC (53, 53)	Vol.	8	D	6	See Note	A39	3-1301-MS.	1	RS213					^{2}35, ^{2}24, 27, 47, 80	175	3
							3-1313-MS.	17	TS102							
KOC (171, 173) 110 V DC	Vol.	8	F	6										^{4}36, ^{2}37, ^{2}38	175	
KU (45, 45Z)	Vol.	7	F	6	See Note	A40	3-1301-MS.	3	RS213	B10				^{2}35, ^{2}27, 24, ^{2}47, 80	175	3
KW (48, 49)	Vol.	15	O	6	See Note	A85	3-1301-MS.	3	RS213					^{3}27, ^{4}35, ^{2}47, 80	175	3
	F.O.G.	‡	F													
KX (61, 66)	Vol.	42	F	6			3-1301-MS.	4	RS213					^{2}35, 24, 47, 80		3
							3-1384-MS.	4	RS213							
KY (66) Early, Late	Vol.	64	O	6			3-1301-MS.	1	RS213					^{2}24, ^{4}35, ^{2}27, 47, 80	175	3
NA (14)	Vol.	64	O	6			5-1209-MS.	1	RN242					6A7, 6D6, 37, 42, 77,		
	Tone	57	UC509			A90	4-1343-MS.	15	BN226					80	265	1
NE (151, 152)	Vol.	15	O	6			5-1209-MS.	1	RN242					6A7, 6D6, 37, 77, 42,		
	Tone	57	M				4-1343-MS.	15	BN226					80	265	1
NF	Vol.	17	O	6			4-1488-MS.	1	RN242					6A7, 6B7, ^{2}6D6, 42, 80	125	1
	Tone	57	UC502				4-1314-MS.	15/19	TS101							
NK (126, 127, 128)	Vol.	16	O	7			4-1380-MS.	1	RN232		30	285	C3	^{3}34, 1A7, ^{3}30	262.5	10
	Tone	34	M													
RA (74, 76, 83, 88, 89)	Vol.	15	O	6			3-1473-MS.	28	RS213					^{3}58, ^{3}56, ^{2}47, 80	175	3
	F.O.G.	‡	Y25MP				3-1384-MS.	28	RS213							
							3-1301-MS.	28	RS213							
							3-1313-MS.	15	TS102							
RC (78, 79)	Vol.	‡	NN	6			3-1473-MS.	28	RS213					^{2}58, ^{3}56, 57, ^{2}47, 80	175	3
	F.O.G.	‡	Y25MP				3-1384-MS.	28	RS213							
	Sil.	12	G12				3-1381-MS.	28	RS213							
RE (73, 75, 85, 98)	Vol.	17	O	6			3-1473-MS.	25	RS213					^{3}58, 55, 56, 47, 80	175	3
							3-1301-MS.	25	RS213							
							3-1313-MS.	17	TS102							
RG (55)	Vol.	6	G12	6			4-1219-MS.	1	RS213					^{2}57, 58, 47, 80	175	3
RH (74, 76, 83, 87, 88, 89, 97)	Vol.	15	O	6			3-1473-MS.	28	RS213					^{3}56, ^{3}58, ^{2}47, 80	175	3
	F.O.G.	‡	Y25MP				3-1384-MS.	28	RS213							
							3-1301-MS.	28	RS213							
							3-1313-MS.	15	TS102							
RK (101 Motoset)	Vol.	17	UM154	M26	See Note	A96	4-1254-MS.	1	CN152		4	221	C3	^{3}39, 84, 85, ^{2}89	175	10
							.01		Buffer	B14						
RL (103 Fadalette)	Vol.	6	G12	6			4-1312-MS.	6	RN231					36, 38, 39, 25Z5		
							4-1314-MS.	15	TS101							
RN (105, 106, 107)	Vol.	17	O	6										6A7, 78, 6B7, 43,		
							4-1362-MS.	6	RN235	B10				25Z5	470	
							4-1343-MS.	15	BN226							
RP (102 Motoset)	Vol.	16	UM154	M26	See Note	A96	4-1254-MS.	1	CN152		4	221	C3	37, ^{3}39, 85, 89, 84	175	10
	Tone	40	L				4-1363-MS.	12	CS133							
							4-1367-MS.	15	TS101							
							.01		Buffer	B14						
RS (112)	Vol.	17	O	6			4-1362-MS.	6	RN235					6A7, 78, 6B7, 43,		
	Tone	22	L				4-1343-MS.	15	BN226					25Z5	470	
RU (131, 132)	Vol.	15	O	6			4-1450-MS.	9	RM257					6A7, 6D6, 25Z5, 37,		
	Tone	22	L				4-1451-MS.	9	RS203					43, 77	265	
							4-1343-MS.	15	BN226							
RV (104B) Auto	Vol.	17	UM161	M26		A96	4-1254-MS.	1	CN152		4	221	C3	6A7, 6B7, ^{2}78, 41, 84	175	10
							4-1343-MS.	15	BN226							
							4-1439-MS.	15	TS101							
							.01		Buffer	B14						
RW, 78-10, 79-10, 97-10, 133, 134, 135	Vol.	17	O	6			4-1488-MS.	28	RN242					^{3}6D6, ^{2}37, 85, ^{2}42, 80	265	1
	Tone	21	M				4-1494-MS.	28	RS213							
	F.O.G.	‡	M10MP													
RX 93, 95	Vol.	17	O	6			3-1473-MS.	1	RS213					^{3}58, 55, 56, 47, 80	125	3
							3-1384-MS.	1	RS213							
RY (108, 109, 125)	Vol.	17	O	6			4-1362-MS.	6	RN235	B103				6A7, 78, 6B7, 43,		
							4-1343-MS.	15	BN226					25Z5	470	
S, 26-36	Vol.	25	DRP307		See Note	A3								^{3}24, ^{2}27, ^{2}45		
"7AC" (475-UA or CA, 472-UA or CA, SF45/75-UA or CA, SF45/72-UA or CA)	Vol.	14	SRP256			A3								^{6}27, 71		3
E180, E180Z							2-4-5-6	‡	See Note	B1				80		
E420, E420Z							1-2-3-4-5	‡	See Note	B1				80		‡
M250, M250Z	Vol.	7	SRP257				1-2-3-4-5	‡	See Note	B1				^{5}27, ^{2}45, 80		3
"Special A. C." (262-UA or CA, 265-UA or CA, RP-62-UA or CA, RP-65-UA or CA)	Vol.	14	SRP256			A3								^{5}27, 71		
10, 10Z, 11, 11Z	Vol.	14	SRP256				‡	‡	See Note	B1				^{5}27, 71, 80		3
15M, 15MZ	Vol.	11	SRP257				1-2-3-4-5	‡	See Note	B1				^{4}27, 24, ^{2}45, 80		3
16, 16Z, 17	Vol.	4	SRP256		(Early)	A27	1-2-4-5-6	‡	See Note	B1				^{5}27, ^{2}71, 80		3
	Vol.	8	SRP257		(Late)	A4										
18DC	Vol.	4	SRP257				1-2-2-1	‡	See Note	B7				^{5}12A, ^{2}71A		
20, 20Z	Vol.	8	SRP257				1-2-4-5-6	‡	See Note	B1				^{5}27, ^{2}71, 80		2
25, 25Z	Vol.	11	SRP257				‡	‡	See Note	B1				27, ^{4}24, ^{2}45, 80		3
30, 30Z, 31, 31Z	Vol.	35	SRP256				‡	3	See Note	B1				^{5}27, 71, 80		2
32, 32Z	Vol.	8	SRP257				‡	‡	See Note	B1				^{5}27, ^{2}71, 80		2
35B	Vol.	25	DRP307				‡	‡	HS690					^{2}27, ^{3}24, ^{2}45, 81		3
35, 35Z	Vol.	12	D12				1-2-3	‡	HS690					^{2}24, ^{2}27, ^{2}45, 81 (or 80)		3
40	Vol.	25	‡		See Note	A47	1-2-3	‡	HS690					^{3}24, ^{3}27, ^{2}45, 80		3
41, 42	Vol.	64	O				1-2-3-4-5	‡	See Note	B1				^{3}24, ^{3}27, ^{2}45, 80		3
43	Vol.	24	DRP119				1-2-3-4	3/14	See Note	B1				^{3}24A, 27, ^{2}45, 80		3
44	Vol.	64	O				1-2-3-4-5	‡	See Note	B1				^{3}24, ^{3}27, ^{2}45, 80		3
46, 47	Vol.	64	O				1-2-3-4-5	‡	See Note	B3				^{3}24, ^{3}27, ^{2}45, 80		3
48, 49	Vol.	‡	‡		See Note	A85								^{3}27, ^{4}35, ^{2}47, 80		
	F.O.G.	‡	F7													
50, 50Z	Vol.	14	SRP256											^{6}27, ^{2}71A, 80		
66Q							2-3-4	‡	See Note	B1				80		2
70, 71, 72, 70Z	Vol.	14	SRP256											^{6}27, ^{2}71A, 80		
75	Vol.	12	SRP259				1-2-4-6-7	‡	See Note	B1				^{3}24, ^{2}27, ^{2}10, 81		5
77	Vol.	12	SRP257				1-4-5-7	‡	See Note	B1				^{3}24, ^{2}27, ^{2}10, 81		‡
86V P.P.							‡	‡	See Note	B1				80		
110A, 110B	Vol.	6	UC509	6	EX200		4-8	24	CN141					6D6, 6C6, 38, 12Z3		
							2-4	15	TN110							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
FADA—Continued																
130	Vol.	6	SRP263	6	EX200		20.22 20.17	6 15	RN235 TN110	B3				[2]6C6, 6D6, 43, 25Z5	175	
130L	Vol.	6	SRP263	6	EX200		20.22 20.17	6 15	RN235 TN110	B3				6A7, 6D6, 6C6, 43, 25Z5	175	
140	Vol.	18	MR48	M26			16-16 4-4	6 6/15	CM164 CN140	B3				6A7, 6D6, 75, 43, 37, 25Z5	175	
140L	Vol.	18	MR48	M26			16-16 4-4	8 8/15	CM164 CN140	B3				[2]6D6, 6A7, 75, 43, 25Z5	175	
140SW	Vol.	18	MR48	M26			8-4-4-16	8/15	CN 141/CN 142					[2]6D6, 6A7, 75, 43, 25Z5	175	
150 (Two Types)	Vol.	17	N	6			20.8	1/15	CN152/TS101	B3				6A7, 6F6-42, 6K7-6D6, 75, 80	456 456	1 1
150A	Vol.	17	O	6			20.33C	1/15	CN 152/TN 110					6A7, 6K7, 75, 6F6, 80	456	1
155	Vol.	4	G12	6	EX450		20.28	6/15	CM 164/TS 101	B3				6A7, 6D6, 76, 43, 25Z5	456	
156	Vol.	6	G12	6	EX 450		20.28	6/15	CM 164/TS 101					6A7, 6D6, 76, 43, 25Z5	456	
157	Vol.	6	G12	6	EX450		20.35	6/15	CN142/TS101					6A8, 6C5, 6K7, 43, 25Z5	456	
158, 159	Vol.	6	G12	6	EX450		20.28	6	CM 164/TS 101					6A7, 6D6, 76, 43, 25Z5	456	
160	Vol.	17	O	6			20.33A	1/15	CN 152/TN110					6A8, 6K7, 6H6, 6F5, 6F6, 5Z4	456	1
160A	Vol.	15	O	6			20.33C	1/15	CN 152/TN110					6A8, 6K7, 6H6, 6F5, 6F6, 5Z4	456	1
162	Vol.	18	MR53				20.27	12	CS130					[2]34, 1C6, 1B5, 30, 19	456	
163	Vol.	15	UM161	M26		A96	20.38 20.39 20.40 .005	1 15 13 	CN152 TN111 CS131 Buffer	 B14	13	245	C3	[2]6K7, 6A8, 75, 6C5, 79	456	10
165	Vol.	17	O	6			20.1A	8/15	CM164/CN140					6A8, 6K7, 75, 6H6, 43, 25Z5	456	
166 Motoset	Vol. Tone	17 22	UM161 MR39	M26	See Note	A96	20.29 20.30 .01	1 15 	CN152 TN110 Buffer	 B14	22	253Y	C3	[2]78, 6A7, 75, 41, 84	175	10
167, 168	Vol. Tone	17 22	N MR44	6			20.36	6/15	CM164/TN110					6A7, 6K7, 75, 6H6, 43, 25Z5	456	
170	Vol.	17	O	6			20.33A 20.34	1/15 13	CN 152/TN110 CS133					6A8, 6F5, 6F6, 6A6, 6K7, 5Z4	456	1
190	Vol.	17	O				20.7 20.4 20.34 20.6	1 1 13 15	WE1247 RS213 CS133 TN110					6A8, 6F5, [2]6F6, 6H6, [3]6K7, 5Z4	456	1
192	Vol.	7/17	DRP314	6			20.32	‡	CM164/CN141/TN110					[2]6K7, 6A8, 6H6, 6C5, [2]43, [2]25Z5	456	
193	Vol.	7/17	DRP314	6			20.32	‡	CM164/CN141/TN110	B267				[2]6K7, 6A8, 6H6, [2]43, [2]25Z5	456	
211	Vol. Tone	17 22	TRP610 N	8 6			20.47 20.25 20.14	6 13 15	CM164/CS126 CS123 TN111					[2]6K7, 6A8, 6Q7, 6C5, [2]25A6, 6G5, [2]25Z6	456	
212	Vol. Tone F.O.G.	17 22 ‡	TRP610 N O	8 8			20.50 20.4 20.44	3 3 15	WE1647 RS213 TN111					[3]6K7, 6L7, [2]6C5, 6Q7, [2]6L6, 6E5, [2]5W4	456	1
216	Vol. Tone F.O.G.	17 22 ‡	TRP610 N O	8 8			20.47 20.52 20.25 20.27 20.44	8 8 13 13 15	CM164/CS126 UR192 CS123 CS126 TN111					[3]6K7, 6L7, [2]6C5, 6Q7, [4]25A6, [3]25Z6, 6G5	456	
242	Vol.	17	MR53	M27			20.37	12	CS130					1C6, 1A4, 1F6, 1F4	456	
246	Vol.	17	MR53	M27			20.57 .007	1 	CN142 Buffer	 B14	13	W245	C3	1C6, 1A4, 1F6, 1F4	456	10
250	Vol.	6	E12	6			20.48	1	RN242					6A7, 6D6, 76, 6B5, 80	456	1
254	Vol.	6	E12	6	EX200		20.58	1/15	CN152/TS101					6A8, 6D6, 76, 25L6, 25Z5	456	
255	Vol. Tone	114 114	MR53 MR48	M26			20.48 20.39	1 15	RN242 TS101					6A7, 6D6, 75, 6B5, 80	456	1
260, 261	Vol.	6	G12	6	EX 450		20.49	6/15	CM164/TS105					6A7, 6D6, 76, 43, 25Z5	456	
262	Vol.	6	G12	6	EX450		20.49	6/15	CM 164/TS 105					6A8, 6K7, 6C5, 43, 25Z5	456	
265	Vol. Tone	114 114	MR53 MR48	M26			20.48	1	RN242					6A7, 6D6, 75, 6B5, 6G5, 80	456	1
266, 266SD, 266SG	Vol. Tone Fil.	17 22 29	UM161 MR39 R	M26	See Note	A96	20.42 20.30 .007	1 15 	CN152 TN110 Buffer	 B14	35	294	C3	78, 6A7, 6K7, 6Q7, 41, 84	175	10
267	Vol. Tone	17 22	UM161 MR39	M26		A96	20.59 .004	4 	RN262 Buffer	 B14	35	294	C3	[2]78, 6A7, 75, 41, 84	175	10
270, 271	Vol. Tone	15 22	O N	8 6			20.4 20.45 20.14	1 12 15	RS213 CS133 TN111					6A8, 6K7, 6H6, 6F5, 6F6, 5W4, 6G5	456	1
272, 273	Vol. Tone	17 21	MR53 MR48	M26			20.46 20.44	8 15	CM164/CS123 TN111					6A8, 6K7, 6H6, 6Q7, 43, 25Z5	456	
280, 281	Vol. Tone	17 21	MR53 MR48	M26			20.16 20.44	8 15	CM164/CS123 TN111					6A8, 6K7, 6Q7, 6H6, 43, 6G5, 25Z5	456	
290	Vol. Tone F.O.G.	17 22 ‡	TRP610 N O	8 6 8			20.51 20.4 20.45 20.44	1 1 13 15	WE1247 RS213 CS133 TN111					[2]6K7, 6A8, 6Q7, 6C5, [2]6L6, 6G5, 5Z4	456	1
291	Vol. Tone F.O.G.	17 22 ‡	TRP610 N O	8 6 8			20.51 20.4 20.45 20.44	1 1 13 15	WE1247 RS213 CS133 TN111					[2]6K7, 6A8, 6Q7, 6C5, [2]6L6, 6E5, 5Z4	456	1
311	Vol. Tone F.O.G.	17 22 ‡	TRP610 N O	8 6 8			20.47 20.25 20.44	6 13 15	CM164/CS126 CS123 TN111					[2]6K7, 6A8, 6Q7, 6C5, [2]25A6, 6E5, [2]25Z6	456	
312	Vol. Tone F.O.G.	17 22 ‡	TRP610 N O	8 8			20.50 20.4 20.44	3 3 15	WE1647 RS213 TN111					[3]6K7, [2]6C5, 6L7, 6Q7, [2]6L6, 6E5, [2]5W4	456	1
316	Vol. Tone F.O.G.	17 22 ‡	TRP610 N O	8 8			20.47 20.52 20.25 20.27 20.44	8 8 13 13 15	CM164/CS126 UR192 CS123 CS126 TN111					[3]6K7, 6L7, [2]6C5, 6Q7, [4]25A6, [3]25Z6, 6G5	456	
350	Vol.	15	MR53	M26			20.75	1/15	UR188					6A7, 6B7, 25L6G, 25Z5	456	
351	Vol.	17	MR53	M26			20.70	1/15	CN145/TS103					6A7, 6D6, 6Q7G, 25L6G, 25Z5	456	
352	Vol.	15	MR53	M26			20.75	1/15	UR188					6A7, 6B7, 25L6G, 25Z5	456	

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
FADA—Continued																
353	Vol.	17	MR53	M26			20.70	1/15	CN145/TS103					6A7, 6D6, 6Q7, 25L6G, 25Z5	456	
354	Vol.	17	MR53	M26			20.72 20.68	1 15	CN152 TS105/TS103					6A7, 6D6, 6Q7G, 25L6, 25Z5	456	
355	Vol.	17	MR53	M26			20.72 20.68	1 15	CN152 TS105/TS103					6A7, 6D6, 6Q7G, 25L6, 25Z5	456	
358	Vol.	17	MR53	M26			20.70	1/15	CN145/TS103					6A7, 6D6, 6Q7G, 25L6G, 25Z6	456	
360	Vol.	17	MR53	M26			20.67 20.68	6 15	CM164/CS126 TS105/TS103					6A7, 6D6, 6Q7G, 25L6, 25Z5	456	
361	Vol.	17	MR53	M26			20.73	1/15	2-CM164/TS103					6A7, 6D6, 6Q7G, 25L6G, 25Z5	456	
362	Vol.	17	MR53	M26			20.67 20.68	6 15	CM164/CS126 TS105/TS103					6A7, 6D6, 6Q7G, 25L6G, 25Z5	456	
365	Vol.	20	MR53	M26			20.71	1/15	CN155/TS103					6A8G, 6D6, 76, 6Q7G, 6V6G, 80	456	1
368	Vol.	17	MR53	M26			20.73	6/15	2-CM164/TS103					6A7, 6D6, 6Q7G, 25L6G, 25Z5	456	
370	Vol.	15	MR53	M26			20.64 20.66	6 6/15	CM164 CM164/TN111					6A8G, 6D6, 76, 6Q7G, 25L6G, 25Z5	456	
380	Vol. Tone	15 22	MR53 MR48	M28 M26			20.69 20.3 20.4	1 1 13	RS215 RS216 RS213					6A8G, [2]6K7, 76, 6Q7G, 6V6G, 6G5, 80	456	1
390	Vol.	15	MR53	M28			20.64 20.65	6 6/15	CM164 CM164/TS105					6A8G, 6K7, 76, 6Q7G, 25L6G, 6G5, 25Z5	456	
410	Vol. Tone	15 22	TM243-SS1 MR48	M28 M26			20.69 20.3 20.4 20.39	1 1 13 15	RS215 RS216 RS213 TN111					6A8G, [2]6K7, 6J7, 6H6, 76, 6Q7G, 6V6G, 6G5, 80	456	1
413	Vol. Tone	15 22	TM243-SS1 MR48	M28 M26			20.3 20.4 20.77	3 3 15	RS216 RS213 TN111					[3]6K7, 6A8G, 6J7, [2]76, [2]6V6G, 6H6, 6Q7G, 6G5, 5Z3	456	1
1242	Vol.	17	MR53	M27			20.37	12	CS130					1C6, 1A4, 1F6, 1F4	456	
1246	Vol.	17	MR53	M27			20.57 .007	1	CN142 Buffer	 B14	13	W245	C3	1C6, 1A4, 1F6, 1F4	456	10
1250	Vol.	6	E12	6			20.48	1	RN242					6A7, 6D6, 76, 6B5, 80	456	1
1255	Vol. Tone	114 114	MR53 MR48	M26			20.48	1	RN242					6A7, 6D6, 75, 6B5, 80	456	1
1262	Vol.	6	G12	6	EX250		20.49	6/15	CM164/TS105					6A8, 6K7, 6C5, 43, 25Z5	456	
1265	Vol. Tone	114 114	MR53 MR48	M26			20.48 20.39	1 15	RN242 TN111					6A7, 6D6, 75, 6B5, 6G5, 80	456	1
1450	Vol.	17	MR48	M26			20.1	8/15	CM164/CN140					6A7, 6D6, 75, 43, 25Z5	456	
1452	Vol.	17	MR48	M26			8-8-5	1/15	CN152/TS105					6A7, 6D6, 75, 42, 80	456	1
1453	Vol.	17	MR48	M26			4-8-8	1/15	CN152/TS101					6A7, 6D6, 75, 42, 80	456	1
1460	Vol.	17	MR48	M26			20.6	8/15	CM164/CN145					[2]6D6, 6A7, 75, 43, 25Z5	456	
1462 (above Ser. 22102)	Vol.	17	N	6			20.36	6/15	CM164/TN110					6A7, 6K7, 75, 6H6, 43, 25Z5	456	
1462	Vol.	17	N	6			20.1	6/15	CM164/CN140	B3				6A7, 6K7, 6C5, 75, 43, 25Z5	456	
1463	Vol.	17	N	6			20.36	6/15	CM164/TN110					6A7, 6K7, 75, 6H6, 43, 25Z5	456	
1470	Vol.	17	N				8 16 4-4	1 1 15	RS213 RS216 TN110					[2]58, 2A7, 2B7, 2A6, 2A5, 80	456	1
1480	Vol.	17	N				20.1	8/15	CM164/CN145					[2]6D6, 6A7, 75, [2]43, [2]25Z5	456	
1556	Vol.	6	SRP263	6	EX200		20.22 20.17	1 15	CN145 TN110	B3				[2]6C6, 6D6, 43, 25Z5	456	
1582	Vol.	17	O				20.7 20.4 20.5 20.6	1 1 12 15	WE1247 RS213 CS130 TN110					[3]6D6, 6A7, 75, [2]42, 80	456	1
1583	Vol.	17	O				20.7 20.4 20.5 20.6	1 1 13 15	WE1247 RS213 CS130 TN110					[3]6A7, 6D6, [2]42, 75, 80	456	1
FAIRBANKS-MORSE—Also see Audiola																
B6	Vol.	17	UC512	‡			8-8 .02	25	CM172 Buffer	B39 B14	38	297	C3	[2]6D6, 6A7, 75, 41, 84	177.5	10
C6	Vol.	18	Order from	Mfr.			8-8 .02	4	CM172 Buffer	B3 B14	35	294	C3	6A7, [2]6D6, 42, 75, 84	177.5	10
4A	Vol.	17	MR53	M27										1C7G, 1D5G, 1F7G, 1F5G	456	
4B	Vol.	17	MR53	M27			8-8 .01-.01	1	See Note Buffer	B3 B14	15	246	C3	1C7G, 1D5G, 1F7G, 1F5G	456	10
5A (5AT-1)	Vol.	6	‡	6	See Note A5		231-2	1	RM262					6A7, 6D6, 76, 41, 80	456	1
5B	Vol.	18	TM231-SS1	M26			232-1	4	RM262					6A8G, 6K7G, 6Q7G, 6F6G, 5Y3	456	1
5C	Vol.	18	TM231-SS1	M26			211-1 231-3	4 4/13	RS216 RN242					6A8G, 6K7G, 6Q7G, 6F6G, 5Y3	456	1
5D (5DC-1B), (5DT-3B)	Vol.	18	N	7			210-1	12	CS123					1C7G, 1D5G, 1F7G, 1H4G, 1J6G	456	
6A	Vol.	18	TM231-SS1	M26			211-1 231-3	4 4/13	RS216 RN242					6A8G, 6K7G, 6Q7G, 6G5, 6F6G, 5Y3	456	1
6C (6CC-2B), (6CT-4B)	Vol.	18	TM231-SS1	M26			210-1 230-1 .01-.01	1 15	RS203 TS101 Buffer	 B14	15	246	C3	6D8G, 15, 6T7G, 6L5G, 1J6G, 6N5	456	10
8A (8AC-2), (8AC-3), (8AT-8)	Vol. Tone	80 80	TM230-SS1 MR53	 M26			211-2 214-1	4 4	RS216 WE1647					[2]6K7G, 6C5G, 6L7G, 6Q7G, 6G5, 6V6G, 5Y3G	456	1
9A (9AC4, 9AC5)	Vol. Tone	80 80	TM230-SS1 N	M26			211-2 214-2 210-2	4 4 13	RS216 WE3540 RS213					[2]6K7G, 6L7G, 6J7G, 6C5G, 6H6G, 6Q7G, 6V6G, 5V4G	456	1
12A (12AC6)	Vol. Tone	140 140	TM230-SS1 N	M26			211-3 214-1 210-2 231-4	1 1 13 15	RS216 WE1647 RS213 TN110					[3]6K7G, 6L7G, 6J7G, [2]6C5G, 6H6G, 6Q7G, [2]6L6G, 5V4G	456	1
40 (4015)	Vol.	40	Y	6			5026 5025	4 4	RS216 RS213					[2]6C6, 41, 80	456	1
41 (4015)	Vol.	27	UC513	13		A41	5438	12	RS203					1C6, 34, 32, 33	456	
42 (42TOB) (42C1B)	Vol.	79	N	‡			6054	12	CS123					1C6, [2]1B4, 33	456	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
FAIRBANKS-MORSE—Continued																
43 (43TIB) (43CIB)	Vol.	79	N	7			6054	12	CS123		15	246	C3	[2]1B4, 1F4, 1C6	456	10
							5612	1	CN152							
							.01-.01		Buffer	B14						
51 (5106, 5107, 5109, 5111, 5112, 5141, 5143); 52 (5212, 5212A, 5241); 53 (5312, 5312A, 5341)	Vol.	17	N	6			EL8	4	RS213					2A7, 58, 2A6, 2A5, 80	456	1
	Tone	22	K12				EL6	15	TS101							
54 (5416, 5445)	Vol.	18	N				5026	4	RS216					6A7, 6D6, 75, 42, 80	456	1
	Tone	22	N	6			5518	4	RS216							
55 (5516, 5545)	Vol.	18	N				5026	4	RS216					6A7, 6D6, 42, 75, 80	456	1
	Tone	22	N	6			5518	4	RS216							
56 (5619, 5645)	Vol.	18	N	6			5025	4	RS213					6A7, 6D6, 75, 42, 80	456	1
							5519	4	RS216							
57 (57TO)	Vol.	18	N	6			5880	4	RS213					6A8G, 6Q7G, 2K7G,		
							5881	4	RS203					6F6G, 5Y3	456	1
58 (58T1, 58T2, 58C1)	Vol.	18	N	6			5825	4	RS213					5Y3, 6A8G, 6F6G,		
							5823	4	RS213					6K7G, 6Q7G	456	1
							8	14	RS213							
60 (6010, 6044)	Vol.	18	M				EL8	4	RS213					[2]6D6, 6A7, 6B7, 42, 80	456	1
	Tone	22	K12	6			EL16	4	RS216							
61	Vol.	17	N	6			5-16-10	11	UR182	B31				6A7, 6B7,[2]6D6, 25Z5,		
	Tone	22	K12											43	456	
62 (6210, 6244)	Vol.	18	M				EL23	8	UR182	B104				[2]6D6, 6A7, 6B7, 43,		
	Tone	34	K12	6										25Z5	456	
63 (6317, 6346)	Vol.	18	N				5025	4	RS213					[2]6D6, 6A7, 75, 42, 80	456	1
	Tone	22	N	6			5026	4	RS216							
							5429	13	RS213							
64 Auto	Vol.	18	UM147		See Note	A96	8-8	4	See Note	B3	35	294	C3	[2]6D6, 6A7, 75, 42, 84	177.5	10
							25	15	TS102							
							.02		Buffer	B14						
64 Home	Vol.	18	N				5429	12	RS203					1C6,[2]34, 30, 19	456	
	Tone	22	K12	13												
65 (6517, 6546)	Vol.	18	M				EL23	8	UR182	B104				[2]6D6, 6A7, 6B7, 43,		
	Tone	34	K12											25Z5	456	
66 (6616, 6645)	Vol.	18	N				5026	4	RS216					6A7, 6D6, 75, 42, 80	456	1
	Tone	22	N	6			5518	4	RS216							
67 (6717, 6746)	Vol.	18	N				5429	13	RS213		15	246	C3	[2]15, 6A7, 75, 19	456	10
	Tone	22	N	6			5317	15	TS101							
							5612	1	CN152	B3						
							.01		Buffer	B14						
68	Vol.	18	N				16-16	6	RM257					6A7, 6D6, 75, 43,		
							5	15	TS101					25Z5	456	
69	Vol.	6	E12				6198	27	RM255	B263				6A7, 6D6, 76, 43,		
														25Z5	456	
70 (7014, 7040, 7042)	Vol.	18	M				EL21	4	RS216					[3]6D6, 6A7, 6B7, 42, 80	456	1
	Tone	22	K12	6			EL8	4	RS213							
							EL18	14	CN150							
71	Vol.	18	N				5026	4	RS216					[2]6K7, 6A8, 6F5, 6H6,		
	Tone	22	N	6			5025	4	RS213					6F6, 5Z4	456	1
							5429	13	RS213							
72 (72T3, 72C2, 72C3)	Vol.	80	TRP616				16	4	RS216					5Y3, 6A8G, [2]6K7G,		
	Tone	80	N				8-8	4/13	RS213					6Q7G, 6L6, 6E5	456	1
73 (73T3B, 73C3B)	Vol.	20	TRP616				5429	13	RS213		15	246	C3	[2]15, 6A7, 75, 76, 19,		
	Tone	21	N				5612	1	CN152					6E5	456	10
							5317	15	TS101							
							.01-.01		Buffer							
74 Auto	Vol.	18	Order from Mfr.				8-8	4	CM172		35	294	C3	[2]6D6, 6A7, 85, 41,		
							8	15	TS106	B39				6A6, 84	177.5	10
							.01		Buffer	B14						
81 (8110, 8114)	Vol.	18	N	7			4	24	RS201					[2]34, 1C6,[4]30	456	
	Tone	22	K12													
82 (8218, 8247, 8248)	Vol.	18	M				5026	1	RS216					[3]6D6, 6A7, 85, [2]42, 80	456	1
	Tone	40	L	6			5317	14	TS101							
90	Vol.	18	M				5026	1	RS216					[3]6K7, 6A8, 6H6, 6C5,		
	Tone	41	L	6			8	14	CS123					[2]6F6, 5Z4	456	1
91 (91T4, 91C4, 91C5)	Vol.	80	TRP616				5888	4	WE3540					5Z4, 6F5, 6H6, [2]6K7,		
	Tone	80	N	6			5920	4	RS216					6L6, 6L7	456	1
							5889	13	RS211							
100 (10049, 10050)	Vol.	45	M				5415	31	RS213					[3]6D6, 6A7, [2]76, 42,		
	Tone	22	L	6			5025	31	RS213					[2]2A3, 5Z3	456	16
							5317	15	TS101							
110	Vol.	18	M				5415	3	RS213					[3]6K7, 6A8, 6H6, 6C5,		
	Tone	22	L	6			5025	3	RS213					6F6,[2]2A3,[2]5Z4	456	16
							5317	15	TS101							
120 (12C6)	Vol.	18	N				6035	3	WE1647					[3]6K7, 6L7, 6J7, 6H6,		
	Tone	80	N				5888	3	WE3540					6C5,[2]6L6, 6E5		
							5823	3	RS213					[2]5W4	456	1
							5317	15	TS101							
346	Vol.	17	UC512	‡			8-8	25	CM172	B39	38	297	C3	[2]6D6, 6A7, 75, 41, 84	177.5	10
	Tone	22	K12				.02		Buffer	B14						
347	Vol.	18	UC512	‡			8-8	25	CM172	B39	38	297	C3	[2]6D6, 6A7, 85,[2]41, 84	177.5	10
	Tone	44	K12				.02		Buffer	B14						
816, 840 (32 Volt)	Vol.	15	N				EL9	1	CS123		47	See Note	C10	[2]37, [3]39, 85, 79, 25Z5	177.5	10
	Tone	22	K12				EL-6	15	TS101							
							.01		Buffer	B14						
FEDERAL RADIO CORP.																
D Code 79-070	Vol.	11	SRP279				4-4-4	3	See Note	B1				[4]01A		25
E Code 79-060	Vol.	11	SRP279				4-4-4	3	See Note	B1				[5]01A		25
F Code 79-080	Vol.	11	SRP279				4-4-4	3	See Note	B1				[6]01A		25
F (25 Cycles)	Vol.	13	SRP279											[5]01A, 71A, 12A		
G (25 Cycles)	Vol.	14	N				2-4-4	3	See Note	B1				[3]26,[2]71A, 80		9
H (71-030)	Vol.	14	‡		See Note	A5	1-1-2-1	3	See Note	B1				[3]26,[2]27, 71A, 80		9
K	Vol.	14	UC503				2-4-4	3	See Note	B1				[3]27, 24,[2]71, 80		2
L	Vol.	‡	‡				‡	3	See Note	B1				[3]27,[2]71A-45, 80		7
M	Vol.	26	N				1-1-2-1	‡	See Note	B1				[5]27, 80,[2]45		1
FEDERATED PURCHASER—"Acratone"																
Cathedral Tone	Vol.	12	N	6			8-8	4	See Note	B3				[3]24, 45, 80		1
2	Vol.	6	G7	6			2-2	1	See Note	B1				[3]24, 47, 80		3
5	Vol.	6	H7	6			5-5	4	See Note	B3				[2]24, 51, 27, 47, 80	175	1
							5	4	See Note	B3						
6A	Vol.	15	UC503				12-8	4	See Note	B3				[3]58,[3]56,[3]59, 5Z3	175	3
	Tone	21	L				5-5	15	TN110							
	Supp.	12	Y													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
FEDERATED PURCHASER—Continued																
7A	Vol.	17	UC503				8-4	4	See Note	B3				^{2}58, 56, 2A6, 47, 80	465	1
	Tone	22	L				5	15	TS101							
8A	Vol.	7	J	6			16-8-4	11	UR182	B31				6A7, 78, 77, 43, 25Z5	465	
8B	Vol.	45	N				4	32	RS211					6A8, 6K7, 6H6, 6A6,		
	Tone	44	‡		See Note	A5	8-4	32	CN151	B3				^{2}6F6, 80	456	1
Royal 9A	Vol.	7	J		EX500		4-4	1	See Note	B3				77, 78, 43, 25Z5		
							5	15	TS101							
10	Vol.	59	Y10MP				8-8	4	See Note	B3				^{3}35, 27, 47, 80		3
11B	Vol.	45	N				4	32	RS211					6A8, 6K7, 6H6, 6A6,		
	Tone	44	‡		See Note	A5	8-4	32	CN151	B3				^{2}6F6, 80	456	1
12A	Vol.	15	UC503				12-8	4	See Note	B3				^{3}58, ^{3}56, ^{3}59, 5Z3	175	3
	Tone	21	L				5-5	15	TN110							
	Supp.	12	Y													
13A	Vol.	17	UC503				8-4	4	See Note	B3				^{2}58, 56, 2A6, 47, 80	465	1
	Tone	22	L				5	15	TS101							
14A	Vol.	56	‡		See Note	A5	4-4-4	7	See Note	B3				^{3}58, ^{2}56, 55, 53, 80	175	3
	Tone	22	‡		See Note	A5										
17	Vol.	15	N				4-4	4	RM261	B3				57, 58, 56, 55, 47, 80	175	1
	Tone	21	M													
24A	Vol.	17	UC503				8-4	4	See Note	B3				^{2}58, 56, 2A6, 47, 80	465	1
	Tone	22	L				5	15	TS101							
26A	Vol.	6	K12				5-16-8	11	UR182	B31				77, 78, 43, 25Z5		
29C, 30C, 31C	Vol.	18	N	6			4	32	RS211					6L7, 6C5, 6K7, ^{2}6Q7,		
	Tone	44	L				8-4	32	See Note	B3				^{3}6F6, 5Z4	456	1
32A	Vol.	15	‡		See Note	A19	8-50	4	See Note	B3				^{3}6D6, ^{2}37, 85, ^{4}43, ^{2}25Z5	175	
	Tone	44	K12				8	13	See Note	B3						
	Supp.	7	J				10	18	See Note	B3						
32C, 33C (L7)	Vol.	45	N	7			P391	1	RN232	B90	14	245C	C3	1C6, ^{2}34, ^{3}30, 19	456	10
	Tone	‡	L				.01-.01		Buffer	B14						
35AC	Vol.	8	G				1948	3	RS213					^{3}51, ^{2}27, ^{2}47, 80	175	3
	Tone	41	P	6			1976	3	RS211							
36A	Vol.	15	‡		See Note	A19	8-50	4	See Note	B3				^{3}6D6, ^{2}37, 85, ^{4}43, ^{2}25Z5	175	
	Tone	44	K12				8	13	See Note	B3						
	Supp.	7	J				10	18	See Note	B3						
38A	Vol.	6	K12				8-4	1	See Note	B3				^{2}58, 57, 47, 80	456	1
	Tone	22	K12													
39A	Vol.	15	N				8	1	RS213					^{2}57, ^{2}56, ^{2}58, 2A5, 80	485	1
	Tone	22	G12	6			10	15	TS101							
40AC	Vol.	8	G				1948	3	RS213					^{3}51, ^{2}27, ^{2}47, 80	175	3
	Tone	41	P	6			1976	3	RS211							
40 Auto	Vol.	17	UM154		See Note	A96	8-8	1	See Note	B3	35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
							5-5	15	TN110							
							.025-.025		Buffer	B14						
43A, 44	Vol.	15	N				8	1	RS213					^{2}57, ^{2}58, ^{2}56, 2A5, 80	485	1
	Tone	22	G12	6			10	15	TS101							
49	Vol.	18	MR48				6-12	1	CN155	B3	35	294	C3	6A7, 6D6, 6B7, 41, 84	456	10
							10	15	TS101							
							.02-.02		Buffer	B14						
52A	Vol.	6	J	6	EX750		10-10	1	See Note	B3				77, 78, 43, ^{2}12Z3		
							5-5	15	TN110							
53, 54, 58, 59	Vol.	6	‡		See Note	A5	10-12	1	See Note	B3				6D6, 6C6, 43, 12Z3		
							4-4	15	TN110							
65, 66	Vol.	6	‡		See Note	A5	12-12	1	See Note	B3				^{2}6D6, 6C6, 43, 12Z3	455	
							4-4	15	TN110							
67	Vol.	17	N				8-4	25	See Note	B3				6A7, 78, 75, 42, 80		1
							25	19	TS102	B6						
79, 80	Vol.	62	N				8-8	1	See Note	B3				^{2}58, ^{4}56, ^{2}57, ^{2}46, 80	175	1
	Tone	21	N				5	12	See Note	B3						
	QAVC	7	F				5	15	TS101							
86, 87	Vol.	15	N				8	1	RS213					^{2}58, ^{2}57, ^{2}56, 2A5, 80	485	1
	Tone	22	G12	6			10	15	TS101							
88	Vol.	6	D7		2		8-4	1	CN151					2A7, 57, 58, 2A5, 80	455	1
	Tone	22	K12				5	15	TS101							
SW88	Vol.	15	N				8, 8	1	RS213					^{2}56, ^{2}57, ^{2}58, 2A5, 80	485	1
	Tone	22	G12	6			10	15	TS101							
92	Vol.	17	N	6			6-8	4	See Note	B3	34	292	C3	^{3}6D6, 6B7, 41, 84	175	10
	Tone	22	H12				10	15	TS101							
							.02		Buffer	B14						
92A-94A (Above 500,001)	Vol.	17	500M No. 1	6	See Note	A1	8-6	4	See Note	B3	34	292	C3	^{3}6D6, 6B7, 41, 84 or		
	Tone	22	H12				.02		Buffer	B14				6Z4	175	10
93, 94, 96, 97	Vol.	18	N				8-8	1	See Note	B3				^{2}6D6, 6A7, 76, 75, 41,		
	Tone	22	G12	6			10-10	15	TN111					80	370	1
100	Vol.	6	G12		EX300		4-4	1	See Note	B3				^{2}24, 47, 80		1
104	Vol.	7	‡		See Note	A5	‡	4	See Note	B3				2A7, 58, 57, 56, 2A5,		
	Tone	57	‡		See Note	A5								80		1
107 Midget	Vol.	6	G12	6			2-2	1	See Note	B1				^{3}24A, 45, 80		3
117	Vol.	17	M	6			9659	1	CM172					2A7, ^{2}58, 2A6, 2A5, 80	465	1
	Tone	22	K12				1110	13	CS131							
							8876	15	TS101							
SA120-SA123	Vol.	64	N				8-8	1	See Note	B3				^{5}56, ^{2}57, ^{2}58, ^{2}46, 80	175	1
	Tone	21	N				5	15	TS101							
	Sil.	59	F				5	17	TS101							
120 Amplifier	Vol.	16	M				6-6	2	See Note	B3				^{2}56, ^{2}45, 80		1
121	Vol.	6	SRP263		EX300		8-8	4	See Note	B3				6A7, 6D6, 6C6, 43,		
							16	13	See Note	B3				25Z5	456	
							4	12	See Note	B10						
125 Amplifier	Vol.	16	L				‡	3	See Note	B2				^{2}57, ^{2}56, ^{2}50, ^{2}81		‡
126	Vol.	16	L				4-4	1	See Note	B2				^{2}57, ^{2}56, ^{2}50, ^{2}81		5
215	Vol.	6	SRP263		EX400		16-16	4	See Note	B3				6D6, 6C6, 43, 25Z5		
228, 229	Vol.	62	N											1C6, 34, ^{2}30, 32, 19	456	
	Tone	22	K12													
248	Vol.	17	N											^{2}6D6, 6A7, 85, ^{2}48	175	
	Tone	‡	K12													
424 Climax	Vol.	6	G12		EX300		4-4	1	See Note	B3				^{2}24A, 47, 80		1
460	Vol.	17	UM154	M26	See Note	A96	8-6	4	See Note	B3	34	292	C3	^{3}6D6, 6B7, 41, 84 or		
	Tone	22	H12				.02		Buffer	B14				6Z4	175	10
470-474 (600, 001 and up)	Vol.	18	N				8-8	1	See Note	B3				^{2}6D6, 6A7, 75, 41, 80,		
	Tone	22	G12	6			10-10	15	TN111					76	370	1
708	Vol.	23	‡		See Note	A5	4-4-8	3	See Note	B3				^{2}57, ^{2}56, ^{2}2A3, 83		5
728							8-8	24	See Note	B3				57, 2B6, 80		1
							5-5	15	TN110							
734	Vol.	23	100M No. 1		See Note	A3	8	12	See Note	B3				^{2}77, ^{2}37, ^{4}48		
745 Amplifier	Vol.	16	‡		See Note	A3	8	12	See Note	B3				^{2}77, ^{2}37, ^{2}46		
749	Vol.	18	N											^{2}78, 6A7, 85	175	
1000	Vol.	6	K12				5-16-8	11	UR182					77, 78, 43, 25Z5		
1200	Vol.	15	TRP623	6			50-8-8-10	64	2-UR182	B226				^{3}6D6, ^{2}37, 85, ^{4}43, ^{2}25Z5	175	
	Tone	44	K12													
	Supp.	7	J													
1940	Vol.	82	TRP609				8, 8	1	WE847					^{2}6K7, 6A8, 6H6, 6E5,		
														6C6, 79, ^{2}6B5, 5Z3	456	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
FIRESTONE																
54	Vol.	18	UM154			See Note A96	6-10	4	See Note	B3	35	294	C3	6A7, 6D6, 75, 42, 84	456	10
							.02		Buffer	B14						
64	Vol.	18	UM154			See Note A96	6-10	4	See Note	B3	35	294	C3	^{2}6D6, 6A7, 75, 42, 84	456	10
							.02		Buffer	B14						
R1322	Vol.	56	UC511	6							33	289Y	C3	77, ^{2}78, 85, ^{2}41	177.5	10
	Tone	44	Z12				83803	15	TS101							
							.005		Buffer	B14						
R1332	Vol.	17	UC512	6		A3					35	294	C3	6A7, 6D6, 75, 41, 84	456	10
							83803	15	TS101							
							.03-.03		Buffer	B14						
R1651AS, R1651WS, (R165)	Vol.	6	Y	6			88033	25	RS213					^{2}6D6, 6C6, 41, 84	456	35
							88007	25	RS213							
R1661 (R166 chassis)	Vol.	18	250M No. 1	6		A19	88512	1	RS216					6A8, 6K7, 6H6, 6G5,		
	Tone	57	N				88511	1	RS216					6F5, 6F6, 5Z4	456	1
							89755	13	CS121							
FORD-LINCOLN																
"Glove Box" (Zenith)	Vol.	17	SRP251	6		See Note A42	8-8	4	CM172	B3	37	296	C3	^{2}6D6, 6F7, 75, 42, 84	252.5	10
							10	15	TS101							
							.02		Buffer	B14						
"Glove Box" (Police)	Vol.	17	SRP251				8-8	4	CM172	B3	3	220B	C3	^{2}6E7, 6A7, 6C7, 42,		
	Sen.	40	G12				10	15	TS101					6Y5	‡	10
							.008-.008		Buffer	B14						
"Glove Box" (40-18805)	Vol.	17	SRP251				8-8	4	CM172	B3	3	220B	C3	^{2}6E7, 6A7S, 6C7, 42,		
							10	15	TS101					6Y5	‡	10
							.008-.008		Buffer	B14						
Police (Grigsby-Grunow)	Vol.	17	M				8	12	See Note	B3				^{2}39, ^{3}38, 85	‡	
B18805	Vol.	54	M				8	12	See Note	B3				^{2}39, 85, ^{3}38	‡	
N "Center Control"	Vol.	20	TRP614	6			30-2030	1	RN241		42	500P	C3	^{2}44, 77, 75, 41, 84	260	10
							30-2076	15	TS101							
							.01		Buffer	B14						
FORDSON																
FP (330001 Up)	Vol.	15	M				4-4	4	See Note	B3				6A7, 78, 75, 42, 80	456	1
	Tone	22	SRP284	7			5	19	TS105							
							5	15	TS101							
FP Batt. (173501 Up)	Vol.	54	M				5	20	TS105					1A6, 34, 32, 30, 19	456	
	Tone	22	L													
FP 32V (350001 Up)	Vol.	15	M	‡			6-10	1	See Note	B3	4	F221	B3	6A7, 78, 75, 42, 84	456	10
	Tone	22	SRP284	7			5	15	TS101							
							.05-.05		Buffer	B14						
FR	Vol.	6	G12	‡	EX100		4-4	4	CM170					58, 57, 2A5, 80		1
	Tone	22	SRP284	7												
FU	Vol.	6	L	6		See Note A14	4-20	6	See Note	B3				78, 44, 77, 43, 25Z5	456	
							5-5	15	TN110							
FV	Vol.	7	UC510	6		See Note A14	4-20	6	See Note	B3				44, 77, 43, 25Z5		
							5-5	15	TN110							
FW	Vol.	17	N	6			4-8-4	26	See Note	B3				^{3}78, 37, 85, ^{2}42, 80	456	1
	Tone	21	L													
R	Vol.	6	G12	‡			4-4	4	See Note	B3				78, 77, 42, 80 or 57,		
	Tone	22	SRP284	7										58, 2A5, 80		1
U	Vol.	6	L	6		See Note A14	4-20	6	See Note	B3				78, 44, 77, 43, 25Z5	456	
							5-5	15	TN110							
V	Vol.	7	UC510	6		See Note A14	20-4	6	See Note	B3				44, 77, 43, 25Z5		
							5-5	15	TN110							
V (All-Wave)	Vol.	15	N	6			40-8	6	See Note	B3				6F7, 77, 43, 25Z5		
							5	15	TS101							
W All Wave	Vol.	17	N	6			4-8-4	5	See Note	B3				37, ^{3}78, 85, ^{2}42, 80	456	1
	Tone	41	L													
X	Vol.	6	G12	6	EX200		4-4	4	See Note	B3				^{2}6D6, 6C6, 42, 80		1
							5-5	15	TN110							
"Warwick"	Vol.	15	L	6			8-4	4	See Note	B3				57, 58, 55, 47, 80	175	1
	Tone	21	N				10	17	TS101							
"Goldentone" 6T	Vol.	15	L	6			6T28	1	CN152					^{2}58, 55, ^{2}59, 80	456	1
							6T26	15	TS106							
6TA	Vol.	18	N				8-4	1	See Note	B3				2A7, 58, 2A6, ^{2}2A5, 80	456	1
FRANKLIN																
6 Tube	Vol.	6	G7	6	5		4-4	1	See Note	B3				27, ^{2}24, 35, 47, 80	175	1
	Tone	22	G12													
43AB or CL	Vol.	7	‡			See Note A5	DS197	1	See Note	B3				37, 39, 38, 36	456	
53	Vol.	6	H12			See Note A14	8-4	6	See Note	B3				^{2}78, 77, 43, 25Z5	456	
							4-4	15	TN110							
54L	Vol.	7	‡			See Note A5	4-8-4	8	CN145	B3				6A7, 78, 6B7, 43,		
														25Z5	456	
55U	Vol.	56	N	6			8-8-8-8	45	UR190	B105				6A7, 78, 6B7, 43,		
							5	15	TS101					25Z5	456	
63L	Vol.	6	G12				8-8	4	CM172	B3				57, 58, 56, 2A6, 47, 80	130	1
	Tone	21	P													
64	Vol.	6	‡			See Note A5	8-‡	1	See Note	B3				57, ^{2}58, 59, 55, 80	‡	1
	Tone	22	L				5	15	TS101							
65VL, 65VU	Vol.	56	N				8-8-8-8	45	UR190	B105				6A7, ^{2}78, 6B7, 43,		
							5	15	TS101					25Z5	456	
94	Vol.	15	M				8-8-8	3	See Note	B3				^{2}57, ^{2}58, 2B7, 56, ^{2}59,		
	Tone	41	N											5Z3	450	3
	Sen.	8	A10MP	6												
100 (Auto)	Vol.	7	UC501			See Note A3								^{3}36, 37, ^{2}38	175	
102	Vol.	6	G12				8-4	4	CM172	B3				^{2}24, ^{2}35, 47, 80	175	1
	Tone	22	G12													
104	Vol.	6	G12		EX500		4-4	1	CN150	B3				^{2}35, 24, 47, 80		1
	Tone	22	G12													
105	Vol.	6	G7	6			DS29	1	CN150	B3				58, 57, 47, 80		1
106	Vol.	6	G12				DS23	1	CN150	B3				57, 58, 55, 47, 80	‡	1
	Tone	21	P			See Note A4										
200 (Auto)	Vol.	15	N			See Note A3								^{2}36, 85, 37, ^{2}89	177	
FREED-EISEMANN																
A7	Vol.	17	N				4-4	15	TN110		2	210		6A7, 78, 6B7, 41	456	26
A9	Vol.	15	UM154			See Note A96	16	1	Order from	Mfr.	2	210	C3	6A7, 6D6, 85, 37, 41	456	26
							8-20	1	Order from	Mfr.						
							5-5	19	TN110							
							.05		Buffer	B14						
FE63 DC	Vol.	6	Y											^{2}39, ^{2}36, ^{2}89		
	Tone	22	L													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
FREED-EISEMANN—Continued																
FE96 DC	Vol.	6	H12	6			24.7	1	See Note	B3				^{3}36, 37, ^{4}38		
	Tone	22	‡		See Note	A5										
FE98	Vol.	7	‡		See Note	A5	24.30	1	See Note	B3				^{2}24, ^{3}35, 27, ^{2}45, 80	175	1
	Tone	22	‡		See Note	A5	24.23	1	See Note	B3						
FE99	Vol.	6	H12											^{3}36, 37, ^{2}33		
	Tone	22	‡		See Note	A5										
NR53 DC	Vol.	5	M				1-2	1	See Note	B7				^{5}01A, ^{2}71A		
NR55 AC, NR56 AC	Vol.	81	DRP240				2-1-4	3	See Note	B1				^{2}27, ^{3}26, ^{2}71, 80		18
NR57	Vol.	4	‡		See Note	A5								^{4}26, 71, 27		
NR60 AC	Vol.	4	M											^{4}26, 27, 71A		
NR60 DC	Vol.	4	M											^{5}01A, ^{2}71A		
NR70 AC	Vol.	4	M											^{5}26, 210, 27		
NR78 AC, NR79 AC	Vol.	7	K				1-1-4-1	3/14	See Note	B1				^{5}27, ^{2}45, 80		3
NR78 DC, NR79 DC	Vol.	13	M											^{5}01A, ^{4}71A		
NR80 DC	Vol.	4	C											^{5}01A, 12A, ^{2}71A		
NR80 AC	Vol.	4	E12											^{5}26, 27, 71, 80		11
NR85 AC	Vol.	4	E12											^{5}26, 27, 50, 81		8
NR90 S	Vol.	24	DRP308				1-2-4	3	See Note	B1				^{4}24, 27, ^{2}45, 80		3
NR95 AC	Vol.	7	K12				1-1-4-1	3/14	See Note	B1				^{6}27, ^{2}45, 80		3
351, 351P, 351L	Vol.	6	SRP263		EX400		12-8	6	See Note	B3				6D6, 6C6, 43, 25Z5		
							5-5	15	TN110	B6						
357P	Vol.	6	Z12		EX400		8-14	6	See Note	B3				6A7, 6D6, 76, 43,		
							5-5	15	TN110	B6				25Z5	456	
357L, 358L	Vol.	6	Z12		EX300		8-14	6	See Note	B3				6A7, 6D6, 75, 43,		
							5-5	15	TN110	B6				25Z5	132	
369S	Vol.	6	Z12		EX300		8-14	6	See Note	B3				6A7, 6D6, 76, 75, 43,		
							5-5	15	TN110	B6				25Z5	456	
FREED																
FE30L	Vol.	6	Y				4-4	24	CN140					6D6, 6C6, 12A7		
FE33	Vol.	6	Y		EX700		12-8	24	See Note	B3				6D6, 6C6, 25A7		
							5	15	TS101							
FE48	Vol.	6	Y		EX700		4-4	24	CN140					6D6, 6C6, 38, 76		
							5	15	TS101							
FE50, FE51L	Vol.	6	Y		EX700		12-8	24	CN145	B3				6D6, 6C6, 43, 25Z5,		
							5	15	TS101					K55C		
FE52, FE56, FE58	Vol.	6	D12				8-12	6	CN145	B3				6A7, 6D6, 75, 43,		
							5	15	TS101					25Z5	456	
FE60	Vol.	6	D7		See Note	A14	12-8	6	CN145	B3				6A7, 6D6, 75, 43,		
							5	15	TS101					25Z5, K49C	456	
FE62	Vol.	6	D7		See Note	A14	12-8	6	CN145	B3				6A7, 6K7, 75, 43,		
							5	15	TS101					25Z5, L49E	456	
FE69X	Vol.	45	MR48				8-8	23	See Note	B3				6A7, 6D6, 76, 75, 42,		
							5	15	TS101					80	456	1
FE351L	Vol.	6	Y		EX700		12-8	24	CN145	B3				6D6, 6C6, 43, 25Z5,		
							5	15	TS101					K55B		
MB5	Vol.	7	‡		See Note	A5	‡	1	See Note	B3				51, 24, 47, 80		1
MB7	Vol.	6	G12				8-4	1	See Note	B3				^{3}58, 56, 55, 47, 80	175	1
	Tone	22	L				4	17	TS105							
MB9	Vol.	6	G12				4-8-8	3	See Note	B3				^{3}58, ^{2}56, 55, ^{2}46, 80	175	1
	Tone	22	K12				4	15	TS105							
							4	17	TS101							
51DC	Vol.	6	Y											^{2}39, 36, ^{2}89	175	
54	Vol.	8	G				8-4	1	CN151	B3				^{2}58, 57, 47, 82		1
56	Vol.	8	G				8-4	1	CN151	B3				^{2}58, 57, 47, 80		1
58 AC	Vol.	6	Y				8-4	4	See Note	B3				57, 58, 55, 47, 80	175	1
	Tone	22	K12													
59	Vol.	8	G				8-4	1	CN151	B3				^{2}58, 57, 47, 82		1
72, 74	Vol.	6	G12				8-4	1	See Note	B3				^{3}58, 56, 55, 47, 80	175	1
	Tone	22	L				4	17	TS105							
90	Vol.	6	G12				4-8-8	3	See Note	B3				^{3}58, ^{2}56, 55, ^{2}46, 80	175	1
	Tone	22	K12				4	15	TS105							
91 DC	Vol.	6	H12				‡	1	See Note	B7				^{3}36, 37, 33		
92 AC	Vol.	8	‡		See Note	A5	‡	28	See Note	B3				^{2}51, 24, 47, 80		1
346	Vol.	6	G12				8-4	1	CN151					78, 77, 42, 80		1
							5	15	TS105							
354	Vol.	6	G12				8-4	1	CN151	B3				6A7, 78, 75, 42, 80	456	1
							5	15	TS105							
355	Vol.	6	G12				25-14	6	See Note	B3				6A7, 78, 75, 43, 25Z5	456	
							5	15	TS105							
360, 360X	Vol.	6	G12	6			8-4	1	CN151	B3				6A7, 78, 75, 76, 42, 80	175	1
							5	15	TS105							
365, 365X	Vol.	6	G12	6			25-14	6	See Note	B3				6A7, 78, 75, 76, 43,		
							5	15	TS105					25Z5	456	
JESSE FRENCH																
"G" Jr	Vol.	25	DRP119	6			1-2	1	See Note	B1				^{3}24, 45, 80		3
H1	Vol.	25	GE	6			8-8-.1	1	CN152 TP418					^{3}24, 45, 80		3
H2 AC	Vol.	6	G12				4	1	See Note	B3				24, 47, ^{2}51, 80		3
H2 Jr.	Vol.	6	G12				4-4	1	See Note	B3				^{3}24, 45, 80		3
	Tone	21	O													
H2 Special 110V DC	Vol.	40	E12				2-2	1	See Note	B11				30, ^{3}32, 71A		
S2	Vol.	25	DRP119	6			5483	2	RN242	B3				^{4}24, 27, ^{2}45, 80		1
	Tone	41	O													
U1	Vol.	7	C	6			8-8	34	See Note	B3				24, 27, ^{3}35, 47, 80	175	1
	Tone	22	K12													
5-093	Vol.	13	K12				‡	37	See Note	B1				^{5}26, 27, ^{2}45, 80		11
JESSE FRENCH EXPORT.																
5X, 6X, 7X	Vol.	15	M	6			22-173	30	WE847					^{3}58, ^{2}57, 56, 59, 80	175	3
	Tone	34	N													
	Sen.	7	‡		See Note	A5										
8 Tube AC	Vol.	1	K12				‡	3	See Note	B1				^{5}26, 27, ^{2}71, 80		9
FRESHMAN																
G (1st Type)	Vol.	35	M				‡	1	See Note	B4				^{4}26, 27, 71, 80		11
G (2nd Type)	Vol.	35	M				‡	3	See Note	B4				^{4}26, 27, 71, 80		11
G (3rd Type)	Vol.	3	G12				2-2-6-4-2-1	3/14	See Note	B4				^{4}26, 27, 71, 80		11
H	Vol.	35	M				‡	1	See Note	B4				^{4}26, 27, 210, ^{2}81		27
K	Vol.	35	M				‡	1	See Note	B4				^{4}26, 27, 12A		7
L DC	Vol.	35	M											01A, ^{2}12A		
M	Vol.	60	K12		See Note	A43	2-4	1	See Note	B1				71, ^{4}26, 27, 80		9
N	Vol.	60	K12		See Note	A43	1-4	1	See Note	B2				^{4}26, 27, 50, 81		8
Q15, Q16	Vol.	60	G12				2-4	1	See Note	B1				22, 27, 26, 71, 80		11
QD-16-S	Vol.	4	G12				1-2-2	3	See Note	B1				22, 27, 26, 71, 80		8
2N with 2N60S	Vol.	60	K12		See Note	A43	1-4	1	See Note	B2				^{4}26, 27, 50, 81		8
30-15, 30-16	Vol.	4	G12				1-4	1	See Note	B1				22, 27, 26, 71, 80		8
21AC and 22AC	Vol.	81	DRP240				2-1-4	3	See Note	B1				^{3}26, ^{2}27, ^{2}71A, 80		18
21 DC	Vol.	13	M											^{5}01A, ^{2}71A		
31, 32, (AC)	Vol.	7	K				1-1-4	3	See Note	B1				^{5}27, ^{2}45, 80		3
31S, 32S, (AC)	Vol.	58	M				1-1-4	3	See Note	B1				24, ^{5}27, ^{2}45, 80		3
41 (AC)	Vol.	7	K				1-1-4	3	See Note	B1				^{6}27, ^{2}45, 80		3

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
FROST MINTON																
FM4, FM5	Vol.	6	G12				4-4	25	See Note	B3				^{3}24, 45, 80		1
4PW	Vol.	6	G12				4-4	25	RM261	B3				^{3}24, 47, 80		1
FULTON																
Pre.							8-8	4	See Note	B3				^{2}76, 84		1
							10	15	TS101							
Z	Vol.	16	M				8-8-8	4/17	RM265	B106				2A3, 2A6, 5Z3, 56		1
							5-5	15	TN110							
13B	Vol.	95	MM				16	1	See Note	B3				2A6, 5Z3, ^{2}50, 53, 56		8
	Equal.	‡	M				4	1	See Note	B4						
							8	17	TS106							
							4	13	CS131	B3						
15B	Vol.	95	MM				16-6	‡	See Note	B2				^{2}2A3, 5Z3, 6A6, 75, 76		14
	Equal.	‡	M		See Note A3		4	13	See Note	B3						
							8	17	TS106							
35B	Vol.	95	MM				6-16	1	See Note	B3				^{2}50, 56, 57, 59, ^{2}83		1
	Equal.	‡	M		See Note A3		2-3	1	See Note	B4						
							10	14	TS106							
							8	15	TS101							
GALVIN MFG CO. "Motorola"																
Super 6	Vol.	56	Order from Mfr.				8420	1	CN141		23	270B		77, ^{2}78, 85, ^{2}12A5	456	10
	Tone	44	L													
Dual 6	Vol.	77	Order from Mfr.				8825	1	SR611		20	253	C3	^{2}78, 77, 75, 42, 84	262	10
	Tone	22	Order from Mfr.				.01		Buffer	B14						
JB	Vol.	7	K				32-16-16	11	SR613					^{2}6D6, 6A7, 75, 43,		
	Tone	22	K12				10	15	TS101					25Z5	‡	
J8	Vol.	7	K		EX150		21632	11	SR613					^{2}6D6, 6A7, 75, 43,		
	Tone	22	K12											25Z5	175	
S10	Vol.	83	N				8-8-12	3	See Note	B3				^{2}78, 77, 85, 56, ^{2}45, 83	175	1
	Tone	22	K12				25	15	TS102							
Twin "8"	Vol.	15	Order from Mfr.				8825	1/19	SR611		20	253	C3	^{2}LA, 37, 77, ^{2}78, 84, 85	262	10
	Tone	22	Order from Mfr.				.01		Buffer	B14						
Auto Set	Vol.	7	UC509											^{3}24, 01A, ^{2}12		
"Golden Voice"	Vol.	18	UM154-SS10	M26			2326	1	SR612		35	294	C3	^{2}6K7, 6A8, 6R7, ^{2}6H6,		
	Tone	22	Order from Mfr.				.005		Buffer	B14				6C5, ^{2}6F6, 0Z4	262	6
	Sen.	7	Order from Mfr.													
Golden Voice (1937)	Vol.	45	TM230-SS7	M26			3348	1/19	SR609		35	294	C3	^{2}6K7, 6A8G, 6H6G,		
							.005		Buffer	B14				6C5G, 6J5G, 6N7G,		
														0Z4/6X5G	262	10
5 Tube, "Split Case"	Vol.	7	UC510		See Note A3									01A, ^{3}24, 71A		
5T (5-1)	Vol.	18	UM147-SS16				14H37285	4	RM262					6A7, 6D6, 75, 41, 80	465	1
	Tone	34	MR33	M26												
5T late (5-3)	Vol.	15	MR53				14H37285	4	RM262					6A7, 6D6, 75, 41, 80	465	1
	Tone	34	MR33	M26												
5T1, 5T2, 5Y9 (5-2)	Vol.	18	UM147-SS16				14H37285	4	RM265					6A7, 6D6, 75, 42, 80	465	1
	Tone	34	MR33	M26												
6A (6-1)	Vol.	18	UM147-SS16				14H37281	4	RM265					6A7, 6D6, 75, 42,		
	Tone	34	MR33	M26										6G5, 80	465	1
5T 71	Vol.	7	UC510		See Note A3		8	12	See Note	B3				^{3}24, 38, 71A		
6A1 (6-5)	Vol.	15	MR53				14H37285	4	RM262					6A7, 6D6, 75, 41, 80,		
	Tone	34	MR33	M26										6U5	465	1
6T, 6Y (6-2)	Vol.	18	MR44				14H37275	25/13/19	SR623					6A8G, 6K7G, 6H6G,		
	Tone	34	MR33	M26			14H37277	4	WE847					6F5G, 6V6G, 5Y3	465	1
							14H37288	13	CS130							
6T-12PL	Vol.	7	UC510		See Note A3		50	‡	See Note	B3				^{3}24, 01, ^{2}12		
6X (6-3, 6-6)	Vol.	18	MR48	M26			14H37286	6	Order from Mfr.					6A8G, 6K7G, 6Q7G,		
							14H37284	15	TN111					25L6G, 25Z6G	465	1
7T-38	Vol.	15	L											^{3}24, 37, ^{2}38		
7T-38A	Vol.	62	N											^{3}51, ^{2}37, ^{2}38		
7T-47A	Vol.	62	N				10	19	TS105					^{3}37, ^{2}39, ^{2}LA	175	
9A, 9R, 9Y (9-1, 9-2, 9-3)	Vol.	20	TM220-SS1				14H37275	25/13/19	SR623					6A8G, ^{2}6K7G, 6H6G,		
	Tone	34	MR33	M26			14H37277	4	WE847					^{2}6J5G, 6V6G, 6G5,		
							14H37279	4	RS213					5Y3	465	1
							14-H-37288	13	CS130							
10Y (10-1)	Vol.	45	MR44				14H37275	25/13/19	SR623					^{3}6K7G, 6A8G, ^{2}6J5G,		
	Tone	‡	MR39	M26			14H37277	25	WE847					6H6G, 6V6G, 6G5,		
	Fid.	‡	MR48				14H37288	13	CS130					5Y3	465	1
	Sen.	7	MR19				14H37279	13	RS213							
10Y late (10-3)	Vol.	18	MR44				14H37275	25/13/19	SR623					^{3}6K7G, 6A8G, ^{2}6J5G,		
	Tone	‡	MR39	M26			14H37277	25	WE847					6H6G, 6V6G, 6G5,		
	Fid.	‡	MR48				14H37279	13	RS213					5Y3	465	1
	Sen.	7	MR19													
10Y1 (10-2)	Vol.	18	MR44				14H37274	25	WE3540					^{2}6K7G, 6A8G, 6B8G,		
	Tone	‡	MR39	M26			14H37277	25	WE847					6H6G, 6G5, 6J7G,		
	Fid.	‡	MR48				14H37273	13/19	CN150/TS103					6R7G, 6V6G, 5Y3	465	37
	Sen.	7	MR19				14H37279	13	RS213							
12Y, 12Y1 (12-1)	Vol.	18	MR44				14H37274	25	WE3540					^{2}6K7G, 6A8G, 6B8G,		
	Tone	‡	MR39	M26			14H37277	25	WE847					^{2}6J5G, 6H6G, 6J7G,		
	Fid.	‡	MR48				14H37273	13/19	CN150/TS103					6R7G, 6V6G, 5X4G,		
	Sen.	7	MR19				14H37279	13	RS213					6U5	465	37
34	Vol.	77	UC515	6			8126	1	CN151		35	294	C3	^{2}78, 77, 75, 42, 84	456	10
							R2520	19	TS102							
							.02		Buffer	B14						
35	Vol.	18	UM154-SS8	M26			3344	19/24	SR632		35	294	C3	^{2}78, 6A7, 75, 41, 84/		
							.01		Buffer	B14				6Z4	262	10
44	Vol.	17	SRP280				1823	1	SR601		11	235	C3	12A5, 75, 77, ^{2}78	456	10
							10	15	TS101							
							.01		Buffer	B14						
45	Vol.	18	UM154-SS8	M26			3344	1/19	SR632		35	294	C3	^{2}78, 6A7, 75, 41, 84/		
							.01		Buffer	B14				6Z4	262	10
50	Vol.	18	UM154-SS11	M26			2317	1	SR602		35	294	C3	6A7, ^{2}78, 75, 41, 84	262	10
							.01		Buffer	B14						
51	Vol.	83	N											^{2}36, 39, 85, 41	175	
55	Vol.	56	SRP280	7			88300	21	CN152		11	231	C3	77, ^{2}78, 75, LA	456	26
							830	1/19	SR603							
							.01		Buffer	B14						
57	Vol.	17	UM154-SS15	M26			1540	1/19	SR604		21	253T	C3	6A7, 41, 75, 78, 84	456	10
							.01		Buffer	B14						
60	Vol.	18	UM154-SS10	M26			2188	1	SR605		35	294	C3	78, 6A7, 75, 6B5, 84	262	10
							.008		Buffer	B14						
61	Vol.	83	N				8200 L or W	1	CS123		39	303S	C3	^{2}36, 39, 85, 41	175	26
							.1		Buffer	B14						
62	Vol.	17	UM154-SS15	M26			1510	1/19	SR604		21	253T	C3	6A7, 41, 75, 78, 84	456	10
							.01		Buffer	B14						
65	Vol.	18	UM154-SS9	M26			3345	1	RN242		35	294	C3	^{2}78, 6A7, 75, 6AB6G,		
							.01		Buffer	B14				0Z4/6X5G	262	10
66	Vol.	17	Order from Mfr.				8420	1	CN141		23	270B		77, ^{2}78, 85, ^{2}12A5	456	10
	Tone	41	L													
70	Vol.	18	UM154-SS7	M26			3346	4	RM262		35	294	C3	^{2}78, 6A7, 75, 42, 0Z4/		
							.005		Buffer	B14				6X5G	262	10

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GALVIN MFG CO.—Continued																
75	Vol.	56	UM154-SS15	M26			1465 or 1468	1/19	SR607		21	253T	C3	^{2}78, 77, 75, 41, 84	262	10
							.01		Buffer	B14						
77	Vol.	17	SRP280				8300A	4	CS123		10	230	C3	^{3}39, 77, 75,^{2}LA	456	26
							8300B	4	CS123							
							6530	19	SR608							
							.01		Buffer	B14						
77A	Vol.	56	SRP280				8420	1	CN141		23	270B		^{2}12A5, 77,^{3}78, 85	456	10
	Tone	44	L													
78	Vol.	15	N											^{2}36,^{2}38, 39, 85, 37	175	
79	Vol.	56	UM154-SS15	M26			1468 or 1465	1/19	SR607		21	253T	C3	^{2}78, 77, 75, 41, 84	262	10
							.01		Buffer	B14						
80	Vol.	55	UM154-SS10	M26			2185	1	SR609		35	294	C3	^{2}6K7, 6A8, 6H6, 6C5,		
	Tone	76	Order from	Mfr.			.005		Buffer	B14				^{2}6N6, 0Z4	262	10
88	Vol.	15	N				8200 L or W	1	CS123		39	302S	C3	^{2}36, 39, 85, 37,^{2}38	175	10
							.05		Buffer	B14						
100	Vol.	77	UM154-SS11	M26			1388	1/19	SR610		21	253T	C3	^{2}78, 77, 85, 76, LA, 84	262	10
							.01		Buffer	B14						
110	Vol.	18	UM154-SS11	M26			1388	1/19	SR610		21	253T	C3	^{2}78, 77, 85, 37,^{2}LA, 84	262	10
							.01		Buffer	B14						
GAMBLE SKOGMO																
A1	Vol.	45	N	6			44X31	23	WE1247					6J7, 6K7, 6C5, 6H6,		
	Tone	34	UC502				44X35	23	WE3540					6G5, 6F5, 6F6,		
														5Y3G, or 6J7G,		
														6U7G, 6C5G, 6H6,		
														6G5. 6F6G, 5Y3G.	456	1
A2	Vol.	20	TM228-SS1	M26			44X30	25	RS216					^{2}6K7, ^{2}6J7, ^{2}6C5, 6H6,		
	Tone	34	O				44X11	25	WE1847					6G5. ^{2}6F6, 5Y3G,		
							45X223	13	CS121					or ^{2}6U7G, ^{2}6J7G,		
							45X222	19	TS103					^{2}6C5G, 6H6, 6G5,		
														^{2}6F6G, 5Y3G	456	1
A3	Vol.	20	TRP618	6			44X21	25	WE2545					^{3}6K7, 6J7, 6C5, 6H6,		
	Tone	65	O				44X36	25	WE4045					6G5, ^{2}6L6, ^{2}5Y3G,		
							45X224	‡	TS103					or ^{3}6U7G, 6J7G,		
														^{2}6C5G, 6H6, 6G5,		
														^{2}6L6G,^{2}5Y3G	456	1
A6	Vol.	20	TRP618	6			44X21	25	WE2545					^{3}6K7, 6J7, ^{3}6C5, 6H6,		
	Tone	65	O				44X36	25	WE4045					6G5, ^{2}6L6, ^{2}5Y3G,		
							45X224	‡	TS103					or ^{3}6U7G, 6J7G,		
														^{3}6C5G, 6H6, 6G5,		
														^{2}6L6G,^{2}5Y3G	456	1
06A	Vol.	97	TRP602				P80968	12	CS121					32,^{2}34, 19, 30	175	
07A	Vol.	15	O	6			P80990	25	RS216					^{2}6D6, 6C6, 37, 42, 80	175	1
	Tone	22	UC502				P80916	25	RS213							
							8	15	TS101	B10						
2-ODM-578	Vol.	7/15	DRP315	6		A59	44X10	4	RS216					^{4}6K7,^{3}76,^{2}45, 80	456	3
	Tone	41	UC504				44X11	4	RS216							
							44X18	13	RS201							
5Y	Vol.	17	P	6			P82002	1/15	CM173		32	286S	C3	^{2}6D6, 6C6, 75, 41	175	10
							.007		Buffer	B14	32	G286S	C16			
6C1	Vol.	18	UM147-SS3	M26			45X210	4	CM171		35	294	C3	^{3}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	UC502				.0075		Buffer	B14						
6J Series	Vol.	56	TM220-SS3	M26			45X219	1/15	RN242/TS101		18	[illegible]43	C3	^{2}6K7, 6J7, 6B7, 41,		
	Tone	22	MR53				.0055		Buffer	B14				6A6	175	10
6L	Vol.	18	UM154-SS3	M26			P45X210	4	CM171		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	UC502				.0075		Buffer	B14						
6U	Vol.	18	UC511	6			P81028	1	CN152		20	253	C3	^{2}78, 77, 75, 41, 84	262	10
	Tone	22	UC502				P91021	15	TN111							
							.01		Buffer	B14						
7J512, 7J574	Vol.	56	N				44X11	23	RS216					^{3}6D6, 76, 6B7, 42, 80	456	1
	Tone	34	UC502				44X10	23	RS216							
11B	Vol.	15	N	6			17644	1	WE1647					^{2}6K7, 6A8, ^{2}6C5, 6F5,		
	Tone	130	N				17645	1	RS216					6G5, ^{2}6L6, ^{2}5Y3	456	1
							17672	14	CS123	B3						
							17080	15	TS101							
20C7, 20C8	Vol.	45	P	6			P81039	2	WE1647					^{4}6D6,^{3}76,^{2}45, 80	456	3
	Tone	41	UC504				P81018	12/13	CM173	B107						
22CM756	Vol.	7/15	DRP315	6			P44X21	25	WE2545					^{4}6K7,^{3}76,^{3}6F6,^{2}80	456	1
	Tone	22	UC504				P44X11	25	RS216							
							P44X20	19	Order from	Mfr.						
26B5	Vol.	56	N				P81016	23	CM172		20	F253	C3	6F7, 6D6, 6B7, 12A5,		
	Tone	34	UC502				.015		Buffer	B14				^{3}12Z3	175	10
26FM552	Vol.	7/15	Order from	Mfr.			P44X22	3	WE3540					^{4}6K7, ^{3}76, 6B7, 6F7,		
	Tone	34	O				P44X23	13	RS208					^{4}2A3, 45,^{2}5Z3	456	‡
							P45X205	13/‡	CN140/CS126							
							P44X26	13	CS135							
26R1	Vol.	17	UC514				E45X206C	4/15	CM171/TS105		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	34	UC502				.0075		Buffer	B14						
26S1	Vol.	17	UC514	6			45X204	1	CN152	B3	20	253	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	M				45X203	15	TN111							
27C1, 27C5	Vol.	45	O				P81014	12	CM164					^{3}34,^{3}30, 19	175	
30A	Vol.	6	SRP263	6	EX200		1258	25	CS133					6D6, 6C6, 42, 80		1
							1260	25	CS131							
31BT	Vol.	45	N				2272	1	CN155	B3	30	285	C3	1C6,^{2}34,^{2}30, 19	465	10
	Tone	22	N	7			.02		Buffer	B14						
34BT	Vol.	18	N	7			2272	1	CN155	B3	30	285	C3	1C6, 34, 1B5, 38	465	10
	Tone	57	N				8876	15	TS105							
							.02		Buffer	B14						
36L	Vol.	18	N	6										6A7, 6D6, 75, 76,^{2}48	465	
	Tone	44	Y													
42DL670	Vol.	45	TM247-SS1				30	2	WE2545					^{4}6K7, ^{3}6C5, 6H6, 6G5,		
	Tone	65	MR55				12	2	RS215					^{2}6L6,^{2}5Z4MG	456	1
46L1	Vol.	18	UM154-SS3	M26			45X210	4	CM171		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	UC502				.0075		Buffer	B14						
47LL	Vol.	17	TRP612				14	23	RS216					^{3}6K7, 6C5, 6Q7, 6G5,		
	Tone	34	Order from	Mfr.			18	23	WE1847					6F6, 5Z4MG	456	1
47P608	Vol.	18	MR48				30-12	13/15	TS107/TS101					^{3}6K7, 6A8, 85, 43, 6A6	456	
	Tone	‡	MR36													
47R, 47RL	Vol.	56	N	6			P44X10	23	RS216					^{3}6K7, 76, 6B7, 6G5,		
	Tone	34	Order from	Mfr.			P44X11	23	WE1847					6F6, 80	456	1
51C	Vol.	6	G12				8	4	RS213					^{2}57, 58, 47, 80	175	1
	Tone	22	K12				4	4	RS211							
							25	17	TS102							
70	Vol.	15	O				8-8	1	CN152	B3				^{4}35,^{3}27,^{2}47, 80	262	3
	Tone	44	UC502				8	13	CS133							
							8	15	TS106							
77, 77A	Vol.	15	N	7										1C6, 19,^{2}30, 32,^{2}34	456	
85	Vol.	6	G12				3366	1	CS131					^{2}24A, 35, 47, 80	262	1
							2803	1	CS133							
90, 92D, 92M	Vol.	2/10	DRP241				4	13	CS121					^{4}32, 33	175	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GAMBLE SKOGMO—Continued																
400A, 410B	Vol.	135	UC501											1C6, 34, 32, 33	456	
404	Vol.	6	TRP601											1A6, 32, 33	465	
	Fil.	29	M4R													
425	Vol.	7	G				8	4	RS203					58, 57, 47, 80		1
							4	4	RS211							
430	Vol.	2	G12				17080	19	TS101					1A6, 19, 33	456	
457 (Regal)	Vol.	6	G12				8-8	4	RM262	B73				58, 57, 47, 80		1
460	Vol.	6	H12		See No	te A14	1840	4	RS215					6A7, 6C6, 42, 80	456	1
							1841	4	RS216							
501	Vol.	70	H12											[2]32, 34, 33, 30	465	
	Fil.	29	R													
510, 511	Vol.	17	MR48				8, 8	4	CS133					6A7, 6D6, 75, 42, 80	456	1
							10	15	TS101							
516	Vol.	134	K12											32, [2]34, 30, 19	456	
Z516	Vol.	15	M	6			22-173	23	CS133					[3]58, 56, [2]57, 59, 80	175	3
	Tone	34	M				22-172	23	CS130							
Z521	Vol.	20	TRP606				22-167	28	CS133					[3]58, [2]56, [2]59, 57, 80	175	7
	Tone	41	M				22-169	15	TS106							
	Sen.	7	UC500													
525	Vol.	17	N	6			C525	11	UR182	B31				6D6, 75, 43, 25Z5	456	
Z530	Vol.	20	TRP606				22-167	28	CS133					[3]58, [3]56, [3]59, [2]57, 80	175	7
	Tone	41	M				22-169	15	TS106							
	Sen.	7	UC500													
540	Vol.	17	N	6			C525C/C525D	11	UR182	B31				[2]6D6, 25Z5, 43, 75	456	
540 (Batt.)	Vol.	131	N	7			17080	19	TS101					1C6, 1A4, 1B5, 950	456	
541	Vol.	56	MR48	M27			17080	19	TS101					1C7G, 1D5G, 1H6G,		
														1G5G	456	
550	Vol.	15	N				17080	19	TS101					1A6, 34, 30, 32, 33	456	
550AC	Vol.	17	MR48	M26			P1003	4	RM262					2A7, 58, 2A6, 2A5, 80	456	1
550 (Batt.)	Vol.	15	N				17081	19	TS101					1A6, 34, 30, 32, 33	456	
566	Vol.	18	UM154-SS13	M26			119-20	4	CM171	B93				6A8, 6K7, 75, 41, 84	465	10
							.01		Buffer	B14						
575	Vol.	6	Z12	6	EX100		P119-6	4	RM262	B73				58, 57, 2A5, 80	175	1
578	Vol.	56	O				P103-6	4	RS213					6A7, 6D6, 6B7, 42, 80	456	1
							P103-7	4	RS213							
580	Vol.	17	N	6			P119-15	4	CM160		35	294	C3	6D6, 6A7, 75, 42, 84	175	10
							.01		Buffer	B14						
585 Series "A"	Vol.	18	N	6			P119-11	1/15	CM173	B75				6F7, 6D6, 75, 42, 80	370	1
585 Series B and C	Vol.	18	N	6			P103-6	4	RS213					6F7, 6D6, 75, 42, 80	370	1
							P103-7	4	RS213						465	
586A	Vol.	18	O	6			P103-6	42	RS213					6A7, 78, 75, 41, 80	465	1
							P103-7	42	RS213							
623	Vol.	18	MR48				18-102	1/15	RN245	B34				6A7, 6D6, 75, 6G5,		
	Tone	21	MR48	M26										41, 80	456	1
645	Vol.	18	MR48				18-102	1/15	RN245	B34				6A7, 6D6, 75, 6G5,		
	Tone	21	MR48	M26										41, 80	456	1
650ABC	Vol.	62	N	7			17080	19	TS101					1C6, [2]1A4, 30, [2]950	456	
660	Vol.	17	N	6			C550	4	CM172		3	220B	C3	[2]6D6, 6A7, 75, 89,		
														6Z4	175	10
670	Vol.	17	N	6			P103-2	4	RM262		37	296	C3	6D6, 6C6, 78, 75, 42,		
							20	15	TS102					84	175	10
							.02		Buffer	B14						
670A	Vol.	17	N	6			P119-4	4	CM172		37	296	C3	[2]6D6, 6C6, 75, 42, 84	175	10
675	Vol.	18	N	6			P103-4	4	WE1647					2A5, 2A6, 27, 57, 58,		
							P103-3	4	WE1847					80	370	1
675A	Vol.	18	MR48	M27			E17080	19	TS101					[2]1D5G, 1C7G, 1H6G,		
														1G5G	456	
680, 680B	Vol.	62	N	7			E17355	12	See Note	B3				1C6, [2]34, [2]30, 1B5, 19	456	
680 late	Vol.	61	UC511	6			P119-17	4	CM162		37	296	C3	[2]6D6, 6A7, 6B7, 42, 84	175	10
							.01		Buffer	B14						
685B	Vol.	18	MR48	M27			E17080	19	TS101					[2]1D5G, 1C7G, 1H6G,		
														1G5G	456	
686 "A" and "B"	Vol.	18	O	6			P103-6	42	RS213					6L7, 6K7, 6Q7, 6C5,		
	Tone	22	K12											6F6, 5Y3, 6G5	465	1
690	Vol.	18	MR48				16-16	1	UR191	B3				6A8G, 6K7G, 6Q7G,		
	Tone	22	MR39											[2]6K6G, 5Y3G	456	1
715	Vol.	18	MR48				16	1	RS216					6A8G, 6K7G, 6Q7G,		
	Tone	22	MR39				16	1	WE1647					6C5G, [2]6F6G, 5Y3G	456	1
735	Vol.	18	MR48				18-202	25	RS215					6A7, 6D6, 76, 6Q7G,		
	Tone	21	MR48	M26			18-201	25	WE1247					6V6G, 6G5, 80	456	1
740 series A	Vol.	18	O	6			103-6	4	RS213					6A8, 6K7, 6Q7, 6C5,		
	Tone	22	M				103-14	4	RS216					[2]6F6, 5Y3	465	1
750	Vol.	18	N				8, 8	4	WE847					[2]58, 2A7, 55, [2]45, 80	175	1
	Tone	21	M				5	14	See Note	B3						
762	Vol.	45	MR48	M26			44X31	23	RS215					6J7, 6K7, 6C5, 6H6,		
	Tone	34	UC502				44X35	23	WE3540					6G5, 6F5, 6F6,		
														5Y3G, or 6J7G,		
														6K7G, 6C5G, 6H6,		
														6G5, 6F5G, 6F6G,		
														5Y3G	456	1
770	Vol.	56	TRP611	6			P103-8	43	RS216					[2]6K7, 6C6, 6C5, 6B7,		
	Tone	21	SRP287	8			P103-4	43	RS216					42, 80	465	1
774	Vol.	45	Order from	Mfr.			44X30	25	RS216					[2]6K7, [2]6J7, [2]6C5, 6H6,		
	Tone	34	MR53				44X11	25	WE1847					6G5, [2]6F6, 5Y3G,		
							45X223	13	CS121					or [2]6U7G, [2]6J7G,		
							45X222	19	TS103					[2]6C5G, 6H6, 6G5,		
														[2]6F6G, 5Y3G	456	1
777C and 777L, Series "A"	Vol.	18	O	6			P103-4	4	RS216					[2]6D6, 6C6, 76, 75, 42,		
	Tone	21	M				P103-3	4	WE1847					80	465	1
777C and 777L, Series "B"	Vol.	56	O	6			P103-8	4	WE1647					[2]6D6, 6C6, 76, 6B7,		
	Tone	62	M				P103-4	4	WE1847					42, 80	465	1
778A	Vol.	18	TRP611	6			P103-8	25	RS216					[2]6K7, 6J7, 6C5, 6Q7,		
	Tone	21	SRP287	8			P103-6	25	RS213					6F6, 5Y3	465	1
780, 780B	Vol.	15	N	7			E17355	12	CS133					1C6, [2]34, [2]30, 1B5, 19	456	
787	Vol.	18	MR53	M26			103-6	23	RS213					6L7, 6C5, 6K7, 6Q7,		
	Tone	22	K12				103-7	23	RS213					6G5, 6F6, 5W4	465	1
810	Vol.	15	N	6			17644	1	WE1647					6A8, 6K7, 6C5, 6G5,		
	Tone	130	UC513	6		A86	17645	1	RS216					[2]41, 80	456	1
							17080	15	TS101							
822	Vol.	56	MR44	M27			103-11	12	RS203					1A6, 1A4, [3]30, [2]34, 19	465	
	Tone	21	MR44													
850B	Vol.	15	N				17355	12	CS133					[2]1A4, 1C6, [3]30, [2]950	456	
	Tone	140	UC513	6		A86	17080	19	TS101							
1050	Vol.	15	N				P1048	26	WE847					[2]58, 2A7, [4]56, [2]45, 80	175	1
	Tone	‡	L	6			P1038	26	WE847							
	Supp.	12	F7													
1170	Vol.	20	1 Meg. No. 1		See No	te A19	103-10	25	WE3540					[2]6K7, 6J7, 6C5, 6H6,		
	Tone	22	E12				103-8	25	RS216					6F5, [3]6F6, 5Z4	465	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GAMBLE SKOGMO—Continued																
2078D	Vol.	6	G12	6			4703	1	CN152					^{2}57, 58, 47, 80	455	1
2090	Vol.	15	M				8-8-8	28	See Note	B3				^{2}58, ^{2}57, 56, ^{2}46, 80	262	7
	Tone	95	L				4	‡	See Note	B3						
	Sen.	98	F													
2092, 2094	Vol.	15	M				8-8-8	28	See Note	B3				^{2}58, ^{2}56, ^{2}46, 80	262	7
	Tone	95	K12				8-8	‡	See Note	B3						
3128	Vol.	6	Y				4-12-4	11	UR182	B182				6F7, 78, 75, 43, 25Z5	455	
6953A	Vol.	18	N	6										6A7, 6D6, 75, ^{2}48	465	
7735, 7742, 7755	Vol.	45	N	7			1291	12	RS201					1C6, 34, ^{2}30, 32, 19	465	
GAROD																
Challenger I	Vol.	17	N	6			12-12	1	CM164	B3				6A7, 6D6, 75, 25L6,		
							5	15	TS101					25Z5	456	
Challenger II	Vol.	17	MR48	M26			12-12	1	CM164	B3				6A7, 6D6, 75, 25L6,		
							5	15	TS101					25Z5	456	
EM	Vol.	16	N				4-4	1	CN150	B3				‡		3
2B2, 2B2-1	Vol.	‡	MR53	M27										1C7G, ^{2}1D5G, 1H6G,		
	Tone	44	MR39											1H4G, 1J6G	456	
2B6, 2B6-1	Vol.	‡	MR53	M27			20-20	1	UR192	B3	13	W245	C3	1C7G, ^{2}1D5G, 1H6G,		
	Tone	44	MR39				.01		Buffer	B14				1H4G, 1J6G	456	10
3B2, 3B2-3	Vol.	‡	MR53	M27			20-20	1	UR192	B3				^{3}1D5G, 1C7G, 1H6G,		
	Tone	44	MR39											1H4G, 1J6G	456	
3B6, 3B6-3	Vol.	‡	MR53	M27			20-20	1	UR192	B3	13	W245	C3	^{3}1D5G, 1C7G, 1H6G,		
	Tone	44	MR39				.01		Buffer	B14				1H4G, 1J6G	456	10
25	Vol.	17	N	6			8-8	4	See Note	B3				‡	‡	1
	Tone	34	L													
26	Vol.	45	N	6			12-12	4	CM164	B3				6A8, 6K7, 6H6, 6F5,		
	Tone	34	L											6F6, 80	456	1
27	Vol.	64	N				12-12	4	See Note	B3				^{3}6D6, 6A7, 76, 42, 80	456	1
	Tone	34	L													
31, 31LW	Vol.	45	N	6			20-12	6	UR192	B3				6A7, 6K7, 6H6, 6F5,		
	Tone	22	L				5	15	TS101					43, 25Z5	456	
32, 32LW	Vol.	45	N	6			25-12-20	63	See Note	B3				6A7, 6K7, 6H6, 6F5,		
	Tone	22	L				5	15	TS101					43, ^{2}25Z5	456	
33 and 33LW	Vol.	18	N				20-12-8	11	UR182	B3				6A7, 6D6, 75, 43, 76,		
	Tone	22	L				5-5	15	TN110					25Z5	456	
33, 33LW (Rev.)	Vol.	45	N	6			20-12	6	UR192	B3				6A7, 6K7, 6H6, 6F5,		
	Tone	22	L				5	15	TS101					43, 25Z5	456	
35SW	Vol.	7	G				20-12	6	UR192	B3				6A7, 6D6, 6C6, 43,		
	Tone	22	L				5	15	TS101					12Z3	456	
49, 49M	Vol.	45	N	6			12, 12	1	RS215	B3				^{2}6K7, 6A8, 6H6, 6E5,		
	Tone	44	L											^{2}6V6, ^{2}45, 80	456	14
58	Vol.	7	D				8-20-12	8	UR182	B3				6A7, ^{2}6D6, ^{2}25Z5, ^{2}43,		
	Tone	22	L				5	15	TS105					85	456	
60	Vol.	18	N	6			20-12	6	UR192	B3				6A7, 6K7, 75, 43,		
							5	15	TS101					25Z5, BK49D	456	
66	Vol.	18	N				20-12	6	See Note	B3				6A7, ^{2}6D6, 75, ^{2}43,		
	Tone	22	L				10-10	15	TN111					25Z5	456	
73, 73LW	Vol.	45	N				12, 12	4	RS215	B3				^{3}6D6, 6A7, 76, 42, 80	456	1
	Tone	34	L				5	15	TS101							
83 and 83LW	Vol.	18	N				25-12-20	6/12	UR182	B3				6A7, ^{2}6D6, ^{2}25Z5, ^{2}43,		
	Tone	44	L											85	456	
104, 104M	Vol.	18	N	7			12-25	6	See Note	B3				^{2}6K7, 6A7, 85, 6E5,		
	Tone	44	L	6			20	12	See Note	B3				^{4}43, ^{2}25Z5	456	
	Sen.	7	D				25	44	See Note	B3						
115	Vol.	7	D	8			20-8-8	75	See Note	B3				6A7, ^{2}6D6, 85, ^{4}43,		
	Tone	22	L	6			12	75	See Note	B3				^{2}25Z5	456	
205, 205C, 205L, 205-1	Vol.	80	1 Meg. No. 1		See Note A19		16-16	4	CM164					6A7, 6K7, 6Q7, 42, 80	456	1
	Tone	80	MR53													
206, 206C, 206L, 206-1, 206P4	Vol.	80	1 Meg. No. 1		See Note A19		16-16	4	CM164	B3				6A7, 6K7, 6Q7, 6U5,		
	Tone	80	MR53											42, 80	456	1
307, 307L, 307T, 307-1	Vol.	140	1 Meg. No. 1		See Note A19		16	4	RS216					6A8G, 6K7, 6H6, 6F5,		
	Tone	140	MR53				9	4	RS213					6U5, 6V6, 80	456	1
309 series	Vol.	140	1 Meg. No. 1		See Note A19		16, 16	4	RS216					^{3}6K7, 6A8G, 6H6,		
	Tone	140	MR53											6F5G, 6U5, 6L6G,		
	Sen.	7	D											80	456	1
310	Vol.	18	N	7			25-20-12	75	See Note	B3				^{2}6D6, 6A7, 85, ^{4}43,		
	Tone	22	‡		See Note A5									^{2}25Z5	456	
	Sen.	42	D	6												
311	Vol.	45	MR48	M27			25-20-12	75	See Note	B3				^{2}6K7, 6A7, 6H6, 6C5,		
	Tone	‡	‡		See Note A5									^{4}43, ^{2}25Z5	456	
	Sen.	42	D	6												
370, 371 series	Vol.	20	1 Meg. No. 1		See Note A19		16	4	RS216					6A8G, 6K7G, 6H6G,		
	Tone	22	L				9	4	RS213					6F6G, 6F5G, 6G5,		
														6L6G, 5Y3, or 6A8,		
														6K7, 6H6, 6F5,		
														6G5, 6L6, 5X4	456	1
380, 381 series	Vol.	20	1 Meg. No. 1		See Note A19		16, 16	4	RS216					^{2}6K7, 6A8, 6H6, 6F5,		
	Tone	34	L											6L6, 5Y3, or ^{2}6K7G,		
														6A8G, 6H6G, 6F5G,		
														6G5, 6L6G, 5Y3	456	1
511A, 511G, 511P	Vol.	45	N	7			12, 12, 12	3	RS215					^{4}6K7, 6A8, 6H6, 6E5,		
	Tone	34	L	6			12	13	RS213					^{2}6C5, ^{2}45, 5Z3	456	14
							5	15	TS101							
							25	15	TS107							
514	Vol.	45	N	7			20-12	‡	UR192	B3				^{4}6K7, 6A7, 6H6, ^{2}6C5,		
	Tone	44	UC503	6			25	‡	RS207					^{4}43, ^{2}25Z5	456	
514M	Vol.	45	N	7			20-12	‡	UR192	B3				^{4}6K7, 6A7, 6H6, ^{2}6C5,		
							30	‡	RS207					6E5, ^{4}43, ^{2}25Z5	456	
520 Twenty Grand	Vol.	45	N	7			12, 12, 12	3	RS215					^{5}6K7, 6A8, ^{2}6H6, ^{4}6C5,		
							8, 8	40	RS213					6E5, ^{5}45, ^{2}5Z3	456	‡
							12	13	CS135							
							5	15	TS101							
							25	15	TS107							
602, 602C, 602L, 602-1	Vol.	80	1 Meg. No. 1		See Note A19		20-12	1	UR192	B3				6A7, 6K7, 6Q7G,		
	Tone	80	MR53				10	15	TS101					25L6G, 25Z5	456	
							7	13	CS133							
620	Vol.	18	MR48	M26			20-12	1	UR192	B3				6A7, 6K7, 75, 43,		
							5	15	TS101					25Z5	456	
703E, 703EC, 703L	Vol.	140	1 Meg. No. 1	M26			20-12	1	UR192	B3				6A7, 6K7, 6Q7G,		
	Tone	140	MR53				7	13	CS133					25L6G, 25Z5, 6U5	456	
							10	15	TS101							
731	Vol.	18	MR48	M26			20-12	1	UR192	B3				6A7, 6K7, 75, 43,		
	Tone	22	L				10	15	TS101					25Z5, 6G5	456	
762	Vol.	140	1 Meg. No. 1		See Note A19		40-25	1	Order from	Mfr.				6A7, 6D6, 76, 6F5,		
	Tone	140	MR53				10	15	TS101					25L6G, 25Z5	456	

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GAROD—Continued 782, 782-1	Vol. Tone	80 80	1 Meg. No. 1 MR53		See Note	A19	40-25 10	6 15	Order from TS101	Mfr.				6A7, 6D6, 6Q7G, 25L6, [2]25Z5	456	
803L, 803T, 803-1	Vol. Tone	80 80	1 Meg. No. 1 MR53		See Note	A19	40-25 10	6 15	Order from TS101	Mfr.				6A8G, 6K7, 6Q7G, 6U5, 25L6, [2]25Z6	456	
830, 830C, 830D, 830KC, 831, 831C, 831D, 831KC	Vol. Tone	20 22	1 Meg. No. 1 L		See Note	A19	20-12 10	6 15	UR192 TS101	B3				6A8, 6K7, 6H6, 6F5, 6G5, 25A6, 25Z6, or 6A8G, 6K7G, 6F5G, 6G5, 25A6G, 25Z6	456	
830A, 831A	Vol. Tone	80 80	1 Meg. No. 1 MR53		See Note	A19	40-25 10	6 15	Order from TS101	Mfr.				6A8, 6K7, 6Q7, 6G5, 25L6, [2]25Z6, or 6A8G, 6K7G, 6Q7G, 6G5, 25L6, [2]25Z6	456	
903 series	Vol. Tone Sen.	80 80 7	1 Meg. No. 1 MR53 D		See Note	A19	80 25 40	75 75 75	Order from RS207 RS208	Mfr.				6K7, 6A8G, 6B8G, 6Q7G, 6G5, [2]25L6, [2]25Z6G	456	
930, 931 series	Vol. Tone	17 44	1 Meg. No. 1 L		See Note	A19	30-20 12	75 75	See Note RS205	B3				[2]6K7, 6A8, 6R7, 6G5, [2]25A6, [2]25Z6, or [2]6K7G, 6A8G, 6R7G, 6G5, [2]25A6G, [2]25Z6G	456	
930A	Vol. Tone	80 80	1 Meg. No. 1 MR53		See Note	A19	60-25-40	75	Order from	Mfr.				6K7, 6A8, 6B8, 6Q7, 6G5, [2]25L6, [2]25Z6, or 6K7G, 6A8G, 6B8, 6Q7G, 6G5, [2]25L6G, [2]25Z6	456	
1203-1204 series	Vol. Tone	80 80	1 Meg. No. 1 MR53		See Note	A19	40-25 80	75 75	See Note Order from	B3 Mfr.				6A7, 6A8G, 6B8G, 6Q7G, 6U5, [4]25L6, [3]25Z6G	456	
1240, 1240E, 1240LC	Vol. Sen.	17 7	1 Meg. No. 1 D	 6	See Note	A19	30-20 12 10	75 75 15	See Note RS205 TS101	B3				[2]6K7G, 6A8G, 6H6G, 6C5G, 6G5, [4]25A6G, [2]25Z6G, or [2]6K7, 6A8, 6H6, 6C5, 6G5, [4]25A6, [2]25Z6	456	
1240A	Vol. Tone Sen.	80 80 7	1 Meg. No. 1 MR53 D	 6	See Note	A19	60-25-40 10	75 15	Order from TS101	Mfr.				6K7, 6A8, 6B8, 6Q7, 6G5, [4]25L6, [3]25Z6, or 6K7G, 6A8G, 6B8G, 6Q7, 6G5, [4]25L6, [3]25Z6G	456	
1603, 1604	Vol. Tone Sen.	140 140 7	TM243-SS1 MR53 D	M27 M26 6			80 10-10	75 15	Order from TN111	Mfr.				[4]6K7, 6A8G, 6H6, 6U5, 6F5, 6J5G, [4]25L6, [3]25Z6G	456	
1650, 1650H and 1650LC	Vol. Tone	20 ‡	TM243-SS1 K12	M27			20-12-10 30 8-8	75/15 75 13	RM259/TN111 RS207 RN232	B266 B266				[5]6K7, 6L7, 6H6, 6G5, [2]6C5, [4]25A6, [2]25Z6, or [5]6K7G, 6L7G, 6H6G, 6G5, [2]6C5G, [4]25A6G, [2]25Z6	456	
1650A	Vol. Tone	17 ‡	1 Meg. No. 1 MR53	 M26	See Note	A19	25-40-10-10 60 8-8	75/15 75 13	Order from See Note RN232	Mfr. B3				[5]6K7, 6L7, 6Q7, 6G5, 6C5, [4]25L6, [3]25Z6, or [5]6K7G, 6L7G, 6Q7G, 6G5, 6C5G, [4]25L6, [3]25Z6	456	
3012 series	Vol. Tone Sen.	140 140 7	TM243-SS1 MR53 D	M27 6			16, 16	25	WE1647					[5]6K7, 6A8G, 6H6, 6U5, [3]6J5G, [2]6V6G, 80	456	1
3016	Vol. Tone Sen.	140 140 7	1 Meg. No. 1 MR53 E	 M26 6	See Note	A19	16, 16, 16 16	3 13	WE1647 RS216					[5]6K7, 6A8G, [2]6H6, 6U5, [3]6J5G, [2]6V6G, [2]80	456	1
4012 series	Vol. Tone Sen.	140 140 7	TM243-SS1 MR53 D	M27 6			16, 16	25	WE1647					[5]6K7, 6A8G, 6H6, 6U5, [3]6J5G, [2]6V6G, 80	456	1
4016	Vol. Tone Sen.	140 140 7	1 Meg. No. 1 MR53 E	 M26 6	See Note	A19	16, 16, 16 16	3 13	WE1647 RS216					[5]6K7, 6A8G, [2]6H6, 6U5, 6J5G, [2]6V6G, [2]80	456	1
4110	Vol. Sen.	20 7	TM243-SS1 D	M27 6			16 16 5	1 1 15	RS216 WE1647 TS101					[5]6K7, 6L7, 6H6, 6F5, 6G5, 6C5, [2]45, 5Y3	456	14
5140	Vol. Tone	20 ‡	TM243-SS1 K12	M27 6			16, 16, 16 16 8-8 10	3 13 13 15	WE1647 RS216 CN142 TS101					[5]6K7, 6L7, 6H6, 6G5, [3]6C5, [2]6L6, 5Z3, or [5]6K7G, 6L7G, 6H6G, 6G5, [3]6C5G, [2]6L6G, 5Z3	456	1
5240	Vol. Bass	‡ 15	MR53 MR53	M27 M26			5-5 16 9, 9 16, 16 8-8-8 10	1 1 ‡ 13 13 15	RS215 WE1647 RS203 RS216 RN245 TS101					[5]6K7, 6L7, [4]6C5, 6J7, [2]6H6, 6G5, [4]6L6, 6X5, [2]5X4	456	‡
GENERAL ELECTRIC A52	Vol.	18	N				RC409 RC403 RC511	1 1 15	RS216 RS213 TN111					6A8, 6K7, 6Q7, 6F6, 5Z4	465	1
A53	Vol.	8	A5MP				RC402 RC403 RC511	1 1 15	RS213 RS213 TN111					5Z4, 6A8, 6F6, 6J7, 6K7	465	1
A54	Vol.	18	N				RC524 RC516	8 8/15	RM259 RN232	B108 B108				6A8, 6K7, 6Q7, 25A6, 25Z6	465	
A55	Vol.	18	N				RC409 RC403 RC511	1 1 15	RS216 RS213 TN111					6A8, 6K7, 6Q7, 6F6, 5Z4	465	1
A60—See RCA—Victor M-32																
A63	Vol.	62	M	6			RC409 RC403 RC501	1 1 13/15	RS216 RS213 CN151					6A8, 6K7, 6H6, 6C5, 6F6, 5Z4	465	1
A64	Vol. Tone	19 34	TRP603 G12				RC404 RC407 RC501 RC502	1 1 13/15 13/14	RS215 RS216 CN151 CN150	 B109 B109				6A8, 6K7, 6H6, 6J7, 6F6, 5Z4	465	1
A65	Vol.	62	M	6			RC409 RC403 RC501	1 1 13/15	RS216 RS213 CN151	 B109				6A8, 6K7, 6H6, 6C5, 6F6, 5Z4	465	1
A67	Vol. Tone	19 34	TRP603 G12				RC404 RC407 RC501 RC502	1 1 13/15 13/14	RS215 RS216 CN151 CN150	 B109 B109				6A8, 6K7, 6H6, 6J7, 6F6, 5Z4	465	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GENERAL ELECTRIC—Continued																
A70	Vol. Tone	19 34	TRP603 L	 6			RC404 RC407 RC502 RC503	1 1 13/14 15	RS215 RS216 CN150 TN111	 B109 				5Z4, 6A8, 6C5, 6F6, 6H6,[2]6K7	465	1
A75	Vol. Tone	19 34	TRP603 L	 6			RC404 RC407 RC502 RC503	1 1 13/14 15	RS215 RS216 CN150 TN111	 B109 				5Z4, 6A8, 6C5, 6F6, 6H6,[2]6K7	465	1
A81—See RCA—Victor P31																
A82	Vol. Tone Sen.	‡ 34 7	DRP311 L C				RC405 RC408 RC502 RC501	1 1 13/14 15	RS215 RS216 CN150 TS101	 B109 				[2]6K7, 6A8, 6H6, 6C5, 6F6, 5Z4	465	1
A83, A85	Vol. Tone	15 22	TRP613 N	 6			RC406 RC415 RC525 RC526	1 1 13/15 15	WE1647 RS216 CN151/TS101 TS102					[2]6K7, 6A8, 6H6, 6F5, [2]6F6, 5Z4	456	1
A87	Vol. Tone Sen.	‡ 34 7	DRP311 L C				RC405 RC408 RC502 RC504	1 1 13/14 15	RS215 RS216 CN150 TS101	 B109 				[2]6K7, 6A8, 6H6, 6C5, [2]6F6, 5Z4	465	1
A125	Vol. B.Tone T.Tone Sen.	‡ ‡ 22 7	Order from M M C	Mfr. 6 			RC406 RC412 RC509 RC518 RC510	1 1 13/15 13 19	WE1647 WE3540 CS121/TN111 CS121 TS106					[3]6K7, 6L7, 6C5, [2]6H6, 6F5,[3]6F6, 5Z4	465	1
E50	Vol.	7	E	6	2		RC564	1	CN152					6A8, 6K7, 6C5, 6F6, 5W4	465	1
E51	Vol.	18	MR48	M26			RC566 RC565	8 8/15	CN145 SR630	 B262				6A8, 6K7, 6Q7, 25A6, 25Z6	465	
E52	Vol.	7	E	6	2		RC564	1	CN152					6A8, 6K7, 6C5, 6F6, 5W4	465	1
E61, E62	Vol.	15	TM248-SS1	M26			RC413 RC403 RC567	4 4 4	WE1647 RS213 RM265	 B20				6A8, 6K7, 6H6, 6F5, 6F6, 5W4	465	1
E68	Vol.	15	TM248-SS1	M26			RC413 RC403 RC567	4 4 4	WE1647 RS213 RM265	 B20				6A8, 6K7, 6H6, 6F5, 6F6, 5W4	465	1
E71, E72, E76	Vol.	15	TRP613	6			RC413 RC412	1 1	WE1647 WE3540					6A8, [2]6K7, 6H6, 6F5, 6F6, 5W4	465	1
E79	Vol.	20	TRP613	6			RC413 RC412	1 1	WE1647 WE3540					6A8, [2]6K7, 6H6, 6F5, 6F6, 5W4	465	1
E81	Vol. Tone	15 22	TRP613 SRP285	6 6			RC414 RC415 RC563	1 1 13/14	WE1647 RS216 CN150					[3]6K7, 6A8, 6H6, 6F5, 6L6, 5Z4	465	1
E86	Vol. Tone	15 22	TRP613 SRP285	6 6			RC414 RC415 RC563	1 1 13/14	WE1647 RS216 CN150					[3]6K7, 6A8, 6H6, 6F5, 6L6, 5Z4	465	1
E91	Vol. Tone	15 22	TRP613 SRP285	6 6			RC414 RC415 RC562	1 1 13/14	WE1647 RS216 CM173					[3]6K7G, 6A8, 6H6, 6F5, 6C5, 6L6, 5Z4	465	1
E95	Vol. Tone	15 22	TRP613 SRP285	6 6			RC414 RC415 RC562	1 1 13/14	WE1647 RS216 CM173					[3]6K7, 6A8, 6H6, 6F5, 6C6, 6L6, 5Z4	465	1
E101	Vol. Tone	15 22	TRP613 SRP285	 6			RC414 RC425 RC424 RC423 RC561	1 1 13 13 13/15	WE1647 WE3540 RS207 RS207 CS131/TN111					[3]6K7, 6A8, 6J7, 6H6, 6F5, 6C5, 6L6, 5Z4	465	1
E105, E106	Vol. Tone	15 22	TRP613 SRP285	6 6			RC414 RC425 RC424 RC423 RC561	1 1 13 13 13/15	WE1647 WE3540 RS207 RS207 CS131/TN111					[3]6K7, 6A8, 6J7, 6H6, 6F5, 6C5, 6L6, 5Z4	465	1
E115	Vol.	15	TRP613				RC405 RC568	1 1/15	RS215 RN245/TS10					[3]6K7, 6A8, 6H6, [2]6C5, [2]6F6,[2]5W4	465	39
E126	Vol. Tone	20 41	TRP621 SRP286	6 6			RC411 RC412 RC426 RC551 RC558	1 1 14 13/15 13/15	WE3540 WE3540 RS205 RS211/TS10 RS200/TS101					[5]6K7, 6L7, 6J7, 6H6, 6C5,[2]6F6, 5Z4	465	39
E129	Vol. Tone	20 41	TRP621 SRP286	6 6			RC411 RC412 RC426 RC551 RC550	1 1 14 13/15 13/15	WE3540 WE3540 RS205 RS211/TS101 RS200/TS101					6J7, [5]6K7, 6L7, 6H6, 6C5,[2]6F6, 5Z4	465	39
E155	Vol. Tone	20 22	Order from SRP284	Mfr. 6			RC406 RC411 RC409 RC553 RC554 RC504	3 3 3 13/15 13/14 15	WE1647 WE3540 WE1647 RS200/CN151 RN245 TS101					[5]6K7, 6L7, 6J7, [2]6H6, 6C5, 6F6,[2]6L6,[2]5Z4	465	1
F40	Vol.	6	F7	6	4		RC585	1	RN245					6A7, 6B7, 41, 80	455	1
F51	Vol.	18	MR55	M26			RC587	4	RM265					6A7, 6D6, 75, 44, 80	455	1
F53	Vol.	7	E	6	2		RC564	1	CN152					6A8, 6K7, 6C5, 6F6, 5W4	465	1
F63	Vol.	20	TM245-SS1	M26			RC574	4	RM265					6A8, 6K7, 6H6, 6F5, 41, 80	465	1
F65, F66	Vol.	20	TM245-SS1	M26			RC574	4	RM265					6A8, 6K7, 6H6, 6F5, 41, 80	465	1
F70	Vol.	20	TM245-SS1				RC575	1/15	RN245					6A8, [2]6K7, 6H6, 6F5, 42, 80	465	1
F74	Vol.	20	TM245-SS1	M26			RC589	1/14/15	RN245/TS101					6A8, 6H6, 6K7, 6F5, 41, 80, 6U5	465	1
F75	Vol.	20	TM245-SS1				RC575	1/15	RN245					6A8, [2]6K7, 6H6, 6F5, 42, 80	465	1
F77	Vol.	20	TM245-SS1	M26			RC589	1/14/15	RN245/TS101					6A8, 6H6, 6K7, 6F5, 41, 80, 6U5	465	1
F80	Vol.	20	TM245-SS1				RC575	1/14/15	RN245/TS101					6A8, [2]6K7, 6H6, 6F5, 42, 80, 6U5	465	1
F81	Vol.	20	TM245-SS1				RC569	1/14/15	RN245/TS101					6A8, [3]6K7, 6H6, 6F5, 42, 80	465	1
F85	Vol.	20	TM245-SS1				RC575	1/14/15	RN245/TS101					6A8, [2]6K7, 6H6, 6F5, 42, 80, 6U5	465	1
F86	Vol.	20	TM245-SS1				RC569	1/14/15	RN245/TS101					6A8, [3]6K7, 6H6, 6F5, 42, 80	465	1
F88	Vol.	20	TM245-SS1				RC575	1/14/15	RN245/TS101					6A8, [2]6K7, 6H6, 6F5, 42, 6U5, 80	465	1
F96	Vol.	20	TM253-SS1				RC427 RC428 RC579	1 1 14/15	WE1647 WE3540 Order from	 Mfr.				[3]6K7, 6A8, 6J5G, 6H6, 6F5, 42, 80	465	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GENERAL ELECTRIC—Continued																
F107	Vol.	20	TM253-SS1				RC427	1	WE1647					^{3}6K7, 6A8, ^{2}6J5G, ^{2}6H6, 6L6G, 5Z4	465	1
							RC428	1	WE3540							
							RC579	14/15	Order from Mfr.							
F135	Vol.	20	TM253-SS1				RC427	30	WE1647					^{3}6K7, 6L7, ^{4}6J5G, ^{2}6H6G, ^{2}6L6G, 5Z3	465	1
							RC429	30	WE3540							
							RC580	30/15	Order from Mfr.							
FA60	Vol.	15	UM161-SS12				RC570	1/15	RN241/TS101		18	248	C3	^{2}6K7, 6A8, 6H6, 6F5, 6F6	175	10
							.02-.02		Buffer	B14						
FA61	Vol.	15	UM161-SS12				RC570	1/15	RN241/TS101		18	248	C3	^{2}6K7, 6A8, 6H6, 6F5, 6F6	175	10
							.02-.02		Buffer	B14						
FA80	Vol.	15	UM161-SS12				RC571	1/15	RN245/TS101		18	248	C3	^{2}6K7, 6A8, ^{2}6C5, 6H6, 6R7, 6N7	175	10
							.02-.02		Buffer	B14						
FB52, FB53, FB56, FB57	Vol.	17	MR55				RC572	13	CN145		15	W246	C3	1C7G, ^{2}1D5G, ^{2}1F7G	465	10
							RC573	1	RN232	B8						
							.03-.03		Buffer	B14						
FB72, FB73, FB76, FB77	Vol.	17	MR55				RC572	13	CN145		15	W246	C3	1C7G, ^{2}1D5G, 1F7G, 1H4G, 1J6G, 1E5G	465	10
							RC573	1	RN232	B8						
							.03-.03		Buffer	B14						
FD62	Vol.	17	TM249-SS1	M26			50-50	4	Order from Mfr.					6A8, 6K7, 6Q7, 43, 25Z5, BL49C	465	
FD625	Vol.	17	TM249-SS1	M26			50-50	4	Order from Mfr.					6A8, 6K7, 6Q7, 43, 25Z5, BL49C	465	
FE62	Vol.	20	TM245-SS1				RC576	1/14/15	RN245/TS106					6A7, 6K7, 6H6, 6F5, 42, 80	455	1
FE63	Vol.	20	TM241-SS1	M26			RC589	1/14/15	RN245/TS101					6A8, 6K7, 6H6, 6F5, 41, 80	465	1
FE67, FE68	Vol.	20	TM245-SS1				RC576	1/14/15	RN245/TS106					6A7, 6K7, 6H6, 6F5, 42, 80	455	1
FE82	Vol.	20	TM245-SS1				RC427	1	WE1647					^{3}6K7, 6A8, 6H6, 6F5, 42, 80	455	1
							RC583	‡	RN245/CN151	B55						
FE87	Vol.	20	TM245-SS1				RC427	1	WE1647					^{3}6K7, 6A8, 6H6, 6F5, 42, 80	455	1
							RC583	1/14/15	RN245/CN151	B55						
FE112	Vol.	20	TM248-SS1				RC429	1	WE3540					^{3}6K7, 6L7, 6J5G, ^{2}6H6, 6F5, 6L6G, 6U5, 5Z3	455	1
							RC428	1	WE3540							
							RC584	14/15	RN242/TS101 /TS107	B82						
FE116	Vol.	20	TM248-SS1				RC429	1	WE3540					^{3}6K7, 6L7, 6J5G, ^{2}6H6, 6F5, 6L6G, 6U5, 5Z3	455	1
							RC428	1	WE3540							
							RC584	14/15	RN242/TS101 /TS107	B82						
FE119	Vol.	20	TM248-SS1				RC429	1	WE3540					^{3}6K7, 6L7, 6J5G, ^{2}6H6, 6F5, 6L6G, 6U5, 5Z3	455	1
							RC428	1	WE3540							
							RC584	14/15	RN242/TS101 /TS107	B82						
H91, H91R	Vol.	8	K		See Note A16		G5020	4	CS133					24, ^{2}27, ^{3}35, ^{2}47, 80	175	1
	Tone	‡	K		See Note A16											
N60	Vol.	17	UM163-SS3				RC779	4/15	CM175	B3	35	294	C3	6F6, 6J7, ^{2}6K7, 6Q7, 6X5	175	10
	Tone	34	MR42				.0075		Buffer	B14						
U50	Vol.	45	MR53				4.	12	CS121					1A6, 34, 30, 32, 1F4	175	
U51, U55	Vol.	18	MR53	M26			RBC502	46	RM259		15	246	C3	1C6, ^{2}34, 1B5, 1F4	456	10
							.01		Buffer	B14						
U70, U75	Vol.	45	O	7			RBC504	1	RS207		Order from Mfr.			^{3}34, 1C6, ^{2}30, 19	456	10
	Tone	‡	UC502				RBC503	1/13	RM259							
For all other General Electric Models see the Cross Reference below.																

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

CROSS REFERENCE OF GENERAL ELECTRIC–RCA VICTOR MODELS

A-90—See RCA Victor M30
BX—See RCA Victor R17M
B40—See RCA Victor M34
B52—See RCA Victor M116
B81—See RCA Victor 142B
B86—See RCA Victor 241B
C30—See RCA Victor 91B
C41—See RCA Victor M105
C60—See RCA Victor M107
C61—See RCA Victor M123
C62—See RCA Victor 126B
C67—See RCA Victor 223
C70—See RCA Victor 135B
C75—See RCA Victor 235B
D50—See RCA Victor M101
D51—See RCA Victor M104
D52—See RCA Victor M108
D72—See RCA Victor M109
E52—See RCA Victor T5
H31—See Radiola 80
H32—See RCA Victor R50
H51—See Radiola 82
H51R—See Radiola 82R
H71—See Radiola 86
H71R—See Radiola 86R
H72—See RCA Victor RAE 59
H91, H91R—See Previous Page
J70—See RCA Victor R4
J72—See RCA Victor R70 and R70N
J75—See RCA Victor R6
J80—See RCA Victor R8
J82—See RCA Victor R71
J83—See RCA Victor R-73 with 47's
J83A—See RCA Victor R73 with 2A5's
J85—See RCA Victor R12
J86—See RCA Victor R72
J87—See RCA Victor R75 (47's)
J87A—See RCA Victor R75 (2A5's)
J88—See RCA Victor R71
J100—See RCA Victor R100
J105—See RCA Victor R76
J107—See RCA Victor R77
J109—See RCA Victor RE81
J125—See RCA Victor R78
J125A—See RCA Victor R78 (2)
JZ30—See RCA Victor SW2
JZ822—See RCA Victor R24
JZ822A—See RCA Victor R24A (47)
JZ826—See Victor R24
JX828-J88 with SW adapter
JZ835—See RCA Victor RO23
K40—See RCA Victor R27
K40A—See RCA Victor R18W
K41—See RCA Victor R17M
K43—See RCA Victor 100
K48—See RCA Victor 300
K50—See RCA Victor R28
K50P—See RCA Victor R28P
K51—See RCA Victor R28
K51P—See RCA Victor R28P
K52—See RCA Victor 110
K53—See RCA Victor 111
K53M—See RCA Victor 115
K54—See RCA Victor RE40
K54P—See RCA Victor RE40P
K55—See RCA Victor 210
K58—See RCA Victor 310
K60—See RCA Victor R37
K60P—See RCA Victor R37P
K62—See RCA Victor R11
K63—See RCA Victor 120
K64—See RCA Victor 121
K64D—See RCA Victor 127
K65—See RCA Victor R38
K65P—See RCA Victor R38P
K66—See RCA Victor 220
K66M—See RCA Victor 222
K78—See RCA Victor 330
K79—See RCA Victor 331
K80—See RCA Victor 140 and 140E
K80X—See RCA Victor 141 and 141E
K82—GE K62 in clock cabinet
K85—See RCA Victor 240
K88—See RCA Victor 340
K88X—See RCA Victor 34E
K105—See RCA Victor 261
K106—See RCA Victor R90
K106P—See RCA Victor R90P
K107—See RCA Victor R260
K126—See RCA Victor 280
KZ-62P—See RCA Victor RE18, RE18A
L50—See RCA Victor R22S
L51—See RCA Victor R22W
L52—See RCA Victor 112
L52A—See RCA Victor112A
L53—See RCA Victor 114
M40—See RCA Victor 102
M41—See RCA Victor 101
M42—See RCA Victor 103
M49—See RCA Victor 301
M50—See RCA Victor 117
M51—See RCA Victor 118
M51—See RCA Victor 118 (mod)
M52—See RCA Victor 119
M55—See RCA Victor 214
M56—See RCA Victor 211
M61—See RCA Victor 128
M62—See RCA Victor 125
M63—See RCA Victor 124
M65—See RCA Victor 221
M66—See RCA Victor 226
M67—See RCA Victor 224
M68—See RCA Victor Duo 321
M69—See RCA Victor 322
M81—See RCA Victor 143
M85—See RCA Victor 243
M86—See RCA Victor 242
M89—See RCA Victor 341
M106—See RCA Victor 262
M107—See RCA Victor 263
M125—See RCA Victor 281
M128—See RCA Victor Duo 380
M128R—See RCA Victor 380HR
M129—See RCA Victor 381
N60—See Previous Page
S22—See RCA Victor R7
S22X—See RCA Victor R7
S22D—See RCA Victor R7 DC
S42—See RCA Victor R9
S42B—See RCA Victor R43
S42D—See RCA Victor R9 DC
S132—See RCA Victor R10
SZ42P—See RCA Victor RE16
T12—See RCA Victor R5
T11D—See RCA Victor R5 DC
T12E—See RCA Victor R5X
T41—See RCA Victor Radiola 48

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
GENERAL ELECTRONICS																
AW50	Vol.	17	N				8-8	1	See Note	B3				^{5}58, 55, 47, 56, 80	465	1
							25	17	TS102							
GENERAL FIREPROOFING																
P	Vol.	7	‡			See Note A5	A407	1	CN140					77, 78, 38, 6Z3, or 1V		
							A408	15	TN110							
GENERAL HOUSEHOLD UTILITIES—See Grunow																
GENERAL MOTORS—"Day-Fan"																
"Little General"	Vol.	24	DRP309				8	4	RS213					^{4}24, 45, 80		1
	Tone	22	G12			See Note A45	12	4	RS215							
F	Vol.	7	K											^{4}36, ^{2}38		
	Tone	22	L													
"Day-Fan" 5AC	Vol.	11	A400P				2-2-1	3	See Note	B1				^{5}27, BH		
"Day-Fan" 25, 26, 27, 28	Vol.	5	K12				‡	3	See Note	B1				^{5}26, 27, ^{2}71, 80		11
"Day-Fan" 43, 48	Vol.	5	K12				‡	3	See Note	B1				^{5}26, 27, ^{2}71, 80		11
110	Vol.	24	DRP309				8	4	RS213					^{5}24, 45, 80		1
	Tone	22	G12			See Note A45	12	4	RS215							
120, 130, 140, ("A", "B") Below serial 29100A-1700B	Vol.	25	DRP310				3-2-4-4-5	‡	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	41	N													
120, 130, 140 ("A", "B") Between serials 29100A & 62100A, & 1700B & 1964B	Vol.	24	DRP309				3-2-4-4-5	‡	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	41	N													
120, 130, 140 ("A", "B") Above serial 62100A, 1964B	Vol.	25	DRP309				8, 8, 8	3	RS213					^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	41	N													
170E	Vol.	29	SRP268											^{4}32, 30, ^{2}31		
	Tone	41	N													
180, 190	Vol.	24	DRP309				8	4	RS213					^{4}24, 45, 80		1
	Tone	22	G12			See Note A45	12	4	RS215							
200-201 (E2)	Vol.	54	Y25MP	6										^{4}32, 30, ^{2}31		
	Tone	41	O													
211 (S9A, S9B)	Vol.	6	K12	6			8-8	1	CN152					^{2}24, 35, 27, 47, 80	175	1
216, 217, 219 (S1A, S1B)	Vol.	6	K12				1203346	7	RN241					24, ^{2}35, ^{2}27, 47, 80	175	1
	Tone	22	‡			See Note A5	8	7	RS213							
220 (S10A, S10B)	Vol.	8	Y10MP				206566	1	CN152					^{2}35, ^{2}27, 24, 47, 80	175	1
250 (S1A, S1B)	Vol.	6	K12				1203346	28	RN241					24, ^{2}35, ^{2}27, 47, 80	175	1
	Tone	22	‡			See Note A5	8	28	RS213							
251 (S2A, S2B)	Vol.	14	UC501	6			C6629	28	RS211					24, ^{2}35, ^{3}27, 47, 80	175	1
	Tone	22	L				8	28	RS213							
252, 253, 254, 255 256, 257, 258 (S3A, S3B)	Vol.	84	UC501	6			8, 8, 8	28	RS213					24, ^{3}27, ^{3}35, ^{2}45, 80	175	1
	Tone	22	K12													
281 (R1A)	Vol.	‡	G7			See Note A44								36, 37	535	
290, 291, 292, 293 (S4A, S4B)	Vol.	7	G	6			8, 8	1	RS213					24, ^{3}27, ^{3}35, 45, 80	175	1
	Tone	22	‡			See Note A5										
A5003	Vol.	2	K12				5-3-3-1	3	See Note	B1				^{5}26, 27, ^{2}45, 80		8
A5005	Vol.	12	K12				1-3-5-4	3	See Note	B1				^{3}24, 27, 80, ^{2}45		3
A5010	Vol.	5	M				1-3-3-5	3	See Note	B1				^{5}26, 27, ^{2}45, 80		8
A5020	Vol.	12	K12				1-3-4-5	3	See Note	B3				^{3}24, 27, ^{2}45, 80		3
5051, MG Set	Vol.	26	L				2-12-4	3	See Note	B3				^{6}01A		
5052	Vol.	26	K12											^{6}01A		
5057	Vol.	26	Y				2-2-2	3	See Note	B1				^{6}Kellog, BH		‡
5060	Vol.	26	Y											^{6}01A		
5065 AC	Vol.	26	K12											^{4}26, 27, 71		
5066	Vol.	26	K12											‡		
5077	Vol.	2	K12				‡	3	See Note	B1				^{5}26, 27, ^{2}71, 80		11
5080	Vol.	2	K12				‡	‡	See Note	B1				^{5}26, 27, ^{2}71, 80		11
5091	Vol.	2	K12				5-3-1-2	3	See Note	B1				^{5}26, 27, ^{2}45, 80		8
GENERAL TELEVISION																
"A," "B," "C," "E," "SW"	Vol.	6	K12	6			20-4-10	6/15	UR182	B110				12Z3, 43, 44, 77		
	Tone	22	L	7												
"G," "GSW," "M," "MSW"	Vol.	6	G12				4-4	4	See Note	B3				58, 57, 47, 80		1
	Tone	22	L													
GILFILLAN																
GN6	Vol.	29	Q											^{5}01A		
4T	Vol.	6	G12				4-4	4	CM170	B3				2A5, 57, 58, 80		1
5C, 5T	Vol.	17	N	6			8-4	4	CM171	B3				2A5, 2A6, 57, 58, 80	175	1
	Tone	22	K12													
5 tubes all wave	Vol.	18	M	6			8-4	1	CN151	B3				6A7, 78, 75, 42, 80	460	1
							10	19	TS101							
5X	Vol.	6	H12				8-16	6	CN145					25Z5, ^{2}36, 39, 43	450	
6C, 6T	Vol.	15	N	6			8-8	4	See Note	B3				2A5, 2A7, 55, ^{2}58, 80	262.5	1
	Tone	22	K12													
7A	Vol.	15	UM154			See Note A96	8-8	1	CN152	B3	37	296	C3	76, ^{2}77, 78, 85, 42, 84	175	10
							10	15	TS101							
7 tubes all wave	Vol.	18	M	6			8-8	1	CN152	B3				6A7, ^{2}78, 75, ^{2}42, 80	460	1
							10	19	TS106							
8C, 8T	Vol.	15	N	6			8-8	36	See Note	B3				^{2}2A5, 2A7, 55, 56, ^{2}58	262.5	1
	Tone	85	K12													
8X	Vol.	7/83	DRP314				8-8	74	CN152	B3	35	294	C3	^{2}6K7, 6A8, 6R7, 6C5,		
	Tone	22	MR33				10	19	TS101					^{2}6F6, 84	265	10
							.01		Buffer	B14						
30	Vol.	6	G12				4-4	4	CM170					2A5, 57, 58, 80		1
32	Vol.	17	N	6			8-4	4	CM171	B3				2A5, 2A6, 57, 58, 80	175	1
	Tone	22	K12													
33	Vol.	3	G12				‡	3	See Note	B4				^{5}27, ^{2}12, 80		2
34	Vol.	6	H12				16-8	6	CN145					25Z5, ^{2}36, 39, 43	450	
35 with 71's	Vol.	7	K				2-2-4	3	See Note	B1				^{5}27, ^{2}71, 80		2
35 with 2A5	Vol.	18	N	6			8-4	4	CM171	B3				57, 58, 2A6, 2A5, 80	175	1
	Tone	22	K12													
41	Vol.	17	N	6			8-4	4	CM171	B3				2A5, 2A6, 57, 58, 80	175	1
	Tone	22	K12													
42A	Vol.	6	H7				5-5	23	See Note	B3				42, 77, 78, 80		1
43A	Vol.	6	G12				4-4	4	CM170	B3				2A5, 57, 58, 80		1
44	Vol.	3	G12				‡	3	See Note	B3				^{5}27, ^{2}12, 80		2

‡Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GILFILLAN—Continued																
47, 50	Vol.	15	N	6			8-8	36	See Note	B3				^{2}2A5, 2A7, 55, 56, ^{2}58,		
	Tone	85	K12											80	262.5	1
52A, 54A	Vol.	6	H12				4-4	4	CM170	B3				^{2}77, 78, 42, 80	460	1
55A, 55B	Vol.	6	H12				16-8	6	CN145					25Z5, ^{2}36, 39, 43	450	
60	Vol.	86	J				2-2-3	3	See Note	B1				^{4}26, 27, 71, BH		18
62BX	Vol.	17	N	6			8-4	23	See Note	B3				5Z4, 6F5, 6F6, 6H6,		
	Tone	22	K12											6J7, 6K7	175	1
63B, 63X (AC)	Vol.	17	M	6			8-8	1	See Note	B3				5Z4, 6A8, 6F5, 6F6,		
							10	19	TS106					6H6, 6K7	460	1
66	Vol.	3	E12				‡	3	See Note	B1				^{2}10, ^{5}27, 81		5
67A, 67R	Vol.	18	UM154			A96	6-8	4	CM172	B3	35	294	C3	^{2}6K7, 6A8G, 6Q7G,		
	Tone	22	‡		See Note	A5	.005		Buffer	B14				6K6G, 84	252.5	10
77	Vol.	3	G12				‡	3	See Note	B4				^{2}12, ^{5}27, 80		2
77R	Vol.	45	UM154			A96	6-8	4	CN172	B3	35	294	C3	^{2}6K7G, 6A8G, 6H6G,		
	Tone	22	‡		See Note	A5	.005		Buffer	B14				6F5G, 6F6G, 84	252.5	10
78B, 78X	Vol.	17	N				8-8	1	See Note	B3				5Z4, 6A8, 6F5, 6F6,		
	Tone	76	K12				10	19	TS101					6H6, ^{2}6K7	460	1
100 with PP 71's	Vol.	58	K				2-2-4	3	See Note	B1				^{5}27, ^{2}71, 80		2
100 with 45	Vol.	6	G12				2-2-2	3	See Note	B1				^{6}27, 45, 80		1
105, 106 (1st Type)	Vol.	6	H12				2-2	1	See Note	B1				^{4}24, 45, 80		1
	Tone	22	H12													
116B, 116X, 117B, 117X	Vol.	46	N	6			16	1	RS216					^{3}6K7, 6A8, 6H6, ^{3}6C5,		
	Tone	76	M				18	1	RS216					^{2}6F6, 5Z4	460	1
	Sen.	7	UC500				10	19	TS106							
402T	Vol.	6	H12			A14	5-5	23	CM172	B3				78, 77, 42, 80		1
410	Vol.	6	G12				4-4	23	CM170	B3				57, 58, 2A5, 80		1
412T	Vol.	6	G12			A14	4-4	23	CM170	B3				58, 57, 2A5, 80		1
510	Vol.	18	N	6			8-4	23	CM171	B3				57, 58, 2A6, 80	175	1
	Tone	22	K12													
515	Vol.	18	M	6			8-4	1	CN151	B3				6A7, 78, 75, 42, 80	460	1
							10	19	TS101							
520	Vol.	18	N	6			8-4	23	CM171	B3				57, 58, 2A6, 2A5, 80	175	1
	Tone	22	K12													
521T-C	Vol.	18	MR48				5-5	23	CM172	B3				6A7, 6D6, 75, 42, 80	460	1
	Tone	22	K12				10	15	TS101							
525	Vol.	18	M	6			8-4	1	CN151	B3				6A7, 78, 75, 42, 80	460	1
							10	19	TS106							
615	Vol.	15	N	6			8-8	4	See Note	B3				2A7, ^{2}58, 55, 2A5, 80	262.5	1
	Tone	22	K12				10	15	TS101							
625	Vol.	15	N	6			8-8	4	See Note	B3				2A7, ^{2}58, 55, 2A5, 80	262.5	1
	Tone	22	K12				10	15	TS101							
700	Vol.	15	UM154		See Note	A96	8-8	1	CN152	B3	37	296	C3	42, 76, ^{2}77, 78, 84, 85	175	10
							10	15	TS101							
							.015		Buffer	B14						
711T	Vol.	45	MR48	M26			8-4	23	CM171	B3				6A8, 6K7, 6H6, 6G5,		
	Tone	22	K12											6F5, 6F6, 5Y3	175	1
715	Vol.	18	M	6			8-8	1	See Note	B3				6A7, ^{2}78, 75, ^{2}42, 80	460	1
							10	19	TS106							
723T-C	Vol.	45	M				8	12	CS123					1C6, ^{2}34, ^{2}30, 32, 19	460	
	Tone	41	N													
725	Vol.	18	M	6			8-8	1	CN152	B3				6A7, ^{2}78, 75, ^{2}42, 80	460	1
							10	19	TS106							
731T-C	Vol.	124	MR48	M26			8-8	1	CN152					6A8, 6K7, 6H6, 6G5,		
	Tone	22	K12				10	19	TS101					6F5, 6F6, 5Y3	460	1
815, 825	Vol.	15	N	6			8-8	36	See Note	B3				2A7, ^{2}58, 55, 56, ^{2}2A5,		
	Tone	22	K12											80	262.5	1
831T-C	Vol.	7/17	DRP314				16	1	WE1647					^{3}6K7, 6A8, 6B7, 6G5,		
	Tone	22	K12				18	1	WE1847					6F6, 5Y3	462	1
							10	19	TS101							
1131C	Vol.	7/83	DRP314				16	1	WE1647					^{3}6K7, 6A8, 6R7, 6G5,		
	Tone	44	K12				18	1	WE1847					^{2}6C5, ^{2}6F6, 5X4G	462	1
							8	13	CS133							
							25	19	TS103							
1331C	Vol.	7/56	DRP314				16-18	1	RS216					^{3}6K7, 6A8, 6H6, 6G5,		
	Tone	44	K12				8	13	CS133					6Q7, ^{3}6C5, ^{2}6F6,		
							25	15	TS103					5X4G	462	1
GILT EDGE—See Airking																
GLORIATONE—See U. S. Radio & Tel.																
GOLDENTONE																
L5	Vol.	18	N	6			P474	32	RS211					5Z4, 6F5, 6H6, 6K7,		
	Tone	34	L				P160	32	CN151	B81				6L7, 6C5	456	1
							P304	15	TS101							
L6	Vol.	18	N	6			P474	32	RS211					5Z4, 6C5, ^{2}6F6, 6K7,		
	Tone	44	L				P160	32	CN151	B81				6L7, ^{2}6Q7	456	1
							P304	15	TS101							
L7	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{3}30, ^{2}34	456	10
	Tone	‡	L				.01-.01		Buffer	B14						
Z4	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275				P958	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
GOLD MEDAL																
L5	Vol.	18	N	6			P474	32	RS211					5Z4, 6F5, 6F6, 6H6,		
	Tone	34	L				P160	32	CN151	B81				6K7, 6L7, 6C5	456	1
							P304	15	TS101							
L6	Vol.	18	N	6			P474	32	RS211					5Z4, 6C5, ^{2}6F6, 6K7,		
	Tone	44	L				P160	32	CN151	B81				6L7, ^{2}6Q7	456	10
							P304	15	TS101							
L7	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{3}30, ^{2}34	456	10
	Tone		L				.01-.01		Buffer	B14						
Z4	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
GOODYEAR																
570	Vol.	17	N	6			C525C, D	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	456	
575	Vol.	6	Z12	6	EX100		P119-6	4	RM261	B37				2A5, ^{2}57, 58, 80	175	1
580	Vol.	17	N	6			119-15	4	CM171	B3	35	294	C3	6D6, 6A7, 75, 42, 84	175	10
							.01		Buffer	B14						
661	Vol.	18	UM154-SS13	M26			119-37	4	RM262		35	294	C3	^{2}6K7, 6A8, 6Q7, 41,		
							.005		Buffer	B14				6X5	465	10
667	Vol.	17	UM147-SS13	M26			119-34	4	RM261		35	294	C3	^{2}6K7, 6A8, 6Q7, 6F6,		
	Tone	22	MR53				.01		Buffer	B14				6X5	262.5	10
670	Vol.	17	N	6			P103-2	4	RM262		35	294	C3	6C6, 6D6, 42, 75, 78,		
							20	15	TS102					84	175	10
							.02		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GOODYEAR—Continued																
675	Vol.	18	N.	6			P103-4	4	RS216					2A5, 2A6, 27, 57, 58,		
							P103-3	4	RS216					80	370	1
741	Vol.	18	MR53	M26			103-6	4	RS213					6A8, 6K7, 6Q7, 6C5,		
	Tone	22	MR14				103-14	4	WE1647					[2]6F6, 5Y3	465	1
777 series A	Vol.	18	O.	6			P103-4	4	WE1647					[2]6D6, 6C6, 76, 75, 42,		
	Tone	57	M.				P130-3	4	WE1847					80	465	1
777 series B	Vol.	56	O.	6			P103-8	4	WE1647					[2]6D6, 6C6, 76, 6B7,		
	Tone	57	M.				P103-4	4	WE1647					42, 80	465	1
1173	Vol.	20	‡			See Note A19	103-10	25	WE3540					[2]6K7, 6J7, 6C5, 6H6,		
	Tone	22	SRP287	8			103-8	25	RS216					6F5, [3]6F6, 5Z3, 6G5	465	1
1174	Vol.	20	‡			See Note A19	103-5	30	RS213					[2]6K7, 6J7, 6C5, 6H6,		
	Tone	22	SRP287	8			103-10	30	WE3540					6F5, [3]6F6, 5Z3, 6G5	465	1
							103-8	30	RS216							
GRAYBAR ELECTRIC CO.																
GB4 (Graybarette)—See RCA Model R5																
GB8 (Midget)—See RCA Model R7																
GB8A—See RCA Model R7A																
GB9—See RCA Model R11																
GB100—See RCA Model R55																
GB300—See RCA Model Rad. 16																
GB310—See RCA Model Rad. 18																
GB311—See RCA Model R33																
GB320—See RCA Model Rad. 51																
GB330—See RCA Model Rad. 60																
GB340—See RCA Model R62																
GB500—See RCA Model R14																
GB550—See RCA Model R46																
GB600—See RCA Model R66																
GB678—See RCA Model R18																
GB700—See RCA Model R80																
GB770—See RCA Model R82																
GB900—See RCA Model R86																
GB989—See RCA Model R10																
GC13—See RCA Model R6																
GC14—See RCA Model R12																
GG15—See RCA Model R6																
GT7—See RCA Model R4																
GT8—See RCA Model R8																
GT8-56—See RCA Model R71																
GT8-69—See RCA Model R72																
GT10-69—See RCA Model R74																
GT10-88—See RCA Model R76																
GT10-99—See RCA Model R77																
GREBE																
AH1	Vol.	8	A1MP	6			‡	1	See Note	B4				[3]24, 27, [2]45, 80		7
	Tone	34	L.				.01		See Note	B9						
HS3	Vol.	6	G12	6			8-8	4	See Note	B3				[2]24, 35, 47, 80	175	1
	Tone	22	L.													
HS4 1 Pentode	Vol.	7	E.	6			8, 8, 8	3	RS213					[2]35, [2]24, 27, 47, 80	175	1
	Tone	22	L.													
HS4 with 45PP	Vol.	6	F12	6			8, 8, 8	3	RS213					[3]24, [3]27, [2]45, 80	175	3
	Tone	22	L.													
HS5	Vol.	7	E.	6			8, 8, 8	3	RS213					[2]27, [2]35, 24, [2]47, 80	175	3
	Tone	22	L.													
HS6	Vol.	15	N.	6			8, 8, 8	3	RS213					[3]27, 24, [4]35, [2]47, 80	175	3
	Tone	‡	Y100MP			See Note A46										
HS7	Vol.	7	E.	6			6, 6	3	RS213					[2]24, 27, [2]35, 47, 80	175	1
HS8	Vol.	64	N.	6			8, 8, 8	5	RS213					[4]35, [2]27, 47, 80	175	1
	Tone	22	L.													
HS11	Vol.	18	N.	6			6, 6	3	RS213					[4]35, [3]27, [2]47, 80	175	3
	Sil.	12	A5MP			See Note A14										
	Tone	34	L.													
HS12	Vol.	62	N.	6			8, 8, 8	3	RS213					[3]27, [4]35, 24, [2]47, 80	175	3
	Supp.	12	A400P													
Synchrophase SK4	Vol.	8	A3MP				‡	3	See Note	B4				[3]24, 27, [2]45, 80		3
61R	Vol.	56	N.				8-8	1	CN152		34	292	C3	6A7, 37, 41, 78, 84, 85	456	10
							5	15	TS101							
							.025		Buffer	B14						
89	Vol.	6	E12				8, 8	4	RS213					[2]56, [3]58, [2]59, 80	175	1
111B	Vol.	18	M.				16	35	RS216					[3]46, 55, 56, [4]58, 57, 82	175	1
	Supp.	8	UC500				8	35	RS213							
428 Console	Vol.	26	‡			See Note A5	‡	1	See Note	B4				[4]26, 27, 71A, [2]81, [2]50		11
GRIGSBY - GRUNOW—See Majestic																
DAVID GRIMES																
"New Yorker" 110 V. DC	Vol.	26	K.											[4]12, [2]71		
	Fil.	29	S.													
GRUNOW																
2A (1101)	Vol.	‡	P.				27710	28	WE847					[2]78, 6F7, 6B7, 85, 37,		
	Tone	41	O.				27711	28	WE847					[4]45, 5Z3	262	14
							27715	28	CM171							
4A (450, 451)	Vol.	6	G12	6			29168	1	CN152					[2]6F7, 42, 84	455	1
							24789	15	TS101							
4B (460, 461), 4BX (460X, 461X)	Vol.	6	F7	6	3		31208	4	CM172					6A7, 6F7, 42, 80	455	1
4C (470)	Vol.	6	F7		3		31208	4	CM172					6A7, 6F7, 41, 80	465/490	1
4NB (410, 411)	Vol.	18	M.	6			35202	1	CN152		13	245	C3	1A6, 1A4, 75, 41	465	10
							32987	15	TS101							
							.0075		Buffer	B14						
5A (500)	Vol.	18	O.	6			27713	1	RS213					6F7, 78, 75, 47, 80	455	14
							27712	1	RS213							
							27838	13	TS101							
							27489	17	TS101							
5AB (508, 509)	Vol.	18	MR48	M27			8-16	1	RN235	B3	35	294	C3	6D8G, 6S7G, 6T7G,		
							32987	15	TS101					41, 84	465	41
							.0075		Buffer	B14						
5AD	Vol.	6	MR33	M26			39941	1	RM257	B3				6D6, 6C6, 25L6, 25Z5		
5B (501, 520, 530, 550)	Vol.	17	N.	6			27151	11/15	SR618					6F7, 25Z5, 43, 75, 78.	455	
5C (502, 503)	Vol.	6	G12											[2]32, 30, 34, 33	455	
	Fil.	29	R.													
5D (570, 571)	Vol.	17	O.	6			29562	4	RS216					6A7, 6D6, 75, 42, 80	455	1
							27711	4	RS213							
							31477	24	RS215							
							24789	15	TS101							
5E (560)	Vol.	17	N.	6			31849	1	CN152					6A7, 6D6, 75, 42, 80	455	1
							31857	15	TN110							

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
GRUNOW—Continued																
5G (580, 581)	Vol.	18	TRP604	6			31424	4	RS215					6A7, 6D6, 42, 75, 80	465/490	1
							33469	4	WE1847							
							33371	14	RS205							
							32987	15	TS101							
5H (532)	Vol.	7	E	6	2		35181	4	RS213					6A7, 6D6, 76, 41, 80	465	1
							34741	4	RS215							
5J (542)	Vol.	18	M	6			34813	4	RS213					6A8, 6K7, 6Q7, 6F6, 5W4	465	1
							34669	4	RS215							
5K (551, 553)	Vol.	18	TRP623	6			33469	4	RS216					6A8, 6K7, 6Q7, 6F6, 5W4	465	1
							33369	4	RS215							
5L (555, 572)	Vol.	18	TRP605	6			33369	4	RS215					6A8, 6K7, 6Q7, 6F6, 5W4	465	1
							33469	4	RS216							
5M (590)	Vol.	18	M	6			35177	4	CM164					6A8, 6K7, 6Q7, 25A6, 25Z6	465	
5N (592, 594)	Vol.	18	M	6			35177	1	CM164					6A7, 6D6, 75, 43, 25Z5	465	
5NB (510)	Vol.	18	MR44	M23										[2]1A4, 1A6, 1B5, 33	465	
5P (599)	Vol.	18	TRP623	6			33369	4	RS215					6A7, 6D6, 75, 42, 80	465	1
							33469	4	WE1847							
5Q (573)	Vol.	18	TRP605	6			33469	4	WE1847					6A8, 6K7, 6Q7, 6F6, 5W4	465	1
							33369	4	RS215							
5R (564)	Vol.	7	E	6			36350	4	RM262	B73				6A7, 6D6, 76, 41, 80	465	1
5S (566)	Vol.	7	E	6	2		36350	4	RM262	B73				6A7, 6D6, 76, 41, 80	465	1
5T (576, 578)	Vol.	7	E	6			36350	4	RM262	B73				6A7, 6D6, 76, 41, 80	465	1
5U (587, 589)	Vol.	18	TRP623	6			33369	4	RS215					6A7, 6D6, 75, 42, 80	465	1
							33469	4	WE1847							
5UA (585)	Vol.	18	TRP623	6			33369	4	RS215					6A7, 6D6, 75, 42, 80	465	1
							33469	4	WE1847							
							39546	4	RM265							
5V (596, 598)	Vol.	18	MR44	M26			36350	4	RM262	B73				6A7, 6D6, 75, 41, 80	465	1
5VB (544, 545)	Vol.	15	MR48											1C6, 34, 1F6, 33	465	
5W (583, 585, 586, 588)	Vol.	18	MR44	M26			36350	4	RM262	B73				6A7, 6D6, 75, 41, 80	465	1
6A Early (650, 651)	Vol.	17	TRP610	6			29557	4	CS133					6A7, [2]6D6, 42, 75, 80	262	1
	Tone	22	M				29086	4	RS216							
6B (622)	Vol.	18	MR44	M26			38608	4	RS207					6A8, 6K7, 6Q7, 25L6, 25Z5	465	
							38610	4	RS207							
							38709	13	CN140							
6C Early (660, 661, 662)	Vol.	17	TRP610	6			29562	23	RS216					[2]6D6, 6A7, 75, 42, 80	262	1
	Tone	22	M				29557	23	CS133							
6D (670, 671)	Vol.	17	O				30091	4/13 15/19	SR614					[2]6D6, 6A7, 75, 42, 80	455	1
	Tone	22	L	6												
6E (663)	Vol.	18	TRP623	6			33369	4	RS215					[2]6K7, 6A8, 6Q7, 6F6G, 80	465	1
							33469	4	WE1847							
6F (690, 691)	Vol.	17	TRP608	6			30091	4/13 15/19	SR614					[2]6D6, 6A7, 75, 42, 80	455	1
	Tone	22	L													
6G (680, 681)	Vol.	18	TRP604	6			33369	4	RS215					6A8, 6K7, 6H6, 6F5, 6F6, 5Z4	465	1
							33469	4	WE1847							
							33371	14	RS215							
							32987	15	TS101							
6H (632)	Vol.	18	MR44	M26			33369	4	RS215					[2]6K7, 6A8, 6Q7, 6F6G, 80	465	1
							33469	4	WE1847							
6HB (620, 621)	Vol.	15	P	7			33943	12	RS203					1C6, 34, [2]30, 32, 19	465	
6J (640, 641)	Vol.	17	TRP604	6			33369	4	RS215					6A7, [2]6D6, 42, 75, 80	465/490	1
							33370	4	WE1847							
							33371	14	RS205							
							33469	‡	WE1847							
							32987	15	TS101							
6K (623, 627)	Vol.	18	TRP623				38608	4	RS207					6A8, 6K7, 6Q7, 25L6, 25Z5	465	
							38610	4	RS207							
							38611	13	CS121							
6L (653)	Vol.	18	TRP623	6			33369	4	RS215					6A8G, 6K7G, 6H6G, 6F5G, 6F6G, 80	465	1
							33469	4	WE1847							
6M (631, 643)	Vol.	18	TRP605	6			33469	4	WE1847					6A8, [2]6K7, 6Q7, 6F6, 5W4	465	1
							33369	4	RS215							
6N (654)	Vol.	18	M	6			33369	4	RS215					6A8G, [2]6K7G, 6Q7G, 6F6G, 80	465	1
							33469	4	WE1847							
6Q (624)	Vol.	18	MR44	M26			38608	4	RS207					6A8, 6K7, 6Q7, 25L6, 25Z5	465	
							38610	4	RS207							
							38709	13	CN140							
7A (700, 701)	Vol.	20	TRP610				27414	1	RS213					[3]78, 37, 75, 42, 80	262	1
	Tone	22	M				27413	23	RS213							
7B (750, 751, 752, 753)	Vol.	17	TRP610	6			29558	1	CS135					6D6, 6A7, 6F7, 75, 76, 42, 80	262	1
	Tone	22	Order from	Mfr.			29562	1/23	RS216							
							31052	23	CS133							
							29559	23	CS133							
7C (760, 761)	Vol.	20	TRP611				33369	1	RS215					[2]6K7, 6A8, 6H6, 6F5, 6F6, 5Z4	175	1
							33371	1	RS205							
							33469	14	WE1847							
							33169	15	TN111							
7DB (720, 721)	Vol.	15	P	7			33943	12	RS203					1C6, 34, [2]30, 32, 19	465	
7M (723, 731, 733, 735)	Vol.	19	TRP605	6			33369	4	RS215					6A8, [2]6K7, 6Q7, 6F6, 5W4, 6E5	465	1
							33469	4	RS216							
7NB (711)	Vol.	19	TRP608				35202	1	CN152		13	245	C3	[3]1A4, 6A7, 1B5, 30, 19	455	10
							35154	24	RS205							
							35340	‡	Order from	Mfr.						
							.0075		Buffer	B14						
7Q (755)	Vol.	18	TRP623	6			33369	4	RS215					[2]6K7G, 6A8G, 6Q7G, 6F6G, 80, 6G5	465	1
							33469	4	WE1847							
8A (801)	Vol.	17	TRP610	6			27414	1	RS213					[3]78, 37, 85, 6B7, 42, 80	262	1
	Tone	34	M				27413	1/23	RS213							
8B (821)	Vol.	17	O				27414	1	RS213					[2]78, 6A7, 85, [2]37, 42, 80	262	1
	Tone	22	M				27413	1/23	RS213							
							29562	23	RS216							
							27668	15	TS101							
8D (861)	Vol.	17	TRP610				29562	23	RS216					[2]6D6, 6A7, [2]76, 75, 42, 80	455	1
	Tone	22	Order from	Mfr.			29558	23	CS135							
							30152	13	CS133							
8E (871)	Vol.	17	TRP611				33852	24	WE1247					[2]6K7, 6A8, 6H6, 6C5, [2]6F6, 5Z4	455	1
							33598	1	RS215							
							33469	1	RS216							
							33371	13	RS205							
							32987	15	TS101							
8H (823, 831, 833, 835)	Vol.	20	TRP611				33369	1	RS215					[2]6K7, 6A8, 6H6, 6F5, 6F6, 6E5, 5Z4	455	1
							33469	1	RS216							
							33371	14	RS205							
							33169	15	TN111							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
GRUNOW—Continued																
9A Early (901, 902)	Vol.	17	TRP610	6			27710	1	WE847					^{3}78, 37, 85, ^{2}45, 6B7, 80	262	14
	Tone	41	O				27711	1/23	RS213							
							27670	14/15	RN242							
							28400	‡	RN242							
9A (901, 902) Revised	Vol.	17	TRP610	6			8	1	RS213					^{3}78, 37, 6B7, 85, ^{2}45,		
	Tone	41	O				8-8	24	RN242					80	262	14
							27670	14/15	RN242							
9B (1101)	Vol.	‡	P				27710	1	WE847					^{2}78, 6F7, 6B7, 85, 37,		
	Tone	41	O				27711	1	WE847					^{4}45, 5Z3	262	14
							27715	24	CM171							
9C (921)	Vol.	17	TRP610	6			27710	28	WE847					^{2}78, 6A7, 85, 76, ^{2}45, 80	262	14
	Tone	44	O				27711	28	RS213							
							29562	28	RS216							
							27670	14/15	RN242							
							24789	15	TS105							
9E (941)	Vol.	20	TRP611				33852	24	RS215					^{2}6K7, 6A8, 6H6, 6C5,		
							33598	1	RS215					^{2}6F6, 6E5, 5Z4	455	1
							33469	1	RS216							
							33371	14	RS205							
							32987	15	TS101							
10D (1067)	Vol.	20	TRP610	6			36752	1	WE2545					^{3}6K7, 6A8, 6H6, ^{2}6C5,		
							36720	1	WE3540					^{2}6F6G, 5Z3	465	1
							36721	14	RS215							
10G (1091)	Vol.	20	TRP608	6			36752	1	WE2545					^{3}6K7, 6A8, 6J7, 6H6,		
							36720	1	WE3540					6N7, ^{2}6F6G, 5Z3	465	1
							36721	14	RS215							
11A Type 1 (1151, 1152)	Vol.	17	O	6			27710	1	WE847					^{2}6D6, 6A7, ^{4}76, 85, ^{2}45,		
	Tone	41	O				27711	1/23	RS213					5Z3	262	14
							27715	14/19	CM171							
							29632	13	CS133							
							24789	15	TS101							
11A Type 2 (1151, 1152, 1161, 1162)	Vol.	17	O	6			31743	1	WE1247					^{2}6D6, 6A7, ^{4}76, 85, ^{2}45,		
	Tone	41	O				31629	1/23	WE1647					5Z3	262	14
							27715	14/19	CM171							
							29632	13	CS133							
							24789	15	TS101							
11B (1151, 1152, 1161, 1162)	Vol.	17	O	6			31743	28	WE1247					^{2}6D6, 6A7, ^{4}76, 85, ^{2}45,		
	Tone	41	O				31629	28	WE1647					5Z3	262	14
							27715	4/19	CM171							
							29632	13	CS133							
							24789	15	TS101							
11C (1171)	Vol.	17	TRP608				33645	4	WE847					^{3}6K7, 6A8, 6H6, ^{2}6C5,		
							33768	4	RS215					6F5, ^{2}6F6, 5Z4	455	1
							34466	1	RS216							
							33371	13	RS203							
							33169	15	TN111							
							33646	19	TS105							
11G (1191)	Vol.	17	TRP610	6			36719	46	WE1647					6G5, ^{3}6K7, 6A8, 6H6,		
							36752	46	WE2545					^{2}6C5, ^{2}6F6, 5Z3	465	1
							36720	46	WE3540							
							36721	46	RS215							
11H (1181, 1183, 1185)	Vol.	20	TRP608	6			36752	1	WE2545					^{2}6K7, 6A8, 6J7, 6H6,		
							36720	1	WE3540					^{2}6C5, ^{2}6L6G, 5Z3	465	1
							36721	14	RS215							
12A (1241)	Vol.	20	TRP608				33947	33	WE847					5Z4, 6A8, ^{2}6C5, 6F5,		
							33946	33	WE1247					^{3}6F6, 6H6, ^{3}6K7	455	1
							34466	33	RS216							
							33646	33	TS105							
							33169	15	TN111							
12B (1291), 12W (1297)	Vol.	18	TRP608	6			36752	46	WE2545					^{3}6K7, 6A8, 6J7, ^{3}6C5,		
							36720	46	WE3540					6H6, ^{2}6L6, or ^{2}6F6,		
							36721	46	RS215					5Z3	465	1
							33371	14	RS205							
							33169	15	TN111							
							36776	15	TS101							
15W (1541)	Vol.	18	TRP608				36290	31	HD680					^{4}6K7, 6L7, ^{2}6J7, 6H6,		
							36596	31	WE1247					6R7, 6C5, ^{3}6F6, 5Z4	455	1
							36466	31	RS216							
							36597	14	RS205							
							33646	19	TS105							
30 Apex Auto Set	Vol.	7	UC501											^{2}24, 26, 01A, 71A		
99 and 99A	Vol.	6	G12				8-4	1	CN151	B3				^{2}24, 35, 47, 80	175	1
513	Vol.	6	Y				4-12-4	11	UR182					6F7, 78, 75, 43, 25Z5	455	
614-618	Vol.	18	TM241-SS3				35390	1/15	CN155/TN111		35	294	C3	^{2}6K7G, 6A8G, 6Q7G,		
							.005		Buffer	B14				6F6G, 6X5G	262	10
625	Vol.	17	TM241-SS3				34119	1/15	CN152/TN110		26	273D		^{2}6K7G, 6A8G, 6R7G,		
	Tone	22	MR53											6C5G, 6A6	262	10
GULBRANSEN (Also see Wells-Gardner)																
Champion Jr.	Vol.	6	G12				1-1-1	28	See Note	B7				^{3}24, 27, ^{2}45, 80		1
	Tone	41	O													
V6Z2	Vol.	17	N	6			P80956	25	CM172/TS102	B112	34	292	C12	77, ^{2}78, 75, 41, 84	262	10
							P80937	1/12	CN140							
							‡		Buffer	B14						
Z6Z1	Vol.	17	N	6			P80956	25	CM172/TS102	B112	34	292	C12	77, ^{2}78, 75, 41, 84	262	10
							P80937	1/12	CN140							
05A	Vol.	6	G12	6	EX300		5-15-8	11	UR182	B31				^{2}77, 78, 43, 25Z5	262	
							4	20	TS105							
06W	Vol.	56	N				16-8	1	CN155		2	210	C3	^{2}78, 77, 85, ^{2}41	262	26
							4	15	TS101							
062A	Vol.	45	N				4	15	TS105		1	206	C3	^{3}39, 36, 37, 41	262	
	Tone	34	UC502				4	13	CS123							
9 in line (Club)	Vol.	1	E12				2-1-1-1-.5	3	See Note	B1				^{5}26, 24, ^{2}45, 80		9
	Vol.	1/15	DRP241													
10 Series, 13	Vol.	7	F		1		80848	23	RS213					^{2}35, ^{2}24, 27, 47, 80	175	3
	Tone	22	O	6			80849	23	RS213							
20 Series	Vol.	‡	N				8, 8, 8	28	RS213					^{4}35, ^{3}27, ^{2}47, 80	175	1
	Tone	41	P	6												
23	Vol.	‡	N				8, 8, 8	28	RS213					^{4}35, ^{3}27, ^{2}47, 80	175	1
	Tone	41	P	6												
53 Battery	Vol.	6	H7		2									^{2}24, ^{2}01A, 71		
	Tone	21	O	6												
53 AC	Vol.	59	SRP272				80894	23	CM172					^{2}35, ^{3}24, 47, 80	175	7
	Tone	34	UC502				80891B	13	CS121							
60, 63	Vol.	6	TRP600				P80849	25	RS213					^{4}24, 45, 80		1
							P80848	25	RS213							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	CONTROLS: Circuit	CONTROLS: Correct Replacement	CONTROLS: Switch	CONTROLS: Bias	CONTROLS: *Note	CONDENSERS: Original Part	CONDENSERS: Circuit	CONDENSERS: Correct Replacement	CONDENSERS: *Note	VIBRATORS: Vibr. Conn.	VIBRATORS: Replacement	VIBRATORS: *Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
GULBRANSEN—Continued																
80A 60 Cycles	Vol.	6	D7				1-1-1	5	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		1
	Tone	41	O													
80A 25 Cycles	Vol.	24	GG				2.5-4-2	28	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	41	O													
92, 93	Vol.	2/10	DRP243											^{4}32, 33	175	
160, 161, 60 Cycles	Vol.	24	GG				1-1-1.5-1.5	28	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	41	O	6												
160, 161, 25 Cycles	Vol.	24	GG				2.5-4-2	28	See Note	B1				^{2}27, ^{2}45, 80, ^{3}24		3
	Tone	41	O													
162	Vol.	‡	TRP600				P80849	25	RS213					^{4}24, 27, 45, 80		3
	Tone	41	O	6			P80818	25	RS213							
200, 291, 292, 295	Vol.	1/15	DRP243				2-1-1-1-.5	‡	See Note	B7				^{5}26, 24, ^{2}45, 80		9
322	Vol.	64	Z12				8	30	WE847					^{4}58, ^{3}56, ^{2}57, ^{2}46, 82	175	3
	Tone	41	L	6			8-4	30	CN151							
	Supp.	8	A5MP				4	19	CS121							
351	Vol.	6	H7	6			80894	4	CM172					^{2}57, 35, 47, 80	262	1
362	Vol.	45	N											^{3}39, 36, 37, 38	262	
392	Vol.	18	N											^{3}34, ^{6}30	175	
	Tone	22	UC502													
742	Vol.	40	‡		See Note A5		1.5-1-3	3	See Note	B1				^{3}24, 27, ^{2}45, 80		3
872	Vol.	59	SRP271				80894B	23	CM172					^{2}58, ^{3}57, 47, 80	175	7
	Tone	34	L				80891	13	CS121							
9950	Vol.	1/15	DRP243				2-1-1-1-.5	‡	See Note	B7				^{5}26, 24, ^{2}45, 80		9
HALLICRAFTERS																
5PA "Sky Buddy"	Vol.	18	N	6			4214	23	RM261	B3				6A7, 6F7, 75, 42, 80		1
"Ultra Sky Rider"	Vol.	45	500M No. 1		See Note A19		4216	1	RS216					^{2}6K7, ^{2}6L7, 6C5, 6R7, 6J7, 6Q7, 6F6, 5Z4	1600	1
	Tone	‡	O	6			4203	15	TS106							
	Sil.	8	G													
	BFO.	‡	N													
HALSON																
"Dual Range"	Vol.	7	G	6			8, 8	4	RS213	B3				^{2}35, 24, ^{2}47, 80		1
	Tone	22	O													
"Roadmaster"	Vol.	15	N				8-8	1	CN152	B3	3	220B		6A7, 78, 75, 42, 84	456	10
							5	15	TS101							
AW6	Vol.	45	M	6			25-8	23	UR182	B3				6A7, 6D6, 6H6, 6J7, 43, 25Z5, or 6A7, 6D6, 76, 6C6, 43, 25Z5	456	
MA63	Vol.	45	M				8-8-4	25/13	CM175	B3				6A8, 6K7, 6H6, 6J7, 6F6, 5Y3	456	1
	Tone	22	Y													
MG5	Vol.	6	Y				16-8-5-5	6/15	UR189	B3				6K7, 6J7, 43, 25Z5, 55A1		
NS40	Vol.	6	UC509	6	EX150		4-16-4	8	UR193					78, 77, 43, 25Z5		
							5	15	TS101							
NS50	Vol.	7	G	6	1		4-16-8	8	UR193					6A7, 78, 75, 43, 25Z5	456	
NS60	Vol.	7	G		2		4-16-16	8	UR182					^{2}78, 6A7, 75, 43, 25Z5	456	
							5	15	TS101							
5L-E	Vol.	6	‡		See Note A5		16-12-4-5-5	25/15	See Note	B3				6D6, 6C6, 43, 25Z5, L49B		
6L6	Vol.	45	M				1652	25	RS213					6A7, 6D6, 76, 6C6, 6E5, 42, 80	456	1
							8-4	25/13	See Note	B3						
20A	Vol.	6	G7	6	1		8-4	6	CN141	B3				^{2}78, 77, 43, 25Z5		
							5	15	TS101							
20B, 20B "European"	Vol.	7	G	6	1		8-8	6	CN142	B3				6A7, 78, 77, 43, 25Z5	456	
							5	15	TS105							
25	Vol.	18	N	6			2263	23	RM257	B261				6A7, 6D6, 75, 43, 25Z5	456	
35	Vol.	18	N	6			2270	23	RS213					6A7, 6D6, 75, 41, 80	456	1
							2271	23	WE847							
45	Vol.	6	SRP263	6			1408	6/15	UR189	B98				6D6, 6C6, 43, 12Z3		
50S	Vol.	18	M	6			25-8	40	See Note	B3				6A7, 6K7, 75, 43, 25Z5	456	
50X	Vol.	18	N				25-12-10	6/15	UR182	B3				6A7, 6K7, 75, 43, 25Z5, L42B	456	
52	Vol.	6	SRP263	6			1437	25	CS133	B3				6D6, 6C6, 41, 76, 80		1
54	Vol.	6	SRP263	6			1440	38	UR190	B3				6D6, 6C6, 43, 25Z5, 76		
60L	Vol.	18	M				25-12-10	6/15	UR182	B3				6A7, 6D6, 75, 43, 6E5, 25Z5	456	
60M	Vol.	18	M				25-12-10	6/15	UR182	B3				6A7, 6K7, 75, 43, 25Z5, L42D	456	
66AW	Vol.	8	‡	6	See Note A5		6606	8	UR182	B3				6A7, ^{2}6D6, 75, 43, 25Z5	456	
							6611	16	TS105							
100, 100M	Vol.	18	N				25-12-10	6/15	UR182	B3				6A7, 6D6, 75, 43, 25Z5 (L42B)	456	
102	Vol.	18	N	6			2302	6	Order from	Mfr.				6A7, 6D6, 75, 25L6G, 25Z5	456	
							10	15	TS101							
103	Vol.	18	N	6			2302	6	Order from	Mfr.				6A7, 6D6, 75, 6G5, 25L6G, 25Z5	456	
							10	15	TS101							
104	Vol.	18	N	6			1652	25	RS213					6A7, 6D6, 76, 6F5, 41, 80	456	1
							2308-2	25/13	RN241							
106	Vol.	18	N	6			1652	25	BS213					6A7, 6D6, 76, 6G5, 6F5, 41, 80	456	1
							2308-2	25/13	RN241							
161	Vol.	98	E	6	See Note A14		32-8	23	See Note	B3				6A7, 6C6, 25L6G, 25Z5, L49D	456	
162	Vol.	98	E	6	See Note A14		32-8	23	See Note	B3				6A7, 6C6, 25L6G, 6E5, 25Z5, L42D	456	
410	Vol.	6	Y	6	EX300		1194	25	CS133	B3				6D6, 6C6, 42, 80		1
515	Vol.	6	G12				8	4	See Note	B3				^{2}35, 24, 47, 80		1
							6	4	See Note	B3						
515SW	Vol.	6	G12	6			8	4	See Note	B3				^{2}35, 24, 47, 80		1
							6	4	See Note	B3						
516	Vol.	3	G12	6										^{2}39, 38, ^{2}33		
520	Vol.	6	Y	6	EX100		1194	25	RS213	B3				6A7, 6D6, 6C6, 42, 80	456	1
530	Vol.	6	SRP263	6			1320	7	CM175	B3				6A7, 6D6, 6C6, 43, 12Z3	456	
535	Vol.	6	SRP263	6			1392	38	UR190					6A7, 6D6, 6C6, 43, 25Z5	456	
536	Vol.	18	N				1921	1	RS213					6A7, 6K7, 75, 41, 80	456	1
							1914	1	RS213							
580	Vol.	6	SRP263	6			1381	‡	CM175	B3				6A7, 6D6, 6C6, 43, 12Z3	456	
610	Vol.	18	N	6			1088	3	CN155	B3				6A7, ^{2}6D6, 75, 42, 80	456	1
615	Vol.	26	G12											^{5}01A, 33		
620, 630	Vol.	18	L	6			1230	38	UR190	B3				6A7, ^{2}6D6, 75, 43, 25Z5	456	
HAMMARLUND MFG. CO.																
"Comet Pro" Battery	Vol.	7	H											^{4}77, ^{2}78, 42	465	
	Tone	22	Y	6												

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
HAMMARLUND—Continued																
"Comet Pro" Dec. 1931	Vol.	7	H				8, 8	1	RS213					^{2}24A, ^{2}35, 47, 80, ^{2}27	465	3
	Tone	34	Y	6			8	16	TS101							
"Comet Pro" July 1932	Vol.	7	H				8, 8, 8	3	RS213					^{2}24A, ^{2}35, 37, 80, ^{3}27	465	1
	Tone	34	Y	6			8	15	TS101							
"Comet Pro" Feb. 1932	Vol.	7	H				8, 8, 8	3	RS213					^{2}57, ^{4}58, 2A5, 80	465	1
	Tone	34	G12	6			8	18	TS101							
"Comet Pro" Sept. 1932	Vol.	7	H				8, 8, 8	3	RS213					^{2}57, ^{4}58, 47, 80	465	1
	Tone	34	G12	6			8	19	TS101							
"Comet Pro" Oct. 1932	Vol.	7	H				8, 8, 8	3	RS213					^{2}57, ^{4}58, 47, 80	465	1
	Tone	34	G12	6			8	19	TS101							
"Comet Pro" Standard Model	Vol.	7	H				8, 8, 8	3	RS213					^{2}57, ^{4}58, 2A5, 80	465	1
	Tone	34	G12	6			8	19	TS101							
"Comet Pro" (Crystal)	Vol.	7	H				8, 8, 8	3	RS213					^{2}57, ^{4}58, 2A5, 80	465	1
	Tone	34	Y	6			8	19	TS101							
"Comet Pro" AVC Model	Vol.	15	M				8, 8, 8	3	RS213					^{2}57, ^{4}58, 2B7, 2A5, 80	465	1
	Gain	7	H	6			8	19	TS101							
HAMMARLUND ROBERTS																
HiQ 30 AC	Vol.	12	Y				‡	‡	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		7
HiQ 30 Battery	Vol.	12	Y											^{3}22, ^{2}12A, 71A		
HiQ 30 DC	Vol.	12	Y											^{3}24, ^{2}27, ^{2}45		
HiQ 31 AC	Vol.	12	H12				‡	‡	See Note	B1				^{4}24, 27, ^{2}45, 80		3
HARRIS																
500	Vol.	45	MR48	M26			8-8	4	CM172	B3				6A8, 6K7, 6H6, 6C5, ^{2}6F6, 5Z4	465	1
	Tone	41	MR39													
501W	Vol.	45	MR48	M26			8-8	4	CM172	B3				6A8, 6K7, 6H6, 6C5, ^{2}6F6, 5Z4	465	1
	Tone	41	MR39													
600	Vol.	45	MR48	M26			8-8	4	CM172	B3				6A8, 6K7, 6H6, 6C5, ^{2}6F6, 5Z4	465	1
	Tone	41	MR39													
700	Vol.	45	MR48	M26			8-8	4	CM172	B3				6A8, 6K7, 6H6, 6C5, ^{2}6F6, 5Z4	465	1
	Tone	41	MR39													
701W	Vol.	45	MR48	M26			8-8	4	CM172	B3				6A8, 6K7, 6H6, 6C5, ^{2}6F6, 5Z4	465	1
	Tone	41	MR39													
800	Vol.	18	MR48	M26			16-16-8	63	See Note	B3				6A8, 6K7, 6R7, ^{2}25A6, ^{2}25Z6	465	
	Tone	41	MR39													
900	Vol.	45	MR48	M26			8-8	4	CM172	B3				6A8, 6K7, 6H6, 6C5, ^{2}6F6, 5Z4	465	1
	Tone	41	MR39													
1000	Vol.	18	MR48	M26			16-16-8	63	See Note	B3				6A8, 6K7, 6R7, ^{2}25A6, ^{2}25Z5	465	
	Tone	41	MR39													
1201W	Vol.	45	MR48	M26			8-8	4	CM172	B3				6A8, 6K7, 6H6, 6C5, ^{2}6F6, 5Z4	465	1
	Tone	41	MR39													
HATRY & YOUNG																
H-Y "7"	Vol.	12	Y											^{3}24, ^{3}27	175	
	Sens.	9	E12													
H-Y "7B"	Vol.	12	K12				‡	3	See Note	B1				^{4}24, ^{2}27, 45, 80	175	2
	Sens.	7	E													
H-Y Short-Wave 6 "7" Battery	Vol.	12	L											01A, ^{2}12A, ^{3}22	175	
	Sens.	9	K12													
HETRO																
6 Tube AC	Vol.	17	N	6			8	4	RS213					^{2}6D6, 6A7, 6B7, 42	456	1
	Tone	34	K12				10	15	TS101							
6 Tube AC-DC	Vol.	17	N	6			C2092	6/15	UR182/TS101	B114				6A7, ^{2}6D6, 6B7, 42	456	
	Tone	34	K12				10	15	TS101							
8 Tube Superhet	Vol.	15	P				622	3	RS213					2A7, ^{2}58, 55, 56, ^{2}2A5, 80	456	1
	Tone	41	N	6			604	3	RN242							
							490	15	TS101							
9 Tube Air Ace	Vol.	18	N	6			30	1	WE3540					^{3}6D6, 6A7, 85, ^{2}42, 80	456	1
	Tone	44	K12				14	1	RS216							
							10	15	TS101							
9 Tube Air Ace (Rev.)	Vol.	18	N	6			30	1	WE3540					^{3}6K7, 6A8, 6R7, 6C5, ^{2}6B5, 5Z3	456	1
	Tone	22	K12				14	1	RS216							
							10	15	TS101							
6 LB, 6 SB	Vol.	18	N											1C6, 34, 1B5, ^{3}30	456	
	Tone	21	O													
F9 to F12	Vol.	17	M				24	4	CN145	B8				6A8, 6K7, 6Q7, 25A6, 25Z5	456	
							16	4	CS126	B3						
F13 to F20	Vol.	80	500M No. 1		See Note A19		30	4	WE3540					6A8, 6K7, 6Q7, ^{2}6F6, 80	456	1
	Tone	80	N				61	4	RS216							
							10	15	TS101							
F21 to F28	Vol.	140	500M No. 1		See Note A19		24	27	CN145	B8				6A8, 6K7, 6Q7, ^{2}25A6, 25Z6	456	
	Tone	140	N				16	27	CS126	B3						
22	Vol.	6	H12		EX200		8-8	1	See Note	B3				^{3}58, 57, ^{2}47, 56, 80	115	1
	Tone	22	Y													
31	Vol.	77	N				8-8	1	See Note	B3				57, ^{3}58, 55, ^{2}47, 80	175	1
	Tone	44	Y													
71	Vol.	56	N				10-25-10	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	456	
207	Vol.	17	N	6			623	4	CM172	B3				2A7, 58, 2A6, 2A5, 80	456	1
							490	15	TS101							
209	Vol.	17	N	6			623	4	CM172	B3				2A7, 58, 2A6, 2A5, 80	456	1
							490	15	TS101							
251	Vol.	6	H12		EX250		428	4	CM171	B3				57, 58, 2A5, 80		1
	Tone	22	Y	6												
257, 259	Vol.	17	N	6			623	4	CM172	B3				2A7, 58, 2A6, 2A5, 80	456	1
							490	15	TS101							
293	Vol.	6	Y		EX200		2023	23	CM164					6D6, 6C6, 43, 25Z5		
295	Vol.	17	N	6			166	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	456	
							490	15	TS101							
297	Vol.	17	N	6			466	11	UR182	B31				6A7, 6D6, 75, 43, 25Z5	456	
							190	15	TS101							
412, 466	Vol.	17	N				659	6/15	UR182/TS101	B114				^{2}6D6, 6A7, 75, 43, 25Z5	456	
	Tone	22	L	6			10	15	TS101							
HIGH FREQUENCY LABS.																
A. C. Special	Vol.	7	UC509				5-9-9	24/1	See Note	B1				^{4}24, ^{4}27, 71A, 80	‡	3
L	Vol.	7	H				1-4	4	See Note	B3				24, 35, 47, 80		1
"Mastertone" 1929	Vol.	12	K12				5-15-5	3	MN277	B60				^{5}24, ^{3}27, ^{2}45, 80		7
"Mastertone" Super 10, 1931	Vol.	12	G12				8-8-8	3	See Note	B3				^{5}24, ^{2}27, ^{2}45, 80		3
"Nine in Line"	Vol.	33	M											^{8}01A, 12A	175	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
HIGH FREQUENCY—Continued																
4 Tube Pentode	Vol.	7	J				4-4	1	See Note	B3				51, 24, 47, 80		1
117-4	Vol.	7	H				8-8	4	See Note	B3				^{2}27, 24, ^{2}35, 47, 80	175	1
	Tone	22	N													
160-6 (280)	Vol.	7	H				4-4	4	See Note	B3				35, 24, 47, 80		1
200	Vol.	7	H				8-8	25	See Note	B3				27, ^{3}35, 47, 80		1
	Tone	41	N													
208-1	Vol.	7	H				4-4	4	See Note	B3				24, ^{2}35, 47, 80		1
	Tone	22	N													
222	Vol.	7	H				4-4	4	See Note	B3				^{2}24, 27, ^{2}35, 47, 80	‡	1
	Tone	22	N													
HI-LO																
34TDDA 4 Tube AC-DC	Vol.	7	UC509		See Note	A10	12-6	6	See Note	B3				39, 36, 41, 25Z5		
							10-10	15	TN111	B6						
HOODWIN																
Aero A. F. Amplifier							4-4	25	See Note	B3				56, 57, 47, 80		1
							8	14	See Note	B3						
6 Tube Super (DC)	Vol.	33	L				20	15	TS102					^{4}36, ^{2}38	175	
	Tone	22	L													
Aero Auto Radio	Vol.	26	H12											^{3}24, ^{2}27, 45		
Aero Auto Pent. "A"	Vol.	7	H											^{4}36, ^{2}38		
Aero Auto Pent. "B"	Vol.	7	H		3									^{4}56, ^{2}38		
International Aero.	Vol.	15	L				8-8-6	3	See Note	B3				^{3}56, ^{4}58, 55, ^{2}47, 80	485	3
	Tone	95	L													
4 Tube AC	Vol.	7	H				6-8	25	See Note	B3				^{2}35, 47, 80		1
4 Tube DC	Vol.	7	G				20	15	TS102					^{2}36, ^{2}38		
4 T.R.F.	Vol.	6	G12				8-8	1	See Note	B3				58, 57, 47, 80		1
5 Tube (Midget)	Vol.	7	H	6			4-8	25	See Note	B3				57, ^{2}58, 47, 80		1
5 Tube T.R.F.	Vol.	88	P				8-8	1	See Note	B3				57, ^{2}58, 47, 80		1
5 Tube 110V, 220V DC	Vol.	7	H				6-6	12	See Note	B3				^{3}36, ^{2}38		
							20	15	TS102							
6 Tube Super	Vol.	33	L				4-8	25	See Note	B3				55, 56, 57, 58, 47, 80	175	1
6 Tube Batt. Super.	Vol.	54	Y100MP											32, 33, ^{3}34	175	
6 Tube 32V DC	Vol.	15	L											^{3}36, 37, ^{2}38	175	
	Tone	22	L													
6-33 AVC	Vol.	33	N				8-8	25	See Note	B3				^{3}58, Wunderlich, 47, 80		1
	Tone	21	N													
6 Tube Superhet 110V DC Super	Vol.	15	L				8-8	1	See Note	B3				^{3}36, 37, 38	175	
	Tone	22	L				10	15	TS101							
HERBERT H. HORN	"Tiffany Tone"															
5	Vol.	6	SRP263				4-4	23	CM170	B3				57, 58, 56, 2A5, 80	465	1
5A	Vol.	6	Y				5-5	23	See Note	B3				‡	465	1
	Tone	22	K12													
5MT	Vol.	6	SRP263				5-5	23	See Note	B3				6J7, 6K7, 6C5, 6F6, 5Z4	465	1
5MTD	Vol.	18	N				5-5	23	See Note	B3				‡	465	1
	Tone	22	K12													
7MT	Vol.	56	N				8-8	23	CM172	B3				6A8, 6K7, 6H6, ^{2}6C5, 6F6, 5Z4	465	1
	Tone	22	K12													
9MT, 9MTC	Vol.	46	N				16, 16	23	RS216	B3				^{3}6K7, ^{2}6A8, 6H6, 6C5, 6F6, 5Z4	465	1
	Tone	22	Y													
10MT	Vol.	45	N				8-8	23	CM172	B3				^{3}6K7, 6L7, 6C5, 6H6, 6G5, 6J7, 6F6, 5Y3	1600	1
	Tone	22	K12				10	19	TS101							
15	Vol.	6	‡		See Note	A5	8, 8	4	RS213					^{4}24, 45, 80		3
	Tone	22	‡		See Note	A5										
15M	Vol.	6	D7				8, 8	4	RS213					27, 47, 80, ^{3}35		3
	Tone	22	G12													
16MT	Vol.	‡	‡		See Note	A3	8-8-8	30	See Note	B3				^{4}6K7, ^{2}6A8, ^{2}6H6, ^{3}6C5, ^{3}6F6, ^{2}5Z4	1600	1
	H. F. Tone	22	Y				8	15	TS106							
							10	15	TS101							
17MT	Vol.	83	N				16-8-8-8	‡	See Note	B3				^{4}6K7, 6L7, ^{4}6C5, ^{2}6H6, 6G5, ^{3}6F6, ^{2}5Y3	1600	1
	Bass	‡	UC513				8	15	TS106							
							8	13	CS133							
21	Vol.	6	Y	6			4-8	23	CM171	B3				57, 58, 47, 82		3
	Tone	22	G12													
24	Vol.	6	SRP263				4-4	4	CM170	B3				2A7, 57, 2A5, 80	465	1
25	Vol.	6	G12	6			8-4	23	CM171	B3				57, 58, 47, 80		1
	Tone	22	G12													
36	Vol.	17	N	6			4-4	4	See Note	B3				6A7, 78, 6B7, 42, 80	465	1
	Tone	22	N													
49	Vol.	6	C12				8-8	1	See Note	B3				^{3}24, 45, 80		1
51	Vol.	18	N				8-8	23	See Note	B3				6A7, 6D6, 75, 42, 80	465	1
52	Vol.	18	N				8-8	23	See Note	B3				6A8G, 6K7G, 75, 6F6G, 5Y3	465	1
	Tone	22	K12													
55	Vol.	56	N				8-8	23	See Note	B3				57, 58, 2A6, 2A5, 80	465	1
	Tone	22	Y													
58	Vol.	15	N	6			8-8	1	See Note	B3				2A7, ^{2}58, 56, 57, 2A5, 80	465	1
	Tone	76	N				10	15	TS101							
58 (1933)	Vol.	15	N				8-8	1	See Note	B3				2A7, ^{2}58, 56, 2A5, 80	465	1
	Tone	21	N				10	15	TS101							
59	Vol.	7	G				8-8	1	See Note	B3				24, ^{2}27, ^{3}51, ^{2}47, 80	175	3
	Tone	39	M													
62	Vol.	18	N				8-8	23	See Note	B3				6A8G, 6K7G, 75, 6F6G, 5Y3	465	1
	Tone	22	K12													
63	Vol.	18	N				8-8	23	See Note	B3				6A8, 6K7, 75, 6F6, 5Y3	465	1
	Tone	22	K12													
66	Vol.	15	N				8-8	23	See Note	B3				‡	465	1
66MT	Vol.	18	N				5-5	23	CM172	B3				6A8, 6K7, 6H6, 6J7, 6F6, 5Z4	465	1
	Tone	22	K12													
69	Vol.	7	G				8-8	1	See Note	B3				24, ^{2}27, ^{3}51, ^{2}47, 80	465	1
	Tone	39	M													
70, 71	Vol.	6	G12	6			8-8	4	RS213					^{2}35, ^{2}24, 27, 47, 80	175	3
76	Vol.	45	N				8-8	23	See Note	B3				6A8, 6K7, 6H6, 6J7, 6F6, 6E5, 5Y3	465	1
	Tone	22	K12													
77	Vol.	83	N				8-8	23	See Note	B3				2A7, ^{2}58, 55, ^{2}2A5, 80	465	1
	Tone	22	Y													
	Sen.	7	J													
79	Vol.	6	G12				8-8	4	See Note	B3				^{2}27, ^{3}51, ^{2}47, 80	175	3
	Tone	22	M													
83	Vol.	83	N				8-8	23	CM172	B3				6A8, 6K7, 6H6, 6G5, 6J7, 6F6, 5Y3	465	1
	Tone	22	K12													
90	Vol.	7	G				8-8	1	See Note	B3				24, ^{2}27, ^{3}51, ^{2}47, 80	175	3
	Tone	39	M													
99	Vol.	6	G12				8-8	4	See Note	B3				^{2}27, ^{3}51, ^{2}47, 80	175	3
	Tone	22	M													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
HERBERT H. HORN—Continued																
101	Vol.	15	M				8-8	4	See Note	B3				^{4}27,^{4}35,^{2}47, 80	175/550SW	3
	Tone	39	N													
	Tunlgt.	‡	A10MP													
101B, 102B	Vol.	15	N	6			8-8	1	See Note	B3				^{2}24,^{4}27,^{3}35,^{2}47, 80	175	3
	Tone	39	N													
	Tunlgt.	‡	A10MP													
109	Vol.	6	G12				8-8	4	See Note	B3				^{2}27,^{3}51,^{2}47, 80	175	3
	Tone	22	M													
110	Vol.	15	N				8-8	4	See Note	B3				^{4}27,^{3}35,^{2}47, 80	175/550SW	3
	Tone	39	N													
	Tunlgt.	‡	A10MP													
112A	Vol.	15	N				8-8-4	32	See Note	B3				^{3}58, 2A7,^{5}56,^{2}2A3, 5Z3	175	1
	Tone	22	N													
156	Vol.	56	N	6			4-4	23	See Note	B3				2A7, 2B7, 58, 2A5, 80	465	1
	Tone	22	N													
156AW	Vol.	56	N	6			4-4	23	See Note	B3				2A7, 58, 2B7, 2A5, 80	465	1
	Tone	22	N													
158 (1933)	Vol.	15	N				8-8	1	See Note	B3				2A7,^{2}58, 56, 57, 2A5, 80	465	1
	Tone	21	N													
535	Vol.	18	N				4-4	1	See Note	B3	35	294	C3	6A7, 6D6, 75, 42, 84	465	10
							.008		Buffer	B14						
536	Vol.	18	N				4-4	1	See Note	B3	35	294	C3	6A7, 6D6, 75, 42, 84	465	10
	Tone	22	K12				.008		Buffer	B14						
537, 538	Vol.	18	MR48				5-5	23	See Note	B3	35	294	C3	6A8, 6K7, 6Q7, 6F6, 84	465	10
	Tone	22	K12				.01		Buffer	B14						
1934	Vol.	17	N				4-4	1	See Note	B3				6A7,^{2}78, 6B7, 42	172	MG
	Tone	22	K12													
HOWARD																
AA25	Vol.	6	H12	‡	EX300		16-12	4	See Note	B3				6D6, 6C6, 43, 25Z5		
AP	Vol.	16	‡	‡		See Note A5	2335	3	CS123					55,^{2}56,^{3}58,^{2}42, 80	175	3
	Tone	41	P	6			1948	3	RS213							
							2209	3	CS133							
							1976	3	RS213							
A SW Converter							1859	1	RS211					^{2}24, 35, 27		1
AVH (45, 60)	Vol.	94	N				1883	3	RN245					^{3}27,^{3}35,^{2}47, 80	175	7
	Tone	44	N	6												
AVO (35-A)	Vol.	35	N				1883	3	RN245					^{3}35,^{3}27, 47, 80	175	7
	Tone	34	‡	6		See Note A5	2282	16	TS101							
A12	Vol.	6	H12	‡	EX300		16-12	4	See Note	B3				6D6, 6C6, 43, 12Z3		
B13	Vol.	17	N				8-16-12	27	UR182	B115				6A7, 6D6, 75, 43, 25Z5	456	
CC23, CC24	Vol.	17	N				8-8	1	See Note	B3				^{2}6D6, 75, 42, 76, 80	456	1
							10	15	TS101							
D4 (Cable-Nelson)	Vol.	8	‡	6		See Note A5	1869	1	CS133					51, 24, 47, 80		1
							2209	1	CS133							
D8	Vol.	19	TRP606	6			3004	28	RN242					^{3}78, 6A7, 85, 76, 42, 80	465	1
	Tone	22	Y				1948	28	RS213							
	Supp.	9	G													
EX (Dual Range)	Vol.	8	‡			See Note A5	1869	3	CS133					^{3}27,^{4}51,^{2}47, 80	140	3
	Tone	44	N	6			2209	3	CS133							
E14, E107	Vol.	18	N	6			8-4	23	See Note	B3				6C6, 6D6, 75, 42, 80	456	1
E57 (Long Wave)	Vol.	18	N	6			8815	11	CN145	B3				6A7, 6D6, 75, 43, 25Z5	456	
							8816	11	CS123	B3						
F	Vol.	15	N				3288	1	CN152					6A7,^{3}78, 85,^{3}76,^{2}42, 80	465	1
	Tone	22	Y				3004	25	RN242							
	Sen.	7	G				1948	25	RS213							
F (with 45's)	Vol.	24	‡			See Note A5	1748	1	RS213					^{3}24, 27,^{2}45, 80		3
	Tone	41	UC504	6												
Series 1 (Grand)	Vol.	15	N				8-8	1	RN242					^{3}76, 6C6,^{6}78, 80, 85,^{5}42 84, 5Z3	175	1
	Tone	15	N				8-8	24	RN232							‡
	Hum	30	A10MP				5	15	TS105							
							25	15	TS102							
							8-8	12	RN242							
Series 2 (Grand)	Vol.	15	N	6			8-8	1	RN242					^{6}78, ^{3}76, 6C6, 85, ^{5}42, 5Z3, 80, 84	465	‡
	Tone	15	N				8-8	24	RN232							
	Hum	30	A10MP				5	15	TS105							
							25	15	TS102							
							30-8	1	See Note	B3						
"Green Diamond" 8 Mag. Speaker	Vol.	1	D12				‡	‡	See Note	B4				^{5}26, 27,^{2}71A, 80		11
	Phono.	10	K12													
"Green Diamond" 8 Dyn. Speaker	Vol.	1	D12				P1727	3	See Note	B3				^{5}26, 27,^{2}71A, 80		11
	Phono.	10	K12				P1728	3	See Note	B3						
"Green Diamond" 8 Dyn. Speaker 45's	Vol.	1	D12				SA1090	3	MN275					^{5}26, 27,^{2}45, 80		11
	Phono.	10	K12													
G26	Vol.	6	H12		EX300		8-8	24	CN142	B3				39, 36, 38, 37		
							10-10	15	TN111	B6						
H (with 45's) (35, 40)	Vol.	8	G				1948	1	RS213					^{3}51,^{2}27,^{2}45, 80	175	3
	Tone	41	N	6												
H (35, 40) (with 47's)	Vol.	8	G				1948	3	RS213					^{3}51,^{2}27,^{2}47, 80	175	3
	Tone	41	N	6			1976	3	RS211							
Auto (Series 1)	Vol.	18	UM154	6		See Note A96	8-8	1	CN152	B3	19	249	C3	^{2}6D6, 76, 75, 42, 6L7	465	10
	Tone	22	MR39				.005		Buffer	B14						
HA1 (670A)	Vol.	17	N	6			P119-4	4	CM172		35	294	C3	6C6,^{2}6D6, 75, 42, 84	175	10
							.015		Buffer	B14						
HA2 (52, 502)	Vol.	18	UM154			See Note A96	8-8	4	CM172	B3	34	292	C3	6A7, 6D6, 75, 41, 84	456	10
							10-10	15	TN111							
							.008-.008		Buffer	B14						
HA3	Vol.	17	UM154			See Note A96	8-8	4	CM172	B3	35	294	C3	6A7, 6D6, 75, 41, 84	456	10
							5-5	15	TN110							
							.015-.015		Buffer	B14						
HA4	Vol.	18	UC512			See Note A3	8-8	4	CM172	B3	35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
							10	15	TS101							
							.015-.015		Buffer	B14						
HA6	Vol.	‡	UC512				8-8	‡	See Note	B3	19	249	C3	^{2}6D6, 6L7, 75, 76, 6B5	465	10
	Tone	22	MR39				.005		Buffer	B14						
HA7	Vol.	18	UM157-SS17				26-266	4	RM262	B16	35	294	C3	^{2}6K7G, 6A8G, 6Q7G, 6V6G, 0Z4	262	10
							.0075		Buffer	B14						
HA8	Vol.	18	UM157-SS17				27-266	4	RM262	B16	35	294	C3	^{2}6K7G, 6A8G, 6Q7G, 6C5G,^{2}6V6G, 0Z4	262	10
							.0075		Buffer	B14						
HA9	Vol.	18	UM157-SS17				26-266	4	RM262	B16	35	294	C3	^{2}6K7G, 6A8G, 6Q7G, 6V6G, 0Z4	262	10
							.0075		Buffer	B14						
"Highwayman"	Vol.	17	UC512	6			P103-2	4	RM262		37	296	C3	6D6, 6C6, 78, 75, 42, 84	175	10
			N				.02		Buffer	B14						
J3	Vol.	8	G	6			2178A	1	CN150					^{2}78, 77, 43, 84, 37	456	1
							2427	12	CS131							
							2177	15	TN110							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
HOWARD—Continued																
K (400)	Vol.	13	L				1869	28	CS133					^{3}56, 57, ^{3}58, ^{2}47, 80	175	7
	Tone	41	P	6			2335	28	CS133							
L (410)	Vol.	13	M				2335	3	CS133					55, ^{3}56, ^{4}58, ^{2}42, 80	175	7
	Supp.	56	M				1869	3	CS133							
	Tone	41	P	6												
M (420)	Vol.	13	M				2335	3	CS133					55, ^{3}56, ^{4}58, ^{4}42, 84	175	7
	Supp.	18	M	6												
	Tone	41	P	6												
O (20, 25, 30, 32)	Vol.	8	‡		See Note A5		1858	1	RM262					^{3}51, ^{2}27, 47, 80	175	3
	Tone	21	‡		See Note A5		1859	1	CS131							
Q	Vol.	15	M				2303	28	CM172					^{2}78, 6A7, 76, ^{2}12A5, 80	170	1
	Tone	22	M	6			2427	28	CS133							
R9	Vol.	15	M				2803	3	CM172					^{3}76, 77, 78, 6B7, ^{2}42, 80	465	1
	Tone	22	‡	6	See Note A5		2427	3	CS131							
SG "A," "C," (R.F. chassis)	Vol.	24	DRP244											^{3}24, 27		
SG "A,", SG "C" (A.F. Chassis)							P1080	3	MN275					^{2}45, 80		3
SG "B"	Vol.	8	G				1748	1	RS213					^{3}24, 27, 45, 80		3
	Tone	21	P	6												
SG "T"	Vol.	8	F	6	3		1868	1	CN152					^{2}51, 24, 47, 80		3
S2, S7	Vol.	15	‡	7	See Note A5									1A6, ^{2}30, 32, ^{2}31, ^{2}49	175	
W 1st Type	Vol.	15	N											^{2}56, ^{3}57, ^{3}58, 2A7	465	
	Tone	22	N	6												
	Supp.	8	G													
	AVC	‡	Y1000MP													
W 2nd Type	Vol.	15	N											^{3}56, ^{4}57, ^{3}58	465	
	Tone	22	N	6												
	Supp.	12	G12													
	Tunlgt.	‡	O													
W 2nd Revision	Vol.	17	N				8	13	CS133	B3				2A7, ^{8}56, ^{5}58, ^{4}2A5, 83V	465	7
	Tone	22	N	6			10	15	TS106							
	Sen.	8	G													
W (Power Amplifier)							2851	3/14	HS692/UR191	B116				83V, ^{2}2A5, ^{4}56		7
							2850	4	CM162							
							2427	15	TS101							
X2, X3, X8	Vol.	17	N	6			1948	3	RS213					6A7, 6B7, ^{2}78, 77,		
							1976	3	RS213					12A5, 80	175	1
							2427	15	TS101							
Z4	Vol.	15	N	6			1948	3	RS213					6A7, 6B7, ^{3}78, ^{2}77, ^{2}2A5,		
							2209	3	CS133					80	175	14
5B	Vol.	18	N	7			23-266	12	RS201					1C6, 1A4, 1F6, 1F4,		
														1B1	465	
6B-A	Vol.	124	O	7			20-266	1	RN235	B16	14	245C	C3	6D8G, ^{2}6S7G, 6T7G,		
	Tone	22	N				.005		Buffer	B14				30, 19	465	10
6B-T	Vol.	124	O	7			20-266	1	RN235	B16	14	245C	C3	6D8G, ^{2}6S7G, 6T7G,		
	Tone	22	N				.005		Buffer	B14				30, 19	465	10
47A	Vol.	6	H12	6	EX300		16-12	4	CM165	B117				6D6, 6C6, 43, 25Z5		
50SW	Vol.	6	H12	6			8812	4	CM164					^{2}6D6, 6J7, 43, 25Z5		
							3003	15	TS101							
50 (Series 2)	Vol.	6	H12	6	EX300		16-12	4	CM165	B117				^{2}6D6, 6J7, 43, 25Z5		
							5	15	TS101							
56	Vol.	18	MR48				16-12	4	See Note	B3				6A7, 6D6, 75, 43,		
														25Z5, K49B	465	
57A, 57AUS	Vol.	18	N	6			8815	11	CN145	B3				6A7, 6D6, 75, 43,		
							8816	11	CS123	B3				25Z5	456	
58 (B5)	Vol.	45	N	6			8812	27	CM164	B225				6A7, 6D6, 75, 43,		
														25Z5	465	
60 (Series 1), 60 (Short Wave)	Vol.	18	N	6			8815	11	CN145	B3				6A7, 6D6, 6H6, 6F5,		
							8816	11	CS123	B3				43, 25Z5	456	
67	Vol.	18	N	6			8817	1	RN242					6A7, 6D6, 6H6G,		
							3003	15	TS101					6F6G, 42, 80	465	1
68	Vol.	18	MR48	M26			8826	1	RN242					6A7, 6K7, 6Q7, 6B5,		
	Tone	22	MR48											80, 6G5	465	1
77C, 77T	Vol.	18	N	6			3004	1	RN242					6A8, ^{2}6K7, 6H6, 6F5,		
							8814	14	CS131					6F6, 5Y3	465	
							3003	15	TS105							
99C, 99T	Vol.	15	N	6			3004	1	RN242					^{3}6K7, 6A8, 6H6, 6C5,		
	Tone	41	N				8814	14	CS131					^{2}6F6, 5Z4	465	1
							3003	15	TS105							
118	Vol.	45	O	6			17-266	1	RS213					^{3}6K7, 6A7, 6H6, 6F5,		
	Tone	22	N				8826	1/13	RN242					6C5, ^{2}6F6G, 6G5, 80	465	1
135AC (395, 445, 470, 495)	Vol.	10	GK				P1603A	3	See Note	B2				^{4}26, 27, 10, 81		5
135 D. C.	Vol.	10	E12											^{5}01A, 71A		
214	Vol.	‡	DRP232				8	1	RS213					^{3}6K7G, 6L7G, ^{3}6J5G,		
	B.Tone	‡	MR53	M26			8-8	1/14	RN242					6H6, 6G5, ^{2}6F5,		
							8-4	14	CN141					^{2}6V6G, ^{2}80	465	1
218	Vol.	45	O	6			17-266	1	RS213					^{3}6K7, 6A7, 6H6, 6F5,		
	Tone	22	N				8826	1/13	RN242					6C5, ^{2}6F6G, 6G5, 80	465	1
225, S225	Vol.	18	MR48				28-266	1	RN242					6A7, 6D6, 75, 41, 80	465	1
	Tone	22	MR48	M26												
240-1	Vol.	18	MR48				28-266	1	RN242					6A7, 6D6, 75, 6U5,		
	Tone	21	MR48	M26										41, 80	465	1
240-2	Vol.	18	MR48				28-266	1	RN242					6A7, 6D6, 75, 6U5,		
	Tone	21	MR48	M26										41, 80	465	38
250, S250	Vol.	18	MR48				28-266	1	RN242					6A7, 6D6, 75, 41, 80	465	1
	Tone	22	MR48	M26												
256, S256	Vol.	18	MR48				4-8	1	See Note	B3				6A7, 6D6, 75, 42, 80	465	1
259, S259	Vol.	18	MR48				40-10	6	See Note	B3				6A7, 6D6, 76, 6K5,		
														25B5, 25Z5, K24B	465	
260, S260	Vol.	18	MR48				28-266	1	RN242					6A7, 6D6, 75, 6U5,		
	Tone	22	MR48	M26										41, 80	465	1
266	Vol.	45	N	6			24-266	1/19	RN245	B141				6A7, 6D6, 76, 6F5G,		
	Tone	22	N											42, 80	465	1
268	Vol.	45	N	6			19-266	1/13	RN245					6A7, 6K7, 76, 6F5G,		
	Tone	22	N											6B5, 80, 6G5	465	1
275, 280	Vol.	18	MR48				29-266	1	RN242					6A7, 6D6, 75, 6V6G,		
	Tone	21	MR48	M26										6U5, 80	465	1
318	Vol.	124	MR53				8824	1	WE847					^{3}6K7, 6A7, 6U5, 6Q7G,		
	Tone	22	MR48	M26			8826-5	1/13	RN242					6C5G, ^{2}6V6G, 80	465	1
325	Vol.	124	MR53				8824	1	WE847					^{3}6K7, 6A7, 6Q7G,		
	Tone	22	MR48	M26			8826-5	1/13	RN242					6C5G, ^{2}6V6G, 6U5,		
														80	465	1
368	Vol.	124	MR53				19-266	1/13	RN245					6A7, ^{2}6K7, 6H6, 6F5G,		
	Tone	21	MR48	M26										6V6G, 6U5, 80	165	1
368A (with Aut. Tuning)	Vol.	124	MR53				19-266	1/13	RN245					6A7, 6A8, ^{2}6K7, 6H6,		
	Tone	21	MR48	M26										6U5, 6F5G, 6V6G,		
														80	465	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
HOWARD—Continued																
400	Vol.	‡	DRP232				17-266	1	RS213					^{3}6K7, 6L7, ^{2}6J5, 6Q7G, 6U5, 6F5, ^{2}6V6G, 80	465	1
	Tone	‡	MR53	M26			29-266	1/14	RN242							
							8-4	14	See Note	B3						
400A	Vol.	‡	DRP232				17-266	1	RS213					^{3}6K7, 6L7, ^{2}6J5G, 6Q7G, 6U5, 6F5, ^{2}6V6G, 80	465	37
	Tone	‡	MR53	M26			29-266	1/14	RN242							
425	Vol.	‡	DRP232				17-266	1	RS213					^{3}6K7, 6L7, ^{2}6J5G, 6H6, 6U5, ^{2}6F5G, ^{2}6L6G, ^{2}80	465	1
	Tone	‡	MR53				29-266	1/14	RN242							
							8-8	14	See Note	B3						
425A	Vol.	‡	DRP232				17-266	1	RS213					^{3}6K7, 6L7, ^{2}6J5G, 6H6, 6U5, 6J6G, 6F5, ^{2}6L6G, ^{2}80	465	37
	Tone	‡	MR53	M26			29-266	1/14	RN242							
							8-8	14	See Note	B3						
626	Vol.	18	N	6			8817	1	RN242					6A7, 6D6, 6H6, 6F5G, 42, 80	465	1
							3003	15	TS101							
1626	Vol.	18	N	6			8817	1	RN242					6A7, 6D6, 6H6G, 6F5G, 42, 80	465	1
							3003	15	TS101							
HUDSON-ROSS																
38	Vol.	6	M		EX250		8-8	24	CN142	B3				6D6, 6C6, 38, 12Z3		
							10	15	TS101							
48	Vol.	6	M		EX250		16-12	1	See Note	B3				6D6, 6C6, 38, 25Z5		
							10	15	TS101							
59	Vol.	6	G7	6	2		20-20	6	UR192	B3				6A7, 6D6, 75, 43, 25Z5		
							10	15	TS101							
69	Vol.	6	G7	6	2		20-20	6	UR192	B3				6A7, 6D6, 85, 43, 25Z5	456	
							3	13	CS121							
							10	15	TS101							
80	Vol.	18	N	6			701	23	CM171	B3				6A7, 6D6, 75, 42, 80	456	1
"Legion"	Vol.	6	M		EX250		8-8	24	CN142	B3				6D6, 6C6, 38, 12Z3		
							10	15	TS101							
HUDSON-TERRAPLANE (Also see R. C. A.-Victor, Zenith.)																
Hudson H6	Vol.	56	UM147		See Note A96		8	1	RS213		35	294	C3	^{2}6D6, 6A7, 6B7, 41, 84	260	10
							4	1	RS211							
							.02-.02		Buffer	B14						
IMPERIAL FURNITURE																
14	Vol.	6	Y				8-8-8-16	6/15	UR189	B98				‡		
35B5	Vol.	76	N				8-4	25	See Note	B3				6A7, 78, 75, 42, 80	456	1
	Tone	76	M				25	19	TS102							
IMPERIAL RADIO																
5M-17	Vol.	6	K12	6			B16973	27	RS207					6D6, 6C6, 43, 25Z5		
							B17042	27	RS207							
6M-27	Vol.	17	O				B17041-3	4	RS208					6A8G, 6K7G, 6Q7G, 25B6G, 25Z6G	456	
	Tone	‡	M	6			B17197	4	RS208							
6U-107, 6L-137, 6C-607	Vol.	18	N	6			B16466	4	RS216					6A8G, 6K7G, 6Q7G, 6G5, 6K6G, 5Y3	456	1
	Tone	34	UC502				B16467-2	4	WE847							
7U-117, 7L-147, 7C-707	Vol.	18	N	6			B16466	4	RS216					6L7G, 6C5G, 6K7G, 6Q7G, 6G5, 6F6G, 5Y3	456	1
	Tone	34	UC502				B16567-2	4	WE847							
8C-807	Vol.	18	N	6			A15236-3	25	WE3540					6A8G, 6K7G, 6Q7G, 6G5, 6C5G, ^{2}6F6G, 5Y3	456	1
	Tone	44	UC502				A15237-2	25	RS213							
8U-127	Vol.	18	N	6			A15236-3	25	WE3540					6A8G, 6K7G, 6Q7G, 6G5, 6C5G, ^{2}6F6G, 5Y3	456	1
	Tone	44	SRP284	8			A15237-2	25	RS213							
10C-1007	Vol.	17	TRP618	6			B16554-3	1	WE3540					^{2}6K7G, 6L7G, 6C5G, 6Q7G, 6G5, ^{3}6F6G, 5Z3	456	1
	Tone	22	UC502				B15427	1	WE1647							
							B16551-4	15	TN111							
INSULINE CORP.																
"Classic"	Vol.	17	N	6			32-16	27	See Note	B3				6A7, 78, 6B7, 43, 25Z5	132	
							5-5	15	TN110							
"Conquerer"	Vol.	8	D		2		2-4-4	3	See Note	B3				51, ^{2}27, 47, 80		3
AVC Super Seven, AVC Long Wave 110V DC	Vol.	6	G7		2		8	39	See Note	B11				^{3}39, 85, 37, ^{2}43	175/115	
"Elite"	Vol.	17	N	6			32-16	27	See Note	B3				6A7, 78, 6B7, 43, 25Z5	132	
							5-5	15	TN110							
"Envoy"	Vol.	8	G				4-4	1	See Note	B3				^{3}51, 24, 47, 80		1
"Envoy Midget"	Vol.	8	C	6			8-4	1	See Note	B3				^{2}51, 24, 47, 80		1
"Envoy Midget" DC	Vol.	8	C	6			8	39	See Note	B11				^{3}36, ^{2}33		
	Tone	21	M													
"Envoy DC" Broadcast—Long Wave	Vol.	6	E12	6			8	39	See Note	B11				^{3}36, ^{2}33		
"Envoy AC" Broadcast—Long Wave	Vol.	8	A2MP	6	2		8-4	1	See Note	B3				^{2}51, 24, 47, 80		1
"Envoyette" AC	Vol.	8	G	6	2		8-4	1	See Note	B3				^{2}58, 56, 47, 80		1
"Envoyette" DC 5T Rec.	Vol.	8	G	6	2									^{2}39, 37, ^{2}43		
"Envoyette" AC 5T Receiver—Long Wave	Vol.	8	G	6	2		8-4	1	See Note	B3				^{2}58, 57, 47, 80		1
							25	17	TS102							
"Icasix"	Vol.	17	N	6			8-8	1	See Note	B3				^{2}6D6, 6A7, 80, 75, 42	462.5	1
							5-5	15	TN110							
LW 4 Tube Midget AC	Vol.	8	G	6	2		4-4	1	See Note	B3				51, 24, 47, 80		1
"Insulette & Mascot" 4 Tube Midget AC	Vol.	8	G	6	2		4-4	1	See Note	B3				51, 24, 47, 80		1
"Super-Conqueror" Short and Long Wave AC	Vol.	8	G	6			8-8-8	3	See Note	B3				^{2}57, ^{3}58, 55, 47, 80	115	1
	Tone	22	Z12				25	17	TS102							
"Super-Conqueror" AC 108-250 V w/ Noise Suppressor	Vol.	18	N				8-8-8	3	See Note	B3				55, ^{3}57, ^{3}58, 47, 80	115	1
	Supp.	32	A5MP				5	17	TS105							
Super Six AVC LW	Vol.	6	G7		2		8-8	1	See Note	B3				55, 57, ^{2}58, 47, 80	115	1
							25	17	TS102							
Super Six AVC Broadcast	Vol.	6	G7	6	2		8-8	1	See Note	B3				55, 57, ^{2}58, 47, 80	175	1
							25	17	TS102							
"Super Seven" AC LW	Vol.	17	N	6			8-8	1	See Note	B3				55, 57, ^{3}58, 47, 80	115	1
							25	17	TS102							
							10	‡	TS106							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
INSULINE CORP.—Continued																
"TransPacific"	Vol. Sen.	15 7	N G	6			6-6-6 5-5	3 15	CN155 TN110					6A7, [2]78, 6B7, 77, [2]45, 80	1580	14
"Universal Companion" "AC-DC Battery Portable"	Vol.	8	E				4-8	1	CN141	B3				36, [2]37, [2]38		
"Universal Mascot" AC-DC	Vol.	7	M	6	EX300		8-8-4 5-5	8 15	CN145 TN110	B3				39, 37, 36, 43, 25Z5		
"Universal Companion" AC-DC Battery Portable (Revised)	Vol.	4	C				4-4	1	CN140	B3				[2]36, [3]37, [2]33		
"Trans-Atlantic"	Vol. Sen.	15 7	N G	6	 2		6-6-6 5-5	3 15	CN155 TN110	B3				6A7, [2]78, 6B7, 77, [2]45, 80	1580	14
"Americus" 5T Unaradio Super AC-DC	Vol.	17	N	6			32-16	27	See Note	B3				6A7, 78, 6B7, 43, 25Z5	132	
"Aiglon" 5T Unaradio Super. AC-DC	Vol.	17	N	6			4-8-8 5-5	8 15	CN115 TN110	B3				6A7, 78, 6B7, 43, 25Z5	132	
"Bijou" 5T Unaradio Super. AC-DC	Vol.	17	N	6			4-8-8 5-5	8 15	CN115 TN110	B3				6A7, 78, 6B7, 43, 25Z5	132	
"Atlantic" 5T Unaradio Super. AC-DC	Vol.	17	N	6			32-16 5-5	27 15	See Note TN110	B3				6A7, 78, 6B7, 43, 25Z5	132	
"Latinic" 5T Unaradio Super. AC-DC	Vol.	17	N	6			32-16 5-5	27 15	See Note TN110	B3				6A7, 78, 6B7, 43, 25Z5	132	
"Mignon" 5T Unaradio Super. AC-DC	Vol.	18	N	6			4-8-8 5-5	8 15	CN145 TN110	B3				6A7, 78, 6B7, 43, 25Z5	132	
"Uni-Nine"	Vol. Sil.	18 ‡	N E	6			32-16	27	See Note	B3				[2]78, 6A7, 85, 77, [2]43, [2]25Z5	115	
"Gnome" 5T Unaradio Super AC-DC	Vol.	17	N	6			4-8-8 5-5	8 15	CN145 TN110	B3				6A7, 78, 6B7, 43, 25Z5	132	
"Pacific" 5T Unaradio Super. AC-DC	Vol.	17	N	6			32-16 5-5	27 15	See Note TN110	B3				6A7, 78, 6B7, 43, 25Z5	132	
"Superheterodyne" 6T AC	Vol.	6	G7	6	2		8-8	1	See Note	B3				[2]35, [2]24, 47, 80	175	1
"Superheterodyne" 7T 220V DC	Vol.	6	G7	6	2		8	39	See Note	B11				[2]39, [2]36, 37, [2]71	175	
"Envoyette" ICA-ette	Vol.	6	H12	6			24-12 10-10	6 15	UR182 TN111	B3				6A7, 6D6, 6C6, 43, 12Z3	456	
INTERNATIONAL RADIO CORP.—"Kadette"																
A, B Kadette	Vol. Tone	77 22	M K12	6			A424	11	UR193	B31				6A7, 6D6, 6B7, 43, 25Z5	262.5	
All Wave Duo	Vol. Tone	6 22	UC501 M				8-8	4	See Note	B3				[3]24, 27, [2]35, 47, 80		1
Chassis D, DSP, (DA8, DA9, DA10, D11, D12, D14)	Vol.	56	M	6			A430	11	UR193	B31				6A7, 6D6, 6B7, 43, 25Z5	262.5	
CB (Battery)	Vol.	9	M	6			A416	19	TS102					1A6, 32, 30, 31, 33	262.5	
CM	Vol.	6	M	6			A414	27	CM162	B3				[2]6D6, 73, 38, 12Z3	262.5	
CMS	Vol.	6	M	6			A414	27	CM162	B3				6A7, 6D6, 76, 38, 12Z3	262	
CS	Vol.	6	G7		2		A404	4	CM170	B3				35, [2]24, 47, 80	175	1
DAC (A7, BW, CD)	Vol.	56	M	6			A429	27	CM165	B88				6A7, 6D6, 6B7, 43, 25Z5	262.5	
DAS (A8, A9, A10, AD11, AD12)	Vol.	56	M	6			A430	11	UR193	B31				6A7, 6D6, 6B7, 43, 25Z5	262.5	
ES (ES19, ES20, ES25)	Vol. Tone	56 22	M K12				A412	27	SR620					6A7, 6D6, 6B7, 43, 25Z5	262.5	
Kadette	Vol.	7	UC509	6	EX150		A407 A408	1 15	CN140 SR619					39, 36, 38, 1V		
"F" Kadette Jr.							A427	1/15	UR183					6F7, 12A7		
"J," "JS"	Vol. Tone	6 22	G7 ‡		 See Note A5		A401	4	CM170	B3				35, [2]24, 47, 80	175	1
"KS"	Vol. Tone	7 22	G K12	6	1		A-3 A18	4 4	CS133 CS133	B3 B3				[2]35, [2]24, 27, 47, 80	175	1
"K6" (K60 St. Regis)	Vol.	17	UM154	M26	See Note A96		A20 A402 A417 .02	14 1 15 	CS131 CN152 TS101 Buffer	B3 B3 B14	37	296	C3	[2]6D6, 6F7, 75, 42, 84	262.5	10
"M" (K40 Regal)	Vol. Tone	6 22	G12 G12				A3 A4	4 ‡	CS133 CS131	B3				35, 24, 47, 80		1
"P"	Vol.	7	‡		See Note A5		A407 A408	1 15	CN140 SR619					78, 77, 38, 1V or 39, 36, 38, 6Z3		
"T"	Vol.	6	‡		See Note A5		A401	4	CM170	B3				35, 24, 47, 80		1
"TS"	Vol.	6	G12		2		A404	4	CM170	B3				35, 24, 47, 80		1
10, 11, 12, 13, 14, 15, 16	Vol.	17	MR48				30-16 A417	1 15	See Note TS101	B3				[2]6D6, 6Q7, 25B5, 25Z5	448	
21, 22, 24	Vol.	6	‡		See Note A3		A449	4	SR620	B113				6D6, 6C6, 43, 25Z5		
25	Vol.	88	UC513		EX100		A437	1/15	CN155					6D6, 6C6, 41, 80		1
26	Vol.	88	UC513		EX200		A438	1/15	CN155	B3				[2]6J7G, 6F6G, 5Z4		1
36	Vol. Tone	18 34	N K12				A451	4	RM265					[2]6D6, 76, 75, 41, 80	448	1
40 (Jewel)	Vol.	88	UC513	6	EX200		A421	1/15	UR183					6C6, 12A7		
50	Vol.	6	UC509	‡	EX250		A419	4	CM172					[2]57, 47, 80		1
52	Vol.	88	UC513	6	EX200		A438	4/15	CN155	B3				6A8G, 6K7G, 6J7G, 6F6G, 5Z4	448	1
53 (Early, Late)	Vol. Vol. Tone	6 17 34	UC509 N K12	 6	EX250	A27 A4	A439 A417	1 15	CN152 TS105	B3				6A8G, 6K7G, 75 or 6J7G, 5Z4, 6F6G	448	1
55	Vol.	6	UC509		EX250		A419	4	CM172	B3				[2]57, 47, 80		1
"AW" 55	Vol.	7	H	6	2		8-4	4	CM171	B3				[2]24, 56, 58, 47, 80	445	2
56	Vol.	88	UC513		EX100		A437	1/15	CN155	B3				6D6, 6C6, 41, 80		1
60	Vol. Tone	56 22	M K12				A412	27	SR620					6A7, 6D6, 6B7, 43, 25Z5	262	
61	Vol. Tone	56 22	N K12	 6			A440 A417	6 15	CM164 TS105					6A8G, 6K7G, 6B7, 43, 25Z5	448	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
INTERNATIONAL RADIO CORP.—Continued																
65	Vol. Tone	56 22	M K12				A412	27	SR620	B115				6A7, 6D6, 6B7, 43, 25Z5	262	
66	Vol.	6	UC509	6	EX150		A422	4	RM259	B113				^{2}6D6, 76, 43, 25Z5	448	
66X	Vol.	6	L	6	EX250		A443	4	SR620	B113				^{2}6D6, 6C6, 43, 25Z5, 165R4 Ballast Tube	448	
70	Vol. Tone	40 22	K12 K12				A416	19	TS102					1A6, 32, ^{2}30, 33	262	
71	Vol. Tone	56 22	N K12				A416	19	TS102					1A6, 34, 25S, 30, 33	456	
71C	Vol.	56	N				A431	12	CS121					1C6, 34, 25S, 30, 33	456	
72	Vol.	17	N				A412	12	CS121					1C6, 34, 25S, 30, 19	448	
76	Vol.	6	SRP263	6	EX300		A450	4	RM259	B113				^{2}6D6, 6C6, 43, 25Z5, 165R4 Ballast Tube		
77 (777, 778, 779)	Vol.	6	UC509	6	EX250		A444	4	SR620	B113				6A7, 6D6, 76, ^{2}43, 25Z5	262.5 or 456	
85	Vol.	56	M	6			A412	27	SR620					6A7, 6D6, 6B7, 43, 25Z5	456	
86	Vol.	6	L	6	EX250		A443	4	SR620	B113				^{2}6D6, 6C6, 43, 25Z5, 165R4 Ballast Tube	448	
87 Series	Vol.	17	N	6			A444	4	SR620	B113				6A7, 6D6, 75, ^{2}43, 25Z5, 878R48 Ballast Tube	448	
90	Vol.	17	M				A425	1/15	UR183					6D6, 6C6, 75, 12A7	262/456	
96	Vol.	6	L	6	EX250		A443	4	SR620	B113				^{2}6D6, 6C6, 43, 25Z5, 165R4 Ballast Tube	448	
105, EL105	Vol. Tone	56 22	N K12	 6			A435 A436 A417	1 1 15	RS213 RS213 TS101	B3 B3				6A7, 6D6, 85, 76, 42, 80	456	1
120	Vol. Tone	17 22	N K12	 6			A439 A417	1 15	CN152 TS101	B3				^{2}6K7G, 6A8G, 6H6G, 6C5G, 6F6G, 5Z4	448	1
150, 151	Vol.	18	MR48	M26			A462 A417	4 15	SR620 TS101					6A8, 6K7, 6Q7, 25A7	448	
226	Vol.	88	UC513		EX200		A438	1/15	CN155	B3				^{2}6J7, 6F6, 5Z4		1
400	Vol.	17	N	7										1C6, 34, 25S, 950	448	
500	Vol.	17	N	7										1C6, ^{2}34, 25S, 33	448	
553 (Early, Late)	Vol. Vol. Tone	6 17 22	UC509 N K12	 6	EX250	A27 A4	A439 A417	1 15	CN152 TS105	B3				6A8G, 6K7G, 6J7 or 75, 6F6G, 5Z4 or 5Y3	448	1
661	Vol. Tone	56 22	N K12	 6			A440 A417	6 15	CM164 TS105					6A8G, 6K7G, 6B7, 43, 25Z5	448	
666	Vol.	6	UC509	6	EX250		A422	4	RM259	B113				^{2}6D6, 76, 43, 25Z5	448	
676	Vol.	6	SRP263	6	EX300		A450	4	RM259	B113				^{2}6D6, 6C6, 43, 25Z5, 165R4 Ballast Tube		
1019	Vol.	62	MR44	M26			8-8-8-12	29	UR190	B89				6A7, 6D6, ^{2}76, ^{2}41, 25Z5	448	
1050	Vol. Tone	56 22	N K12	 6			A435 A436 A417	1 1 15	RS213 RS213 TS101	B3 B3				6A7, 6D6, 85, 76, 42, 80	456	1
1200, 2200	Vol. Tone	17 22	N K12	 6			A439 A417	1 15	CN152 TS101	B3				^{2}6K7G, 6A8G, 6H6G, 6C5G, 6F6G, 5Z4	448	1
INTEROCEAN RADIO CORP.—Also See Zenith																
500, 515, 516	Vol. Tone	15 34	N N				22-173 22-172	23 23	CS133 CS130					^{3}58, 56, ^{2}57, 59, 80	175	3
520, 521, Chassis 2035	Vol. Tone Sen.	10 41 7	TRP606 N ‡		 See Note A5		22-167 22-169	28 15	WE847 TS106					^{2}56, 57, ^{3}58, ^{3}59, 80	175	3
530, 531, 533, Chassis 2038	Vol. Tone	20 41	TRP606 N				22-167 22-169	28 15	WE847 TS106					^{3}56, ^{2}57, ^{3}58, ^{3}59, 80	175	3
JACKSON BELL CO. LTD.																
S	Vol. Reg.	4 ‡	C A	6			4-2	1	See Note	B1				^{3}26, ^{2}27, ^{2}71, 80		9
4	Vol. Tone	6 22	G12 M	6			4-4	23	See Note	B3				^{2}57, 47, 80		1
5	Vol.	10	B				4-4-2	1/13	See Note	B1				01A, 27, 12, BH		1
5A	Vol.	10	C				2-2	1	See Note	B1				^{2}26, 27, 71A, 80		11
8	Vol. Reg.	3 ‡	C A	6			1-2	1	See Note	B1				^{3}26, ^{2}27, ^{2}71, 80		9
8 (45 Output)	Vol. Reg.	6 ‡	C A	6			4-1-2	3	See Note	B1				^{3}26, ^{2}27, ^{2}45, 80		11
24	Vol. Tone	6 22	G12 M	6			4-4	23	See Note	B3				^{2}57, 47, 80	175	1
25	Vol.	6	G7	6	1		4-4	4	See Note	B3				35, ^{2}24, 47, 80	175	1
25A, 25U	Vol.	6	G12	6			4-4	4	See Note	B3				24, ^{2}58, 47, 80	175	1
26	Vol.	6	G7	6	2		8-8	4	See Note	B3				35, ^{3}24, 47, 80		1
26S, B, 1	Vol.	6	G7	6	3		8-4	23	See Note	B3				56, ^{2}57, 58, 47, 80	175	1
27 Type 1	Vol.	6	G12				8-8	4	See Note	B3				^{2}51, 24, 27, ^{2}47, 80	175	1
27 Type 2	Vol. Tone	6 22	G12 G12	6			8-8	23	See Note	B3				24, 27, ^{2}35, ^{2}47, 80	175	1
28	Vol. Tone	6 22	G12 G12				8-8	4	See Note	B3				^{3}35, 27, ^{2}24, 47, 80	175	1
29	Vol. Tone	‡ 22	N G12	6			8-8	23	See Note	B3				^{2}24, ^{2}27, ^{2}35, ^{2}47, 80	175	1
33							4-4	1	See Note	B3				24, 27, 80		1
50	Vol. Tone	6 22	D12 G12	6			8-8	4	See Note	B3				^{3}24, 45, 80		1
59	Vol.	6	C12				2-4	1	See Note	B1				^{3}26, 27, ^{2}71, 80		11
60	Vol.	6	C				8-8	1	See Note	B3				24, ^{3}26, 27, ^{2}71A, 80		9
62, 63, 64	Vol. Tone	6 22	D7 G12				8 2-4	41 41	RS213 See Note	 B3				^{4}24, 45, 80		3
62 Series 2 and 3	Vol. Tone	6 22	D7 G12	6	3		8, 8	4	RS213					^{4}24, 45, 80		3
68	Vol. Tone	6 22	D7 G12	6			8, 8	4	RS213					^{4}24, 27, ^{2}45, 80		3
69 DC	Vol. Tone	12 22	H12 G12				8-8	1	See Note	B3				^{3}32, ^{2}30, ^{2}31		
79	Vol. Tone	7 41	D N	6			8, 8	4	RS213					^{2}35, 24, ^{2}27, ^{2}45, 80	175	3
84 "Peter Pan"	Vol.	6	G12		EX300		4-4	23	See Note	B3				^{2}24, 47, 80		1
86	Vol.	6	G12	6	2		4-4	23	See Note	B3				24, ^{2}27, 35, 47, 80	175	1
87	Vol. Tone	6 22	D7 N	6	1		4 8	23 23	RS211 RS213					^{3}27, ^{2}35, 47, 80	175	1
88	Vol. Tone	6 22	G7 N	6	1		8-8	23	See Note	B3				24, ^{3}27, ^{2}35, 47, 80	175	3
89	Vol. Tone	6 41	D7 N	6	2		4-4-4 10	3 15	See Note TS101	B3				^{2}27, 24, ^{2}35, ^{2}47, 80	175	3
89A	Vol. Tone	6 39	G7 N	6	1		4-4	1	RN241					24, ^{2}27, ^{3}35, ^{2}47, 80	175	3

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
JACKSON BELL CO. LTD.—Continued																
96	Vol.	6	Y		EX300		4-4	1	See Note	B3				^{2}24, 27,^{2}47, 80		1
							4	13	CS131							
99	Vol.	6	D7	6	1		8-4	1	See Note	B3				24,^{3}27,^{2}35,^{2}47, 80	175	3
	Tone	39	N				4	13	CS131							
205 Auto	Vol.	15	M	6			5	19	TS105					55, 57,^{2}58, 47	465	
645M	Vol.	6	C	6			4-2	1	See Note	B1				^{4}27, 45, 80		3
	Tone	22	N													
845S	Vol.	6	C	6			4-1	1	See Note	B1				^{5}27,^{2}45, 80		3
	Tone	39	N													
JACKSON RADIO & TELEVISION CO.																
447, J104, 401A	Vol.	6	G12	6	EX250		4-4	1	See Note	B3				^{2}24, 47, 80		1
SF547, 504B, J105, LK447, J104, 401A	Vol.	3	G7				4-4	1	See Note	B3				^{3}57, 47, 80 or 82		1
JACKSON RESEARCH																
NJ8	Vol.	12	K12				2-2	1	See Note	B1				^{5}24, 27, 45, 80	175	3
JEFFERSON																
6L6SPAMP	Vol.	82	TRP609				16, 16	12	CS136					6J7, 6N7, ^{2}6F6, ^{2}6L6, ^{2}83		12
							8, 8	2	CS133							
							2	13	CS130							
							10	15	TS106							
KADETTE—See International																
KARADIO CORP.																
56	Vol.	17	UM147		See Note	A96								77, 78, 6F7, 75, ^{2}41	456	
57B	Vol.	18	UM147		See Note	A96	8-4	1	See Note	B3	37	296	C3	6F7,^{2}41, 75, 77, 78, 84	456	10
	Tone	44	UM147		See Note	A96	.01		Buffer	B14						
KELLER FULLER MFG. CO. LTD.—"Radiette"																
F	Vol.	6	E12				3-3	1	See Note	B1				24,^{2}27, 45, 80		3
F12	Vol.	6	C12	6			4-2-2	3	See Note	B1				^{2}27, 24, 45, 80		3
F14	Vol.	6	C12	6			4-2-2	41	See Note	B1				^{4}24, 45, 80		3
F14A	Vol.	6	C12	6			8-8	1	See Note	B3				^{3}24, 27, 45, 80		3
F14B	Vol.	6	C12	6			8-8	4	See Note	B3				^{3}24, 27, 45, 80		1
M	Vol.	3	C12				4-2	1	See Note	B1				^{3}01A, 27, 71A, 80		20
20	Vol.	8	A10MP				8-8	1	See Note	B3				^{3}36, 37,^{2}38, 71A		13
Radiette "30"	Vol.	8	A10MP				8-8	1	See Note	B3				^{3}36, 37,^{2}38, 71A		13
Radiette "40"	Vol.	7	A2MP	6	2		8-4	23	See Note	B3				^{2}24, 47, 80		1
	Tone	21	N													
Radiette "50"	Vol.	6	H12				8-8	4	See Note	B3				^{3}24, 45, 80		1
	Tone	22	G12													
Radiette "60"	Vol.	6	H12				8-8	4	See Note	B3				^{4}24, 45, 80		1
	Tone	22	N													
Radiette "70"	Vol.	8	G				8-8	1	See Note	B3				^{2}24,^{2}51, 47, 80	175	1
	Tone	21	N													
80	Vol.	8	E				8-8	4	See Note	B3				^{3}24,^{3}27,^{2}45, 80	175	1
	Tone	41	N													
KELLOGG SWITCHBOARD & SUPPLY CO.																
"A" AC7 Tube	Vol.	8	G				10-7	1	See Note	B1				^{6}401, 403 (Kellogg) 80		1
"B"	Vol.	8	‡		See Note	A5	10-7	1	See Note	B1				^{4}401, 403 (Kellogg) 80		1
523, 524, 525, 526, 527, 528	Vol.	8	X				5-2	1	See Note	B3				^{3}24,^{2}27,^{2}45, 80		
	Sen.	40	K12													5
533, 534, 535, 536	Vol.	8	Y50MP				5-2	1	See Note	B1				^{3}24,^{2}27,^{2}45, 80		3
COLIN B. KENNEDY CORP.																
5T AC-DC	Vol.	6	K	6	See Note	A34	D324	11	UR182	B118				6E7, 6D7, 43, 25Z5		
Royal	Vol.	11	A10MP		See Note	18/26	8-8-8	3	RN245	B41				‡		3
10	Vol.	11	A10MP		See Note	A26	302	3	RN245	B41				^{5}27,^{2}45, 80		3
20	Vol.	11	A10MP		See Note	A26	317	3	RN245	B41				^{3}24,^{2}27,^{2}45, 80		3
22	Vol.	25	GG				6-6	24	See Note	B11				^{3}22,^{2}12A,^{2}71A		
	Tone	22	K12													
26	Vol.	25	GK				8-8-8	3	RN245	B41				^{3}24,^{2}27,^{2}45, 80		3
	Tone	22	K12													
30, 32	Vol.	12	A10MP				8-8-8	3	RN245	B41				^{3}24,^{2}27,^{2}45, 80		3
	Tone	22	K12													
34	Vol.	12	G12											^{3}24		
36, 38, 40	Vol.	25	GK				6-6	24	See Note	B11				^{3}22,^{2}12A,^{2}71A		
	Tone	22	K12													
42 "Coronet"	Vol.	40	G12	6			6-16	1	See Note	B3				^{3}24, 27, 45, 80		3
42B	Vol.	6	G7	6	1		8-8	1	See Note	B3				^{2}51,^{2}27, 47, 80		3
44	Vol.	40	G12				8-16	1	See Note	B3				^{3}24, 27, 45, 80		3
48	Vol.	12	G12				8-8-8	3	See Note	B3				^{3}24,^{2}27,^{2}45, 80		3
	Tone	22	K12	6												
50	Vol.	6	G7		1		15302	1	RS213					^{2}35, 24, 47, 80		1
							16302	1	RS213							
52	Vol.	6	G7		1		16302	1	RS213					^{2}35, 27, 47, 80	175	1
	Tone	22	K12	6			17302	1	RS215							
55	Vol.	6	G7		1		1-10-302	1	CN152					58, 57, 47, 80		1
56	Vol.	6	G7	6	1		16302	1	RS213					^{2}51, 24,^{2}27,^{2}47, 80	175	1
	Tone	22	K12				17302	1	RS215							
"Royal" 60	Vol.	35	N				1.5-4-4	3	See Note	B1				^{4}26, 27, 71A, 80		11
62	Vol.	‡	N	6			16302	3	RS213					^{4}35,^{3}27,^{2}47, 80	175	1
	Tone	22	K12				27302	3	RS213							
							18302	3	CS133							
62A	Vol.	14	N	6			16302	3	RS213					^{4}27,^{3}35,^{2}47, 80	175	3
	Tone	22	K12				27302	3	RS213							
							48302	3	CS133							
62D (882)	Vol.	15	N	6			8	3	RS213	B3				55, 57,^{2}56,^{3}58,^{2}47, 80	175	3
	Tone	44	K12				8	3	CS133	B3						
	Sil.	8	G													
63, 63A (563A)	Vol.	17	N	6			110302	1	CN152					55, 57, 58, 47, 80	175	1
64	Vol.	6	G7	6			10	1	RS215					^{2}24,^{2}35,^{3}27, 47,^{2}80	175	1
	Tone	22	K12													
64B (164B)	Vol.	6	G7	6	1		10	1	RS215					^{3}56,^{2}57,^{2}58, 47,^{2}80	175	1
	Tone	22	K12													
64C (882)	Vol.	15	N	6			8	3	RS213	B3				55,^{2}56,^{2}57,^{2}58,^{2}47, 80	175	3
	Tone	44	K12				8	3	CS133	B3						
	Sil.	8	G													
66, 66A	Vol.	94	N	6			16302	3	RS213					^{2}24,^{4}27,^{2}35,^{2}47,^{2}80	175	3
	Tone	22	K12				27302	3	RS213							
							48302	3	CS133							
66B (266B, 366B)	Vol.	94	N				16302	3	RS213					^{4}56,^{2}57,^{2}58,^{2}80,^{2}47	175	3
	Tone	22	K12	6			27302	3	RS213							
							48302	3	CS133							
80	Vol.	35	N				1.5-1.5-4	3	See Note	B1				^{5}26, 27,^{2}71, 80		11
826B	Vol.	25	GK				8-8-8	3	RN245	B41				^{6}24,^{2}27,^{2}45, 80		3
	Tone	22	K12													
	Reg.	12	G12													

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
KING MFG. CORP.—Also See Sears Roebuck																
FF	Vol.	4	G12				‡	1	See Note	.B1				27,^{3}26, 12A, 80		11
H	Vol.	4	F12				1-1-2	3	See Note	.B1				^{4}26, 27, 71A, 80		11
J	Vol.	4	F12				3-2-3	1/14	See Note	.B1				^{4}26, 27,^{2}71A, 80		11
82	Vol.	10	E12				4-4	1	See Note	.B2				99,^{4}26, 10, 81		20
97 "Royal"	Vol.	6	G12				1-2-2	3	See Note	.B1				^{3}26,^{2}27,^{2}71A, 80		3
98 "Imperial"	Vol.	6	G7				1-2-1	3	See Note	.B1				^{6}27,^{2}45, 80		3
101 "Monarch"	Vol.	6	G12				1-2-1	3	See Note	.B1				^{2}24,^{2}27,^{2}45, 80		3
218	Vol.	6	G12				8-8-8	3	MN275					^{3}24, 27,^{2}45, 80		3
	Tone	34	K12													
KINGSTON PRODUCTS CORP.																
"Gypsy"	Vol.	6	G7	6	3		8-8	1	CN142	.B3				^{2}77, 78, 38, 1V	456	
							5-5	15	TN110							
55	Vol.	6	G12	6			12-8-12-12	6/15	CN145/TS102	.B119				^{2}78, 77, 38, 12Z3	456	
							10	15	TS101							
500, 500A	Vol.	18	N	6			6-6	1	CN152	.B3				6A7, 6D6, 75, 42, 80	456	1
							E-17080	15	TS101							
600A, 600B, 610B	Vol.	18	N				6-6	1	CN152	.B3				^{2}78, 6A7, 75, 42, 80	Early	
	Tone	21	N	6			10	15	TS101						182.5	
															Late	
															172.5	1
700, 700A, 700B	Vol.	18	N				E17125	1/15	CN152					76,^{3}6D6, 75, 42, 80	456	1
	Tone	34	L	6			E17217	1	RS213							
							12	15	TS101							
KNIGHT—Also See "Allied"																
A31	Vol.	18	N				8-4	23	See Note	.B3				6A7, 6D6, 75, 42, 80	456	1
KOLSTER RADIO, Inc.																
6F, 6J, 6K, 6L, 6M, 6R	Vol.	29	‡		See Note A18		2-2-2	30	See Note	.B1				^{4}26, 27, 71, 80		11
7 Tube (60∽ & 25∽)	Vol.	5	‡		See Note A5		2-2-2	30	See Note	.B1				^{5}26, 27, 71A, 80		7
K20	Vol.	10	H12				2-2-2	30	See Note	.B1				^{4}26, 27, 71, 80		8
K21, K22, K23	Vol.	10	H12				2-2-1	30	See Note	.B1				^{5}26, 27, 71A, 80		8
K24 (210 O.P., 250 O.P.)	Vol.	4	H12				3-4-2	30	See Note	.B2				^{5}26, 27, 10 or 50,^{2}81		8
K25, K27, K28	Vol.	10	H12				2-2-1	30	See Note	.B1				^{4}26, 27, 71A, 80		11
K30, K32	Vol.	10	Y											^{5}01A, 71A		
K38	Vol.	14	K12				3-2-2	30	See Note	.B2				^{6}27, 50,^{2}81, 886		8
K42	Vol.	40	Y	6			2-2-2	30	See Note	.B1				^{4}26, 27,^{2}71, 80		11
K43, K43A	Vol.	25	DRP244				2-1-5	30	See Note	.B1				^{3}24,^{2}27,^{2}45, 80		3
K44	Vol.	25	DRP244				2-2	1	See Note	.B2				^{3}24,^{2}27,^{2}45,^{2}81		8
K45	Vol.	‡	‡		See Note A3		2-2	1	See Note	.B2				^{3}24A,^{4}27,^{2}50,^{2}81		5
K48	Vol.	40	Y				2-2-1	41	See Note	.B3				^{3}24,^{2}27, 45, 80		3
	Equal	7	A1MP		See Note A3											
K60, K62	Vol.	8	A5MP				8-8-8	26	See Note	.B3				^{2}24,^{2}35, 47, 80	175	1
K63	Vol.	40/42	DRP239				4	12	See Note	.B11				^{4}36, 37,^{2}38	175	
K70, K72	Vol.	59	H12				8-8-8	26	See Note	.B3				^{3}24, 27,^{2}35, 47, 80	175	1
K73	Vol.	40/42	DRP239				4	12	See Note	.B11				^{4}36, 37,^{2}38	175	
K80, K82	Vol.	59	H12				8-8-8	26	See Note	.B3				^{2}24,^{2}27,^{2}35,^{2}47, 80	175	1
K83	Vol.	40/42	DRP239				‡	12	See Note	.B11				^{3}36,^{2}37,^{4}38	175	
K90, K92	Vol.	59	H12				8-8-8	26	See Note	.B3				^{2}24,^{2}27,^{2}35,^{2}47, 80	175	1
K93, K103	Vol.	40/42	DRP239				4	12	See Note	.B11				^{3}36,^{2}37,^{4}38	175	
K110	Vol.	15	N				6-6-6	26	CM175					^{3}56,^{3}58, 47, 80	175	1
K113	Vol.	15	N				4	12	See Note	.B11				^{3}37,^{2}38,^{3}39	175	
K114	Vol.	15	N				8	12	See Note	.B3				^{6}30,^{3}34	175	
K120, K122	Vol.	15	N	6			6-6-6	26	CM175					^{3}56,^{3}58, 47, 80	175	1
K123	Vol.	15	N				4	12	See Note	.B11				^{2}37,^{2}38,^{3}39	175	
K130, K132	Vol.	15	N	6			6-6-6	5	CM175					^{3}56,^{3}58,^{2}47, 80	175	1
K133	Vol.	15	N				4	12	See Note	.B11				^{3}37,^{4}38,^{3}39	175	
							4	15	TS101							
K140, K142	Vol.	15	N	6			8-8-8	26	CM175					^{3}56,^{4}58,^{2}47, 80	175	1
K143	Vol.	15	N				4	12	See Note	.B11				^{3}37,^{4}38,^{3}39	175	
							4	15	TS101							
K165 "Intern't'l"	Vol.	15	K12				6-6-6	40/23	CM175					^{3}56,^{3}58, 47, 80	535	1
K175 "Intern't'l"	Vol.	15	N	6			6-6-6	40/23	CM175					^{3}56,^{3}58, 47, 80	505	1
S.W. "Converter"	Vol.	11	K12											56, 57, 58		
KROHLER																
93B Viking	Vol.	7	G	6			8	4	RS213					^{2}27,^{3}35, 47, 80	175	1
	Tone	22	Y													
KYLECTRON—See United Reproducers																
R. E. LECAULT																
LR4	Vol.	31	A400P											^{9}01A	175	
	Sen.	29	T													
L2 Ultradyne	Vol.	31	A400P											^{8}01A	175	
LAFAYETTE RADIO & TELEVISION CO.																
A7	Vol.	6	G	6	2		533	4	CM170	.B3				^{3}56, 57, 58, 47, 80	115	1
	Tone	21	M				721	4	CS133	.B3						
AM8	Vol.	18	N	‡			1085/1295	8	UR182	.B3				6A7, 75; 76,^{2}78, 43,		
	Tone	21	M											25Z5	175	
AM10	Vol.	6	G12	6			1085/1295	8	UR182	.B3				76,^{3}77, 78, 43, 25Z5	115	
	Tone	22	M				928	15	TS102							
A11	Vol.	6	G12	6			965	8	UR182	.B3				^{2}77, 78, 43, 25Z5	175	
							928	15	TS102							
A12	Vol.	76	N	6			496	4	CM170	.B3				6A7, 78, 75, 42, 80	175	1
	Tone	76	M				928	19	TS102							
A14	Vol.	18	N	6			1085	8	UR182	.B3				^{2}78, 6A7, 75, 43	175	
	Tone	21	M				928	15	TS102							
A15	Vol.	6	G12	6			1085	8	UR182	.B3				^{2}77, 78, 43, 25Z5	175	
							928	15	TS102							
A19	Vol.	6	G12	6			1085	8	UR182	.B3				^{3}77, 78, 43, 25Z5	115	
	Tone	22	M				928	15	TS102							
A20	Vol.	18	N				8-8-8	4	RS213	.B3				56,^{3}58, 2A6, 2A5, 80	175	1
	Tone	21	M													
AM20	Vol.	18	UM154		See Note A96		6-6	2	See Note	.B3	37	296	C3	75, 77,^{2}78, 41, 84	175	10
							25	15	TS102							
							.015		Buffer	.B14						
AM25	Vol.	6	G12	6			1295	8	UR182	.B3				^{2}77, 78, 43, 25Z5	115	
							928	15	TS102							
AM26	Vol.	17	N	6			721	25	See Note	.B3				6A7, 75, 58, 42, 80	175	1
							1379	25	See Note	.B3						
							928	19	TS102							
B51, B52, B53, B54	Vol.	17	P	6			P80984	2/13	CN155/CN142	.B120				55,^{3}56,^{4}58,^{3}45, 82	175	21
	Tone	41	UC504													
B60	Vol.	15	O				P80968	12	CS121					^{6}30,^{3}34, 10AB	175	
	Tone	44	UC502													
B62	Vol.	17	UM163	M26	See Note A96		P82002	2/15	CM173		32	286S	C3	6C6,^{2}6D6, 75, 41	175	10
							.007		Buffer	.B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes In Note Section If specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
LAFAYETTE RADIO & TELEVISION CO.—Continued																
B97, B98	Vol.	20	TM247-SS1				30	2	WE2545					^{4}6K7, ^{3}6C5, 6H6, 6G5,		
	Tone	65	MR55				12	2	RS215					^{2}6L6, ^{2}5Z4MG	456	1
C25	Vol.	18	MR48				8-8	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
C60	Vol.	17	UM154			See Note A96	8-8	1	See Note	B3	35	294	C3	6A7, 6D6, 75, 41, 84	175	10
							5	15	TS105							
							.0015		Buffer	B14						
C79, C80	Vol.	45	MR48				20-12	6	UR192	B3				6A7, 6K7, 6H6, 6G5,		
	Tone	22	L											43, 25Z5	456	
D10	Vol.	6	‡			See Note A5	12	4	RS215					6A7, 6C6, 42, 80	456	1
							16	4	RS216							
D11	Vol.	18	MR48				8-8	23	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
D30, D31	Vol.	17	MR48				8, 8	4	RS213	B3				^{2}6D6, 76, 75, 42, 80,		
	Tone	22	L											6G5	456	1
E20	Vol.	‡	MR48	M26			9193	3	CN155					^{3}58, ^{2}57, 55, ^{3}59, 80	115	3
	Tone	22	K12				9197	14	CS121							
	NSC	‡	‡			See Note A5	9196	15	TS103							
							8876	15	TS105							
E204	Vol.	‡	MR48	M26			9193	3	CN155					^{3}58, ^{2}57, 55, ^{3}59, 80	115	3
	Tone	22	K12				9197	14	CS121							
	NSC	‡	‡			See Note A5	9196	15	TS103							
							8876	15	TS105							
EB8	Vol.	18	MR48	M26			20-12	27	UR192	B3				6A7, 6D6, 75, 25A7	456	
EB9	Vol.	6	MR21				4806A	27	UR194	B3				6D6, 6C6, 43, 25Z5		
F20	Vol.	70	H12		EX250									^{2}32, 30, 34, 33	465	
J60	Vol.	45	MR48				8-4	1	See Note	B3	31	285XS	C3	1C6, 34, 30, 19	465	10
	Tone	22	‡			See Note A5	.01-.01		Buffer	B14						
L1, L2, L3, L4	Vol.	45	Z12				8	58	RS213					^{3}56, ^{2}57, ^{4}58, ^{2}46, 82	175	3
	Tone	41	UC502				4	58	CS131							
	Sen.	8	E				4	19	CS121							
L11, L12	Vol.	45	N											^{6}30, ^{3}34	175	
	Tone	22	UC502													
	Fil.	29	R	7												
L16, L17, L18, L19	Vol.	59	SRP271				P80894B	23	CM172					^{3}57, ^{2}58, 47, 80	175	7
	Tone	34	UC502				P80891B	23	CS121							
L30	Vol.	18	M	6			8-8	1	CN152		20	253	C3	75, 77, ^{2}78, 84, 41	262.5	10
	Tone	34	UC502				10-10	15	TN111							
							.01		Buffer	B14						
LW10	Vol.	17	N				2210	1	CN152		35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
							2212	15	BN226							
							2211	15	TS101							
							.025-.025		Buffer	B14						
M14-20	Vol.	12	K12				‡	1	See Note	B4				^{2}78, 37, ^{2}48		
							5	15	TS101							
M15	Vol.	12	K12											^{2}34, 32, 33		
M35, 37	Vol.	15	N				4-8-4	4	See Note	B3				55, 56, ^{3}58, 47, 80	175	1
	Tone	22	M													
M44	Vol.	45	MR48				4-4	1	See Note	B3	31	285XS	C3	1C6, 34, ^{3}30, 19	456	10
	Tone	22	MR33				.01-.01		Buffer	B14						
M47	Vol.	18	N	6			4-4-8	26	See Note	B3				55, ^{3}56, ^{3}58, ^{2}47, 80	520	3
	Sen.	8	G12													
M69, 70	Vol.	6	G	6	2		533	4	CM170	B3				^{3}56, 57, 58, 47, 80	115	1
	Tone	21	M				721	4	CS133	B3						
R71	Vol.	6	G		EX500		4-4	4	See Note	B3				58, 57, 47, 80		1
S17762	Vol.	17	N				8-16	1	CN155		2	210	C3	77, ^{2}78, 85, ^{2}41	262	10
							4	15	TS101							
							.01		Buffer	B14						
10, 12	Vol.	12	K12				8-8-8	3	See Note	B3				^{2}58, 56, ^{2}59, 80		1
							5	15	TS101							
							25	15	TS103							
10C10	Vol.	18	N				P80900	30	RS213					^{3}27, ^{4}35, ^{2}47, 80	175	1
	Tone	41	P	6			P80901	30	RS213							
53	Vol.	15	N	‡			4-8-4	4	See Note	B3				55, 56, ^{3}58, 47, 80	175	1
	Tone	22	M													
80M (2 Types)	Vol.	8	A5MP			See Note A27	80873B	30	CS131	B3				^{2}24, 27, ^{3}35, 47, 80	175	3
	Vol.	14	N			See Note A4	80874	30	CS130	B3						
	Tone	34	UC502				80875	30	CS131							
							80878	30	CS121							
100A	Vol.	‡	NN				8	2	See Note	B3				57, ^{3}59, 83		3
102A	Vol.	15	N				8	2	See Note	B3				^{2}57, ^{2}53, ^{4}2A3, 83		3
	Tone	21	N				5-5	1	CN140							
							5-5	15	TN110							
106A	Vol.	15	N				8-8	2	See Note	B3				53, ^{2}56, ^{2}6B5, 83		3
	Tone	21	N				25	15	TS102							
115A	Vol.	15	N				8-8	2	See Note	B3				^{2}53, 2A3, ^{5}45, 83		3
							10-10-10	26	See Note	B3						
120A	Vol.	15	O				8-4-16	2/12	See Note	B3				6C6, 6A6, ^{2}6B5		3
	Tone	21	N				25	15	TS102							
132A, 133A	Vol.	15	N				8-8	2	See Note	B3				^{2}75, 6A6, ^{2}6B5, 5Z3		16
							25	15	TS103							
137X	Vol.	18	MR48				8-4	23	See Note	B3				6A7, 6D6, 75, ^{2}42, 80	456	1
143, 144	Vol.	18	MR48				8-4	23	See Note	B3				6A7, 6D6, 75, ^{2}42, 80	456	1
149	Vol.	18	MR48				8-4	23	See Note	B3				6A7, 6D6, 75, ^{2}42, 80	456	1
150X	Vol.	18	MR48				8-4	23	See Note	B3				6A7, 6D6, 75, ^{2}42, 80	456	1
151, 154	Vol.	15	TRP606	6			3288	1	CN152					^{3}78, 6A7, 85, ^{3}76, ^{2}42,		
	Tone	22	Y				3004	25	RN242					^{2}80	465	1
	Sen.	7	G				1948	25	RS213							
158P	Vol.	6	G12			See Note A28	8	2	See Note	B3				53, 55, 57, 58, 2A5, 83		3
	Vol.	15	N			See Note A29	32	2	See Note	B3						
							25	15	TS102							
							5	15	TS101							
171X	Vol.	18	MR48				8-4	23	See Note	B3				6A7, 6D6, 75, ^{2}42, 80	456	1
186, 188	Vol.	15	TRP606	6			3288	1	CN152					^{3}78, 6A7, 85, ^{3}76, ^{2}42,		
	Tone	22	Y				3004	25	RN242					^{2}80	465	1
	Sen.	7	G				1948	25	RS213							
324	Vol.	114	N				8-8-8	26	See Note	B3				^{2}58, 2A7, 2A6, 2A5,		
	Tone	114	P				4	15	TS101					^{2}45, 80	456	1
"Orthotone"	Vol.	15	‡			See Note A19	6-4-4	3	See Note	B3				56, ^{3}57, ^{3}58, ^{2}47, 80		3
	Supp.	12	J	6			8	17	TS106							
LANG RADIO CO.																
BA5	Vol.	40	D12				8	4	RS213	B3				^{3}24A, 45, 80		1
							4	4	RS211	B3						
BA5P	Vol.	40	D12				8-8	4	RS213	B3				^{3}24A, 47, 80		1
	Tone	22	K12													
BD5P	Vol.	40	D12											^{2}36, 37, ^{2}33		
	Tone	22	K12													
BD6	Vol.	40	D12											30, ^{2}31, ^{3}32		
BD6P	Vol.	40	D12											^{2}36, ^{2}37, ^{2}33		
	Tone	22	K12													
DC6	Vol.	6	G12											^{2}39, ^{2}37, ^{2}48		
	Tone	44	K12													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
LANG RADIO—Continued																
F7 110V DC	Vol.	10	D12											^{5}12A, ^{2}71A		
F9	Tone	34	L											^{5}12A, ^{4}71A		
J7	Tone	34	L											^{3}22, 12A, 71A		
M7	Vol.	12	A5MP				2-4	1	See Note	B1				^{3}24, ^{3}45, 80, 27		3
	Tone	34	L													
MA7	Vol.	6	G7	6	2		8, 8	4	RS213					^{2}24, 27, ^{2}35, 47, 80	175	1
	Tone	22	K12													
MA8	Vol.	62	N	6			8-8	4	See Note	B3				^{2}24, ^{2}27, ^{2}35, 47, 80	175	1
	Tone	22	K12				5	15	TS101							
MD7	Vol.	6	G7	6	3									^{4}36, 37, ^{2}33	175	
	Tone	22	K12													
MD8	Vol.	15	N	8										^{2}33, 36, ^{2}37, ^{3}39	175	
	Tone	22	K12													
SA7	Vol.	6	G12				16-8	4	CM175	B3				^{3}24, ^{2}35, 47, 80	175	1
	Tone	22	K12													
SA8	Vol.	6	G12				4-8-4	26	See Note	B3				^{2}24, 27, ^{2}35, ^{2}47, 80	175	1
	Tone	22	K12													
UG5B	Vol.	6	G12	6	EX200		12-8-10-10	6/15	UR189	B98				^{2}6C6, 6D6, 43, 12Z3	456	
UG5H	Vol.	7	E		2		12-8-10-10	6/15	UR189	B98				6A7, ^{2}6D6, 6C6, 43, 12Z3	456	
40UL	Vol.	6	G12	6	EX120		E1153A	6/15	UR189	B98				6A7, 6C6, 43, 25Z5	470	
50AS	Vol.	6	G12		EX120		4-8-12	4/12	See Note	B3				6A7, 6D6, 76, 38, 80	470	1
50UP	Vol.	6	G12	‡			12-8-10-10	6/15	UR189	B98				6A7, 6D6, 76, 43, 25Z5	470	
50US	Vol.	6	G12	6	EX120		E1153A	6/15	UR189	B98				6A7, 6D6, 76, 43, 25Z5	470	
60AA	Vol.	18	N				8-8	4	See Note	B3				^{2}6D6, 6A7, 75, 41, 80	470	1
							4-4	12	CN140	B3						
							5	15	TS101							
60UP	Vol.	6	G12	‡			12-8-10-10	6/15	UR189	B98				6A7, 6D6, 76, 43, 25Z5	470	
80UA	Vol.	17	N				16-16-16	8	See Note	B3				^{2}6D6, 6A7, 75, 43, 25Z5	470	
502UA	Vol.	7	E		2		12-8-10-10	6/15	UR189	B98				6A7, 6D6, 6C6, 43, 12Z3	456	
502US	Vol.	14	E	6	2		E1153A	6/15	UR189	B98				6A7, 6D6, 6C6, 43, 12Z3	456	
503AS	Vol.	17	N				12-8-5	4/15	See Note	B3				2A7, 58, 2A6, 2A5, 80	175	1
503US	Vol.	7	E	6	2		8-12-10-10	6/15	UR189	B98				6A7, 6D6, 6C6, 43, 25Z5	470	
503UT, 523UT	Vol.	17	O				8-16-8	6	UR190	B3				6A7, 6D6, 75, 43, 25Z5	470	
							10	15	TS101							
703US	Vol.	17	N				16-8-8	11	UR190	B3				6A7, 6D6, 85, ^{2}43, ^{2}12Z3	175	
							6	12	CS123	B3						
							5	15	TS101							
LARKIN CO.																
88	Vol.	42	G				8-8	4	See Note	B3				24, ^{2}27, ^{2}35, 47, 80	175	1
	Tone	21	O				5	15	TS101							
90	Vol.	17	N				5	15	TS101					77, ^{2}78, 85, ^{2}41	175	
91	Vol.	17	N				6-10	1	See Note	B3	34	292	C3	6A7, ^{2}78, 85, ^{2}41, 81	175	10
							5	15	TS101							
							.015		Buffer	B14						
LEAR-WUERFUL CO.																
Suprex Six	Vol.	6	Y				8-8	4	See Note	B3				^{2}24, 27, 47, 51, 80	175	1
	Tone	22	M													
C. R. LEUTZ INC.																
"C"	Vol.	12	K											^{2}22, ^{3}01A, 71A		
"Seven Seas Console"	Vol.	16	M				8-8	1	See Note	B2				^{3}24, ^{2}27, ^{2}10 or ^{2}50, ^{2}81		5
	Sen.	12	UC513													
"Silver Ghost"	Vol.	33	‡		See Note A5		2-4-2	3	See Note	B3				^{4}22, 01A, 40, 12A, ^{2}10, ^{2}81		
"Trans-Oceanic"	Vol.	15	N											^{8}01A, 12A		
LEWOL MFG. CO.																
LW4, LW4DW	Vol.	6	SRP263		EX300		110	27	UR182	B115				6D6, 6C6, 43, 25Z5		
60MS	Vol.	20	‡		See Note A19		8-16-4	11	UR193	B31				^{2}78, 6A7, 85, 43, 25Z5	456	
63	Vol.	20	‡		See Note A19		8-16	4	See Note	B3				^{2}78, 6A7, 85, 42, 80	262.5	1
64	Vol.	20	‡		See Note A19		12-16-6	11	UR182	B31				^{2}78, 6A7, 85, 43, 25Z5	262.5	
9682	Vol.	64	N	7			8-4	1	See Note	B3	31	285XS	C3	1C6, 34, ^{3}30, 19	465	10
	Tone	22	‡		See Note A5		.01-.01		Buffer	B14						
LINCOLN RADIO CORP.																
"Hollister" AC8	Vol.	12	D12											^{4}24, ^{3}27, 50	‡	
DCSW8	Vol.	12	K12											^{3}30, 31, ^{4}32	‡	
R9	Vol.	16	N				8	1	RS213					^{4}56, ^{4}58, ^{2}45, 80	480	3
	Sen.	12	K													
"DeLuxe" 10	Vol.	58	F				2-2-2	3	See Note	B1				^{5}24, ^{3}27, ^{2}45, 80	‡	3
31	Vol.	7	K				2-4	1	See Note	B1				^{6}24, ^{2}27, ^{2}45, 80	‡	3
SW32	Vol.	7	K	6			4	1	RS211					^{2}27, ^{6}24, ^{2}45, 80	‡	3
SW33	Vol.	23	NN				8	4	RS213					^{5}35, ^{3}56, ^{2}45, 80	‡	3
	Sen.	98	K													
LONG RADIO CORP.																
70	Vol.	6	G12				8-8	1	See Note	B3				^{3}24, 27, 45, 80		3
R. H. MACY & CO.																
MB5	Vol.	6	UC501				8	1	See Note	B3				24, ^{2}51, 47, 80		1
56, 58	Vol.	6	‡		See Note A5		8-8	4	See Note	B3				55, 57, 58, 47, 80		1
	Tone	22	‡		See Note A5											
MB92	Vol.	6	G12				2	3	See Note	B2				55, ^{2}56, ^{3}58, ^{2}46, 80		1
	Tone	22	M				8-8	3	See Note	B3						
							4	15/17	TS101							
MB710	Vol.	6	G12				8-4	1	See Note	B3				55, ^{3}58, 56, 47, 80	175	3
	Tone	22	L				4	17	TS105							
MAJESTIC																
7BP3, 7BP6							3-4-3-3	47	See Note	B121				80		27
							2-3-3-2	47	See Note	B121						
7P3, 7P6							2-6-2-2-1	47	See Note	B121				80		27
8P3, 8P6							2-2-3-1-1	47	See Note	B121				81		5
9P3, 9P6							4-4-1-2	47	See Note	B121				80		3
10 (11)							6433	1	CN150					^{2}24, 80	1000	1
15 Below 65149	Vol.	6	G7	6	3		5414	4	CS133					^{2}24, 47, 51, 80	175	1
	Tone	22	K12				8385	4	CM172							
15, 15B (151, 153, 154, 155, 156) Above 65150	Vol.	6	G12	6	EX300		5414	4	CS133					^{2}24, 51, 47, 80	175	1
	Tone	22	K12				8385	4	CM172							

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
MAJESTIC—Continued																
20 (21, 22, 23)	Vol.	8	E	6			2-2	1	See Note	B1				^{2}27, ^{3}51, 45, 80	175	3
							.07		See Note	B9						
25 (251, 253, 254)	Vol.	8	F	6	2		4713	3	CS133					^{3}27, ^{3}51, ^{2}47, 80	175	3
	Tone	44	L				5414	3	CS133							
25B (251B, 253B, 254B)	Vol.	15	F12	6			5608	3	CS131					^{3}27, ^{3}51, ^{2}47, 80	175	3
							4713	3	CS133							
							.15 mf		See Note	B9						
							.35 mf		See Note	B12						
30 (31)	Vol.	24	DRP122	6	See Note A24		2-3	1	See Note	B1				^{3}24, ^{2}45, 80		3
							.1		See Note	B9						
35 (351, 353)	Vol.	15	F12	6			4713	1	CS133					^{3}27, ^{4}51, ^{2}45, 80	175	3
	Tone	22	G12				5806	1	CS131	B1						
							.15		See Note	B9						
							.35		See Note	B12						
50 (51, 52)	Vol.	24	DRP122				3-2	1	See Note	B1				^{2}27, ^{3}24, ^{2}45, 80	175	3
							.09		See Note	B9						
50 (1937)	Vol.	6	K12	6			B16973	4	RS207					6D6, 6C6, 43, 25Z5		
							B17042	4	RS207							
F50	Vol.	15	M	6			16-16-10-20	2/15	UR191/TN111	B3				^{2}56, ^{2}58, ^{2}47, 82	175	7
	Tone	22	M													
55 (56, 57, 58)	Vol.	6	H7	6	2		6501	4	CM172					24, 27, ^{2}35, 47, 80	175	1
	Tone	22	K12													
60 (61, 62)	Vol.	7	SRP223				2-2-2-1	3	See Note	B1				27, ^{3}51, ^{2}24, ^{2}45, 80	175	3
							4-3-3-1	3	See Note	B1						
							.07		See Note	B9						
							.25		See Note	B12						
60 (1937)	Vol.	17	O				B17041-3	4	RS208					6A8G, 6K7G, 6Q7G,		
	Tone	‡	M	6			B17197	4	RS208					25B6G, 25Z6G	456	
65. 66 ('37)	Vol.	18	O	6			B16466	4	RS216					6K6G, 6Q7G, 6K7G,		
	Tone	22	UC502				B16467-2	4	RS213					6A8G, 5Y3, 6G5	456	1
66	Vol.	17	M	6			9979	4	CM172		3	220B	C3	^{2}6E7, 6A7, 6C7, 89,		
	Tone	22	K12				10067	15	TS101					6Y5	175	10
							.008-.008		Buffer	B14						
67 (68, 69)	Vol.	18	M				16	1	RS216					^{2}58, 2A7, 55, 2A5, 80	175	1
	Tone	22	M				8	1	RS213	B3						
							10	15	TS101							
70, 70B (71, 72)	Vol.	40	G12											^{4}26, 27, 71, 80		11
75, 76 ('37)	Vol.	18	O	6			B16466	4	RS216					6L7G, 6K7G, 6Q7G,		
	Tone	22	UC502				B16467	4	RS213					6F6G, 6G5, 5Y3,		
														6C5G	456	1
85, 86	Vol.	18	O	6			A15236-3	25	WE2545					6A8G, 6K7G, 6Q7G,		
	Tone	22	UC502				A15237-2	25	RS215					^{2}6F6G, 6C5G, 5Y3.	456	1
90, 90B (91, 92, 93)	Vol.	7	Z				2-2-2-1	2	See Note	B1				^{5}27, ^{2}45, 80		3
	Equal	7	SRP160				4-4-2-1	2	See Note	B1						
100 (101)	Vol.	7/63	DRP222		See Note A49		See the		9P3, 9P6					^{5}27, ^{2}45		
	Equal	7	SRP160													
100B (102, 103)	Vol.	7/16	DRP312				2-2-2-1	2	See Note	B1				^{5}27, ^{2}45, 80		3
	Equal	7	SRP160				4-4-2-1	2	See Note	B1						
110	Vol.	15	Y100MP											^{3}36, ^{2}37, ^{2}38		
114	Vol.	8	M				8	1	See Note	B3				^{2}39, ^{3}38, 85	175	
							8286	15	TS101							
							7784-2	15	TS102							
116 (Type 1)	Vol.	17	M				9337	4	CM162		3	220B		57, ^{2}58, 75, 89, 6Z5	175	10
116 (Type 2, 3)	Vol.	17	M				9337	4	CM162		3	220B		57, ^{2}58, 85, 89, 6Y5	175	10
116 (Type 4)	Vol.	17	M				9979	4	CM172		3	220B		57, ^{2}58, 75, 89, 6Z5	175	10
118, 118P	Vol.	17	SRP251				10369	4	CM172		3	220B		^{2}6E7, 6A7, 6C7, 42,		
							10488	15	TS101					6Y5	175	10
120 (121)	Vol.	24	GG	7										30, ^{4}32, 33	175	
120B (123)	Vol.	24	GG											30, ^{4}32, 33	175	
130A (131, 132, 133)	Vol.	8	A1MP				2-2-2	3	See Note	B1				^{4}24, ^{2}45, 80		3
							4-4-2	3	See Note	B1						
150	Vol.	6	G7	6	3		5411	4	CS133					^{2}24, 51, 47, 80	175	1
	Tone	22	K12				8385	4	CM172							
	Phono.	63	W													
160 (163)	Vol.	8	SRP223				2-2-2-1	3	See Note	B1				27, ^{3}51, ^{2}24, ^{2}45, 80	175	3
							4-3-3-1	3	See Note	B1						
							.07		See Note	B9						
							.25		See Note	B12						
180 (181)	Vol.	7	DRP222		See Note A49									27, ^{2}50, ^{2}81		5
200 (201, 203, 204)	Vol.	15	N				6277	28	CM175					^{4}35, 27, G2S, 47, 80	175	1
	Tone	22	K12	6												
210 (211, 214, 215)	Vol.	15	M				4713	3	CS133					^{4}35, ^{2}27, ^{2}47, 80	175	3
	Tone	44	L	6			6324	3	CS133							
220 (221, 223)	Vol.	15	M				4713	3	CS133					^{2}27, ^{5}35, ^{2}50, ^{2}81	175	5
	Tone	22	K12	6												
230A (233 Comet)	Vol.	8	DRP313				2-2-2	3	See Note	B1				^{4}24, ^{2}45, 80		3
							4-4-2	3	See Note	B1						
290 (291, 293, 294)	Vol.	15	M				7173	2	CS133					^{4}58, 56, 57, 47, 80	175	1
	Tone	22	K12	6			7278	14	CM162							
	Supp.	12	E12				7102	15	TS101							
300, 300A (303, 304, 307)	Vol.	15	M				7489	2	CS136					58, 56, 57, 47, 82	175	3
	Tone	22	M	6			7278	14	CM162							
	Supp.	12	Y				7402	15	TS101							
	Hum	37	HU20				7781	15	TS102							
310A (311)	Vol.	15	M				7824	1	CN155					^{3}58, 55, 56, 47, 80	175	1
	Tone	22	K12	6			8118	16	TS102							
310B (314, 315)	Vol.	15	M				7824	1	CN155					^{3}58, 56, 55, 47, 80	175	1
	Tone	22	K12	6			8118	16	TS102							
	Hum	37	HU20				7402	15	TS101							
320 (324)	Vol.	15	M				7489	2	CS136					^{4}58, 56, ^{2}57, ^{2}47, 82	175	7
	Tone	22	M	6			7988	14	CS123							
	Supp.	12	Y				7784	15	TS102							
	Hum	37	HU20				7402	19	TS101							
330 (331, 336, 77)	Vol.	15	M				8721	1	RS216					^{3}58, 56, 55, 59, 80	175	1
	Tone	22	M	6			8722	1	RS213							
							8118	15	TS102							
340, 340B (344)	Vol.	15	M				8722	3	RS213					56, ^{3}58, ^{2}57, ^{3}59, 82	175	3
	Tone	22	M	6			8721	3	RS216							
	Supp.	12	Y				7988	14	CS123							
							9019	19	TS101							
							8118	15	TS105							
360 (363)	Vol.	45	M				8721	2	RS216					^{3}58, ^{3}56, ^{2}57, ^{2}59, 82	175	3
	Tone	22	M	6			7988	14	CS123							
	Supp.	12	Y				8118	18	TS102							
	Hum	37	HU20				9019	19	TS101							
370 (371, 373)	Vol.	6	Y	6	EX250		9219	1	CN152					^{2}57, 58, 59, 80	456	1
							9019	15	TS101							
380 (381)	Vol.	6	K12	6	EX250		8755	1	CN151					57, 58, 89, 84		1
							8774	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
MAJESTIC—Continued																
390 (393)	Vol.	17	M.				8722	1	RS213					^{2}56, ^{3}58, 55, 53, 80	175	1
	Tone	22	M.	6			8721	1	RS216							
							8118	15	TS102							
400 (411, 413)	Vol.	6	Y	6	EX250		9661	6, 15	SR630					^{2}57, 58, 43, 25Z5	456	
400A (411A, 413A)	Vol.	6	Y	6	EX250		9661	6, 15	SR630					^{2}6D7, 6E7, 43, 25Z5	456	
440 (44, 94, 194)	Vol.	6	F7	6	3		10536	1, 15	SR629					6A7, 6F7, 41, 6Z5	456	1
460 (461, 463)	Vol.	56	M.				10207	1	RS216					^{2}58, 2A7, 55, 2A5, 80	175	1
	Tone	22	M.	6			10193	1	RS213							
							10208	15	TN111							
490 (491, 493)	Vol.	18	M.				10630	4, 15	CM172/TS101		3	F220C	C11	^{2}6E7, 6A7, 85, 42, 6Y5	175	10
	Tone	22	M.	6			10946	18	TN111		35	F294	C11			
							.008-.008		Buffer	B14						
500 (55, 59, 75, 195, 560, 566)	Vol.	17	M.	6			10827	1/15	CN152/TS101					6A7, 6F7, 6B7, 42, 80	456	1
520 (95, 105)	Vol.	18	M.	7										^{2}34, 1A6, 25, 33	175	
570	Vol.	18	M.				12038-1	25	RS216					^{2}58, 2A7, 55, 2A5, 80	175	1
	Tone	22	M.	6			12039-1	25	RS213							
							12026-2	15	TS102/TS101							
600 AC-DC	Vol.	17	M.	6			16-8	6	CN145	B124				6A7, ^{2}6E7, 6C7, 43,		
							10	15	TS101					25Z5	456	
650 (1937)	Vol.	18	O.	6			B16466	4	RS216					6A8G, 6K7G, 6Q7G,		
	Tone	22	UC502				B16467-2	4	RS213					6K6G, 6G5, 5Y3	456	1
750	Vol.	18	O.	6			B16466	4	RS216					6C5G, 6L7G, 6K7G,		
	Tone	22	UC502				B16467	4	RS213					6Q7G, 6F6G, 6G5,		
														5Y3	456	1
800 (85, 86, 998)	Vol.	18	M.				11017	25	RS216					^{2}58, 2A7, 56, 53, 80	175	1
	Tone	22	M.	6			11200	24	RN241							
							11099	15	TS102							
850	Vol.	18	O.	6			A15236-3	25	WE2545					6A8G, 6K7G, 6Q7G,		
	Tone	22	UC502				A15237-2	25	RS215					6C5G, 6G5, ^{2}6F6G,		
														5Y3	456	1
1050	Vol.	17	TRP618	6			B16554-2	1	WE3540					^{2}6K7G, 6L7G, 6Q7G,		
	Tone	22	UC502				B15427	1	RS216					^{3}6F6G, 5Z3, 6C5G,		
							B16551-3	15	TN111					6G5	456	1
1250	Vol.	17	TRP610	6			B16613-2	1	UR191	B128				^{3}6K7G, 6L7G, 6H6G,		
	Tone	22	P.				B16614-3	14/15	CN152	B128				^{2}6C5G, 6G5, 6F5G,		
														^{2}6L6G, 5Z3	456	1
MAJOR LABORATORIES																
ML 210 Amp	Vol.	16	N.				4-2-4	3	See Note	B4				27, 10, 81		5
	Mon.	‡	M200MP													
	Bias	‡	M2MP													
250 Amp	Vol.	16	N.											27, ^{2}26, ^{2}50		
P. R. MALLORY & CO.																
"B" Eliminator (Types 1 to 6 incl.)							15233	3	On Order	B125	1	201–206	C3	BR		26
							.05		Buffer	B14						
"B" Eliminator 10 to 14 Incl. 1933-34							16736	3	On Order	B125	2	210–214				26
							16737	3	On Order	B125						
							16738	3	On Order	B125						
"Vibrapacks"																
VP551							.005		Buffer	B14	19	725				
VP552							.005		Buffer	B14	19	725				
VP553							.005		Buffer	B14	35	825		0Z4		
VP554							.005		Buffer	B14	35	825		0Z4		
VP-G556							.005		Buffer	B14	19	G725				
MARTI																
T	Vol.	4	‡		See Note A5		6-2	3	See Note	B1				^{6}27, 10, 81		1
							.02		See Note	B9						
2R10	Vol.	3	‡		See Note A5		2-6	3	See Note	B1				Kellogg plus '10, 81		5
							.02		See Note	B9						
MASTER																
Mighty Midget (50, 70)	Vol.	6	‡	6	See Note A5		2-2	1	See Note	B1				^{3}26, 24, 45, 80		11
424	Vol.	6	F12				2-2	1	See Note	B1				^{4}24, 45, 80		7
McMILLAN RADIO CO.																
8 (Two Types)	Vol.	5	K12				‡	3	See Note	B1				^{5}26, 27, ^{2}71A, 80		11
900 Series	Vol.	13	K12				1-2-3-5	3	See Note	B1				^{5}26, 27, ^{2}45, 80		11
MEISSNER																
8	Vol.	15	N.	6			8, 8, 8	3	RS213					^{2}6K7, 6A8, 6C5, 6H6,		
	Tone	22	UC501				10	15	TS101					6F5, 6F6, 5Z4	‡	1
	Sen.	7	J.													
METEOR—See Airking																
MID-WEST RADIO CORP.—"Miraco"																
AC6 '33 Model	Vol.	83	N.	6			4-4	25	CM170					55, 56, ^{2}58, 59, 80	450	1
AC6 Midget	Vol.	6	G7	6	2		8-8	1	See Note	B3				^{3}24, 27, 45, 80		3
	Tone	22	G12													
AC8 ('32)	Vol.	83	N.	6			8, 8	1	RS213					55, 56, 57, ^{2}58, ^{2}2A5, 80	450	1
	Tone	22	K12													
AC8 ('33)	Vol.	83	N.				8-8	1	CN152	B3				55, 56, 57, ^{2}58, ^{2}59, 80	456	1
	Tone	22	K12													
AC9 (1SG, 227 Type)	Vol.	7	‡		See Note A5		2-2-2	3	See Note	B3				24, ^{5}27, ^{2}45, 80		3
							.1		See Note	B9						
AC9-4SG	Vol.	6	G12				8, 8, 8	28	RS213					^{4}24, ^{3}27, ^{2}45, 80		3
	Tone	22	G12													
AC9 Pentode Super (2 Types)	Vol.	62	N.				8-8	4	See Note	B3				24, ^{2}27, ^{2}35, ^{2}47, 80	175	1
	Tone	22	N.		See Note A27											
	Tone	22	L.		See Note A4											
AC9 T.R.F.	Vol.	14	‡		See Note A5		4-2-2-1	3	See Note	B1				^{4}26, 27, ^{2}71A, 80		11
AC10	Vol.	6	G12				8-8	1	See Note	B3				^{5}24, ^{2}27, ^{2}45, 80	175	3
	Tone	44	G12													
AC11 '32	Vol.	‡	UC513				8-8	4	See Note	B3				^{2}35, ^{2}24, ^{4}27, ^{2}47, 80	175	3
	Tone	44	M.													
AC12	Vol.	45	N.				25	15	TS103	Additional Listing				55, ^{6}58, ^{3}42, 80	450	3
	Sen.	7	UC500				8-8	3	See Note	B3						
							25	15	TS103							
Battery 6 Super	Vol.	15	N.											^{2}30, ^{3}34, 19	456	
Battery 7 (2 Volt Model)	Vol.	10	M.											^{2}30, 31, ^{3}32		

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
MID-WEST—Continued																
Battery 8 (Super-2 Volt)	Vol.	76	M				24	12	See Note	B3				^{6}30, ^{2}34	‡	
	Tone	76	M													
"Imperial"	Vol.	‡	NN				16	3	RS216					^{6}6D6, ^{2}6C6, ^{3}76, 6B7,		
	Tone	‡	Order from	Mfr.			8	3	RS213					^{5}2A5, 5Z3	456	14
	Supp.	12	K12				10	15	CS124							
	Att.	‡	Order from	Mfr.			25	15	TS103							
Miraco 1SG-226	Vol.	25	DRP240				4-2-2-1-1	3	See Note	B1				24, ^{4}26, 27, ^{2}71, 80		11
Miraco 16 Tube ('32)	Vol.	15	N	6			4	1	HD681	B3				55, ^{2}56, 57, ^{7}58, 42, ^{2}46,		
	Tone	22	K12				8	1	HD683	B3				80, 82	150	1/7
	Supp.	7	UC500				4-4-8	3	See Note	B3						
							8	13	RS213							
Regal (1937)	Vol.	18	N				25	3	WE2545					^{5}6K7, ^{3}6C5, 6J7, ^{2}6H6,		
	Tone	‡	N				40	3	WE4045					6L7, ^{4}6N6, ^{2}80,		
							24	3	WE2545					^{2}2M2	456	1
							60	15	TS104							
							20	13	WE1847							
"Royale"	Vol.	64	N				16, 16	1	WE1647					^{5}6K7, ^{5}6C5, ^{2}6H6, 6J7,		
	Tone	133	L				16, 16	37	WE1647					^{8}6F6, ^{3}5Y3 or ^{3}5Z4	456	1/1
	Att.	‡	Order from	Mfr.												
SW5-36 (AC-DC)	Vol.	6	‡	6	See Note	A5	20-12-5	27/15	UR182	B221				6A8, 6K7, 75, 43,		
														25Z5	456	
Z4 Short Wave Converter							8-8	1	See Note	B3				24, 27, 80	‡	1
6DC (110 Volt)	Vol.	56	N											37, ^{2}78, 85, ^{2}43	175	
6-33	Vol.	83	N				4-4	1	CN150					^{2}58, 56, 55, 59, 80	450	1
6-34	Vol.	83	N				8, 8	1	RS213					^{2}58, 2A7, 2B7, 2A5, 80	450	1
	Tone	22	K12													
6-37	Vol.	18	N	6			20-12	27	RM257					6A7, 6D6, 75, 43,		
	Tone	147	N											25Z5	456	
6-37 (Auto)	Vol.	17	UM154-SS17	M26			8-8	1	CN152	B3	35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
	Tone	22	MR39				5-5	15	TN110							
							.025-.025		Buffer	B14						
7-36	Vol.	56	N				8, 8	25	RS213					^{3}58, 56, 55, 2A5, 80	456	1
	Tone	22	N													
7-36 (AC-DC)	Vol.	18	N	6			20	63	RS207					6A7, 6K7, 6H6, 6F5,		
	Tone	22	L				12-25-5-5	63/15	UR192/TN110	B223				43, ^{2}25Z5	450	
7-36 (Batt.)	Vol.	45	N				8-20	1	See Note	B3	13	245	C3	1C6, ^{2}34, ^{3}30, 19	465	10
	Tone	22	K12	6			.02		Buffer	B14						
7-36 (Metal Tube)	Vol.	56	N				8, 8	25	RS213					^{3}6K7, 6C5, 85, 42, 80	456	1
	Tone	22	N													
7-37	Vol.	18	N	6			8, 8	25	RS213					^{3}6K7, 6C5, 6Q7, 6F6,		
	Tone	22	K12											5Y3	456	1
7-37 (AC-DC)	Vol.	64	N	6			20	6	RN232	B8				6A8, 6K7, 6H6, 6F5,		
	Tone	22	N				10	15	TS101					25A6, ^{2}25Z6	456	
7-37 (Batt.)	Vol.	45	N				8	1	CS123		13	245	C3	6A7, ^{2}15, ^{2}76, 19, 6G5,	465	10
	Tone	22	K12	6			10	15	TS101							
							.02		Buffer	B14						
7-38 (AC-DC)	Vol.	18	MR48	M26			12-20	4	UR192					6A8, 6K7, 6Q7, 25B6,		
	Tone	147	MR48											25Z5	456	
8-'31 (Batt.)	Vol.	129	M				24	19	RS103	B3				^{2}32, ^{6}30	‡	
	Tone	129	M													
8-38 (AC-DC)	Vol.	18	MR48	M26			12-20	4	UR192					6A8, 6K7, 6Q7, 6G5,		
	Tone	147	MR48											25B6, 25Z5	456	
8-38 (Batt.)	Vol.	45	MR48	M26			8-8	1	CN152		13	245	C3	6D8, 6S7, ^{3}6L5, 6N5,		
	Tone	22	MR48				10	15	TS101					1J6	456	10
9-31 (3SG)	Vol.	7	K				6-2-4	3	See Note	B3				^{3}24, ^{3}27, ^{2}45, 80		3
	Tone	41	N													
9-32	Vol.	107	N				8-8	4	CM172	B3				^{2}35, 24, ^{3}27, ^{2}47, 80	175	3
	Tone	39	N													
9-34	Vol.	83	N				8, 8	1	RS213					55, 56, 57, ^{3}58, ^{2}2A5, 80	456	1
	Tone	22	K12													
	Sen.	7	UC500													
9-34 (RT9, G9, F9, H9)	Vol.	83	N				8, 8	1	RS213					^{3}58, 57, 56, 55, ^{2}2A5, 80	456	1
	Tone	45	K12				1	12	CS130	B3						
	Sen.	7	UC500													
9-38 (AC-DC)	Vol.	18	MR48	M26			20-12	4	UR192					6A8, 6K7, 6Q7, 6C5,		
	Tone	39	MR48											^{2}25B6, 25Z5	456	
10A-33-34	Vol.	45	N				8, 8	1	RS213					^{3}56, ^{4}58, ^{2}2A5, 80	456	1
	Tone	22	K12				1	12	CS130	B3						
	Sen.	7	UC500													
10-34	Vol.	83	N				8, 8	1	RS213					^{3}56, 57, ^{3}58, ^{2}2A5, 80	456	1
	Tone	22	K12				2	13	CS130	B3						
	Sen.	7	UC500				1	13	CS130	B3						
10-35	Vol.	45	N	6			8	1	RS213					^{3}56, ^{4}58, ^{2}2A5, 80	456	1
	Tone	22	K12				16	1	RS216							
	Sen.	7	UC500				1	12	CS130							
10-37	Vol.	18	N	7			20	12	RS207					^{2}6K7, 6A7, 85, ^{4}43,		
	Tone	44	L	6			25-12	6	UR182	B18				^{2}25Z5	456	
	Sen.	7	D													
10-38 (AC-DC)	Vol.	18	MR48	M26			20-12	4	UR192					6A8, 6K7, 6Q7, 6G5,		
	Tone	39	MR48											6C5, ^{2}25B6, 25Z5	456	
11-31	Vol.	107	N				8, 8	4	RS213					^{2}35, ^{2}24, ^{4}27, ^{2}47, 80	175	3
	Tone	149	M													
11-36	Vol.	45	N				16	1	WE1647					^{4}6K7, ^{2}6C5, 6H6, 6F6,		
	Tone	21	K12				8	1	WE847					5Z4	456	1
							2	14	CS130							
							12	15	TS101							
11-37	Vol.	18	N	6			24	1	WE2545					^{4}6K7, ^{3}6C5, 6H6, ^{2}6F6,		
	Tone	21	N				40	1	WE4045					5Z3	456	1
11-37 (AC-DC)	Vol.	64	N	6			25	1	WE2545					^{4}6K7, ^{3}6C5, 6H6,		
	Tone	21	N				40	1	WE4045					^{2}25B6G, 25Z6	456	
12-33	Vol.	83	N				8	3	RS213					^{6}58, 55, 57, ^{3}42, 80	450	3
	QAVC	7	UC500				8-8	3	RN245							
							5	15	TS105							
12-38 (AC)	Vol.	‡	MR48	M26			24	1	WE2545					^{3}6K7, 6L7, ^{2}6C5, 6H6,		
							40	1	WE4045					6J7, 6C8, ^{2}6V6, 80	456	1
							10	15	TS101							
12-38 (Batt.)	Vol.	‡	TM230-SS1				24	1	WE2545		13	245	C3	^{3}6S7, 6L7, ^{3}6L5, 6J7,		
14-37	Vol.	18	N	6			25	15	TS103					6H6, 6N5, ^{2}6K6	456	10
	Tone	21	N				16	25	RS216					^{4}6K7, 6H6, ^{3}6C5, ^{3}6F6,		
							20	25	WE1847					5Z3	456	1
							8	13	RS213							
							25	15	TS102							
14-37A	Vol.	64	N	6			24	1	WE2545					^{4}6K7, ^{4}6C5, 6H6, ^{4}6F6,		
	Tone	21	N				40	1	WE4045					5Z3	456	1
16-33	Vol.	18	N				4	3	HD681	B3				^{8}58, ^{2}56, 55, 42, ^{2}46, 80, 83	456	1/7
	Tone	22	K12				4	3	RS211	B3						
	Sen.	7	UC500				8	3	RS213	B3						
							25	15	TS102							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
MID-WEST—Continued																
16-34 (RT16, A16, B16, D16, PR16, RM16)	Vol.	15/22	MN				8, 8, 8	26	RS213					6D6, 6C6, [2]78, [2]6B7,		
	Tone	22	K12				25	19	TS107					[4]37, [4]45, 5Z3	456	7
	Supp.	‡	K12				10	19	TS106							
							12	15	TS101							
16-35 1935 Deluxe (J-16, L-16, M-16, S16), (EP16)	Vol.	‡	MN				8	3	RS213					[5]6D6, [3]76, 6B7, 2A5,		
	Tone	‡	Order from	Mfr.			16	3	RS216					[4]45, 6C6, 5Z3	456	3
							10	17	TS106							
							25	15	TS102							
							10	15	TS101							
16-37	Vol.	45	N				25	1	WE2545					[4]6K7, [4]6C5, 6H6, 6J7,		
	Tone	21	N				40	1	WE4045					[4]6N6, [2]80	456	1
16-38	Vol.	45	TM230-SS1				24	1	WE2545					[4]6K7, 6L7, [4]6C5, [2]6H6,		
							40	1	WE4045					6J7, [2]6V6, [2]80	456	1
							10	15	TS101							
18-36	Vol.	64	N				8	3	RS213					[5]6K7, [4]6C5, [2]6H6, [5]6F6,		
	Tone	132	N				16	3	RS216					[2]5Z4, or [2]5Y3	456	1
							2	13	CS121							
							8-25-25	15	CS123/ 2-TS103							
18-36A	Vol.	45	N				20	1	WE1847					[5]6K7, [3]6C5, [2]6H6, 6J7,		
	Tone	‡	N				40	1	WE4045					6L7, [4]6N6, [2]80	456	10
							8-25-25	13/15	CS123/ 2-TS103							
18-37	Vol.	45	N				25	1	WE2545					[5]6K7, [3]6C5, [2]6H6, 6J7,		
	Tone	‡	Order from	Mfr.			40	1	WE4045					6L7, [4]6N6, [2]80	456	1
							20	14	RN232	B8						
							60	15	TS108							
20-38	Vol.	45	500M No. 1		See Note A19		24	1	WE2545					[4]6K7, 6L7, [2]6H6, [5]6C5,		
							40	1	WE4045					6J7, 6R7, [4]6V6, [2]80	456	1
							10	15	TS101							
35-5-SW AC DC Super	Vol.	7	G	‡			12-20	6	UR182	B98				6A7, 6D6, 6C6, 12Z3.	465	
	Tone	22	L				5-5	15	TN110							
746M & 747M ('31-'32)	Vol.	6	E12		‡		8-8	4	See Note	B3				[2]24, [2]27, [2]35, 47, 80	175	1
MISSION BELL RADIO CO.																
4A	Vol.	96	UM133		See Note A96		10	15	TS106					[3]39, 38		
6A	Vol.	61	UM147		See Note A96									[3]39, 37, 24, 38		
10A	Vol.	15	UM147		See Note A96		4-4	1	See Note	B3	34	292	C3	36, [2]39, 84, 85, 41	252	10
							25	15	TS102							
							.02		Buffer	B14						
11, 12	Vol.	18	UM147		See Note A96		4-4	1	See Note	B3	34	292	C3	75, 77, [2]78, 42, 84	252	10
							25	15	TS102							
							.05		Buffer	B14						
14	Vol.	18	UM154		See Note A96		4-8	1	See Note	B3	34	292	C3	77, 78, 75, 42, 84	456	10
							25	15	TS102							
							.05		Buffer	B14						
16	Vol.	18	UM154	6	See Note A96		4-4	23	See Note	B3	34	292	C3	6A7, 6D6, 75, 41, 84.	465	10
							.02-.02		Buffer	B14						
17, 18	Vol.	15	MR48				6-6	4	CM172	B3	47	See Note	C6	[2]6K7, 6A8, 6R7, or		
	Tone	22	M				10	15	TS101					6H6 and 6C5, 6F6,		
							.006		Buffer	B14				84.	262	10
19, 19A	Vol.	15	UM154		See Note A96		4-8	1	See Note	B3	Order	from Mfr.		57, 58, Wunderlich, 41,		
							10	15	TS101					1V	252	
25A	Vol.	15	UM154		See Note A96		4-8	1	See Note	B3	34	292	C3	77, [2]78, 75, 42, 84	252	10
	Tone	22	L				25	15	TS102							
							.05		Buffer	B14						
35	Vol.	6	G12		EX300		4-4	4	See Note	B3				6D6, 76, 42, 80		1
40	Vol.	18	N	6			4-4	4	See Note	B3				2A7, 58, 2A6, 2A5,		
														80	456	1
40 All-Wave	Vol.	18	N	6			4-4	4	See Note	B3				2A7, 58, 2A6, 2A5, 80	465	1
41AW, 41 Skip Band	Vol.	18	N				4-4	4	See Note	B3				6A7, 6D6, 75, 42, 80	465	1
MONARCH																
L5	Vol.	18	N				P474	32	RS211					5Z4, 6F5, 6F6, 6H6,		
	Tone	34	L				P160	32	CN151	B81				6K7, 6L7, 6C5	456	1
							P304	15	TS101							
L6	Vol.	18	N	6			P474	32	RS211					5Z4, 6C5, [2]6F6, 6K7,		
	Tone	44	L				P160	32	CN151	B81				6L7, [2]6Q7	456	1
							P304	15	TS101							
L7	Vol.	45	N	7			P391	1	RN232		14	245C	C3	1C6, 19, [3]30, [2]34	456	10
	Tone	‡	L				.01-.01		Buffer	B14						
Z4	Vol.	45	SRP275	7			P391	1	RN232		14	245C	C3	1C6, 19, [2]30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275	7			P958	1	RN232		14	245C	C3	1C6, 19, [2]30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
A31	Vol.	18	N				8-4	4	See Note	B3				6A7, 6D6, 75, 42, 80.	456	1
54	Vol.	18	UM154		See Note A96		6-10	4	See Note	B3	35	294	C3	6A7, 6D6, 75, 42, 84.	456	10
							.02		Buffer	B14						
64	Vol.	18	UM154		See Note A96		6-10	4	See Note	B3	35	294	C3	[2]6D6, 6A7, 75, 42, 84.	456	10
							.02		Buffer	B14						
MONTGOMERY WARD & CO. (Airline)																
Note: The prefix "62-" or form of "62-" indicates Radio Division in Montgomery-Ward Catalog.																
Auto Radio	Vol.	45	N				4	15	TS101		1	206		36, 37, [3]39, 38	262	
Troubadour (32W)	Vol.	6	G7		3		8, 8, 8	31	RS213					[3]24, 27, [2]45, 80		1
AE10 (Two Types)	Vol.	60	E12		(Early)		1-1-2	3	See Note	B1				24, [5]26, 27, [2]45, 80		9
	Vol.	60/15	DRP243		(Late)											
AE11	Vol.	8	A400P				1-1.5-1-1	3/13	See Note	B1				[5]27, [2]71, 80		2
AE51, 52, 53, 54	Vol.	8	A400P				1-1.5-1-1	3/13	See Note	B1				[5]27, [2]71, 80		2
062	Vol.	45	N				4	15	TS101		1	206		36, 37, 38, [3]39	262	
7GM	Vol.	7/56	DRP314	6			44X10	23	WE1647					[2]6K7, 6B7, 76, 6F6, 80	456	1
	Tone	34	UC502				44X11	23	RS216							
13, 15, 16, 16X, 17, 18, 18X	Vol.	6	G12				4-8	1	CN151	B3				[2]24, 35, 47, 80	262	1
17 ('31) "Turret Cond."	Vol.	59	SRP273				927	4	See Note	B1				[3]24, [2]35, [2]47, 27, 80	175	3
							928	4	See Note	B1						
							972	14	See Note	B1						
20W	Vol.	6	G7				8-8	25	See Note	B3				[2]24, 71A, 80		2
22	Vol.	6	G7				8	3	RS213					[3]24, [2]27, [2]45, 80	‡	1
	Tone	22	‡		See Note A5		8-6	3	CN152							
26P, 26PX	Vol.	6	G7		3		2678	1	RS213					[3]24, 45, 80		1
	Tone	22	UC502													
26W	Vol.	6	G7		3		8, 8	1	RS213					[3]24, 45, 80		1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
MONTGOMERY WARD & CO.—Continued																
Note: The prefix "62-" or form of "62-" indicates Radio Division in Montgomery-Ward Catalog.																
27W, 27WX (1500, 15000, Collegian)	Vol.	6	G7		3		8-8	1	CN152	B3				^{2}24, 27, 45, 80		1
	Tone	22	K12													
49	Vol.	6	G7											^{2}24, 26, 01A, 71A		
62	Vol.	45	N				4	15	TS101		1	206		36, 37, 38, ^{3}39	262	
77	Vol.	97	TRP602				4	12	See Note	B3				30, 32, ^{2}34, 19	175	
87	Vol.	17	N				P80936	25/19	RM262/TS102	B126	34	292	C12	75, 77, ^{2}78, 41, 84	262	10
							P80937	14/15	RN231	B127						
95	Vol.	97	TRP602				4	12	See Note	B3				30, 32, ^{2}34, 19	175	
102	Vol.	17	UM154	M26		A96	P103-2	4	RM262		37	296	C3	6D6, 6C6, 78, 75, 42, 84		
							20	15	TS102						175	10
							.02		Buffer	B14						
123 (Series 7D)	Vol.	56	N	6			P80916	23	WE847					^{3}6D6, 6B7, 76, 42, 80	456	1
	Tone	22	UC502				P81043	23	WE1647	B10						
							P81032	23	WE847							
							P81042	23	WE1647	B10						
131 (7D), 133 (7D), 142 (7D), 144 (7D)	Vol.	56	N	6			P80916	23	WE847					^{3}6D6, 6B7, 76, 42, 80	456	1
	Tone	22	UC502				P81043	23	WE1647	B10						
							P81032	23	WE847							
							P81042	23	WE1647	B10						
181	Vol.	7	D				1-1-1	3	See Note	B1				^{2}24A, ^{2}27, ^{2}45, 80		1
	Tone	41	O													
187	Vol.	7	D	(1st	Type)		1-2-3	26	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80		1
	Vol.	6	D7	(2nd	Type)	A4	.53		See Note	B9						
500 Dictator	Vol.	8	A400P				1-1.5-1-2	3	See Note	B1				^{2}24, ^{2}27, ^{2}45, 80		3
							.1		See Note	B9						
811 Solo (62-1711)	Vol.	7	F		1		8, 8	23	RS213					^{2}24, 27, ^{2}35, 47, 80	175	3
	Tone	95	O	6												
839, 921, 923, 924	Vol.	12	K12	13										^{2}22, ^{2}12A, 71A		
1111 Fantasy (62-1611)	Vol.	7	F		1		8-8	23	RS213					^{2}24, 27, ^{2}35, 47, 80	175	3
	Tone	95	O	6												
1238, 1238X	Vol.	15	O				2803	1	CN152					^{2}27, ^{3}35, 47, 80	262	3
	Tone	34	UC502				2852	19	CS123							
1355 Minstrel (62-1955)	Vol.	15	O				2803	1	CN152					^{3}27, ^{3}35, ^{2}47, 80	262	3
	Tone	44	UC502				2719	13	CS133							
							2852	15	CS123							
1522 (12A or 01A Det.)	Vol.	6	G12		See Note	A32								^{2}24, ^{2}12A-01A, 71A		
1522 ('26 Det.)	Vol.	6	G12		See Note	A32								^{2}24, 26, 01A, 71A		
1562 (12A or 01A Det.)	Vol.	6	G12											^{2}01A, ^{2}24, 12A, 71A		
	Tone	21	O													
1562 ('26 Det.)	Vol.	6	G12		See Note	A32								^{2}24, 26, ^{2}01A, 71A		
	Tone	21	O													
1922	Vol.	6	G12											^{3}36, 01A, 12A		
	Tone	21	O													
2655	Vol.	1/15	DRP243				‡	‡	See Note	B4				24, ^{5}26, 27, ^{2}45, 80		11
2822, 2827 (Balboa), 2895, 2897 (DeSoto)	Vol.	8	A400P				1-1.5-1-2	3	See Note	B1				^{2}24, ^{2}27, ^{2}45, 80		3
	Tone	41	N				.1		See Note	B9						
2955, 2955X, 2957, 2957X	Vol.	24	GG				2.5-4-2	28	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	41	O													
3035, 3037, 3065, 3067	Vol.	6	G7				8, 8, 8	28	RS213					^{3}24^{2}27, ^{2}45, 80		1
	Tone	41	N													
10,000 Serenader	Vol.	8	A400P				1-1.5-1-2	3	See Note	B1				^{2}24, ^{2}27, ^{2}45, 80		3
							.1		See Note	B9						
11,000 Challenger (2 Types)	Vol.	6	G7		3		1-1	1	See Note	B1				^{3}24, 27, ^{2}45, 80		1
	Tone	41	O													
14,000 Commander, 62,000 Cavalier	Vol.	6	F7		3		8, 8, 8	28	RS213					^{3}24, ^{2}27, ^{2}45, 80		1
	Tone	41	N													
62-010	Vol.	8	Y25MP				1.5-1.5-.5	3	See Note	B1				^{3}24, ^{2}45, 80		1
							.6		See Note	B9						
62,020 (51)	Vol.	8	Y25MP				1.5-1.5-1.5	3	See Note	B3				^{3}24, ^{2}27, ^{2}45, 80		3
62-030	Vol.	6	G7		3		8, 8, 8	28	RS213	B3				^{3}24, 27, ^{2}45, 80		1
62-040 Commodore	Vol.	7	D				1-1-1	26	See Note	B7				^{3}24, ^{2}27, ^{2}45, 80		1
62-055	Vol.	6	G7	6	2									^{2}24, 26, ^{2}01A, 71A, or		
	Tone	21	O											36, 01A, 12A		
62-060 Challenger, Jr., 62-070 Princess (1800)	Vol.	6	G7	6	3		8, 8	1	RS213	B3				^{3}24, 45, 80		1
62-078	Vol.	6	H7	6	3		8-8	4	See Note	B3				^{2}57, 35, 47, 80		1
62-080	Vol.	6	G7				8	3	RS213					^{3}24, ^{2}45, 27, 80	‡	1
	Tone	22	‡		See Note	A5	8-6	3	CN152							
62-090	Vol.	6	G7				8	3	RS213					^{3}24, 27, ^{2}45, 80	‡	1
	Tone	22	‡		See Note	A5	8-6	3	CN152							
62-1, 62-2	Vol.	15	L	6			8, 8	25	RS213					^{3}27, ^{2}35, ^{2}47, 80	175	3
	Tone	44	L													
62-7, 62-8	Vol.	7	H	6			8, 8	4	RS213	B3				24, 27, 47, 80, ^{2}35	175	3
	Tone	22	Y													
62-9	Vol.	7	H	6			8, 8	4	RS213	B3				24, ^{2}27, ^{2}35, ^{2}47, 80	175	3
	Tone	22	L													
62-11, 62-12, 62-14 (1st Type)	Vol.	8	A5MP				4-2-6	30	See Note	B3				^{2}24, 27, ^{3}35, 47, 80	175	1
	Tone	34	UC502				4	19	CS121							
62-11, 62-14 (2nd Type)	Vol.	14	N				4-2-4	30	See Note	B3				^{2}24, 27, ^{3}35, 47, 80	175	3
	Tone	34	UC502				4	19	CS121							
62-16	Vol.	13	O	6			62-A12	4	RS213	B3				24, ^{4}27, ^{2}35, ^{2}47, 80	175	3
	Tone	22	L													
62-19 (1st Type)	Vol.	8	Y5MP				4-2-6	30	See Note	B3				^{2}24, 27, ^{3}35, 47, 80	175	3
	Tone	34	UC502				4	19	CS121							
62-19 (2nd Type)	Vol.	14	N				4-2-6	30	See Note	B3				^{2}24, 27, ^{3}35, 47, 80	175	3
	Tone	34	UC502				4	19	CS121							
62-20, 62-20X	Vol.	59	SRP272				8, 8	43	RS213					^{3}24, 27, ^{2}35, 47, 80	175	7
	Tone	34	UC502				4	13	CS121	B3						
62-21, 62-22	Vol.	15	N				4-2-4	28	See Note	B3				24, 27, ^{2}35, 47, 80	262	3
	Tone	22	UC502													
	Sen.	42	Y200MP													
62-23	Vol.	2/10	DRP241				4	12	CS121	B3				^{4}32, 33	175	
62-25	Vol.	59	SRP272				8, 8	43	RS213					^{3}24, 27, ^{2}35, 47, 80	175	7
	Tone	34	UC502				4	13	CS121	B3						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
MONTGOMERY WARD & CO.—Continued																
Note: The prefix "62-" or form of "62-" indicates				Radio	Divis	ion in	Montgomery-	Ward	Catalog.							
62-26	Vol.	15	O				8-8	1	CN152	B3				^{3}27,^{3}35, 47, 80	262	3
	Tone	34	UC502				8	19	CS123	B3						
62-27 (1st Type)	Vol.	8	A5MP				4-2-4	30	See Note	B3				^{2}24, 27,^{3}35, 47, 80	175	3
	Tone	34	UC502				4	19	CS121	B3						
62-27 (2nd Type)	Vol.	14	N				4-2-6	30	See Note	B3				^{2}24, 27,^{3}35, 47, 80	175	3
	Tone	34	UC502				4	19	CS121							
62-29 (1st Type) (Models 11, 12, 16 and 33)	Vol.	7	H				928	1	RS213	B3				^{2}24,^{2}35, 47, 80	175	1
	Tone	22	Y200MP				929	1	RS213	B3						
62-29 (11, 12 2nd Type)	Vol.	15	N				928	1	RS213	B3				^{2}24, 27,^{3}35, 47, 80	175	1
	Tone	22	Y200MP				929	1	RS213	B3						
62-30	Vol.	15	N				4-2-4	28	See Note	B3				^{2}24, 27,^{3}35, 47, 80	262	3
	Tone	22	UC502													
	Sen.	7	Y200MP													
62-34 (Washington)	Vol.	15	O				8-8	1	CN152	B3				^{3}35,^{2}27, 47, 80	262	3
	Tone	22	UC502				8	19	CS123	B3						
62-35	Vol.	15	N				928	1	RS213	B3				^{2}24, 27,^{2}35, 47, 80	175	1
	Tone	22	Y200MP				929	1	RS213	B3						
62-36	Vol.	15	O				8-8	1	CN152	B3				^{3}35,^{2}27, 47, 80	262	3
	Tone	22	UC502				8	19	CS123	B3						
62-38, 62-40, 62-38X, 62-40X	Vol.	15	O				8-8	1	See Note	B3				^{2}27,^{4}35,^{2}47, 80	262	3
	Tone	41	M				8	19	CS123	B3						
							8	14	CS123	B3						
							4	12	CS121							
62-41	Vol.	45	N											^{6}30,^{3}34	175	
	Tone	22	UC502													
62-42	Vol.	15	N				4-2-4	28	See Note	B3				^{2}24, 27,^{2}35, 47, 80	262	3
	Tone	22	UC502													
	Sen.	42	Y200MP													
62-43, 62-43X	Vol.	6	H7	6	3		8-8	4	See Note	B3				35,^{2}57, 47, 80	262	1
62-PC43	Vol.	6	E12	6	EX200		SW4319	4	CM170					56, 57, 58, 47, 80	‡	1
62-44	Vol.	15	O				8-8	1	See Note	B3				^{2}27,^{2}35, 47, 80	262	3
	Tone	41	M				8	19	CS123	B3						
							8	14	CS123	B3						
62-45	Vol.	6	G7				8-8	1	See Note	B3				^{2}56, 57,^{2}58, 47, 80	455	3
	Tone	34	Y200MP				8	19	TS106							
62-46	Vol.	15	O				8-8	1	CN152					^{3}35,^{2}27, 47, 80	262	3
	Tone	34	UC502				8	19	CS123							
62-47	Vol.	6	G7				8-8	1	See Note	B3				^{2}56, 57,^{2}58, 47, 80	455	3
	Tone	34	Y200MP				8	19	TS106							
62-49	Vol.	15	M				8-8-8	28	RS213	B3				56,^{2}57,^{2}58,^{3}46, 80	262	7
	Tone	22	L				4	19	TS105							
	Supp.	7	F													
62-50, 62-50X	Vol.	15	O				8-8	1	CN152	B3				^{2}27,^{4}35,^{2}47, 80	262	3
	Tone	41	Y200MP				8	13	CS123	B3						
							8	14	CS123	B3						
62-51	Vol.	45	Z12				8	30	HD682					^{3}56,^{2}57,^{4}58,^{2}46, 82	175	3
	Tone	41	UC502				8	30	RS213							
	Supp.	8	E				4	30	RS211							
							4	19	CS121							
62-52	Vol.	15	N				4-2-6	30	See Note	B3				^{2}24,^{2}27,^{3}35,^{2}47, 80	175	1
	Tone	21	O				4	14	CS121							
62-53	Vol.	59	SRP271				8-8	23	CM172	B3				^{3}57,^{2}58, 47, 80	175	7
	Tone	34	UC502				4	14	CS121	B3						
62-PC55	Vol.	56	O	6			8-4	4	CM171					55, 56,^{2}58, 47, 80	465	1
	Tone	22	L													
62-57	Vol.	6	H7	6	3		8-8	4	See Note	B3				^{2}57, 35, 47, 80	262	1
62-64, 62-64X	Vol.	45	Z12				8	30	HD682					^{3}56,^{2}57,^{4}58,^{2}46, 82	175	3
	Tone	41	UC502				8	30	RS213							
	Supp.	8	E				4	30	RS211							
							4	19	CS121							
62-PC64	Vol.	45	N				PC642	7	RM262	B3				^{4}56,^{3}58,^{2}57,^{3}46, 82	175	3
	Tone	22	L				PC643	7	RM261	B3						
	Supp.	8	Y100MP				PC6442	15	TS101							
62-67	Vol.	17	N				8-8	1	RN242	B3				55, 56, 57,^{2}58, 47, 80	175	1
	Tone	22	K12													
62-68, 62-68X	Vol.	15	M				8-8	28	RN242	B3				56,^{2}57,^{2}58,^{3}46, 80	262	7
	Tone	22	L				8	28	RS213	B3						
	Supp.	7	F				4	19	TS105							
62-PC68	Vol.	15	L	6			8, 8, 8	3	RS213					55, 56, 57,^{2}58,^{3}46, 82	175	3
	Tone	22	L													
	Sen.	7	H													
62-69	Vol.	15	M				8-8	28	RN242	B3				^{3}56,^{3}46,^{3}58, 80	262	7
	Tone	22	K12				8	28	RS213	B3						
							8-8	13/19	UR180							
62-70, 62-70X	Vol.	6	G7				8-8	1	CN152					^{2}56, 57,^{2}58, 47, 80	455	3
	Tone	34	M				8	19	TS106							
62-71	Vol.	59	SRP271				8-8	23	CM172	B3				^{3}57,^{2}58, 47, 80	175	7
	Tone	34	UC502				4	14	CS121							
62-72, 62-72X	Vol.	6	G7				8-8	1	CN152					^{2}56, 57,^{2}58, 47, 80	455	3
	Tone	34	M				8	19	TS106							
62-74, 62-74X	Vol.	59	SRP271				8-8	23	CM172					^{3}57,^{2}58, 47, 80	175	7
	Tone	34	UC502				4	14	CS121							
62-75	Vol.	45	N				4	12	CS121					^{6}30,^{3}34	175	
	Tone	22	UC502													
62-76	Vol.	15	N				12-4-4	30	See Note	B3				^{2}56,^{2}57,^{3}58,^{2}47, 80	175	1
	Tone	21	O				4	13	See Note	B3						
62-79	Vol.	15	M				8-8	28	RN242	B3				^{3}56,^{3}58,^{3}46, 80	262	7
	Tone	22	K12				8	28	RS213	B3						
							8	13/19	UR180							
62-80	Vol.	17	N				8-8	1	RN242	B3				55, 56, 57,^{2}58, 47, 80	175	1
	Tone	22	K12													
62-81	Vol.	40	Y				8-8	1	CN152					^{2}57, 47, 80	455	1
							4	19	TS105							
62-82	Vol.	17	N				8-8	1	CN152					55, 57, 58, 47, 80	175	1
62-83	Vol.	15	N				4	13	CS121					^{2}36,^{3}39,^{2}41	175	
	Tone	22	K12													
62-84, 62-84X	Vol.	15	M				8-8	28	RN242	B3				^{3}56,^{3}58,^{3}46, 80	262	7
	Tone	22	K12				8	28	RS213	B3						
							8-8	13/19	UR180							
62-86, 62-86X	Vol.	15	‡		See No	te A19	4-8-8	3	See Note	B3				^{3}58,^{3}56,^{2}57,^{3}46, 82	262	7
	Tone	22	N				8	18	TS106							
	Supp.	‡	DRP316													
62-88	Vol.	15	M				8-8-8	28	See Note	B3				57,^{2}58, 56,^{3}46, 80	262	7
	Tone	22	L				4	19	TS105							
	Supp.	7	F													
62-89	Vol.	17	P	6			P80984	2/13	CN155/CN142	B120				55,^{3}56,^{4}58,^{3}45, 82	175	21
	Tone	41	UC504													

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MONTGOMERY WARD & CO.—Continued

Note: The prefix "62-" or form of "62-" indicates Radio Division in Montgomery-Ward Catalog.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
62-90	Vol.	6	G7				8-8	1	See Note	B3				^{2}56, 57,^{2}58, 47, 80	455	3
	Tone	34	M				8	19	TS106							
62-91	Vol.	17	O				P80988	12	CS121					^{6}30,^{3}34	175	
	Tone	44	UC502													
62-92	Vol.	6	H7	6	3		8-8	4	See Note	B3				^{2}57, 35, 47, 80	262	1
62-93	Vol.	15	O				P80989	12	CS123					^{3}6D6, 6C6, 37,^{2}41	175	
	Tone	34	K12													
62-94, 62-94X	Vol.	15	M				8-8	28	RN242	B3				^{3}56,^{3}58,^{3}46, 80	262	7
	Tone	22	K12				8	28	RS213	B3						
							8	13/19	UR180							
62-96	Vol.	6	G7	6	3		P80944	11	UR182	B31				^{2}77, 78, 43, 25Z5	262	
							P80788C	20	CS121							
							P80936C	15	TS105							
62-97, 62-97X	Vol.	17	N				8-8	1	CN152					55, 56,^{3}58, 2A5, 80	262	1
	Tone	22	K12				8	15	TS101							
62-98	Vol.	6	G7	6	3		P80944	11	UR182	B31				^{2}77, 78, 43, 25Z5	262	
							P80878C	12	CS121							
							P80936C	15	TS105							
62-99, 62-99X	Vol.	17	N				8-8	1	CN152					55, 56,^{3}58, 2A5, 80	262	1
	Tone	22	K12				8	15	TS101							
62-100	Vol.	6	G7				8	3	RS213					^{3}24, 27,^{2}45, 80	‡	1
	Tone	22	‡		See Note A5		8-6	3	CN152							
62-101, 62-101X	Vol.	15	N	6			8-8-4	28	CM175	B3				^{3}58,^{4}56,^{2}45, 80	262	1
	Tone	41	N													
62-103	Vol.	15	O	6			P80916	25	WE847					^{2}6D6, 6C6,^{2}37, 42, 80	175	1
	Tone	22	UC502				P80990	25	RS216							
							8	15	TS101	B10						
62-104	Vol.	6	H7	6	3		P80944E	11	UR182	B31				6C6,^{2}6D6, 43, 25Z5	262	
62-105	Vol.	15	O	6			P80916	25	WE847					^{2}6D6, 6C6,^{3}37, 42, 80	175	1
	Tone	22	UC502				P80990	25	RS216							
							8	15	TS101	B10						
62-106, 62-107	Vol.	15	P	‡			16	2	CN152	B3				^{3}56,^{4}58,^{2}45, 80	175	1
	Tone	41	‡		See Note A5		8	2	CS133	B3						
62-114, 62-116	Vol.	64	O				P81014	40	2-CS126					^{3}34,^{3}30, 19	175	
62-118	Vol.	18	UC511	6			81028	1	SR601		20	253	C3	75, 77,^{2}78, 41, 84	262.5	10
	Tone	22	UC502				81021	15	TN111							
							.01		Buffer	B14						
62-120	Vol.	97	TRP602				P80963	12	CS121					30, 32,^{2}34, 19	175	
62-121	Vol.	15	P	‡			16	2	CN152	B3				^{3}56,^{4}58,^{2}45, 80	175	1
	Tone	41	‡		See Note A5		8	2	CS133	B3						
62-122	Vol.	97	TRP602				80968	12	CS121					30, 32,^{2}34, 19	175	
62-124	Vol.	15	P				P82001	12/13	CN141					^{4}30,^{4}34, 19	456	
	Tone	44	K12													
62-126, 62-128	Vol.	97	TRP602				80963	12	CS121					30, 32,^{2}34, 19	175	
62-129	Vol.	15	P				P82001	12/13	CN141					^{4}30,^{4}34, 19	456	
	Tone	44	K12													
62-130	Vol.	17	N	6			C550	4	CM172		3	220B	C3	^{2}6D6, 6A7, 75, 89, 6Z4	175	10
62-132	Vol.	15	P	6			P81039	2	RS216					^{4}6D6,^{3}76,^{2}45, 80	456	3
	Tone	41	UC504				81018	2/13	CM173							
62-134, 62-134X	Vol.	15	P	6			P81058	48	WE1647					^{4}6D6,^{3}76,^{3}42,^{2}80	456	1
	Tone	21	UC502				P81039	48	RS216							
							P81056	48	CN141							
							P82000	48	Order from	Mfr.						
62-135, 62-135X	Vol.	18	N	6			P103-4	4	WE1647					57, 27, 58, 2A6, 2A5, 80	370	1
							P103-3	4	RS216							
62-136	Vol.	56	N				P81016	23	CM172		20	F253	C3	6F7, 6D6, 6B7, 12A5,		
	Tone	34	UC502				.015		Buffer	B14				^{2}12Z3	175	10
62-137	Vol.	15	P	6			P81039	2	RS216					^{4}6D6,^{3}76,^{2}45, 80	456	3
	Tone	41	UC504				81018	2/13	CM173							
62-138	Vol.	56	N				P81016	23	CM172		20	F253	C3	6F7, 6D6, 6B7, 12A5,		
	Tone	34	UC502				.015		Buffer	B14				^{2}12Z3	175	10
62-139, 62-139X	Vol.	15	P	6			P81058	48	WE1647					^{4}6D6,^{3}76,^{3}42,^{2}80	456	1
	Tone	21	UC502				P81039	48	RS216							
							P81056	48	CN141							
							P82000	48	Order from	Mfr.						
62-140, 62-140X	Vol.	6	Z12	6	EX100		BE119-6	4	RM262	B37				^{2}57, 58, 2A5, 80	175	1
62-147 Series "A"	Vol.	18	N	6			P119-11	1/15	CM173	B75				6F7, 6D6, 75, 42, 80	370	1
62-147, 62-147X Series "B" & "C"	Vol.	18	N	6			P103-6	4	RS213					6F7, 6D6, 75, 42, 80	370/465	1
							P103-7	4	RS213							
62-148, 62-148X	Vol.	6	Z12	6	EX100		BE119-6	4	RM262	B37				^{2}57, 58, 2A5, 80	175	1
62-150, 62-154, 62-150X, 62-154X	Vol.	18	N	6			P103-4	4	WE1647					27, 58, 2A6, 2A5, 80	370	1
							P103-3	4	RS216							
62-156, 62-164, 62-156X, 62-164X Series "A"	Vol.	18	N	6			P119-11	1/15	CM173	B75				6F7, 6D6, 75, 42, 80	370	1
62-156, 62-156X, 62-164, 62-164X Series "B" & "C"	Vol.	18	N	6			P103-6	4	RS213					6F7, 6D6, 75, 42, 80	465	1
							P103-7	4	RS213							
62-166	Vol.	17	P	6			P45X204	1	CN152		20	253	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	M				P45X203	15	TN111							
							.01		Buffer	B14						
62-169	Vol.	97	TRP601											1A6,^{2}32, 33	465	
	Batt.	29	C6P													
62-171	Vol.	97	TRP601											1A6,^{2}32, 33	465	
	Batt.	29	C6P													
62-173, 62-175, 62-176, 62-177	Vol.	56	N	6			44X10	23	RS216					^{3}6D6, 6B7, 76, 42, 80	456	1
	Tone	34	UC502				44X11	23	RS216							
62-178	Vol.	97	TRP617	14			4	12	CS121					30, 32,^{2}34, 19	175	
62-179	Vol.	7/15	DRP315	6		A59	44X10	4	RS216					^{3}76,^{4}6K7,^{2}45, 80	456	16
	Tone	65	UC504				44X11	4	RS216							
							44X18	13	RS201							
62-181 (Battery Super)	Vol.	6	TRP617	14			4	12	CS121					30, 32,^{2}34, 19	175	
62-181 "Sovereign"	Vol.	7	D				1-1-1	26	See Note	B1				^{3}24,^{2}27,^{2}45, 80		1
	Tone	41	O													
62-185, 62-187	Vol.	7/56	DRP314	6		A59	44X10	23	RS216					76,^{3}6K7, 6B7, 6F6, 80	456	1
	Tone	34	UC502				44X11	23	RS216							
62-188	Vol.	56	N	6			44X10	23	RS216					^{3}6D6, 6B7, 76, 42, 80	456	1
	Tone	34	UC502				44X11	23	RS216							
62-189	Vol.	6	TRP617	14			4	12	CS121					30, 32,^{2}34, 19	175	
62-190	Vol.	7/56	DRP314	6		A59	44X10	23	RS216					76,^{3}6K7, 6B7, 6F6, 80	456	1
	Tone	34	UC502				44X11	23	RS216							
62-192	Vol.	7/15	DRP315				44X21	25	WE1847					^{4}6K7, ^{3}76, ^{3}6F6, ^{2}80	456	1
	Tone	21	UC504				44X11	25	RS216							
							44X20	19	Order from	Mfr.						
62-193	Vol.	56	N	6			44X10	23	RS216					^{3}6D6, 76, 6B7, 42, 80	456	1
	Tone	34	UC502				44X11	23	RS216							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
MONTGOMERY WARD & CO.—Continued																
Note: The prefix "62-" or form of "62-" indicates Radio Division in Montgomery-Ward Catalog.																
62-194	Vol.	7/15	DRP315	6		A59	44X10	4	RS216					^{2}76,^{4}6K7,^{2}45, 80	456	16
	Tone	65	UC504				44X11	4	RS216							
							44X18	13	RS201							
62-195	Vol.	7/15	DRP315				44X21	25	WE1847					^{4}6K7, ^{3}76, ^{3}6F6, ^{2}80	456	1
	Tone	21	UC504				44X11	25	RS216							
							44X20	19	Order from	Mfr.						
62-196	Vol.	7/56	DRP314	6		A59	44X10	23	RS216					76,^{3}6K7, 6B7, 6F6, 80	456	1
	Tone	34	UC502				44X11	23	RS216							
62-197	Vol.	‡	Order from	Mfr.			30	3	WE3540					^{4}6K7, ^{3}76, 6F7, 6B7,		
	Tone	21	O				60	19	RS208					45,^{4}2A3,^{2}5Z3	456	16
							4-16-4	13/19	UR193							
62-199	Vol.	17	UM163	M26	See Note	A96	P82002	1/15	CM173	B75	32	286S	C3	^{2}6D6, 6C6, 75, 41	175	10
							.007		Buffer	B14						
62-202	Vol.	17	UM163	M26		A96	4-5-8	25	CM171/TS101		20	253	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
							.0075		Buffer	B14						
62-203, 62-205	Vol.	45	O	13			44X17	12	RS207					1C6,^{3}34,^{2}30, 19	456	
	Tone	44	UC502													
62-206	Vol.	7/15	DRP315	6		A59	44X10	4	RS216					^{3}76,^{4}6K7,^{2}45, 80	456	16
	Tone	65	UC504				44X11	4	RS216							
							44X18	13	RS201							
62-207	Vol.	15	P	14			45X46	12	CN141					^{4}34,^{4}30, 19	456	
	Tone	44	UC502													
62-208	Vol.	45	O	13			44X17	12	RS207					1C6,^{3}34,^{2}30, 19	456	
	Tone	44	UC502													
62-209	Vol.	15	P	14			45X46	12	CN141					^{4}34,^{4}30, 19	456	
	Tone	44	UC502													
62-211	Vol.	6	TRP617	14			P45X28	12	CS121					30, 32,^{2}34, 19	175	
62-212	Vol.	45	O	13			44X17	12	RS207					1C6,^{2}30,^{3}34, 19	456	
	Tone	44	UC502													
62-215	Vol.	15	O	7			44X17	13	RS207					^{3}34, 1C6,^{2}30, 19	456	MG
	Tone	44	UC502													
62-216	Vol.	7/15	DRP315	6		A59	44X10	4	RS216					^{3}76,^{4}6K7,^{2}45, 80	456	16
	Tone	65	UC504				44X11	4	RS216							
							44X18	13	RS201							
62-217	Vol.	45	O	13			44X17	12	RS207					1C6,^{3}34,^{2}30, 19	456	
	Tone	44	UC502													
62-218	Vol.	7/15	DRP315	6		A59	44X10	4	RS216					^{3}76,^{4}6K7,^{2}45, 80	456	16
	Tone	65	UC504				44X11	4	RS216							
							44X18	13	RS201							
62-219	Vol.	45	O	13			44X17	12	RS207					1C6,^{3}34,^{2}30, 19	456	
	Tone	44	UC502													
62-221	Vol.	15	P	14			45X46	12	CN141					^{4}34,^{4}30, 19	456	
	Tone	44	UC502													
62-226, 62-228	Vol.	17	TRP613	6			44X10	23	RS216					^{3}6K7, 6C5, 6Q7, 6F6,		
	Tone	34	Order from	Mfr.			44X11	23	RS216					5Z4MG, 6G5	456	1
							44X209	15	TS101							
62-229 (32 Volt DC)	Vol.	18	N	6			P44X25	1	WE3540					^{2}6D6, 6A7, 85, 43, 6A6	175	
	Tone	44	Z12				P45X207	15	TS101							
62-230 (2 Volt Wet Battery)	Vol.	56	O	6			BE119-22	19	TS101					1A6, 34, 30, 32, 950	465	
62-232	Vol.	6	G7		3		8, 8, 8	28	RS213					^{3}24, 27,^{2}45, 80		1
62-233	Vol.	56	O				103-6	4	RS213					6A7, 6D6, 6B7, 42, 80	465	1
							103-7	4	RS213							
62-235	Vol.	18	N	6			P103-6	4	RS213					6F7, 6K7, 75, 6F6, 80	465	1
							P103-7	4	RS213							
62-236	Vol.	18	UM154	M26		A96	5-8	4	CM171		20	253	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	UC502				.0075		Buffer	B14						
62-240 (2 Volt Dry Battery)	Vol.	56	O	6			BE119-22	19	TS101					1A6, 34, 30, 32, 19	465	
62-242	Vol.	17	UM163	M26		A96	5-8-4	4/15	CM171/TS105		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	UC502				.0075		Buffer	B14						
62-248	Vol.	18	N	6			P103-6	4	RS213					6F7, 6K7, 75, 6F6,		
							P103-7	4	RS213					80	465	1
62-249	Vol.	18	O	6			BE103-6	23	RS213					6L7, 6C5, 6K7, 6Q7,		
	Tone	22	K12				BE103-7	23	RS213					6F6, 5W4, 6G5	465	1
62-251	Vol.	62	M	6			BE103-11	12	RS203					1A6, 1A4,^{2}30,^{2}34, 19	465	
	Tone	21	M													
62-254	Vol.	18	O				45X212	12	CS121					1A6, 34, 1B5, 1F4	456	
62-255	Vol.	62	M	6			BE103-11	12	RS203					1A6, 1A4, 30, 34, 19	465	
	Tone	21	M													
62-259	Vol.	17	TRP613	6			44X10	23	RS216					^{3}6K7, 6C5, 6Q7, 6F6,		
	Tone	34	Order from	Mfr.			44X11	23	RS216					6G5, 5Z4MG	456	1
							44X209	15	TS101							
62-261	Vol.	62	TRP613	6			44X10	25	RS216					^{4}6K7,^{3}6C5, 6G5,^{2}6F6,		
	Tone	65	Order from	Mfr.			44X11	25	RS216					5Z4MG	456	1
							44X213	13/15	CS121/TS101							
62-267	Vol.	18	MR48	M26			12	23	RS215					6J7, 6K7, 6Q7, 6C5,		
	Tone	22	Order from	Mfr.			16	23	RS216					6F6, 5W4	456	1
62-274	Vol.	18	MR53	M26			119-47B	23	CM172					6A8G, 6K7, 6Q7G,		
														6U5, 6K6G, 5Y3G	465	1
62-277	Vol.	18	MR48	M26			12	23	RS215					6J7, 6K7, 6Q7, 6C5,		
	Tone	22	Order from	Mfr.			16	23	RS216					6G5, 6F6, 5W4	456	1
62-288, 62-290	Vol.	18	MR53	M26			119-47B	23	CM172					6A8G, 6K7, 6Q7G,		
														6U5, 6K6G, 5Y3G	465	1
62-307	Vol.	18	O	6			P103-6	23	RS213					6L7, 6C5, 6K7, 6Q7,		
	Tone	22	K12				P103-7	23	RS213					6F6, 5W4, 6G5	465	1
62-308	Vol.	17	TRP613	6			44X10	23	RS216					^{3}6K7, 6C5, 6Q7, 6F6,		
	Tone	34	Order from	Mfr.			44X11	23	RS216					5Z4MG, 6G5	456	1
							44X209	15	TS101							
62-310	Vol.	64	TM248-SS1	M23			4	12	CS121	B3				^{6}30, 32,^{3}34	456	
	Tone	44	Order from	Mfr.												
62-311	Vol.	62	TRP613	6			44X10	25	RS216					^{4}6K7,^{3}6C5, 6G5,^{2}6F6,		
	Tone	65	Order from	Mfr.			44X11	25	RS216					5Z4MG	456	1
							44X213	13/15	CS121/TS101							
62-313	Vol.	17	TM248-SS1	M26			P44X21	30	WE3540					^{4}6K7,^{3}6C5, 6G5, 6H6,		
	Tone	65	Order from	Mfr.			P44X11	30	RS216					^{2}6L6,^{2}5Z4	456	1
							P45X216	13	CS121							
							P45X209	19	TS101							
62-315	Vol.	18	O	6			BE103-6	23	RS213					6A7, 78, 75, 41, 80	465	1
							BE103-7	23	RS213							
62-316	Vol.	18	O	6			BE103-6	23	RS213					6L7, 6C5, 6K7G,		
							BE103-7	23	RS213					6Q7G, 6F6G, 5Y3	465	1
62-317	Vol.	18	O	6			BE103-6	23	RS213					6L7, 6C5, 6K7, 6Q7,		
	Tone	22	K12				BE103-7	23	RS213					6F6, 5W4, 6G5	465	1
62-318	Vol.	17	TRP613	6			44X10	23	RS216					^{3}6K7, 6C5, 6Q7, 6F6,		
	Tone	34	Order from	Mfr.			44X11	23	RS216					5Z4, 6G5	456	1
							44X209	15	TS101							
62-326	Vol.	18	O	13			4	12	CS121					1B5, 1C6, ^{3}30, 34	456	
62-327	Vol.	45	O	6			4-18-18	1/13	RM259		Order	from M	fr.	^{3}34, 1C6,^{2}30, 19	456	10
	Tone	44	UC502				20	1	RS207							
							.01		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
MONTGOMERY WARD & CO.—Continued																
Note: The prefix "62-" or form of "62-" indicates Radio Division in Montgomery-Ward Catalog.																
62-328	Vol.	62	M	6			BE103-11	12	RS203					1A6, 1A4, ^{2}30, ^{2}34, 19	465	
	Tone	21	M													
62-332 (32 volt DC)	Vol.	18	N	6			12	15	TS101					^{3}6K7, 6A8, 85, 43, 6A6	456	
	Tone	44	Z12													
62-336	Vol.	18	O	13			4	12	CS121					1B5, 1C6, ^{3}30, 34	456	
62-337	Vol.	45	O	6			4-18-18	1/13	RM259		Order	from	Mfr.	^{2}34, 1C6, ^{2}30, 19	456	10
	Tone	44	UC502				20	1	RS207							
							.01		Buffer	B14						
62-338	Vol.	62	M	6			BE103-11	12	RS203					1A6, 1A4, ^{2}30, ^{2}34, 19	465	
	Tone	21	M													
62-360, 62-367	Vol.	6	TRP600				6, 8	25	RS213					^{4}24, 45, 80		1
62-407	Vol.	18	O	6			P103-6	23	RS213					6L7, 6C5, 6K7, 6Q7,		
	Tone	22	K12				P103-7	23	RS213					6F6, 5W4, 6G5	465	1
62-408	Vol.	17	TRP613	6			44X10	23	RS216					^{3}6K7, 6C5, 6Q7, 6F6,		
	Tone	34	Order from	Mfr.			44X11	23	RS216					5Z4, 6G5	456	1
							44X209	15	TS101							
62-410	Vol.	64	TM248-SS1	M23			4	12	CS121	B3				^{6}30, 32, ^{3}34	456	
	Tone	44	Order from	Mfr.												
62-411	Vol.	62	TRP613	6			44X10	25	RS216					^{4}6K7, ^{3}6C5, 6G5, ^{2}6F6,		
	Tone	65	Order from	Mfr.			44X11	25	RS216					5Z4MG	456	1
							44X213	13/15	CS121/TS101							
62-413	Vol.	17	TM248-SS1	M26			P44X21	30	WE3540					^{4}6K7, ^{3}6C5, 6G5, 6H6,		
	Tone	65	Order from	Mfr.			P44X11	30	RS216					^{2}6L6, ^{2}5Z4	456	1
							P45X216	13	CS121							
							P45X209	19	TS101							
62-415	Vol.	18	O	6			BE103-6	23	RS213					6A7, 78, 75, 41, 80	465	1
							BE103-7	23	RS213							
62-416	Vol.	18	O	6			BE103-6	23	RS213					6L7, 6C5, 6K7G,		
							BE103-7	23	RS213					6Q7G, 6F6G, 5Y3	465	1
62-418	Vol.	17	TRP613	6			44X10	23	RS216					^{3}6K7, 6C5, 6Q7, 6F6,		
	Tone	34	Order from	Mfr.			44X11	23	RS216					5Z4, 6G5	456	1
							44X209	15	TS101							
62-425	Vol.	18	O	6			119-24	23	SR633					6A7, 78, 75, 41, 5Z4	465	1
62-426	Vol.	18	O	13			4	12	CS121					1B5, ^{3}1C6, 30, 34	456	
62-427	Vol.	45	O	6			4-18-18	1/13	RM259		Order	from	Mfr.	^{3}34, 1C6, ^{2}30, 19	456	10
	Tone	44	UC502				20	1	RS207							
							.01		Buffer	B14						
62-428	Vol.	62	M	6			BE103-11	12	RS203					1A6, 1A4, ^{2}30, ^{2}34, 19	465	
	Tone	21	M													
62-432 (32 volt DC)	Vol.	18	N	6			12	15	TS101					^{3}6K7, 6A8, 85, 43, 6A6	456	
	Tone	44	Z12													
62-436	Vol.	18	O	13			4	12	CS121					1B5, 1C6, ^{3}30, 34	456	
62-437	Vol.	45	O	6			4-18-18	1/13	RM259		Order	from	Mfr.	^{3}34, 1C6, ^{2}30, 19	456	10
	Tone	44	UC502				20	1	RS207							
							.01		Buffer	B14						
62-520	Vol.	6	G7		3		8-8	25	RS213	B3				^{2}24, 71A, 80		1
62-1040	Vol.	8	G				4-4-4	3	CM173					^{3}24A, ^{2}27, ^{2}45, 80	‡	1
	Tone	41	N													
62-1838	Vol.	15	O				8-8	1	CN152					^{3}27, ^{3}35, 47, 80	262	3
	Tone	34	UC502				8	14	CS123							
MOTO-METER GAUGE & EQUIPMENT CO.																
Moto-vox 10A (Above 500)	Vol.	17	N				76458	15	TS101					^{3}36, 85, 41	175	
Moto-vox 10E	Vol.	15	N											^{4}36, 41	175	
	Sen.	‡	Y1000MP													
MOTOROLA—See Galvin.																
WILLIAM J. MURDOCK CO.																
8-Tube AC	Vol.	40	‡		See Note	A5	1-4-2	2/14	See Note	B1				‡		3
MUSETTE																
52, 53	Vol.	6	F12	6	2		A203	4	RS213					^{3}24A, 27, 45, 80		1
	Tone	22	‡		See Note	A5										
310	Vol.	6	See Note	‡	‡	A5	8	25	RS213	B3				^{3}24A, 27, ^{2}45, 80		1
	Tone	22	K12													
NASSAU RADIO																
DLPS	Vol.	16	N				2-4-4	3	See Note	B2				^{5}99, 10, 81		‡
	Sen.	26	Y200MP													
NATIONAL CARBON CO (Eveready)																
1, 2, 3	Vol.	13	SRP179				2-4	1	See Note	B1				^{4}26, 27, ^{2}71A, 80		11
31, 32, 33, 34	Vol.	8	A550P				4-2-1-1	3/14	See Note	B1				^{5}27, ^{2}71A, 80		2
42, 43, 44	Vol.	8	A550P				4-2-1-1	3/14	See Note	B1]				^{5}27, ^{2}45, 80		2
52, 53, 54 (Three Types)	Vol.	13/12	DRP117	Types 1, 2		A50	‡	3/15	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		3
	Vol.	13/7	DRP242	Type 3		A50										
THE NATIONAL CO.																
AC-SW 3	Vol.	7	D											^{2}58, 27		
	Regen.	12	K12													
AC-SW 58	Vol.	40	D12											^{2}58, 56, ^{2}45		
	Regen.	12	K12													
AC "Thrill Box"	Vol.	‡	E12											^{2}24A, ^{3}27		
AGS with GRDPU (Power Supply)	Vol.	7	A550P				8-8-8	3	See Note	B3				^{7}36, 37, 89, ^{2}80		1
AGSX	Vol.	7	A550P				8-8-8	3	See Note	B3				77, ^{3}78, 37, ^{3}36, 89, ^{2}80		1
Auto-Box	Vol.	12	K12											^{3}24, ^{2}12A		
DC-SW-3	Vol.	7	D											^{2}36, 37		
	Regen.	12	K12	7												
DC-SW-34 (Batt.)	Vol.	40	D12											^{2}34, 30, ^{2}31		
	Regen.	12	K12													
FBX & FBXA	Vol.	7	G				5	13	CS133					^{2}24, 57, 56, ^{2}58, 59	500	
							5	15	TS101							
HRO	Vol.	17	N				10	15	TS101					^{4}6D6, ^{3}6C6, 6B7, 42, or		
	Sen.	7	G											^{4}58, ^{3}57, 2B7, 2A5	456	
MB-29	Vol.	12	G12				8-8-8	3	MN275					^{4}24, ^{2}27, ^{2}45, 80		3
MB-30	Vol.	12	K12											^{4}24A, 27		
NC100	Vol.	‡	Y50MP				8, 8, 8	3	RS213					^{4}6K7, ^{3}6J7, 6C5, 6E5,		
	Tone	‡	Y500MP											^{2}6F6, 80	456	1
	Sen.	7	G													
Screen Grid SW (71)	Vol.	12	K12											^{2}24A, 27, ^{2}71A		
NATIONAL TRANSFORMER CO.																
Midget 6	Vol.	6	H12				8-8	1	See Note	B3				^{4}27, 45, 80		3
	Tone	22	F12													
Screen Grid 8	Vol.	6	H12				8-8-8	3	See Note	B3				^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	22	F12													

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
NOBLITT-SPARKS (Arvin)																
7	Vol.	15	UM154-SS3	M26			17-4787	1	RN241		35	294	C3	6F7, 6A7, 6B7, 41, 84	170	10
							17-4786	15	TS101							
							.02-.02		Buffer	B14						
9A	Vol.	15	UM157-SS12				17-14132	23	RM255		35	294	C3	^{2}78, 6A7, 75, 41, 84	170	10
							.01		Buffer	B14						
10A (Two Types)	Vol.	15	SRP251	6			8-16	1	CN155		34	292	C3	6A7, 6B7, 78, 41, 84	175	10
							12-12-1	‡	TN111/TP443							
							.02-.02		Buffer	B14						
15	Vol.	15	SRP251	6			17-4184	1	RN245		37	296	C13	78, 6A7, 6B7, 41, 84	175	10
							17-2082	15	TS101		34	292	C14			
							.02-.02		Buffer	B14						
16	Vol.	17	SRP251	6			17-4201	1	CN155	B3	34	292	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
							17-2082	15	TS101							
							.02-.02		Buffer	B14						
17	Vol.	17	UM154-SS3	M26			17-4703	1	RN245		35	294	C3	^{2}78, 6A7, 75, 41, 84	175	10
							17-4707	15	TN111							
							.02-.02		Buffer	B14						
18	Vol.	17	UM157-SS12				17-14614	1	RN245		35	294	C3	75,^{2}78, 6A7, 41, 84	170	10
							17-14606	15	TN111							
							.01		Buffer	B14						
19	Vol.	17	UM157-SS12				17-14614	1	RN245		35	294	C3	^{2}78, 6A7, 75, 41, 84	170	10
							17-14606	15	TN111							
							.005		Buffer	B14						
20A (Two Types)	Vol.	15	SRP251		See Note A4		8-8	1	CN152		34	292	C3	75, 77,^{2}78 41, 8,4	181.5	10
	Vol.	17	SRP251		See Note A27		5	15	TS101							
							.02-.02		Buffer	B14						
20B	Vol.	17	SRP251	‡			16-8	1	CN155		34	292	C3	75, 77, 78, 6A7, 41, 84	175	10
							17	15	TS102							
							12-12-12	‡	See Note	B3						
							.02-.02		Buffer	B14						
25	Vol.	17	SRP251	6			17-4201	1	CN155		37	296	C13	^{2}78, 6A7, 6B7, 41, 84	175	10
							17-2082	15	TS101		34	292	C14			
							17-2253	‡	TN111/TP423							
27	Vol.	56	UM154-SS3	M26			17-4703	1	RN245		35	294	C3	75,^{2}78, 6A7,^{2}41, 84	175	10
							17-4707	15	TN111							
							.02-.02		Buffer	B14						
28	Vol.	17	UM157-SS12				17-14611	1	RN245		35	294	C3	6A7,^{2}78, 75, 42, 84	170	10
	Tone	34	UM143-SS12				.005		Buffer	B14						
							17-4707	15	TN111							
29	Vol.	15	UM157-SS12				17-14092	1	RN245		35	294	C3	^{2}6K7G, 6A8G, 6Q7G,		
	Tone	34	UM143-SS12				17-4707	15	TN111					6V6G, 6X5G	170	10
							.004		Buffer	B14						
30A (Three Types)	Vol.	15	SRP251	6	See Note A27		16-8-5	1/15	CN155 TS101		34	292	C3	^{2}77, 78, 79, 41, 84	181.5	
	Vol.	17	SRP251	6	See Note A4		.02-.02		Buffer	B14					175	10
	Tone	22	L													
33	Vol.	15	UM157-SS12				17-14611	1	RN245		35	294	C3	^{2}6K7, 6A8, 6Q7, 6F6,		
	Tone	34	UM143-SS12				17-4707	1	TN111					6X5	170	10
							.005		Buffer	B14						
35 (Two Types)	Vol.	15	UC511	6			17-4184	1	RN245		37	296	C13	77, 78, 79, 6B7,^{2}41, 84	175	10
							.02-.02		Buffer	B14	34	292	C14			
37	Vol.	15	UM154-SS3	M26			17-4716	1	RN245		35	294	C3	^{2}76, 78, 6A7, 6B7,^{2}41,		
							17-4710	13	RS211					84	175	10
							17-4707	15	TN111							
							.02-.02		Buffer	B14						
38	Vol.	17	UM157-SS12				17-14090	1	RN242	C3	35	294	C3	^{2}78, 6A7, 75, 76, 6A6,		
	Tone	34	UM143-SS12				17-4710	13	RS211					0Z4 or 6X5	170	10
							17-4707	15	TN111							
							.005		Buffer	B14						
39	Vol.	15	UM157-SS12				17-14090	1	RN245		35	294	C3	^{2}6K7G, 6A8G, 6Q7G,		
	Tone	34	UM143-SS12				17-4710	13	RS211					6C5G, 6N7G, 0Z4		
							17-4707	15	TN111					or 6X5	170	10
							.004		Buffer	B14						
41	Vol.	6	G12	6			17-14001	1	RS213					6A7, 6F7, 41, 80	456	1
							17-14002	1	RS216							
							17-14005	15	TS101							
45 (Two Types)	Vol.	17	UC511	6			17-4184	1	RN245		37	296	C13	37,^{2}75, 77,^{2}78,^{2}41, 84	175	10
							.02-.02		Buffer	B14	34	292	C14			
51	Vol.	17	MR48	M26		A58	17-14000	1	RS215					6A7, 6D6, 75, 41, 80	456	1
							17-14002	1	RS216							
							17-14707	15	TN111							
51B	Vol.	17	MR48	M26		A58	17-14053	‡	2-TS101					1C6, 34, 1B5, 33, 1A1	456	
							17-14004	‡	TS101							
61, 62	Vol.	17	N				17-14002	1	RS216					6A7,^{2}6D6, 75, 42, 80	456	1
	Tone	34	L	6			17-14003	1	WE3540							
							17-14004	15	TS101							
61B, 62B	Vol.	17	N				17-4703	1	RN245		13	245	C3	^{2}78, 6A7, 6B7, 41	175	10
							17-4707	15	TN111							
							.005		Buffer	B14						
61M, 62M	Vol.	17	N				17-14002	1	RS216					^{2}6K7, 6A8, 6H6, 6F5,		
	Tone	34	L	6			17-14003	1	WE3540					6F6, 5Z4	456	1
							17-14004	15	TS101							
81	Vol.	15	N				17-14002	3	RS216					^{2}6D6, 6A7, 6B7, 76,		
	Tone	34	L	6			17-14003	3	WE3540					^{2}6B5, 80	456	1
							17-14000	3	RS215							
							17-14004	15	TS101							
81M	Vol.	15	N				17-14002	3	RS216					^{3}6K7, 6A8, 6C5, 6H6,		
	Tone	34	L	6			17-14003	3	WE3540					^{2}6B5, 5Z4	456	1
							17-14000	3	RS215							
							17-14004	15	TS101							
417, 467	Vol.	6	MR18	M26			17-14069	1/15	RN245	B16				6A7, 6F7, 41, 80	456	1
508	Vol.	7	J	6			17-14160	23	RM255					6D6, 6C6, 25B6G,		
														25Z5, BK55B		
517, 527	Vol.	17	MR48	M26			17-14002	1	RS216					6A7, 78, 75, 42, 80	456	1
							17-14000	1	RS215							
							17-4707	15	TN111							
517B, 527B	Vol.	17	MR48	M26			17-14082	1	RN245		13	245	C3	6A7, 15, 75, 76, 19	456	10
							17-14005	15	TS101							
							.01		Buffer	B14						
518, 518A	Vol.	6	G12	6			17-14001	25	RS213					6A7, 78, 76, 41, 80	455	1
							17-14111	25	WE847							
568, 568A	Vol.	6	G12	6			17-14001	1	RS213					6A7, 78, 76, 41, 80	455	1
							17-14111	1	WE847							
608	Vol.	18	MR48	M26			17-14153	23	RN232	B8				6A7, 6D6, 6Q7G,		
							17-14154	23	RS207					25B6G, 25Z5,		
														BK49D	456	
617, 627	Vol.	17	MR48				17-14003	1	WE3540					^{2}6K7G, 6A8G, 6Q7G,		
	Tone	34	L				17-14002	1	RS216					6F6G, 5Y3	456	1
							17-14001	13	RS213							
							17-14075	15	TN111							
617B, 627B	Vol.	17	MR48				17-14082	1	RN245		13	245	C3	^{2}15, 6A7, 75, 76, 19	456	10
	Tone	44	L				17-14084	13	RS203							
							17-14075	15	TN111							
							.01		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
NOBLITT-SPARKS	—Continued															
618, 618A	Vol.	15	MR53				17-14001	23	RS213					6A8G, 6K7G, 6Q7G,		
	Tone	22	MR39	M26			17-14111	23	WE847					6F6G, 5Y3G, 6E5	455	1
							17-14130	23	RM262	B10						
618B	Vol.	‡	MR48	M27			17-14005	19	TS101					1C6,^{2}1A4, 30,^{2}950	456	
628, 628CS	Vol.	15	MR53				17-14001	23	RS213					6A8G, 6K7G, 6Q7G,		
	Tone	22	MR39	M26			17-14111	23	WE847					6F6G, 5Y3G, 6E5	455	1
							17-14130	23	RM262	B10						
628B	Vol.	‡	MR48	M27			17-14005	19	TS101					1C6,^{2}1A4, 30,^{2}950	456	
818	Vol.	20	TM230-SS1				17-14001	1	RS213					6A8G, ^{2}6K7G, 6H6G,		
	Tone	22	MR39	M26			17-14126	1	WE1647					6F5G, 6V6G, 5Y3G,		
							17-14124	14	RS213					6E5	455	1
							17-14123	15	TS104							
828	Vol.	20	TM230-SS1				17-14001	1	RS213					6A8G,^{2}6K7G, 6H6G,		
	Tone	22	MR39	M26			17-14126	1	WE1647					6E5, 6F5G, 6V6G,		
							17-14124	14	RS213					5Y3G	455	1
							17-14123	15	TS104							
927	Vol.	17	TM230-SS1				17-14003	3	WE3540					^{2}6K7G, 6A8G, 6R7G,		
	Tone	44	L	6			17-14002	3	RS216					6C5G,^{2}6N6G, 5Y3,		
							17-14000	3	RS215					6G5	456	1
							17-14075	15	TN111							
1127	Vol.	17	TM230-SS1			See Note A19	17-14003	3	WE3540					^{3}6K7G, 6A8G, 6C5G,		
	Tone	21	MR48				17-14001	3	RS213					^{3}6N6G, 5Z3, 6E5	456	1
	Supp.	7	E	6			17-14000	3	RS215							
							17-14086	14	RS207							
							17-14087	14	RS207							
							17-14075	15	TN111							
1237, 1247, 1247A	Vol.	17	TM230-SS1				17-14002	25	RS216					^{3}6K7G,^{2}6A8G, 6Q7G,		
	Tone	44	L				17-14138	25	WE1647					6J7G, 6H6G, 6E5,	455/	
							17-14005B	20	TS101					^{2}6V6G, 5U4G	100	
NORCO MFG. CO.																
4 Super	Vol.	14	N	6			8-4	4	See Note	B3				^{2}57, 47, 80	250	1
4 Combination																
(Dual Wave)	Vol.	6	H12	6			8-4	4	See Note	B3				58, 24A, 47, 80		1
NORDEN-HAUCK, INC.																
Super DX-5A	Vol.	35	M											^{2}24,^{3}27		
"Admiralty" Super																
12	Vol.	23	MM				2-2-2-2	3/14	See Note	B4				^{4}24,^{5}27,^{2}50,^{2}81		5
	Supp.	8	C													
Super 15	Vol.	23	MM				2-2-2-2	3/14	See Note	B4				^{7}56,^{5}58,^{2}50,^{2}81		5
	Sen.	7	K													
	Supp.	8	C													
	Osc. Adj.	7	G													
OPERADIO MFG. CO.																
484, 484A, 484B	Vol.	15	N											864		
478B, 478AH, 2478A	Vol.	15	N				8	2/25	WE847					56, 53, 2A3, 5Z3		1
							8-8	2/25	RN242	B3						
							10	15	TS101							
							20	19	CN145	B3						
							75	14	SR608	B3						
ORGATRON (Everett Piano)																
LS-2	Quality	Order from Mfr.					Main and Pre-Amp.							56, 53, 45, 83V		7/25
	Pedal		N				8-8-8	3	RS213							
	S. Flute		NN				10	15	TS101							
	U. Flute		NN				Echo Field Supply									
	String		NN				8-8	1	RS213							
	Horn		N													
	Bril.		Order from Mfr.													
MD-1							Pre-Amplifier							77 or 6C6, 79, 56, 45,		
							8-8	13	RN242					80, 83V	1st	1
							25	15	TS102						2nd	‡
							10	15	TS101							
							Main Amplifier									
							30	13	WE3540							
							25	15	TS102							
							Power Supply									
							30	2	WE3540							
							50	19	See Note	B125						
							Echo Field Supply									
							8-8	1	RS213							
OZARKA, INC. (Viking)																
V-16	Vol.	‡	J				‡	4/25	See Note	B2				^{4}35,^{7}27,^{3}45,^{2}80	‡	‡
89AC	Vol.	4	G12				1-1-.5-2	1/14	See Note	B1				^{5}26, 27,^{2}12A, 80		9
90	Vol.	10	F12				4-3-2	1/14	See Note	B1				24,^{3}26,^{2}27,^{2}45, 80		9
91-Battery	Vol.	12	Y											‡		
91AC	Vol.	24	‡			See Note A5	2-2-2	3	See Note	B1				^{4}24, 27,^{2}45, 80		3
"Viking" 91AC	Vol.	12	A5MP				8-8	1	CS133	B129				^{3}24, 27, 45, 80		3
92AC	Vol.	12	G12				8, 8	1	RS213					^{4}24A, 27, 45, 80		3
93-Battery	Vol.	12	‡			See Note A5								^{2}30,^{3}32, 33	175	
	Tone	22	‡			See Note A5										
93A, 93B	Vol.	58	G	6			8, 8	4	RS213					^{2}27,^{3}35, 47, 80	175	1
	Tone	22	Y													
94-AVC	Vol.	‡	‡			See Note A5	‡	4	See Note	B3				^{3}27,^{3}35, 47, 80	175	1
	Tone	22	‡			See Note A5										
95-WD1	Vol.	24	‡			See Note A5	2-2-2	3	See Note	B1				^{4}24A, 27,^{2}45, 80		3
PACIFIC RADIO (Aetna, Knight, Manchester, etc.)																
25	Vol.	6	H12	6		EX300	16-12	23	RM257					6D6, 6C6, 43, 25Z5		
37-61	Vol.	18	N			See Note A5	16-12	27	UR182	B95				6A7, 6D6, 75, 43,		
														6G5, 25Z5	456	
37-321	Vol.	18	N				8-4	23	See Note	B3				6A7, 6D6, 75, 42, 80,		
	Tone	22	‡			See Note A5								or 6A7, 6K7, 75,		
														6F6, 80	465	1
37-6320	Vol.	45	N				8-4	23	See Note	B3				6A8, 6K7, 6H6, 6F5,		
	Tone	34	‡			See Note A5								6F6, 5Z4	465	1
37-6322	Vol.	45	N			See Note A5	16-12	27	UR182	B95				6A7, 6D6, 76, 6F5,		
	Tone	34	‡			See Note A5								43, 6G5, 25Z5	465	
37-7370	Vol.	15	‡			See Note A19	12-14	23	See Note	B3				^{2}6K7, 6A8, 6H6, 6F5,		
	Tone	34	‡			See Note A5	10	15	TS101					6F6, 6G5, 5Y3	465	1
37-14370	Vol.	45	2 Meg. No. 1			See Note A19	12	25	RS215					^{3}6K7, 6A8,^{2}6H6,^{2}6C5,		
	Tone	34	‡			See Note A5	18	25	RS216					6G5,^{2}6F6, 5Z4	465	1
							8	13	See Note	B3						
							10	19	TS106							
101	Vol.	18	UM154	M26		See Note A96	6-12	1	CN155	B3	34	292	C3	6A7, 6D6, 6B7, 41, 84	456	10
							10	15	TS101							
							.02-.02		Buffer	B14						
101B, 101C	Vol.	18	SRP281	6		See Note A3	8-8	4	CM172	B3	35	294	C3	6A7, 6D6, 75, 41, 0Z4	456	10
							.01-.01		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PACIFIC RADIO—Continued																
102 (Knight 6 tube)	Vol.	18	SRP281	6			6-12	1	CN155	B3	34	292	C3	[2]6D6, 6A7, 75, 41, 84	175	10
							10	15	TS101							
							.02-.02		Buffer	B14						
102B	Vol.	18	SRP281	6		See Note A3	8-8	4	CM172	B3	35	294	C3	[2]6K7, 6A8, 6Q7, 6F6,		
	Tone	22	‡			See Note A5	.01		Buffer	B14				0Z4	262	10
682	Vol.	18	N				8-4	1	CN151	B3	31	285XS	C3	1C6, 34, [3]30, 19	465	10
	Tone	22	K12				.01-.01		Buffer	B14						
PACIFIC RADIO EXCHANGE																
Spero Four	Vol.	6	G12	6			4, 4	23	RS211					58, 57, PZ, 82		1
	Tone	22	K12													
Spero Super	Vol.	18	N	6			8-8	1	RS213	B3				[2]56, [4]58, W, [2]47, 82	175	3
	Tone	41	M				4	1	RS211	B3						
PACKARD BELL CO.																
25 (Two Types)	Vol.	18	UM154	M26		See Note A96	8-8	25	See Note	B3	35	294		6A7, 6D6, 85, 42, 84	460	10
34	Vol.	6	G12	6	EX300		5-5	23	See Note	B3				6D6, 76, 42, 80		1
35	Vol.	6	G12	6	EX300		5-5	23	See Note	B3				6C6, 6D6, 76, 42, 80	460	1
	Tone	22	K12													
35 Late	Vol.	18	MR48				4-4	23	CM170					6A7, 6D6, 75, 42, 80	460	1
35A	Vol.	6	G12	6	EX300		4-4	23	CM170	B3				57, 58, 56, 2A5, 80	460	1
35H	Vol.	18	500M No. 1			See Note A19	10	25	RS215					6A7, 6D6, 75, 41, 80	460	1
							12	25	RS215							
36	Vol.	15	N				4-4	23	CM170	B3				2A7, [2]58, 55, 2A5, 80	460	1
45M	Vol.	6	F12		EX175		8-8	23	CM172	B3				6A8, 6K7, 6F5, 6F6,		
	Tone	22	K12											5Z4	460	1
46B	Vol.	17	500M No. 1			See Note A19	12, 12	25	RS215					6A7, 6D6, 75, 41, 80	460	1
47M	Vol.	15	MR48				8-8	25	CM172					[2]6K7, 6A8, 6H6, 6F5,		
	Tone	22	K12				8	13	CS133					6F6, 5Z4	458	1
48	Vol.	15	MR48				8-8	25	CM172					6A8, [2]6K7, 6H6, 6C5,		
	Tone	22	K12				8	13	CS133					6F6, 5Z4	458	1
65	Vol.	6	G12	6	EX300		4-4	23	CM170	B3				56, 57, 58, 2A5, 80	465	1
	Tone	21	M													
65 (Auto)	Vol.	18	UM154			A96	8-8	74	CM172		35	294	C3	6A7, 6D6, 75, 42, 84	460	10
67 (Auto)	Vol.	45	UM154			A96	8-8	4	CM172		35	294	C3	[3]6K7, 6A8, 6H6, 6F6,		
	Tone	22	K12											84	460	10
75	Vol.	18	500M No. 1			See Note A19	8-8	74	CM172		35	294	C3	6A8G, 6K7G, 6Q7G,		
							.005		Buffer	B14				6K6G, 6X5G	460	10
76	Vol.	15	M				4-4	23	CM170	B3				2A7, 2B7, [2]57, 2A5, 80	465	1
	Tone	21	M													
	Supp.	12	Y250MP													
76 (Auto)	Vol.	18	TRP606				8-8	74	CM172		35	294	C3	[2]6K7G, 6A8G, 6Q7G,		
							.005		Buffer	B14				6K6G, 6X5G	460	10
78	Vol.	18	UM154			A96	8-8	1	CN152		35	294	C3	[2]6K7, 6A8, 6Q7G, 6C5,		
							.005		Buffer	B14				[2]6K6G, 6X5G	460	10
86	Vol.	15	N				4-4	23	CM170	B3				2A7, 2B7, [2]57, 2A5, 80	465	1
	Tone	21	M													
	Supp.	‡	Y50MP													
120	Vol.	45	TRP606				16-16	1	See Note	B3				[2]6K7, 6A8, 6H6, 6F5,		
														[2]6C5, [2]6F6, [2]5W4	460	1
4 tube Superhet	Vol.	‡	G12				4-4	23	See Note	B3				[2]57, 47, 80	‡	1
	Tone	22	‡			See Note A5										
4	Vol.	‡	G12	6			4-4	23	CM170	B3				[2]57, 47, 80	235	1
	Tone	22	M													
5 Auto Set	Vol.	11	UM147			See Note A96	5	19	TS105					55, 57, 58, 47	465	
6 tube Auto	Vol.	18	N	‡			4-4	1	CN150	B3	35	294	C3	[2]6D6, 6A7, 75, 41, 84	470	10
							.05-.05		Buffer	B14						
11, 13	Vol.	6	G7	6	3		4-4	23	CM170	B3				58, 57, 2A5		1
24, 24C	Vol.	‡	G12	6			4-4	23	CM170	B3				57, 47, 80	235	1
	Tone	22	M													
85	Vol.	6	G7	6	3		4-4	23	CM170	B3				55, 57, 58, 47 or 2A5,		
	Tone	22	M											80	470	1
PARAMOUNT RADIO CO.																
Laurel Tone	Vol.	6	G7	‡	2		7-7	1	CN152	B3				57, 58, 47, 80		1
							10	19	TS101							
5M-17	Vol.	6	K12	6			B16973	27	RS207					6D6, 6C6, 43, 25Z5		
							B17042	27	RS207							
6M-27	Vol.	17	O				B17041-3	4	RS208					6A8G, 6K7G, 6Q7G,		
	Tone	‡	M	6			B17197	4	RS208					25B6G, 25Z6G	456	
6U-107, 6L-137, 6C-607	Vol.	18	N	6			B16466	4	RS216					6A8G, 6K7G, 6Q7G,		
	Tone	34	UC502				B16467-2	4	WE847					6G5, 6K6G, 5Y3	456	1
7U-117, 7L-147, 7C-707	Vol.	18	N	6			B16466	4	RS216					6L7G, 6C5G, 6K7G,		
	Tone	34	UC502				B16467-2	4	WE847					6Q7G, 6G5, 6F6G,		
														5Y3	456	1
8C-807	Vol.	18	N	6			A15236-3	25	WE3540					6A8G, 6K7G, 6Q7G,		
	Tone	44	UC502				A15237-3	25	RS213					6G5, 6C5G, [2]6F6G,		
														5Y3	456	1
8U-127	Vol.	18	N	6			A15236-3	25	WE3540					6A8G, 6K7G, 6Q7G,		
	Tone	44	SRP284	8			A15237-2	25	RS213					6G5, 6C5G, [2]6F6G,		
														5Y3	456	1
10C-1007	Vol.	17	TRP618	6			B16554-2	1	WE3540					[2]6K7G, 6L7G, 6C5G,		
	Tone	22	UC502				B15427	1	WE1647					6Q7G, 6G5, [3]6F6G,		
							B16551	15	TN111					5Z3	456	1
PATTERSON RADIO CO.																
Pre-Selector	Vol.	6	D12											[2]58		
PR10	Vol.	15	N	6			8, 8	35	RS213					55, 56, [3]57, [3]58, 59, 5Z3	467.5	1
	M. Vol.	7	D12	6			10	15	TS101							
	Sen.	7	C1MP													
	Meter	‡	C1MP													
PR16	Vol.	15	N	6			16, 16, 16	4	RS216					[3]76, 6A6, [2]6A3, 6F7,		
	Tone	21	K12				8	13	RS213					6C6, [5]6D6, 5Z3	458	16
	M. Vol.	15	N	6			10	15	TS101							
	Sil.	7	UC500													
	Meter	‡	C1MP													
50AW	Vol.	83	N	6			8-8	1	See Note	B3				55, 56, 57, [2]58, [2]59, 5Z3	262.5	1
	Tone	22	UC502													
	Sen.	3	UC500													
60 Series	Vol.	15	N	6			8-8	1	See Note	B3				2A7, [2]58, 55, 2A5, 80	465	1
	Tone	22	UC502				10	15	TS101							
70AW (without rear fuse and cover)	Vol.	15	N	6			8-8	1	See Note	B3				56, 57, [2]58, 55, 59, 82	262	1
	Tone	34	UC502				10	15	TS101							
70AW, 74AW (with rear fuse and cover)	Vol.	15	N	6			8-8	35	See Note	B3				56, 57, [2]58, 55, 89, 82	262	1
	Tone	22	UC502				10	15	TS101							

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
PATTERSON RADIO CO.—Continued																
75AWA	Vol.	114	MR48	M26			16	1	RS216					6A7, 6D6, 6B7, 6A6,		
	Tone	114	MR33				8	1	RS213					^{2}42, 80	458	1
80AW, 84AW	Vol.	83	N	6			8-8	1	See Note	B3				55, 56, 57,^{2}58,^{2}59, 5Z3	262	1
	Tone	22	UC502													
	Sen.	8	UC500													
85AW	Vol.	18	MR48	M26			8-8	1	RN242					^{3}6D6, 6A7, 75, or 85,		
	Tone	149	K12				8	14	RS216					^{2}42, 5Z3	432	1
85AWA	Vol.	15	MR48	M26			16	1	RS216					6A7, ^{2}6D6, 85, 6A6,		
	Tone	22	MR33				8	1	RS213					^{2}42, 80	458	1
							10	15	TS101							
87	Vol.	124	MR48				16, 16	1	RS216					^{3}6K7, 6A8, 6Q7, 6G5,		
	Tone	‡	MR48	M26			10	15	TS101					6F6, 5X3	465	1
104AW (46 power tubes)	Vol.	15	N	6			4-8-4	3	See Note	B3				55,^{2}56, 57,^{3}58,^{2}46, 83	262	1
104AW (59 power tubes)	Vol.	15	N	6			8-8	35	See Note	B3				55,^{2}56,^{2}57,^{2}58,^{2}59, 82	262	1
	Tone	22	UC502				4	19	CS121							
	Supp.	‡	UC502		See Note A5											
105AW	Vol.	45	TM230-SS1	M26			8	7	RS213					^{3}6D6, 6A7, ^{2}85, 76, ^{2}42,		
	Tone	22	MR33				8-8	7	RN242					5Z3	432	1
	Sil.	48	C1MP				5	15	TS101							
107	Vol.	124	MR48				16, 16	1	RS216					^{4}6K7, 6L7, 6Q7, 6G5,		
	Tone	‡	MR48	M26										^{2}6F6, 5X3	465	1
107AW (without rear fuse and cover)	Vol.	15	N	6			8-4	1	See Note	B3				57, ^{2}58, 56, 55-Wunderlich, 59, 82	262	1
	Tone	22	UC502				10	15	TS101							
127	Vol.	124	MR48				16, 16	1	RS216					^{5}6K7, 6L7, 6Q7, 6C5,		
	Tone	‡	Y1000MP											6G5,^{2}6F6, 5X4	465	1
	Sen.	7	UC500													
186AW	Vol.	15	N	6			16	4	RS216					6A7, 6B7, 6A6,^{2}6D6,		
	Tone	21	K12				10	19	TS106					^{2}42, 5Z3	458	1
	Sil.	7	UC500													
207AW, 210AW (without rear fuse and cover)	Vol.	15	N	6			8-4	1	See Note	B3				55, 56, 57,^{2}58, 59, 82	262	1
	Tone	22	UC502				10	15	TS101							
286AW, 386AW	Vol.	15	N	6			16	4	RS216					6A7, 6A6, 6B7,^{2}6D6,		
	Tone	21	K12				10	19	TS106					^{2}42, 5Z3	458	1
	Sil.	7	UC500													
507AW (with rear fuse and cover)	Vol.	15	N	6			8-8	35	See Note	B3				55, 56, 57,^{2}58, 59, 82	262	1
	Tone	22	UC502				10	15	TS101							
508AW	Vol.	83	N	6			8-8	1	See Note	B3				55, 56, 57,^{2}58,^{2}59, 5Z3	262	1
	Tone	22	UC502													
	Sen.	8	UC500													
510AW (46 power tube)	Vol.	15	N	6			4-8-4	3	See Note	B3				55,^{2}56, 57,^{3}58,^{2}46, 82	262	1
510AW (59 power tubes)	Vol.	15	N	6			8-8	35	See Note	B3				55,^{2}56,^{2}57,^{2}58,^{2}59, 82	262	1
	Tone	22	UC502				4	19	CS121							
	Supp.	‡	UC502		See Note A5											
1106AW	Vol.	15	N	6			16	4	RS216					6A6, 6A7, ^{3}6D6, 76,		
	Tone	21	K12				10	19	TS106					6C6,^{2}42, 5Z3	458	16
	Sil.	7	UC500													
1126AW	Vol.	15	N	6			16	4	RS216					6A6, 6A7, 6C6,^{3}6D6,		
	Tone	21	K12				10	19	TS106					^{2}6A3, 5Z3,^{3}76	458	16
	Sil.	7	UC500													
2106AW	Vol.	15	N	6			16	4	RS216					6A6, 6A7, 6C6,^{3}6D6,		
	Tone	21	K12				10	19	TS106					76,^{2}42, 5Z3	458	16
	Sil.	7	UC500													
2126AW	Vol.	15	N	6			16	4	RS216					^{3}6D6, 6A7, 6C6, 6A6,		
	Tone	21	K12				10	19	TS106					^{3}76,^{2}6A3, 5Z3	458	16
	Sil.	7	UC500													
3106AW	Vol.	15	N	6			16	4	RS216					6A6, 6A7,^{3}6D6, 6C6,		
	Tone	21	K12				10	19	TS106					76,^{2}42, 5Z3	458	16
	Sil.	7	UC500													
3126AW	Vol.	15	N	6			16	4	RS216					^{3}6D6, 6A7, 6C6, 6A6,		
	Tone	21	K12				10	19	TS106					^{3}76,^{2}6A3, 5Z3	458	16
	Sil.	7	UC500													
9507AW (with rear fuse and cover)	Vol.	15	N	6			8-8	35	See Note	B3				55, 56, 57,^{2}58, 59, 82	262	1
	Tone	22	UC502				10	15	TS101							
PEERLESS—See United Reproducers																
PERFECTONE, INC.																
4 tube receiver	Vol.	15	N		See Note A3		10	15	TS101					^{3}36, 41		
PHILCO																
A (Packard)	Vol.	16	N	7										^{3}36, 85, 37, 79	260	MG.
AC206 (Studebaker)	Vol.	18	N	6			4-8-10	1/15	CN151/TS101	B130	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
							.01		Buffer	B14						
AC206 code 122 (Studebaker)	Vol.	18	TRP605	6	FS252	A52	4-8	1	CN151	B131	42	500P	C3	^{2}44, 6A7, 75, 42, 84	260	10
							20	15	TS102							
							.01		Buffer	B14						
AC236 (Studebaker Jr.)	Vol.	18	N	6	FS251	A51	4-8-10	1	CN151	B131	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
							10	15	TS101							
							.01		Buffer	B14						
AC266 (ST3) (Studebaker DeLuxe)	Vol.	17	TRP605	6	FS251	A51	4-8	1	CN151	B131	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
							10-10	15	BN226							
AC989 (Nash)	Vol.	19	TRP603	6	FS252	A52	4-8	1	CN151	B131	42	500P	C3	^{2}44, 6A7, 75, 41, 84	260	10
							20	15	TS102							
							.006		Buffer	B14						
AC989 (Code 122) (Nash)	Vol.	18	TRP605	6	FS252	A52	4-8	1	CN151	B131	42	500P	C3	^{2}44, 6A7, 75, 41, 84	260	10
							20	15	TS102							
							.006		Buffer	B14						
AC1089 (Nash)	Vol.	18	N	6			4-8-10	1/15	CN151/TS101	B130	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
							.01		Buffer	B14						
AC1289 (Nash Jr.)	Vol.	18	N	6	FS251	A51	4-8	1	CN151	B131	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
							10	15	TS101							
							.01		Buffer	B14						
B	Vol.	16	N	7			4-8	1	RN241	B132	42	500P	C3	^{3}36, 85, 41, 84	260	10
							.25-.5-8	14/15	See Note	B133						
							.006		Buffer	B14						
B6	Vol.	16	N	7			.25-.5-8	14/15	See Note	B133				^{3}36, 85, 41	260	MG.
C (Nash) (AC989)	Vol.	19	TRP603	6	FS252	A52	4-8	1	CN151	B131	42	500P	C3	^{2}44, 6A7, 75, 42, 84	260	10
							20	15	TS102							
							.006		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PHILCO—Continued																
C6 (Chrysler) CT2, CT5	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
C1452	Vol.	18	SRP282				4-8 .008	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, 41, 84	260	10
C1540	Vol.	18	SRP282				4-8 .008	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, 41, 84	260	10
C1550 (Chrysler)	Vol.	17	SRP282				4-8 .0075	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, 42, 84	260	10
CT2 (Chrysler DeLuxe)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
CT5 (Chrysler Air-flow DeLuxe)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
CT11 (Chrysler)	Vol. Sen.	17 7	SRP282 UC500				4-8 .01	4	CM171 Buffer	 B14	42	500P	C3	^{2}78, 6A7, 75, 41, 84	260	10
CU & CV (Chrysler) (Code 122)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
CZ (Chrysler) (CT2, CT5)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
D (Nash) (AC989)	Vol.	19	TRP603	6			4-8 20 .006	1 15	CN151 TS102 Buffer	B131 B14	42	500P	C3	^{2}44, 6A7, 75, 41, 84	260	10
D (Code 122) (AC989 Code 122)	Vol.	18	TRP605	6	FS252	A52	4-8 20 .006	1 15	CN151 TS102 Buffer	B131 B14	42	500P	C3	^{2}44, 6A7, 75, 41, 84	260	10
DP (Code DP121, DP122) Police	Vol.	18	N	6			4-8-10 .006	1/15	CN151/TS101 Buffer	B130 B14	42	500P	C3	^{2}44, 77, 75, 41, 84	260	10
DPV	Vol.	17	N	6	FS251	A51	4-8-10 .01	1/15	CN151/TS101 Buffer	B130 B14	42	500P	C3	^{2}44, 6A7, 75, 42, 84	260	10
DU (Dodge) (CT2, CT5)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
E-(10) (Pierce-Arrow)	Vol.	19	TRP603	6	FS251	A51	4-8 20 .01	1 15	CN151 TS102 Buffer	B131 B14	42	500P	C3	^{2}44, 6A7, 75, 42, 84	260	10
EA Dynamotor							8	12	CS123							M.G.
EF Eliminator							4-8 .006	1	CN141 Buffer	 B14	42	500P	C3	84		10
F1440	Vol.	18	SRP282			A67	4-8 .008	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, 41, 84	260	10
F1442	Vol.	18	SRP282			A67	4-8 .0075	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, 41, 84	260	10
FT6	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
FT9 (Ford)	Vol.	18	SRP282		See Note	A67	4-8 .01	4	CM171 Buffer	 B14	42	500P	C3	^{2}78, 6A7, 75, 41, 84	260	10
G	Vol.	18	UC512	6			4-8 20 .006	1 15	RN241 TS102 Buffer	B132 B14	42	500P	C3	^{2}44, 6A7, 75, 41, 84	260	10
G (Code 122)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
G1418	Vol.	18	SRP282		See Note	A67	4-8 .0075	4	RM261 Buffer	B86 B14	43	505P	C3	^{2}78, 6A7, 75, 41, 84	260	10
G1436	Vol. Tone	18 22	SRP282 ‡		See Note See Note	A67 A71	4-8 .008	4	RM261 Buffer	B86 B14	43	505P	C3	^{2}78, 6A7, 75, 41, 84	260	10
G1528 (Graham)	Vol.	17	SRP282				8-4 .0075	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, ^{2}41, 84	260	10
H	Vol.	18	N	6	FS251	A51	4-8 .25-8-10 .01	1 14/15	CN151 CN152/TP420 Buffer	B131 B135 B14	42	500P	C3	^{2}44, 6A7, 75, 37, 79, 84	260	10
H (Code 122)	Vol.	18	TRP605	6	FS251	A51	4-8 .25-8-10 .01	1 14/15	CN151 CN152/TP420 Buffer	B131 B135 B14	42	500P	C3	^{2}44, 6A7, 75, 37, 79, 84	260	10
HT11X	Vol.	18	SRP282				4-8 .01	4	CM171 Buffer	 B14	43	501P	C3	^{2}78, 6A7, 75, 41, 84	260	10
J (Nash)	Vol.	18	N	6	FS251	A51	4-8 10 .01	1 15	CN151 TS101 Buffer	B131 B14	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
J (Code 122)	Vol.	18	N	6	FS251	A51	4-8-10 .01	1/15	CN151/TS101 Buffer	B130 B14	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
L1427, L1429, L1460	Vol. Tone	18 44	SRP282 L				4-8 .008	1	RN241 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, 37, 79, 84	260	10
LT14X3, LT14X4	Vol.	18	SRP282				4-8 .01	4	CM171 Buffer	 B14	42	500P	C3	^{2}78, 6A7, 75, 41, 84	260	10
ME (Pierce-Arrow)	Vol.	19	TRP603	6	FS252	A52	4-8 20 .01	1 15	CN151 TS102 Buffer	B131 B14	42	500P	C3	^{2}44, 6A7, 75, 42, 84	260	10
MT3 (Pierce-Arrow DeLuxe)	Vol.	17	TRP605	6	FS251	A51	4-8 10-10 .01	1 15	CN151 BN226 Buffer	B131 B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
MT14X4 (Pierce-Arrow)	Vol.	18	SRP282				4-8 .01	4	CM171 Buffer	 B14	42	500P	C3	^{2}78, 6A7, 75, 41, 84	260	10
N (Ford Center-Control)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	B132 B14	42	500P	C3	^{2}44, 77, 75, 42, 84	260	10
N1434H	Vol.	18	SRP282			A67	4-8 .008	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, 41, 84	260	10
N1514	Vol.	18	SRP282				4-8 .0075	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, 41, 84	260	10
N1524 (Nash)	Vol.	17	SRP282				4-8 .0075	4	RM261 Buffer	 B14	43	505P	C3	^{2}78, 6A7, 75, ^{2}41, 84	260	10

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PHILCO—Continued N-FND	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	 .B14	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
NT12X, NT12X2	Vol. Sen.	18 7	SRP282 UC500		See Note	A67	4-8 .01	4	CM171 Buffer	 .B14	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
NT15 (Nash)	Vol.	18	SRP282		See Note	A67	4-4 .01	4	CM170 Buffer	 .B14	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
N1418	Vol.	18	SRP282		See Note	A67	4-8 .0075	4	RM261 Buffer	.B86 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
N1433	Vol.	18	SRP282		See Note	A67	4-8 .008	4	RM261 Buffer	.B86 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
P1417	Vol.	18	SRP282		See Note	A67	4-8 .0075	4	RM261 Buffer	.B86 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
P1430, P1432H	Vol. Sen.	18 7	SRP282 UC500				4-8 .008	4	RM261 Buffer	.B86 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
P1517 (Packard)	Vol.	18	SRP282			A67	4-8 .0075	4	RM261 Buffer	 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
P1530 (Packard)	Vol.	17	SRP282			A67	4-4 .0075	4	RM261 Buffer	 .B14	43	505P	C3	[2]78, 6A7, 75, [2]41, 84	260	10
PA (Packard DeLuxe)	Vol.	16	N	7										[3]36, 85, 37, 79, 84	260	MG.
PB (Packard)	Vol.	16	N	7			4-8 .25-.5-8 .006	1 14/15	RN241 See Note Buffer	.B132 .B133 .B14	42	500P	C3	[3]36, 85, 41, 84	260	10
PHD, PHXD (Packard)	Vol.	18	TRP605	6	FS251	A51	4-8 .25-8-10 .01	1 14/15	CN151 CN152/TP420 Buffer	.B131 .B135 .B14	42	500P	C3	[2]44, 6A7, 75, 37, 79, 84	260	10
PJ (Plymouth) (CT2, CT5), PT5 (120) (Packard DeLuxe)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	.B132 .B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
PT14 (Packard)	Vol. Sen.	18 7	SRP282 UC500				4-8 .01	4	CM171 Buffer	 .B14	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
Q (Nash)	Vol.	18	N	6			4-8-10 .01	1/15	CN151/TS101 Buffer	.B130 .B14	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
R	Vol.	18	N	6	FS251	A51	4-8 10 .01	1 15	CN151 TS101 Buffer	.B131 .B14	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
R (Code 122)	Vol.	18	N	6	FS251	A51	4-8-10 .01	1/15	CN151/TS101 Buffer	.B130 .B14	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
R1415, W1419	Vol.	18	SRP282			A67	4-8 .0075	4	RM261 Buffer	 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
RT3 (Reo DeLuxe)	Vol.	17	TRP605	6	FS251	A51	4-8 10-10 .01	1 15	CN151 BN226 Buffer	.B131 .B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
RT14X (Reo DeLuxe)	Vol.	18	SRP282		See Note	A67	4-8 .01	4	CM171 Buffer	 .B14	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
S1416	Vol.	18	SRP282			A67	4-8 .0075	4	RM261 Buffer	 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
S1431	Vol.	18	SRP282		See Note	A67	4-8 .008	4	RM261 Buffer	.B86 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
S1437	Vol.	18	SRP282			A67	4-8 .008	4	RM261 Buffer	 .B14	43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
SE (DeSoto)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	.B132 .B14	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
SF, SG (DeSoto) (CT2, CT5)	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	.B132 .B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
ST12 (Studebaker)	Vol.	18	SRP282		See Note	A67	4-8 .01	4	CM171 Buffer	 .B14	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
ST15 (Studebaker)	Vol.	18	SRP282		See Note	A67	4-4 .01	4	CM170 Buffer	.B3 .B14	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
T2	Vol.	17	TRP614				4-8 10-10 .01	1 15	RN241 TN111 Buffer	.B132 .B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
T3	Vol.	17	TRP605	6	FS251	A51	4-8 10-10 .01	1 15	CN151 BN226 Buffer	.B131 .B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
T5	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	.B132 .B14	42	500P	C3	36, 77, 44, 75, 42, 84	260	10
T6	Vol.	17	TRP614	6			4-8 10-10 .01	1 15	RN241 TN111 Buffer	.B132 .B14	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
T7, T8 (Nash)	Vol. Tone	18 22	TRP605 L		FS251	A51	8-4 .01	4	CM171 Buffer	.B3 .B14	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
T10, CT10	Vol.	18	SRP282				4-8 .01	4	CM171 Buffer	 .B14	43	501P	C3	[2]78, 6A7, 75, 41, 84	260	10
3 Transitone	Vol.	15	O											[3]24A, [2]71A, [2]01A		
4 Converter							6	1	RS213					27, 24A, 80	1000	1
5 Transitone	Vol.	17	N	6	EC240	A72	4-8 .25-.25/.5-20 .006	1 ‡	CN151 See Note Buffer	.B131 .B136 .B14	42	500P	C3	6A7, 78, 75, 41, 84	460	10
5 (AC Home Receiver)	Vol.	2	‡		See Note	A5	‡	34	See Note	.B3				26, 27, 71A, 80		9
6, 6F	Vol.	16	N	7			.25-.5-8	14/15	See Note	.B133				[3]36, 85, 41	260	
7 Transitone	Vol.	15	L	7			.25-.5-8	14/15	See Note	.B133				[3]36, 38	175	
8	Vol.	16	N	7										[3]36, 38, [2]41	175	
9 Transitone	Vol.	16	N	7										[3]36, 85, 37, 79	260	
10 Transitone	Vol.	18	TRP603	6	FS252	A52	4-8 20 .01	1 15	CN151 TS102 Buffer	.B131 .B14	42	500P	C3	[2]39, 6A7, 75, 42, 84	260	10
10 (Code 122) C-(Studebaker) E-(Pierce-Arrow)	Vol.	18	TRP605	6	FS251	A51	4-8 20 .01	1 15	CN151 TS102 Buffer	.B131 .B14	42	500P	C3	[2]39, 6A7, 75, 42, 84	260	10
11 Transitone	Vol.	18	N	6	FS251	A51	4-8 10 .01	1 15	CN151 TS101 Buffer	.B131 .B14	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
11 (Code 122)	Vol.	18	N	6	FS251	A51	4-8-10 .01	1/15	CN151/TS101 Buffer	.B130 .B14	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
12	Vol.	15	N	7										[2]36, 38, [2]41	175	
12 (122)	Vol.	15	N	7										[3]36, 85, 37, 79	260	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PHILCO—Continued																
14 (Code 121 & 122) (Runs 1-4)	Vol.	64	TRP605	6			8, 8	1	RS213					^{2}78, 6A7, 37, 77, ^{3}42, 80	175	1
							10	19	BN226	B8						
							1-1-2	13/14	UR181	B137						
14 (Codes 121, 122) (Runs 5 & after)	Vol.	64	TRP605	6			8	1	RS213					^{2}78, 6A7, 37, 77, ^{3}42, 80	175	1
							8-10	1/19	RN242	B139						
							1-1-2	13/14	UR181	B137						
14 (123)	Vol.	64	TRP605	6			8, 8	1	RS213					^{2}78, 6A7, 37, 77, ^{3}42, 80	175	1
							10	19	BN226	B8						
							1-1-2	13/14	UR181	B137						
14 (126-226)	Vol.	64	TRP605	6			6, 6	1	RS213					^{2}44, 36, ^{3}37, ^{2}42, 80	260	1
							8, 6	1	RS213							
15 (Early 221)	Vol.	64	N				6	1	RS213					^{3}37, ^{4}44, ^{2}42, 80	175	1
							8	1	RS213							
15 (Early 223) 15 Late	Vol.	64	TRP605		See Note	A53	6, 6	1	RS213					^{4}37, ^{4}44, ^{2}42, 80	175	1
16	Vol.	64	TRP618	6	See Note	A58	8, 8	1	HD683					37, ^{2}77, ^{3}78, ^{3}42, 80	460	1
	Supp.	12	G12				10	19	BN226	B8						
16 (Codes 121, 122, 123)	Vol.	64	TRP618	6	See Note	A58	8	1	HD683					37, ^{2}77, ^{3}78, ^{3}42, 80	460	1
	Supp.	12	G12				8-10	1/19	RN242	B139						
16 (Codes 125, 126, 127)	Vol.	64	TRP618	6	See Note	A58	8	1	HD683					^{3}78, ^{2}77, 37, 76, ^{3}42, 80 or 5Z3	460	1
							8-10	1/19	RN242	B139						
							1-1-1-2	13/14	UR181	B149						
17	Vol.	64	TRP604	6	See Note	A27	8, 8	1	HD683					6A7, ^{2}37, 77, ^{3}78, ^{3}42, 5Z3	175	1
	Vol.	64	TRP618		See Note	A4	10	19	BN226	B8						
	Supp.	‡	Order from	Mfr.												
17 (Code 121)	Vol.	64	TRP604	6	See Note	A27	8	1	HD683					^{3}78, 6A7, ^{2}37, ^{3}42, 5Z3	175	1
	Vol.	64	TRP618	6	See Note	A4	8-10	1/19	RN242	B139						
	Supp.	‡	Order from	Mfr.												
17, 17A (Codes 122 & 123)	Vol.	64	TRP604	6	See Note	A27	8	1	HD683					^{3}78, 6A7, ^{2}37, ^{3}42, 5Z3 or 80	175	1
	Vol.	64	TRP618	6	See Note	A4	8-10	1/19	RN242	B139						
	Supp.	‡	Order from	Mfr.												
18	Vol.	18	TRP605	6			8, 8	1	RS213					6A7, ^{2}78, 75, ^{3}42, 80	260	1
							10	19	BN226	B8						
							1-1-2	13/14	UR181	B137						
18 (Codes 121 & 122)	Vol.	18	TRP605	6			8	1	RS213					6A7, ^{2}78, 75, ^{3}42, 80	260	1
							8-10	1/19	RN242	B139						
							1-1-2	13/14	UR181	B137						
18 (Code 124)	Vol.	18	TRP605				8	1	RS213					6A7, 75, ^{2}78, ^{3}42, 80	260	1
							8-10	1/19	RN242	B139						
							1-1-2	13/14	UR181	B137						
19	Vol.	18	N	6			6, 6	1	RS213					44, 36, 75, ^{2}42, 80	260	1
19 (Codes 122, 126, 126B)	Vol.	18	N				8, 8	1	RS213					^{2}44, 36, 75, 42, 80	260	1
19 (Code 128)	Vol.	18	TRP604				8	1	RS213					36, ^{2}44, 75, 42, 80	260	1
							2-8-10	1/13/19	RN245							
20, 20A, 21	Vol.	2/8	DRP114		See Note	A56	‡	1/19	See Note	B1				^{3}24A, 27, ^{2}71A, 80		2
221	Vol.	64	P				6, 6	1	RS213					^{3}44, 36, 37, 42, 80	260	1
23X	Vol.	64	P				6, 6	1	RS213					36, 37, 42, 80	260	1
28	Vol.	18	TRP605	6	EB247		12-6	49	RN235	B140				6A7, ^{2}39, 75, 43, 25Z5	460	
29, 29 (Code 123TX)	Vol.	18	TRP605	6	EB247		8-8-10	1/19	RN245	B141				6A7, ^{2}44, 75, 42, 80	460	1
							6	13	RS213							
30	Vol.	15	N											^{3}32, ^{3}30, ^{2}31		
32	Vol.	18	N		See Note	A27	8, 8	25	RS213		44	F502P		^{2}39, 36, 75, 42, 84	260	10
	Vol.	18	N	6	See Note	A4										
34, 34A	Vol.	45	N	13										^{2}30, 32, ^{2}34, 1C6, 19	460	
35, 35B, 36	Vol.	43	CE		See Note	A51								^{3}30, ^{3}32, 33	260	
37	Vol.	43	CE		See Note	A54								15, 30, ^{2}32, 19	175	
37-10, 37-11 (Codes 121-125)	Vol.	124	TM251-SS5				20-10	1/19	RS216/TS101					^{2}6K7G, 6A8G, 6N7G, 6H6G, 6J5G, 6K5G, 6G7G, ^{2}6F6G, 5Y4G	470	1
							8	1	RS213							
							16	12	RS216							
37-33	Vol.	18	MR48	M24			3	13	RS201					1D7G, 1D5G, 1H4G, 1E7G	470	
37-34	Vol.	18	UM154-SS5				4-8	1	RN241		15	246	C3	1D7G, 1D5G, 1H6G, 1H4G, 1E7G	470	10
							.01		Buffer	B14						
37-38	Vol.	45	UM154-SS5				2-2-4	13	UR181	B142				1C7G, 1D5G, ^{2}1H4G, 1E5G, 1J6G	470	
37-60	Vol.	18	UM154-SS5				12	25	RS215					6A8G, 6K7G, 6Q7G, 6F6G, 5Y4G	470	1
							8	25	RS213							
							16	14	RS216							
37-61	Vol.	18	UM154-SS5				12	25	RS215					6A8G, 6K7G, 6Q7G, 6F6G, 5Y4G	470	1
							8	25	RS213							
							16	14	RS216							
37-62	Vol.	18	MR48	M26			8-8-10	1/19	RN245					6A8G, 6K7G, 6Q7G, 6F6G, 5Y4G	470	1
37-84, Code 122	Vol.	2	Y	6			8-4	1	RN241					^{2}6J7G, 6F6G, 5Y4G	470	1
37-89	Vol.	18	UM154-SS5				12	25	RS215					^{2}6K7G, 6A8G, 6Q7G, 6F6G, 5Y4G	470	1
							8	25	RS213							
37-93	Vol.	56	N	6			8-8-10	1/19	RN245					6K7G, 6A8G, 6R7G, 6F6G, 5Y4G	470	1
37-116 (Codes 121, 122)	Vol.	17	TM251-SS5				8	1	RS213					^{4}6K7G, ^{3}6J5G, 6L7G, 6N7G, 6A8G, 6H6G, ^{2}6B4G, 6F6G, 5U4G	470	16
	Exp.	15	UM154-SS5				8-10	1/19	RN242	B139						
	Hum.	37	Order from	Mfr.			2-3-8	13/14	RN245							
37-600	Vol.	6	UM121-SS12	M26			8-4	1	CN151	B92				6A8G, 6J7G, 6K6G, 5Y4G	470	1
37-602	Vol.	18	UM154-SS12	M26			16-16-10	1/15	RM259	B143				6A8G, 6K7G, 6Q7G, 25A6G, 25Z6G	470	
37-604	Vol.	18	TM231-SS1	M26	See Note	A64	16-16-10-8	41/15	See Note	B144				6A8G, 6K7G, 6Q7G, 25A6G, 25Z6G	470	
37-610 (Codes 121, 122)	Vol.	17	TM251-SS5		See Note	A58	12	25	RS215					6A8G, 6K7G, 6Q7G, 6F6G, 5Y4G	470	1
							8	25	RS213							
							16	12	RN232	B8						
37-610 (Codes 125, 126)	Vol.	124	TM251-SS5				12	25	RS215					6A8G, 6K7G, 6Q7G, 6F6G, 5Y4G	470	1
							8	25	RS213							
							16	12	RN232							
37-611	Vol.	124	TM251-SS5				16	25	RN232	B8				6A8G, 6K7G, 6Q7G, 25A6G, 25Z6G	470	
							20-10	25/15	RS207/TS101							
							4-8	13/12	RN231							
37-620	Vol.	18	TM251-SS5		See Note	A58	12	25	RS215					^{2}6K7G, 6A8G, 6Q7G, 6F6G, 5Y4G	470	1
							8	25	RS213							
							16	14	RS216							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Cir-cuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replace-ment	*Note	Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
PHILCO—Continued																
37-623	Vol.	18	TM251-SS5			See Note A58	2-2-8	12/13	RN235					^{2}1D5G, 1C7G, 1F7G,		
														1H4G, 1J6G	470	
37-624	Vol.	124	TM251-SS5				8-4	1	RN241		15	246	C3	^{2}1D5G, 1C7G, 1F7G,		
							2-8	13/12	RN231					1H4G, 1J6G	470	10
							.01		Buffer	B14						
37-630	Vol.	18	TM251-SS5			See Note A58	12	25	RS215					^{2}6K7G, 6A8G, 6Q7G,		
							8	25	RS213					6F6G, 5Y4G	470	1
							16	14	RS216							
37-640	Vol.	18	TM251-SS5			See Note A58	12	1	RS215					^{2}6K7G, 6A8G, 6Q7G,		
							8-10	1/19	RN242	B139				^{2}6F6G, 5Y4G	470	1
37-641	Vol.	124	TM251-SS5				16	25	RN232	B8				^{2}6K7G, 6A8G, 6Q7G,		
							10-10	12/15	RN232					^{2}25A6G, 25Z6G	470	
37-643	Vol.	20	TM251-SS5				2-2-8	12	RN235					^{2}1D5G, 1C7G, ^{2}1H4G,		
														1E5G, 1J6G	470	
37-650	Vol.	45	TM251-SS5			See Note A58	20-10	1/19	RN245	B145				^{2}6K7G, 6A8G, 6J5G,		
							8	1	RS213					6K5G, ^{2}6F6G,		
							16	14	RS216					5Y4G	470	1
37-660	Vol.	18	TM251-SS5			See Note A58	8, 8	1	RS213					^{2}6K7G, 6A8G, ^{2}6J5G,		
							1-2-3	13/14	UR181	B146				6K5G, ^{2}6F6G,		
														5Y4G	470	1
37-665	Vol.	124	TM251-SS5				20-10	1/19	RN245	B145				^{2}6K7G, 6A8G, ^{2}6J5G,		
							8	1	RS213					6K5G, ^{2}6F6G,		
							16	12	RS216					5Y4G	470	1
37-670	Vol.	45	TM251-SS5			See Note A58	8	1	RS213					^{2}6K7G, 6A8G, ^{5}6J5G,		
							8-10	1/19	RN242	B139				^{2}6F6G, 5X4G	470	1
							1-2-3	13/14	UR181	B146						
37-675 (Codes 121,																
122)	Vol.	20	TM251-SS5				8, 8	1	RS213					^{3}6K7G, ^{3}6F6G, 6L7G,		
	Tone	15	MR48				8-10	1/19	RN242	B139				6N7G, 6A8G,		
							4-4	13	RN241					6Q7G, 6H6G,		
														5X4G	470	1
37-690	Vol.	15	UM154-SS5				8	30	RS213					^{5}6K7G, 6L7G, 6A8G,		
	Bass	‡	UM154-SS5	M26			8	30	RS213					^{4}6J5G, 6N7G, 6H6G,		
	Exp.	‡	Order from	Mfr.			8-10	30/19	RS213/TS106					6R7G, 6B8G, 6F6G,		
							2-3-3	13/14	UR181					^{2}6B4G, ^{2}5X4G	470	1/16
							2-2-1	13/14	UR181							
38, 38A (Codes 122,																
123)	Vol.	2	Y											15, 30, ^{2}32, 19	460	
38-1 (Code 121)	Vol.	18	TM251-SS1				8-10	30/19	RS213/TS101					6U7G, 6A8G, 6N7G,		
							18	30	WE1847					6K7G, 6H6G,		
							4-3	20/13	RN241					6R7G, ^{3}6J5G, ^{2}6F6G,		
														5X4G	470	1
38-2 (Code 121)	Vol.	18	TM251-SS1				8, 8	30	RS213					6U7G, 6A8G, 6N7G,		
							3-4	30/12	RN241					6K7G, ^{2}6J5G, ^{2}6F6G		
														5X4G	470	1
38-3 (Code 121)	Vol.	18	TM251-SS5				18	1	WE1847					^{2}6U7G, 6A8G, 6N7G,		
							8-10	1/19	RS213/TS101					6H6G, 6Q7G,		
							16	12	RS216					6K7G, ^{2}6F6G,		
														5Y4G	470	1
38-4, 38-5																
(Code 121)	Vol.	127	TM251-SS1				18	1	WE1847					6U7G, 6A8G, 6K7G,		
							8-10	1/15	RS213/TS101					6J5G, 6K5G, ^{2}6F6G,		
							16	12	RS216					5Y4G	470	1
38-7, 38-8, 38-9																
(Code 121)	Vol.	127	TM251-SS1				25	25	WE2545					6A8G, 6K7G, 6J5G,		
							8-4	25/12	RN241					6K5G, 6F6G, 5Y4G	470	1
38-10 (Code 121)	Vol.	18	MR48				12	25	RS215					6A8G, 6K7G, 6Q7G,		
							8-4	25/12	RN241					6F6G, 5Y4G	470	1
38-12 (Code 121)	Vol.	18	MR48	M26			12	25	RS215					6A7, 78, 75, 41, 84	470	35
							4	25	RS211							
38-14																
(Codes 121, 124)	Vol.	18	MR48	M26			16	25	RN232	B8				6A7, 78, 75, 42, 25Z5	470	
							20	25	RS207							
38-15																
(Codes 121, 124)	Vol.	18	MR48	M26			12-10	25/19	RS215/TS101					6A7, 78, 75, 41, 84	470	25
							4-2	25/19	RN213							
38-38 (121)	Vol.	45	MR48				4-2-2	12/13	UR181					1C7G, 1D6G, ^{2}1H4G,		
														1E5GP, 1J6G	470	
38-39 (121)	Vol.	45	MR48				4-8-8-2	1/13	RN235/CS130		15	246	C3	1C7G, 1D5G, ^{2}1H4G,		
							.01		Buffer	B14				1E5GP, 1J6G	470	10
38-60 (Codes 125)	Vol.	18	UM154-SS5				12	50	RS215					6A8G, 6K7G, 6Q7G,		
							8	25	RS213					6F6G, 5Y4G	470	1
							16	12	RN232	B8						
38-89 (Code 125)	Vol.	18	UM154-SS5				12	25	RS215					6U7G, 6A8G, 6K7G,		
							8	25	RS213					6Q7G, 6F6G, 5Y4G	470	1
38-116 (Code 121)	Vol.	18	TM251-SS5				8	1	RS213					^{4}6K7G, 6L7G, 6N7G,		
	Exp.	‡	Order from	Mfr.			8-10	1/19	RS213/TS101					6A8G, ^{4}6J5G, 6R7G,		
							8-8-6	12	RN245					^{2}6L6G, 5X4G	470	1
38-116 (Code 125)	Vol.	18	TM251-SS5				8	1	RS213					6U7G, ^{2}6A8G, 6N7G,		
	Exp.	22	Order from	Mfr.			8-10	1/19	RS213/TS101					^{3}6K7G, ^{4}6J5G, 6R7G		
							8-8-6	12	RN245					^{2}6L6G, 5X4G	470	1
39, 39A	Vol.	45	N	13										1C6, 34, ^{2}30, 32, 19	460	
40 DC	Vol.	8	A2MP											^{3}24A, 27, ^{2}71A		
41 DC, 42 DC	Vol.	2/8	DRP114			See Note A56	2-2-2-1	‡	See Note	B11				^{3}24A, 27, ^{2}71A		
43	Vol.	45	O	6			8, 8	1	RS213					^{2}37, ^{4}44, 42	450	1
							8	13	RS213							
43 (Code 121)	Vol.	45	O	6			8, 8	1	RS213					^{2}37, ^{4}44, 42	450	1
							8	13	RS213							
44	Vol.	18	N	6			8-8	1	RN242					6A7, ^{2}78, 75, 42, 80	460	1
							8	13	RS213							
45, 45C	Vol.	18	TRP605	6	EB247	A58	8-8	1	RN242					6A7, ^{2}39/44, 75, 42, 80	460	1
							8	13	RS213							
46, 46E (DC)	Vol.	24	CE			See Note A54								^{3}14, 17, ^{2}71A		
47 (DC) (Code 121-																
221)	Vol.	45	P											36, ^{2}44, ^{3}37, ^{2}43		
48 (DC)	Vol.	6	E12		(Early)	A27								^{2}36, 44, 43	175	
	Vol.	6	E12	6	(Late)	A4										
49 (DC)	Vol.	18	TRP605	6										6A7, ^{2}78, 85, 76, ^{2}43	260	
50, 50A	Vol.	2/8	CE				8, 8	4	RS213					^{3}24A, 47, 80		1
							10	4	RS215	B12						
51, 51A, 52	Vol.	6	E7				6, 6	4	RS213					^{2}24A, 35, 47, 80	175	1
							10	4	RS215	B12						
53 (AC-DC)	Vol.	2	Y	6			8, 8	4	RS203					^{2}77, 43, 12Z3	450	
							10	15	TS101							
54	Vol.	18	N	6		See Note A57	12	50	RS205					6A7, 78, 75, 43, 25Z5	460	
							12-3	50	RN235							
57	Vol.	2	Y	6			8-4	1	CN151					^{2}77, 42, 80	460	1
							8-4	1	RN241	B20						
58, 59	Vol.	2	Y	6			8-4	1	RN241					^{2}77, 42, 80	460	1
60	Vol.	18	N	6			8, 8	1	RS213					6A7, 78, 75, 42, 80	460	1
65	Vol.	12	A2MP				2-2-1	3	See Note	B1				^{2}24A, 27, ^{2}45, 80		3

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PHILCO—Continued																
66	Vol.	18	N	6			8-8	1	RN242					6A7, 78, 75, 42, 80	460	1
							6	13	RS213							
70, 70A (Below No. B-22,000)	Vol.	2/8	DRP114				8, 8	1	RS213					^{4}24A, 27, 47, 80	260	3
							10	1	RS215	B12						
70, 70A (Above No. B-22,000)	Vol.	45	O				8, 8	4	RS213					^{3}35, 24, 27, 47, 80	260	3
							14	4	RS215	B12						
							10	4	RS215	B12						
71 Series	Vol.	45	O				6, 6	1	RS213					36, 37, ^{3}44, 42, 80	260	1
							8-8	1	RS213	B12						
76	Vol.	8	X				2-2-2	‡	See Note	B1				^{3}24A, 27, ^{2}45, 80		3
							.15	‡	See Note	B9						
77, 77A	Vol.	2/8	DRP114		See Note	A56	2-2-2	30	See Note	B1				^{3}24, 27, ^{2}45, 80		3
							.15	‡	See Note	B9						
80	Vol.	2	Y10MP	6			8	1	RS213					^{2}36, 42, 80	450	1
							4	1	RS211							
							10	19	TS101							
81	Vol.	2	Y		See Note	A27	8	1	RS213					^{2}77, 42, 80	460	1
	Vol.	2	Y	6	See Note	A4	4	1	RS211							
82	Vol.	2	G12				‡	3	See Note	B1				^{4}26, 27, 71A, 80		11
84	Vol.	2	Y10MP	6			8-4	1	RN241					^{2}77, 42, 80	460	1
86	Vol.	2	G12				‡	3	See Note	B1				^{4}26, 27, 71A, 80		11
87	Vol.	2	G12				2-2-2-.1-.1	3/13	See Note	B1				^{4}26, 27, ^{2}45, 80		28
89	Vol.	18	N	6	See Note	A27	6, 6	1	RS213					^{2}44, 36, 75, 42, 80	260	1
	Vol.	18	N		See Note	A4										
89 (Code 123)	Vol.	18	N		See Note	A27	8, 8	1	RS213					^{2}44, 77, 75, 42, 80	260	1
	Vol.	18	N	6	See Note	A4										
89 (Codes 126 & 126B)	Vol.	18	N		See Note	A27	6, 6	1	RS213					^{2}44, 77, 75, 42, 80	260	1
	Vol.	18	N	6	See Note	A4										
90, 90A (with 2-45's)	Vol.	2/8	DRP114				8, 8	1	RS213					^{4}24A, 27, ^{2}45, 80	175	3
							10	1	RS215	B12						
90, 90A (with 1-47, Above 237,001)	Vol.	15	N				8, 8	25	RS213					^{3}24, ^{4}27, 47, 80	175	3
							10	25	RS215	B12						
90, 90A (with 2-47's) Serial No. B-32001 to B-35000, and above B-53100)	Vol.	45	O				8, 8	1	RS213					24A, ^{2}35, ^{3}27, ^{2}47, 80	260	3
91 (Code 121-221)	Vol.	15	O				8, 8	1	RS213					^{2}44, 36, ^{3}37, ^{2}42, 80	260	1
							14	1	RS215	B12						
91 (126-226)	Vol.	45	TRP605			A58	8, 8	1	RS213					^{2}44, 36, ^{3}37, ^{2}42, 80	260	1
95	Vol.	15	N				‡	‡	See Note	B1				^{3}24A, ^{3}27, ^{2}45, 80		3
							.15	‡	See Note	B9						
96, 96A, 96E	Vol.	15	N				‡	‡	See Note	B1				^{3}24A, ^{3}27, ^{2}45, 80		3
97, 98	Vol.	18	N	6			12	1	RS215					^{2}78, 6A7, 85, ^{2}42, 80	460	1
							8	1	RS213							
							2-2-1	13/14	UR181	B147						
111, 111A	Vol.	15	N				‡	‡	See Note	B1				^{4}24A, ^{4}27, ^{2}45, 80	175	3
							.15	‡	See Note	B9						
112, 112A (Below 174,001)	Vol.	15	N				‡	‡	See Note	B1				^{4}24A, ^{4}27, ^{2}45, 80	175	3
							.15	‡	See Note	B9						
112, 112A, 112E (Above 174,001)	Vol.	15	N				6, 6	1	RS213					^{4}24A, ^{3}27, ^{2}47, 80	175	3
116B (Code 121)	Vol.	18	TRP618	6		A58	8	1	RS213					76, ^{2}77, ^{3}78, 37, ^{3}42, 80	460	1
							8-10	1/19	RN242	B139						
							3-1-1-2	13/14	UR181	B148						
116X (Code 122)	Vol.	45	TRP613	6		A58	8	1	HD683					76, ^{2}77, 37, ^{3}78, 42, ^{2}6A3, 5Z3	460	1
							8-10	1/19	RN242	B139						
							3-1-1-2	13/14	UR181	B148						
118, 118 (Code 123RX)	Vol.	18	TRP605	6		A58	8	1	RS213					^{2}78, 6A7, 75, ^{3}42, 80	260	1
							8-10	1/19	RN242	B139						
							1-1-1-2	13/14	UR181	B149						
144	Vol.	18	TRP605	6		A58	8-8-10	1/19	RN245	B141				6A7, 75, ^{2}78, 42, 80	460	1
							8	13	RS213							
200X	Vol.	18	TRP619	6	See Note	A58	8	1	HD683					6A7, ^{3}78, 75, 37, ^{3}42, 5Z3	175	1
	Band		Order from	Mfr.			8-10	1/19	RN242	B139						
							1-1-2	13/14	UR181	B150						
201 (Code 121)	Vol.	18	TRP619	6	See Note	A58	8	1	HD683					^{3}78, 6A7, 37, 75, ^{3}42, 5Z3	260	1
	Band		Order from	Mfr.			8-10	1/19	RN242	B139						
							1-2-1	13/14	UR181	B150						
							4-1	13	UR181	B151						
211, 211A	Vol.	15	N				‡	‡	See Note	B1				^{4}24A, ^{4}27, ^{2}45, 80	175	3
212, 212A (Radio-Phonograph)	Vol.	15	N				‡	‡	See Note	B1				^{4}24A, ^{4}27, ^{2}45, 80	175	3
220, 220A	Vol.	2/8	DRP114		See Note	A56	‡	1/19	See Note	B1				^{3}24A, 27, ^{2}71A, 80		2
270, 270A	Vol.	2/8	DRP114				8, 8	1	RS213					^{4}24A, 27, 47, 80	260	3
							10	1	RS215	B12						
296, 296A, 296E	Vol.	15	N				‡	‡	See Note	B1				^{3}24A, ^{3}27, ^{2}45, 80		3
470, 470A	Vol.	2/8	DRP114				8, 8	1	RS213					^{5}24A, ^{2}27, 47, 80	260	3
							10	1	RS215	B12						
490	Vol.	15	N				8, 8	25	RS213					^{4}24A, ^{5}27, 47, 80	BC175 SW1000	3
							10	25	RS215	B12						
							14	25	RS215	B12						
500, 501	Vol.	64	TRP618	6	See Note	A58	8, 8	1	HD683					76, ^{2}77, ^{3}78, 37, ^{3}42, 5Z3	460	1
	Supp.	12	G12				10	19	BN226	B8						
503	Vol.	18	TRP605	6		A58	8, 8	1	RS213					6A7, ^{2}78, 75, ^{3}42, 80	260	1
							10	19	BN226	B8						
							1-1-2	13/14	UR181	B137						
504	Vol.	18	N	6			8-8	1	RN242					6A7, ^{2}78, 75, 42, 80	460	1
							8	13	RS213							
505	Vol.	18	N	6			8, 8	1	RS213					6A7, 78, 75, 42, 80	460	1
506 (Radio-Phonograph)	Vol.	18	TRP605	6		A58	8-8-10	1/19	RN241	B141				6A7, ^{2}78, 75, 42, 80	460	1
							6	13	RS213							
507	Vol.	18	TRP605	6		A58	8	1	RS213					^{2}78, 6A7, 75, ^{2}42, 80	260	1
							8-10	1/19	RN242	B139						
							1-1-1-2	13/14	UR181	B149						
509X	Vol.	18	TRP619	6		A58	8	1	HD683					^{3}78, 6A7, 37, 75, ^{3}42, 80	260	1
	Band		Order from	Mfr.			8-10	1/19	RN242	B139						
							1-2-1	13/14	UR181	B150						
							4-1	13	UR181	B151						
511, 512, 513, 514, 515, 531, 551	Vol.	2	G12				‡	‡	See Note	B1				^{4}26, 27, 71A, 80		11
570 Grandfather's Clock (Below B-22,000)	Vol.	2/8	DRP114				8, 8	1	RS213					^{4}24A, 27, 47, 80	260	3
							10	1	RS215	B12						

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PHILCO—Continued																
570 Grandfather's Clock (Above B-22,000)	Vol.	45	O				8, 8	4	RS213					[3]35, 24A, 47, 27, 80	260	3
							14	4	RS215	B12						
							10	4	RS215	B12						
571	Vol.	2	G12				‡	‡	See Note	B1				[4]26, 27, 71A, 80		11
600	Vol.	6	UM121-SS12	M26			8-4	1	CN151	B92				6A7, 77, 41, 80	460	1
602	Vol.	18	UM154-SS12	M26			16-16-10	1/15	RM259	B143				6A7, 78, 75, 43, 25Z5	470	
604	Vol.	18	TM231-SS1	M26		A64	16-16-8-10	41/15	CM164/CN142					6A7, 78, 75, 43, 25Z5	470	
610, 610B, 610F	Vol.	18	N	6			8, 8	1	RS213					6A7, 78, 75, 42, 80	460	1
							16	13	RS216							
611, 611 (121)	Vol.	18	N	6			16	51	RN232	B8				6A7, 78, 75, 43, 25Z5	460	
							10-10	51/15	RN232							
620, 620 (Code 121)	Vol.	18	TRP608	6		A58	8-8	1	RN242					[2]78, 6A7, 75, 42, 80	460	1
							16	14	RS216							
623	Vol.	45	N	13			8-4-2	12/13	RN235	B152				1C6, 34,[2]30, 32, 19	460	
624	Vol.	45	N	13			8-8	1	RN232		52	P285Y	C3	1C6, 1A4,[2]30, 32, 19	460	10
							8-10	12/15	RN232							
							.01		Buffer	B14						
625	Vol.	18	TRP608	6		A58	8-8	1	RN242					[2]78, 6A7, 75, 42, 80	460	1
							16	14	RS216							
630, 630 (121), 635, 635 (Code 124)	Vol.	18	TRP608	6		A58	8-8-10	1/19	RN245	B141				[2]78, 6A7, 75, 42, 80	460	1
							16	14	RS216							
640 (Code 121), 640X (Code 122)	Vol.	17	TRP608	6		A58	12	1	RS215					[2]78, 6A7, 85,[2]42, 80	460	1
							8	1	RS213							
							2-2-1	13/14	UR181	B147						
641	Vol.	18	TRP608	6										[2]78, 6A7, 85, 76,[2]43	460	
642	Vol.	20	TRP611	6			5	39	BN225	B11				78, 6A7, 76, 6F7, 85, [2]48	460	
643	Vol.	45	TRP613	13			2-4-8	12/13	RN235	B152				1C6, 1C1,[2]30, 32,[2]34, 19	460	
645	Vol.	18	TRP608	6		A58	12	1	RS215					6A7,[2]78, 85,[2]42, 80	460	1
							8	1	RS213							
							1-1-2	13/14	UR181	B150						
650	Vol.	18	TRP613	6		A58	8	1	RS213					[2]78, 6A7, 75,[3]42, 80	460	1
							8-10	1/19	RN242	B139						
							3-1-2	13/14	UR181	B146						
651	Vol.	18	TRP608	6			16	51	RN232	B8				[2]78, 6A7, 85, 76,[2]43, 25Z5	460	
							4-10-10	51/15	RN235							
655	Vol.	18	TRP613	6		A58	8	1	RS213					6A7,[2]78, 75,[3]42, 80	460	1
							8-10	1/19	RN242	B139						
							3-1-2	13/14	UR181	B146						
660, 665, 665 (Code 122)	Vol.	18	TRP613	6		A58	8	1	RS213					[3]78, 77, 76, 75,[3]42, 80	460	1
							8-10	1/19	RN242	B139						
							3-1-2	13/14	UR181	B146						
680	Vol.	18	N				8-8	1	RN242							
	Tone	15	O				8-4	14	RN241					6B7, 76,[4]78,[3]85, 6F7, 42,[2]6A3, 5Z3, 80	460	15
	Sel.		Order from	Mfr.			2-1-1-2	13/14	UR181	B153						
							50	19	RS208							
700	Vol.	18	N	6	FS251	A51	4-8-10	1/15	CN151/TS101	B130	42	500P	C3	[2]44, 77, 75, 42, 84	260	10
							.01		Buffer	B14						
800	Vol.	18	N	6	FS251	A51	4-8	1	CN151	B131	42	500P	C3	[2]44, 6A7, 75, 37, 79, 84	260	10
							.25-8-10	14/15	See Note	B135						
							.01		Buffer	B14						
800 (Code 122), 802	Vol.	18	TRP605	6	FS251	A51	4-8	1	CN151	B131	42	500P	C3	[2]44, 6A7, 75, 37, 79, 84	260	10
							.25-8-10	14/15	See Note	B135						
							.01		Buffer	B14						
805	Vol.	18	N		FS251	A51	4-4	4	CM170	B3	42	500P	C3	6A7, 78, 75, 41, 84	260	10
							.01		Buffer	B14						
806	Vol.	18	TRP605		FS251	A51	8-4	4	CM171	B3	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
	Tone	22	L				.01		Buffer	B14						
808	Vol.	18	TRP611		FS251	A51	4-8	1	CN151	B3	42	500P	C3	77, 6A7, 78, 75, 76, 6A6, 84	260	10
	Tone	44	UM140-SS12				8	14	CS133							
							10-10	15	BN226	B3						
							.01		Buffer	B14						
809	Vol.	18	N		FS251	A51	8-4	4	CM171	B3	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
	Tone	22	UM140-SS12				.01		Buffer	B14						
810PA, 810PB, 810PV	Vol.	18	N		FS251	A51	8-4	4	CM171	B3	42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
							.01		Buffer	B14						
816, 816B	Vol.	18	SRP282			A67	4-4	4	CM170		42	500P	C3	[2]78, 6A7, 75, 41, 84	260	10
							.01		Buffer	B14						
817	Vol.	18	SRP282			A67	4-8	4	RM261	B86	43	501P	C3	[2]78, 6A7, 75, 41, 84	260	10
							.0075		Buffer	B14						
818, 818K	Vol.	18	N				4-8	4	RM261	B86	43	501P	C3	[2]78, 6A7, 75, 41, 84	260	10
	Tone	22	M				.0075		Buffer	B14						
819, 819H	Vol.	18	N				8-8	23	RM262	B50	43	501P	C3	[2]78, 6A7, 75, 41, 84	260	10
	Tone	22	M				4	14	RS201							
							.0075		Buffer	B14						
811PA, 811PB, 811PV	Vol.	18	SRP282			A67	4-4	4	CN170		43	501P	C3	[2]78, 6A7,[2]75, 41	VAR	10
							.01		Buffer	B14						
821P	Vol.	18	SRP282			A67	4-8	4	RM261		15	506P	C3	[2]78, 6A7,[2]75, 41, 84	274	40
							.006		Buffer	B14						
821PV	Vol.	18	SRP282			A67	4-8	4	RM261		15	506P	C3	[2]78, 6A7,[2]75, 41, 84	260	40
							.006		Buffer	B14						
826	Vol.	18	SRP282			A67	4-8	4	RM261		43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
							.0075		Buffer	B14						
827	Vol.	18	SRP282			A67	4-8	4	RM261		43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
							.0075		Buffer	B14						
827K	Vol.	18	SRP282			A67	4-8	4	RM261		43	505P	C3	[2]78, 6A7, 75, 41, 84	260	10
							.0075		Buffer	B14						
828	Vol.	18	SRP282			A67	4-8	4	RM261		43	505P	C3	[2]78, 6A7, 75,[2]41, 84	260	10
							.006		Buffer	B14						
828K	Vol.	18	SRP282			A67	4-8-10	1/19	RN241/TS101		43	505P	C3	[2]78, 6A7, 85,[2]41, 84	260	10
							.006		Buffer	B14						
901, 902	Vol.	16	MR33				16-16	1	RM257					[2]6K5G, 25A6G, 25Z6G		
							10-10	15	TN111							
1421P	Vol.	18	TRP614			A3	4-8	1	RN241		43	505P	C3	[2]78, 6A7, 75, 37, 79, 84	260	10
	Sen.	7	UC500				.008		Buffer	B14						
PIERCE-ARROW—(Also see DeWald).																
506R	Vol.	6	SRP263		See Note	A14	2279	27/15	UR189	B94				6D6, 6C6, 43, 25Z5		
515	Vol.	6	SRP263	6	See Note	A14	10-10-4-4	6/15	UR189	B36				6D6, 6C6, 43, 25Z5		
517 Auto	Vol.	17	N	6	See Note	A1	2310	1	CN152		35	294	C3	6A7, 6D6, 75, 41, 84	456	10
	Tone	22	Z12		See Note	A1	2312	15	TS101							
							.01		Buffer	B14						
518	Vol.	6	SRP263	6	See Note	A14	10-10-4-4	6/15	UR189	B36				6D6, 6C6, 43, 25Z5		
520	Vol.	6	E12	6			2292	4	CM172					6A7, 6D6, 76, 42, 80	456	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PIERCE-ARROW—Continued																
522	Vol.	18	N	6										1A6, 1A4, 1B5, 30, 33	456	
523	Vol.	18	N	6			5-5	23	See Note	B3				6A7, 6D6, 75, 41, 84	456	1
525	Vol.	6	C12				2354	27/15	UR182	B95				6A7, 6D6, 76, 43,		
														25Z5	456	
609	Vol.	6	‡	6	See Note	A5	2294	27/15	UR182	B95				6A7, 6K7, 6J7, 43,		
														25Z5	456	
610, 610LW	Vol.	17	N	6	See Note	A5	2292	4	CM172					6A8, 6K7, 6H6, 6F5,		
														6F6, 80	456	1
611, 611LW	Vol.	6	‡	6	See Note	A5	2296	27/15	UR182	B95				6A8, 6K7, 6F5, 43,		
	Tone	21	‡		See Note	A5								25Z5	456	
612, 612LW	Vol.	6	‡		See Note	A5	2201	27/15	UR182	B95				6A8, 6K7, 75, 43,		
														25Z5	456	
615, 615LW	Vol.	6	‡	6	See Note	A5	2201	27/15	UR182	B95				6A8, 6K7, 75, 43,		
														25Z5	456	
617	Vol.	17	UM154	6	See Note	A96	2269	1	CN152		35	294	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
	Tone	22	UM137		See Note	A96	2270	15	TN110							
							.025-.025		Buffer	B14						
618	Vol.	18	N	6			16-16	27	CM164	B3				6A7, 6D6, 75, 43,		
	Tone	21	‡		See Note	A5								25Z5	456	
619	Vol.	6	C12	6			20-12-5	27/15	UR182	B95				6A7, 6D6, 76, 43,		
														25Z5	456	
620, 620LW	Vol.	18	N	6	See Note	A5	8-8	4	CM172	B3				6A7, 6D6, 75, 42, 80,		
	Tone	76	‡		See Note	A5								6G5	456	1
621, 621LW	Vol.	18	‡	6	See Note	A5	20-12	27	UR182	B155				6A7, 6D6, 75, 43,		
	Tone	76	‡		See Note	A5								25Z5	456	
622	Vol.	6	C12	6			20-12-5	27/15	UR182	B95				6A7, 6D6, 76, 43,		
														25Z5	456	
804, 805	Vol.	76	N	6			2282	26	CS133					^{2}58, 2A7, 2A6, ^{2}45,		
	Tone	76	N				2286	26	RM262					2A5, 80	456	1
							2259	15	TN111							
901, 902	Vol.	18	P	6			8	4	CS133					^{2}6K7, ^{2}6F6, 6H6, 6F5,		
	Tone	76	P				16	4	RS216					6A8G, 80, 6G5	456	1
1100	Vol.	15	N	6			20-12-5	27/15	UR182	B95				6A8, 6K7, 6H6, 6C5,		
	Tone	21	O				8	12	CS133					^{3}43, ^{2}25Z5	456	
1102, 1103	Vol.	18	N	6			8	12	RS203					^{2}6K7, 6A8G, 75, ^{2}25B6,		
	Tone	‡	‡				25-40	4	Order from	Mfr.				^{2}25Z5, 6G5	456	
PILOT																
Dual Wave TRF Midget	Vol.	7	E				12-8	4	See Note	B3				^{2}51, 24A, 47, 80		1
	Tone	34	L													
Pilotone (Electric)	Vol.	5	D12											^{5}26, 27		
2	Vol.	6	Y	6			4-12-8	8	CN145	B3				^{2}77, 78, 43, 25Z5	‡	
							6	15	TS101							
							5	15	TS101							
B2 Standard	Vol.	6	Y	6			4-8-12	6	CN145	B3				^{2}77, 78, 43, 25Z5	456	
							5-5	15	TN110							
D3	Vol.	6	G12	6			70871	8/15	UR189	B134				^{2}77, 78, 43, 25Z5	456	
4 Tube DC Super	Vol.	5	G12		EX150		2	4	See Note	B3				^{2}36, 37, 48	‡	
							4	‡	TN111							
PE6SG	Vol.	72	K12				3-3-3	3	See Note	B1				^{2}24, ^{2}27, ^{2}71A, 80		2
7, 8 (Dragon AW)	Vol.	17	UC503				8-8	4	See Note	B3				^{2}58, ^{2}57, 56, 2A6, 2A5,		
	Tone	34	L	6			2-2	13/15	See Note	B3				5Z3	115	1
	Supp.	12	Y				5-5	15	TN110							
L8 (8 Tube Dragon)	Vol.	18	UC503				8-8	23	See Note	B3				^{2}58, ^{2}56, 57, 55, 2A5,		
	Tone	34	L	6			2	13	See Note	B3				5Z3	115	1
	Sen.	6	H7		5		5-5	15	TN110							
10AC Dragon Super	Vol.	25	GG				8-8	4	See Note	B3				^{2}58, ^{2}57, 56, 47, 80	115	1
11 Dragon DC	Vol.	6	G7											^{2}36, 39, 37, ^{3}38	115	
12	Vol.	18	N				8-8	23	See Note	B3				57, 58, 55, 56, 59, 82	115	1
	Tone	34	Y				P22483	14	CS130							
	Sen.	5	G12				5	15	TS105							
F14 DC	Vol.	18	UC503				4-4	13	CN140	B3				77, 78, 85, 37, ^{2}48	456	
	Tone	22	G12													
	Sen.	5	G12													
20	Vol.	17	UC503				8-8	4	CM172	B3				57, ^{2}58, 55, 2A5, 25Z5	115	‡
	Tone	21	UC503				5	15	TS105							
	Sen.	7	H													
23, 25 (20 Series)	Vol.	15	UC503				85007	4	Order from	Mfr.				^{2}6K7, 6A8, 6Q7, 25L6,		
	Tone	34	G12	6			85008	4	RM252	B3				25Z6, 6G5	456	
							22481	15	TS101							
28DC	Vol.	18	UC503				2	1	CN140	B11				^{2}39, 36, 85, ^{2}37, ^{2}48	115	
	Tone	22	G12	6												
	Sen.	7	H7		5	A27										
31-81 (Rainbow Super)	Vol.	2	G12				8-8	4	CM172	B3				^{2}57, 2A5, 82	115	
							5	15	TS101							
33, 35 (30 Series)	Vol.	15	UC503	6			71045	1	RM262					6A8, 6K7, 6Q7, 6F6,		
	Tone	34	L				72353	14	CS131					5Y3G	456	1
							22481	15	TS101							
39 Series	Vol.	25	GG				8-8	4	See Note	B3				^{2}24A, 27, ^{2}35, 47, 80	115	1
	Tone	34	K12													
41 AC	Vol.	7	E	6	2		71647	1	RN241					6A7, 6F7, 42, 80	456	1
41 Series DC Dragon	Vol.	6	G12											^{2}36, 37, 39, ^{3}38	115	
	Tone	34	K12													
X41	Vol.	7	E	6	2		71647	1	RN241					6A7, 6F7, 42, 80	456	1
43 (with 47 output)	Vol.	6	D12				P22455	4	CS133					^{2}58, 57, 47, 80		1
	Tone	34	L				4	4	CS131							
43, 45 (with 42 output)	Vol.	7	E	6	2		8-4	1	See Note	B3				6A7, 6F7, 42, 80	456	1
Y43, Y45	Vol.	7	E	6	2		8-4	1	RN241					6A7, 6F7, 42, 80	456	1
G44, G45 (G40 Series)	Vol.	17	O				71203	12	RS203					1C7G, 1D5G, 1H6G,		
	Tone	22	L				22481	20	TS101					^{2}1F5G	456	
45 (Long Wave)	Vol.	7	E	6	2		8-4	1	RN241					6A7, 6F7, 42, 80	456	1
53	Vol.	17	UC503				8-8	1	CN152	B3				6A7, 6D6, 75, 42, 80	115	1
	Tone	34	L	6			5-5	15	TN110							
55 Captain Kidd Chest	Vol.	6	D12				8-8	4	See Note	B3				^{2}58, 57, 47, 80		1
	Tone	34	L													
55 (with 42 output)	Vol.	17	UC503				8-8	1	CN152	B3				6A7, 6D6, 75, 42, 80	115	1
	Tone	34	L	6			5-5	15	TN110							
G56, G57 (G50 Series)	Vol.	17	UC503	6			85020	1/13	RN245/CS131	B66	13	245A	C3	^{2}6D6, 6A7, 75, 41	456	10
	Tone	34	L				22481	15	TS101							
							.006		Buffer	B14						
63	Vol.	17	UC503				71106	1/13	CN152/CN140	B3				^{2}6D6, 6A7, 75, 42, 80	456	1
	Tone	34	L	6			70991	15	TN110							
X63, X65	Vol.	17	UC503				71916	1/15	RN245					^{2}6D6, 6A7, 75, 42, 80	456	1
	Tone	34	L	6			71915	13/15	CN150/TS101	B3						
68 DC	Vol.	17	UC503				4-4-4	26	Order from	Mfr.				^{2}6D6, 6A7, 75, ^{2}43	456	
	Tone	34	G12				5	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PILOT—Continued																
X68, X69 (DC)	Vol.	17	UC503				4-4-4	26	Order from	Mfr.				^{2}6D6, 6A7, 75,^{2}43	456	
	Tone	22	G12	6			22481	15	TS101							
73, 75	Vol.	15	NN				7[illegible]	[illegible]	RS203					^{3}34, 1C6, 1A6, 30, 19	456	
	Tone	34	L	7												
X73, X75	Vol.	15	UC503				71203	12	RS203					^{3}34, 1C6, 1B5, 30, 19	456	
	Tone	44	L	7												
81 (Dragon AW)	Vol.	18	UC503				8-8	4	See Note	B3				^{2}58, ^{2}57, 56, 2A6, 2A5, 5Z3	115	1
	Tone	34	L	6			2-2	13	See Note	B3						
	Supp.	12	Y				5-5	15	TN110							
81 Rainbow	Vol.	2	G12				8-8	4	See Note	B3				^{2}57, 2A5 or 47, 80 or 82	482	1
							5	15	TS101							
84 (Dragon AW)	Vol.	17	UC503				8-8	4	See Note	B3				^{2}58, ^{2}57, 56, 2A6, 2A5, 5Z3	115	1
	Tone	34	L	6			2-2	13	See Note	B3						
	Supp.	12	Y				5-5	15	TN110							
93 (AC-DC)	Vol.	17	UC503				70871	8/15	UR189	B134				6A7, 6D6, 75, 43, 25Z5	456	
103, 105	Vol.	17	UC503	6			71045-B	1	RN242					6A7, 6D6, 75, 42, 80	456	1
							71215	13	CS131							
SG105	Vol.	12	M				‡	‡	See Note	B1				^{2}4,^{2}27,^{2}71, 80		‡
K106	Vol.	12	M				‡	‡	See Note	B1				^{2}24,^{3}27, 71A, 80		‡
108, 109 (DC)	Vol.	17	UC503	6			71600	26	Order from	Mfr.				6A7, 6D6, 75,^{2}43	456	
	Tone	34	G12				22481	15	TS101							
K108	Vol.	4	E12				‡	‡	See Note	B1				^{2}26,^{3}27,^{2}71, 80		‡
114, 115	Vol.	15	UC503	6			71589	41/13	RN245					^{3}6D6, 6A7, ^{2}76, 85, 6C6,^{2}42, 5Z3	456	1
	Sen.	7	E				71588	41/14	RN241							
							71590	15	BN226							
K117 "Twin Screen Grid 8"	Vol.	2	D12				2-3-3	3	See Note	B1				^{4}24, 27,^{2}45, 80	•	3
K121, K121X (Battery) Country Special	Vol.	12	K12											^{2}24,^{2}01A,^{2}12A		
K122, K123, K124	Vol.	12	K12				3-3-3	3	See Note	B1				^{2}24A,^{2}27,^{2}71A, 80		2
123	Vol.	17	UC503	6			71676	1/24	UR182					^{2}6D6, 6A7, 75, 43, 25Z5	456	
	Tone	34	L				71675	15	TN111							
125	Vol.	17	MR51				71676	6/13	UR182					^{2}6D6, 6A7, 75, 43, 25Z5	456	
	Tone	34	L	6			71675	15	TN111							
K126, K128	Vol.	12	K12				3-3-3	3	See Note	B1				^{3}24, 27,^{2}45, 80		2
K136 AC Universal Wasp	Vol.	12	K12				4-2-2-1-1	‡	See Note	B1				^{2}24, 27,^{2}45, 80		3
140 Auto Set	Vol.	12	K12											^{2}24A, 27, 45		
S141 Universal	Vol.	12	K12				2-2-4	3	See Note	B1				^{2}24, 27,^{2}45, 80		2
W145 Public Address System	Vol.	15	N				‡	3	See Note	B4				^{3}27,^{2}50,^{2}81		25
S148	Vol.	7	D				12-8	4	See Note	B3				^{2}51, 24,^{2}27, 47, 80	175	1
	Tone	34	L													
C151	Vol.	7	D				12-8	4	See Note	B3				^{2}51, 24,^{2}27, 47, 80	175	1
	Tone	34	L													
C153, C154 (with 2-45s)	Vol.	23	MM				8-8-4	1/14	See Note	B3				^{4}51,^{2}27,^{2}45, 80	175	1
	Tone	41	L													
C153, C154 (with 47s)	Vol.	23	MM				8-8-8-4	3/14	See Note	B3				^{4}51,^{2}27,^{2}47, 80	175	3
	Tone	41	L													
153, 155, X153, X155	Vol.	15	UC503	7			71203	12	RS203					1C6,^{2}34, 1B5, 33	456	
Model AC Midget S155, S155A, S155B, S155F	Vol.	6	E12			A4	2-3-4-1	3	See Note	B1				^{3}24, 27, 45, 80		3
	Vol.	12	K12			A27										
	Tone	21	N			A4										
S156, S158 DC Midget	Vol.	11	K12				6	‡	See Note	B11				^{4}01A,^{2}71A		
AC Midget C157, C157A, C157B, C157F	Vol.	21	K12				2-3-4-1	3	See Note	B1				^{3}24A, 27, 45, 80		3
	Tone	21	N			A4										
C162	Vol.	7	D				12-8	4	See Note	B3				^{2}51, 24,^{2}27, 47, 80	175	1
	Tone	34	L													
G162, TG162, G163 (G160 Series)	Vol.	18	M	6			30-20	4	Order from	Mfr.				6A7, 6D6, 75, 25L6, 25Z5	456	
S164	Vol.	7	D				12-8	4	See Note	B3				^{2}51, 24,^{2}27, 47, 80	175	1
	Tone	34	L													
C165	Vol.	7	D				12-8	4	See Note	B3				^{2}51, 24,^{2}27, 47, 80	175	1
	Tone	34	L													
171 Amplifier and Power Supply	Mic.	......	A400P				2-2-2	3	See Note	B1				27,^{2}71A, 80		25
G174, G175 (G170 Series)	Vol.	17	UC503				40-40	4	Order from	Mfr.				^{2}6K7, 6A8, 6Q7, 25L6, 25Z6G, 6G5	456	
	Tone	34	G12	6			85008	13	RM252	B3						
							22481	15	TS101							
183	Vol.	15	UC503	6			71045	28	RN242					6A8, 6K7, 6H6, 6J7, 6F6, 5Z4	456	1
	Tone	34	L				72168	28	CS133							
							22481	15	TS101							
G184, PG184, TG184, G185 (G180 Series)	Vol.	17	UC503				40-40	4	Order from	Mfr.				^{2}6K7, 6A8, 6Q7, 25L6, 25Z6G, 6G5	456	
	Tone	34	G12	6			85008	13	RM252	B3						
							22481	15	TS101							
185	Vol.	15	UC503	6			71045	28	RN242					6A8, 6K7, 6H6, 6J7, 6F6, 5Z4	456	1
	Tone	34	L				72168	28	CS133							
							22481	15	TS101							
V191, S.W. Conv.	......	......					4-4	1	See Note	B3				^{2}24A, 27, 80		1
193, C193, 195 (190 Series)	Vol.	17	UC503	6			71045	1	RN242					6A8, 6K7, 6Q7, 6F6, 5W4 or 5Y3G	456	1
	Tone	34	L				72353	13	CS131							
							22481	15	TS101	B10						
VX201, WX201, X201	Vol.	17	UC503	6			85014	4	RS208					6A7, 6D6, 75, 25L6, 25Z5	456	
	Tone	22	L				85021	4/13	RN235							
							22481	15/19	TS101							
203, 205	Vol.	17	P	6			72382	1	RM257					6A8, 6D6, 75, 43, 25Z5	456	
							78704	13	RS201							
							22481	15	TS101							
X203, BX203, UX203, WX203, X205	Vol.	17	UC503	6			85014	4	RS208					6A7, 6D6, 75, 25L6, 25Z5	456	
							85021	4/13	RN235							
							22481	15/19	TS101							
213	Vol.	15	UC503				71045	1	RN242					^{2}6K7, 6A8, 6H6, 6J7, 6F6, 5Z4	456	1
	Tone	22	L	6			72252	24	RN241							
							70971	15	TN111							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
PILOT—Continued																
215	Vol.	15	UC503				71045	1	RN242					^{2}6K7, 6A8, 6H6, 6J7,		
	Tone	22	L	6			72252	24	RN241					6F6, 5Z4	456	1
							70971	15	TN111							
253	Vol.	17	UC503	6			78623	1/13	RN245		31	285XS	C17	^{2}6D6, 6A7, 76, 41	456	10
	Tone	34	L				22481	15	TS101		13	245	C18			
							.01		Buffer	B14	13	245A	C19			
G274	Vol.	17	UC503				78594	1/13	RM257					^{2}6K7, 6A8, 6Q7, 25A6,		
	Tone	34	L	6			85013	13	RN235					25Z6G, 6G5	456	
							22481	15	TS101							
G274J	Vol.	17	UC503				12-12-4	1/13	RM257	B3				^{2}6K7, 6A8, 6Q7, 25A6,		
	Tone	34	L	6			34-4	1/13	RM259	B3				25Z6G, 6G5	456	
							22481	15	TS101							
G284	Vol.	17	UC503				40-40	4	Order from	Mfr.				^{2}6K7, 6A8, 6Q7, 25L6,		
	Tone	34	G12	6			85023	13	RN235	B3				25Z6G, 6G5	456	
							22481	15	TS101							
293, 295	Vol.	17	O				85004	1	RS215					^{2}6K7, 6A8, 6Q7, 6F6,		
	Tone	34	L	6			85005	1	RS216					5W4	456	1
							22481	15	TS101							
							72252	13	RN241							
301, 305 (300 Series)	Vol.	17	MR55	M26			30-30	1	Order from	Mfr.				^{2}6K7, 6A8, 6R7, ^{4}25A6,		
	Tone	44	MR39				78688	13	RM259					^{2}25Z6, 6E5	456	
							85002	15	TS103							
X304, X305 (X300 Series)	Vol.	17	MR57	M26			85014	1	RS208					^{2}6K7, 6A8, 6R7, ^{4}25A6,		
	Tone	44	MR18				78688	13	RM259					6E5, ^{2}25Z6	456	
							85002	15	TS103							
G352, VG352, WG352, G353	Vol.	17	MR51	M26			85014	4	RS208					6A7, 6D6, 75, 25L6,		
							85021	4/13	RM257					25Z5	456	
							22481	15/19	TS101							
364, 365 (360 Series)	Vol.	‡	Order from	Mfr.			8-8-8	1/20	RM265					^{3}6K7, ^{2}6C5, 6L7, ^{2}6J7,		
	Tone	44	L				4-4-2-2	13/14	RN245/CS130					6E5, ^{2}6F6, 5Z4	456	1
	Clr'ty	‡	20M		See Note A3											
393, 395	Vol.	17	MR53				71045	1	RN242					^{2}6K7, 6A8, 6Q7, 6G5,		
	Tone	34	L	6			22481	15	TS101					6F6, 5W4	456	1
403, 405 (400 Series)	Vol.	17	MR51	M26			71045-A	1	RN242					6A8, 6K7, 6Q7, 6F6,		
	Tone	34	L				72353	13	CS131					5W4	456	1
423, 425 (420 Series)	Vol.	17	MR51				71676	1/13	UR182					^{2}6K7, 6A8, 6Q7, 25L6,		
	Tone	34	L	6			71675	15	TN111					25Z6	456	
TP423, TP425 (TP420 Series)	Vol.	17	MR51				85014-B	25	RS208					^{2}6K7, 6A8, 6Q7, 25L6,		
	Tone	34	Y	6			78688	25/13	RM259	B3				25Z6G	456	
							22481	15	TS101							
G462	Vol.	18	MR44				30-20	4	Order from	Mfr.				6A7, 6D6, 75, 25L6,		
							4-4	13	CN140					25Z5	456	
G462A, G462B	Vol.	18	MR44	M26			85207	1	RM257					6A7, 6D6, 75, 43,		
							85035	13	CN140					25Z5	456	
							22481	15	TS101							
G463A, G463B	Vol.	18	MR44	M26			85027	1	RM257					6A7, 6D6, 75, 43,		
							22481	15	TS101					25Z5	456	
G508, G509	Vol.	17	MR51				85030	‡	WE2545					^{2}6K7, 6L7, 6J7, 6B8,		
	Tone	41	MR51	M26			85028	13/14	RN245/CS131					6E5, 6Q7, ^{2}6V6G,		
							22481	15	TS101					5U4G	456	1
G528, TG528, G529, TG529	Vol.	17	MR51				85016	1	WE3540					^{2}6K7, ^{2}6L7, 6J7, 6H6,		
	Tone	41	MR51				85019	13/14	RN245/CS131					6E5, 6Q7, ^{2}6L6,		
	Sen.	7	H				85018	1/13	RN245					^{2}5Z3	456	1
							22481	15	TS101							
G562, G563	Vol.	17	MR51	M26			71045-A	1	RN242					6A8G, 6K7G, 6H6G,		
	Tone	34	L				72353	14	CS131					6J7G, 6F6G, 5Y3G	456	1
							22481	15	TS101							
G576, G577 (G570 Series)	Vol.	17	MR53				85004	1	RS215					^{2}6K7, 6A8, 6Q7, 6G5,		
	Tone	34	L	6			85005	1	RS216					6F6, 5Y3G	456	1
							72252	13	RN241							
							22481	15	TS101							
G584, G585 (G580 Series)	Vol.	17	MR51	M26			85024	1	RN245					6A8G, 6K7G, 6Q7G,		
	Tone	44	MR33				85025	13	RN245/CS131					6H6, 6E5, ^{2}6V6G,		
							22481	15	TS101					5Y3G	456	1
G674, G675	Vol.	17	MR53				71045	1	RN242					^{2}6K7, 6A8, 6Q7, 6G5,		
	Tone	34	L	6			72252	13	RN241					6F6, 5Y3G	456	1
							22481	15	TS101							
G752, TG752, G753 (G750 Series)	Vol.	18	MR48				85022	1	CN152					6A7, 6D6, 75, 41, 80	456	1
							22481	19	TS101							
G774	Vol.	17	MR53				71045-B	1	RN242					^{2}6K7, 6A8, 6Q7, 6G5,		
	Tone	34	L	6			72252	13	RN241					6F6, 5Y3G	456	1
							22481	15	TS101							
G852	Vol.	18	MR48				85022	1	CN152					6A7, 6D6, 75, 41, 80	456	1
							85031	13	CN150							
1010 All Wave Dragon	Vol.	6	G12				8-8	4	See Note	B3				^{2}24A, 27, 35, 47, 80	115	1
G5206, CG5206, TG5206, G5207 (G5200 Series)	Vol.	18	UC503	6			85033	1/13	RN245		13	F245	C3	^{2}6D6, 6A7, 75, 41	456	10
	Tone	34	L				22481	‡	TS101							
							.006		Buffer	B14						
PLAZA MUSIC CO.																
6 Tube Long Wave	Vol.	6	‡		See Note A5		8-8	4	See Note	B3				^{2}58, ^{2}57, 47, 80	175	1
	Tone	34	‡		See Note A5											
6 Tube T. R. F.	Vol.	6	‡		See Note A5		8-8	4	See Note	B3				^{3}35, 24A, 47, 80		1
	Tone	22	‡		See Note A5											
7 Tube Super	Vol.	6	‡		See Note A5		8-8	4	See Note	B3				56, 57, ^{3}58, 47, 80	175	1
	Tone	22	L													
24 Standard	Vol.	6	H12				8-8	4	See Note	B3				‡		1
	Tone	22	Z12													
49A	Vol.	7	Y100MP		EX400		8-4	6	CN141					39, 36, 37, 43, 25Z5		
							442A	15	TN113							
549 (5 tube Super)	Vol.	3	K12				380	6	CN142					^{2}78, 77, 43, 25Z5	456	
							442A	15	TN113							
711 (5 Tube Super)	Vol.	6	H7		2		8-8	4	See Note	B3				^{2}57, 58, 47, 80	175	1
711 Junior	Vol.	6	‡	6	See Note A5		8-8	4	See Note	B3				^{2}58, 57, 47, 80		1
PRECISION																
6 Tube A-W Super	Vol.	18	N	6			8-8	23	See Note	B3				6A7, ^{2}6D6, 75, 42, 80	465	1
	Tone	22	Y													
8 Tube A-W	Vol.	83	N				8-8	1	See Note	B3				57, ^{2}58, 55, ^{2}2A5, 5Z3	465	1
	Tone	44	Y													
511	Vol.	18	N	6			4-4	23	CM170	B3				6A7, 6D6, 75, 42, 80	465	1

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
PREMIER—See Airking																
RADIETTE (Also see Keller-Fuller). 54, 64	Vol.	18	UM154	‡	See Note A96		6-10 .02	4	CM172 Buffer	B3 B14	35	294	C3	6A7,^{2}6D6, 75, 42, 84	456	10
RADIOBAR																
106 (6 tube)	Vol. Tone	15 22	N K12	6			8-8	4	See Note	B3				2A7,^{2}58, 55, 2A5, 80	262.5	1
210 (10 tube with 46's)	Vol.	15	N	6			4-8-4	3	See Note	B3				55,^{2}56, 57,^{3}58,^{2}46, 82	262	1
210B (8 tube with 59's)	Vol. Tone Sen.	83 22 8	N UC502 UC500	6			8-8	1	See Note	B3				55, 56, 57,^{2}58,^{2}59, 5Z3	262	1
210B (10 tube with 59's)	Vol. Tone Sil.	15 22 ‡	N UC502 ‡	6	 See Note A5		8-8 4	35 19	See Note CS121	B3 B3				^{2}57,^{2}56,^{2}58, 55,^{2}59, 82	262	1
210C (10 tube with 59's)	Vol. Tone Sil.	15 22 ‡	N UC502 ‡	6	 See Note A5		8-8 4	35 19	See Note CS121	B3				55,^{2}56,^{2}57,^{2}58,^{2}59, 82	262	1
505 (5 tube)	Vol. Tone	56 22	N G12	6			4-8	23	See Note	B3				57, 58, 55, 2A5, 80	175	1
506 (6 tube)	Vol. Tone	15 22	N K12	6			8-8	4	See Note	B3				2A7,^{2}58, 55, 2A5, 80	262	1
508 (8 tube with 59's)	Vol. Tone Sen.	83 22 8	N UC502 UC500	6			8-8	1	See Note	B3				55, 56, 57,^{2}58,^{2}59, 5Z3	262	1
510 (10 tube with 46's)	Vol.	15	N	6			4-8-4	3	See Note	B3				^{3}58, 57, 55, 56,^{2}46, 82	262	1
510 (10 tube with 59's)	Vol. Tone Sil.	15 22 ‡	N UC502 ‡	6	 See Note A5		8-8 4	35 19	See Note CS121	B3				55,^{2}56,^{2}57,^{2}58,^{2}59, 82	262	1
526 (6 tube)	Vol. Tone	83 22	N UC502	6			8-8	4	See Note	B3				2A7,^{2}58, 55, 2A5, 80	262.5	1
528 (8 tube with 59's)	Vol. Tone Sen.	15 22 ‡	N K12 UC500	6			8-8	1	See Note	B3				55, 56, 57,^{2}58,^{2}59, 5Z3	262	1
RADIO CHASSIS, INC. (Marquette).																
Auto Receiver	Vol.	18	UM154		See Note A96		5	15	TS101					^{2}78, 6A7, 75, 41	175	
A5D	Vol.	6	G7		3		16-8 5-5	6 15	CN145 TN110	B124				^{2}78, 77, 43, 25Z5	175	
A6D	Vol.	18	N				16-8 5-5	6 15	CN145 TN110	B124				^{2}78, 6A7, 75, 43, 25Z5	175	
AC25	Vol.	6	G7		3		8-8	4	See Note	B3				58, 57, 55, 47, 80		1
AC35	Vol.	8	G		3		8-8	4	See Note	B3				58, 57, 47, 80	175	1
AC36	Vol.	8	G		3		8-8	4	See Note	B3				^{2}58, 57, 56, 47, 80	175	1
HOAR48	Vol.	8	G		3		8-8	4	See Note	B3				58,^{2}35, 24, 27,^{2}47, 80		1
L5D	Vol. Tone	6 22	D L		3		16-8 5-5	6 15	CN145 TN110	B124				6A7, 78, 77, 43, 25Z5	456	
L6D	Vol.	17	N				16-8 5-5	6 15	CN145 TN110	B124				^{2}78, 6A7, 75, 43, 25Z5	115	
L6W	Vol.	17	N				8-8 5	4 15	See Note TS101	B3				^{2}58, 2A7, 2A6, 47, 80	125	1
LSA36	Vol.	8	G		3		8-8	4	See Note	B3				^{2}58, 57, 47, 80	175	1
LSA37	Vol.	8	G		3		8-8	4	See Note	B3				^{3}58,^{2}56, 47, 80	175	1
QAC35	Vol.	8	G		3		8-8	4	See Note	B3				^{2}58, 57, 47, 80		1
QAC36	Vol.	8	G		3		8-8	4	See Note	B3				^{2}58, 57, 56, 47, 80	175	1
SDC36	Vol.	8	G		2									^{2}39, 36, 37,^{2}48		
SMA24	Vol.	6	G7		3		8-8	4	See Note	B3				58, 57, 47, 80		1
SMA25	Vol.	6	D7		3		8-8	4	See Note	B3				58, 57, 56, 47, 80		1
RADIO CIRCULAR																
5 Tube A. W. (AC)	Vol. Tone	17 22	N L				8-8-4 5	4/13 15	RM265 TS105	B58				6A7, 6D6, 75, 42, 80	456	1
ACE 5 Tone Dual (Battery)	Vol. Tone	15 22	N L	‡			2	12	CS121					1C6, 34,^{2}30, 33	456	
ACE 5 Tube AC-DC Dual All-Wave	Vol.	17	N	‡			5-20-8-4 5	11/13 15	See Note TS105	B154				6A7, 6D6, 75, 43, 25Z5	456	
ACE 817	Vol. Tone	17 22	N L				4-8-8-8-8 5	‡ 15	See Note TS105	B3				^{2}6D6, 6A7, 75,^{3}42, 80	456	1
RADIOCHRON—See Clago.																
R. C. A.																
9 Tube General Purpose A.W. (AVR-5A)	Vol. Tone Sen.	19 21 6	TRP603 UC505 J	6			6889 6609 6626	6 6 14/15	RS216 RS216 CS121/TN111					^{2}58, 2A7, 2B7,^{2}56, 53, 80	445	1
RCA Short Wave Adapter	Vol.	26	J											24A,^{2}27	1000	
Premax P1 AC/DC	Vol.	7	UC509	6			3538 3536	1 15	CN140 TN110					36, 37, 38, 39		
AVR-1	Vol. Tone	19 21	TRP603 O	6			6571 6609 6626	1 1 14/15	RS215 RS216 CS121/TN111					^{3}58, 2A7, 2B7, 56, 53, 80	445	1
R-3-B (Battery)	Vol.	9	Y100MP											^{2}34, 32,^{2}30, 33	456	
R-3-C (200/230 V. D. C.)	Vol.	7	E				4-4	13/15	See Note	B156				^{3}39,^{2}37, 89	460	
4T	Vol.	6	F7	6	3	A59	11240 5212	25 25	RS215 RS216					6A7, 6B7, 41, 1V	460	25
4X, 4X3, 4X4	Vol.	7	G	6	3		12844	50	RM257	B157				6A7, 6F7, 43, 25Z5	460	
R-4	Vol. Tone	7 21	SRP134 K12	6			8839	4/14	CM175	B158				24A,^{2}35, 47, 80,^{2}27	175	1
T4-8	Vol.	98	E	6			6661 6832	1/15 13	SR625 CS121					6A7, 6F7, 41, 1V	460	29
T4-8A	Vol.	6	F7	6	3		11240 11497	25 25	RS215 RS213					6A7, 6B7, 41, 1V	460	25
T4-9	Vol.	98	E	6			6661 6832	1/15 13	SR625 CS121					6A7, 6F7, 41, IV	460	29
T4-9A	Vol.	6	F7	6	3		11240 11497	25 25	RS215 RS213					6A7, 6B7, 41, 1V	460	25
T4-10	Vol.	7	UC509	6			11268 7956	1 15	CN140 TN110					6D6, 6C6, 38, 76		

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
R. C. A.—Continued																
5BT	Vol.	18	MR44	M27			13295	12/13	CN141					1A6, 1A4, 1F6, 30, 19	460	
5M Automobile	Vol.	56	TM222-SS4	M26			12234	1	RS213		19	249	C3	6D6, 6A8, 6K7, 6B7,		
	Tone	22	MR39		See Note	A60	12238	1/15	CS133/TN111					42	260	10
							.01-.01		Buffer	B14						
5T	Vol.	17	TRP613				11240	1	RS215					6A7, 6D6, 75, 42, 80	460	1
							5212	1	RS216							
5T1, 5T4, 5T5	Vol.	17	TRP613				11240	1	RS215					6A7, 6D6, 75, 42, 80	460	1
							5212	1/13	RS216							
5T6, 5T7, 5T8	Vol.	17	TRP613				11240	1	RS215					6A8, 6K7, 6Q7, 6F6,		
							5212	1	RS216					5W4	460	1
5X2	Vol.	18	M	6			12677	4	RM257					6A7, 78, 75, 43, 12Z3	460	
							12682	15	TS101							
5X, 5X3, 5X4	Vol.	18	M	6			12398	6/15	RM259	B159				6A7, 78, 75, 43, 25Z5	460	
AVR-5A 9 Tube																
Gen. Purpose AW.	Vol.	19	TRP603				6889	6	RS216					[2]58, 2A7, 2B7,[2]56, 53,		
	Tone	21	UC505	6			6609	6	RS216					80	445	1
	Sen.	6	J				6626	14/15	CS121/TN111							
R-5-AC Radiolette	Vol.	2	Y				2957	4	RS215					[2]24A, 47, 80		1
R-5 DC	Vol.	2	Y											[2]36,[2]38		
R-5-X AC Radiolette	Vol.	2	Y				2957	4	RS215					[2]24A, 47, 80		1
	Reg.	7	J													
T-5 End Table																
Electrola	Vol.	63	SRP152											No tubes used		
T-5-2	Vol.	19	TRP603	6			7790	1	RS215					6A7, 6D6, 6B7, 41, 80	460	1
							4428	1	RS213							
							7589	13/14	SR627							
							3796	15	TS105							
6BK	Vol.	18	M				12804	12/13	CN152					1C6, 1A4, 1F6, 30,[2]49	460	
6BK6	Vol.	18	M				12804	12/13	CN152		30	W285	C3	1C6, 1A4, 1F6, 30,[2]49	460	10
							11387	12	RS215							
							.02-.02		Buffer	B14						
6BT	Vol.	18	M				12804	12/13	CN152					1C6, 1A4, 1F6, 30,[2]49	460	
6BT6	Vol.	18	M				12804	12/13	CN152		30	W285	C3	1C6, 1A4, 1F6, 30,[2]49	460	10
							11387	12	RS215							
							.02-.02		Buffer	B14						
6K	Vol.	15	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
	Tone	150	SRP288	6	See Note	A59	5212	1	RS216					6F6, 5Z4	460	1
	Vol.	15	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
6K2	Tone	150	SRP288	6	See Note	A59	5212	1	RS216					6F6, 5Z4	460	1
							11387	14	RS215							
6K3	Vol.	20	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
							5212	1	RS216					6F6, 5W4	460	1
							11387	13	RS215							
6M and 6M2	Vol.	17	TM241-SS4				12234	1	RS213		19	249	C3	6D6, 6A8, 6K7, 85,		
	Tone	22	MR39		See Note	A60	12238	1/15	CS133/TN111					6C5, 6A6	260	10
							.01-.01		Buffer	B14						
6T	Vol.	15	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
	Tone	22	SRP288	6	See Note	A59	5212	1	RS216					6F6, 5Z4	460	1
6T2	Vol.	15	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
	Tone	22	SRP288	6	See Note	A59	5212	1	RS216					6F6, 5Z4	460	1
							11387	14	RS215							
6T5	Vol.	15	TRP613				5212	25	RS216					6A7, 6D6, 75, 42,		
							11240	25	RS215					6G5, 80	460	1
BC6-4	Vol.	18	M				11595	12	CS123					1C6, 34, 1B5, 30,[2]49	460	
BC6-6	Vol.	18	M				11387	1	RS215		30	285	C3	1C6, 34, 75, 30,[2]49	460	10
							6832	13	CS121							
							11645	15	TS101							
							.01-.01		Buffer	B14						
BT6-3	Vol.	18	M				11595	12	CS123					1C6, 34, 1B5, 30,[2]49	460	
BT6-5	Vol.	18	M				11387	1	RS215		30	285	C3	1C6, 34, 75, 30,[2]49	460	10
							6832	13	CS121							
							11645	15	TS101							
							.01-.01		Buffer	B14						
BT6-10	Vol.	18	M				11595	12	CS123					1C6, 34, 1B5, 30,[2]49	460	
C6-2	Vol.	20	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
							5212	1	RS216					6F6, 80	460	1
							11387	14	RS215							
C6-8	Vol.	20	TRP613				11821	27/19	RM259/TS101	B170				6A8, 6K7, 6H6, 6J7,		
							5212	13	RS216					25A6, 25Z6	460	
C6-12	Vol.	18	M	6	See Note	A59	11240	25	RS215					6A8, 6K7, 6H6, 6F5,		
							5212	25	RS216					6F6, 5Z4	460	1
(Hudson) H-6	Vol.	17	UM147-SS6	M26			8	1	RS213		35	294	C3	[2]6D6, 6A7, 6B7, 41, 84	260	10
							4	1	RS211							
							10	15	TS101							
							.02-.02		Buffer	B14						
R-6	Vol.	7	SRP134				8839	4/14	CM175	B158				[2]35, 24A,[2]27, 47, 80	175	1
	Tone	21	K12	6												
T6-1	Vol.	20	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
							5212	1	RS216					6F6, 80	460	1
							11387	14	RS215							
T6-7	Vol.	20	TRP613				11821	27/19	RM259/TS101	B170				6A8, 6K7, 6H6, 6J7,		
							5212	13	RS216					25A6, 25Z6	460	
T5-9	Vol.	15	P				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
							5212	1	RS216					6F6, 80	460	1
							11387	13	RS215							
T6-11	Vol.	18	M	6	See Note	A59	11240	25	RS215					6A8, 6K7, 6H6, 6F5,		
							5212	25	RS216					6F6, 5Z4	460	1
7K, 7T	Vol.	20	TRP613				11240	1	RS215					6L7, 6J7, 6K7, 6H6,		
	Tone	150	SRP288	6	See Note	A59	5212	1	RS216					6F5, 6F6, 5Z4	460	1
7K1, 7T1	Vol.	20	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
							5212	1	RS216					6F6, 6G5, 5W4	460	1
							11387	13	RS215							
7U	Vol.	20	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
	Tone	150	SRP288	6	See Note	A59	5212	1	RS216					6F6, 5Z4, 6E5	460	1
							11387	13	RS215							
7U2	Vol.	20	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6G5,		
	Tone	150	SRP288	6			5212	1	RS216					6F5, 6F6	460	1
							11387	13	RS215							
7X	Vol.	20	TRP613				12998	52	RM259/TS101	B186				6L7, [2]6J7, 6K7, 6H6,		
	Tone	150	SRP288	6			5212	52	RS216					25A6, 25Z6	460	
BC7-9	Vol.	45	M				11344	12	CS123					1C6,[2]34,[2]30, 32, 19	460	
BT7-8	Vol.	45	M				11344	12	CS123					1C6,[2]34,[2]30, 32, 19	460	
C7-6	Vol.	20	TRP613				11240	1	RS215					[2]6K7, 6A8, 6H6, 6F5,		
							5212	1	RS216					6F6, 80	460	1
							11387	14	RS215							
C7-14	Vol.	20	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5,		
							5212	1	RS216					6F6, 5Z4, 6E5	460	1
							11387	14	RS215							
D7-7	Vol.	20	TRP613				11240	1	RS215					[2]6K7, 6A8, 6H6, 6F5,		
	Phono.	63	Order from	Mfr.			5212	1	RS216					6F6, 80	460	1
							11387	14	RS215							

4

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
R. C. A.—Continued																
R7 Superette	Vol.	7	SRP134				2957	4	RS215					^{2}35, 24A, ^{2}27, ^{2}45, 80	175	1
	Tone	41	N				3057	4	RS211							
R-7A (AC) Superette	Vol.	7	SRP134				2957	4	RS215					^{2}35, ^{2}27, ^{2}47, 80	175	1
	Tone	41	Y200MP	6												
R-7 Superette (DC)	Vol.	7	SRP134											24A, ^{2}35, ^{2}45, ^{2}27	175	
	Tone	41	N													
R7-LW	Vol.	7	A5MP				2957	4	RS215					^{2}35, 24A, ^{2}27, ^{2}45, 80	110	1
							3057	4	RS211							
T7-5	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6A8, 6H6, 6F5, 6F6, 80	460	1
							5212	1	RS216							
							11387	14	RS215							
T7-12	Vol.	20	TRP613				11240	1	RS215					6A8, 6K7, 6H6, 6F5, 6F6, 5Z4, 6E5	460	1
							5212	1	RS216							
							11387	14	RS215							
Victor 7-11 (Radiola 18)	Vol.	1	SRP144				1-1-.5	3	See Note	B1				^{4}26, 27, 71A, 80		11
Victor 7-25 (Radiola 17)	Vol.	1	SRP145				‡	3	See Note	B1				^{4}26, 27, 71A, 80		11
Victor 7-26 Electrola Radiola	Vol.	1	SRP144				1-1-.5	3	See Note	B1				^{4}26, 27, 71A, 80		11
	Phono.	63	‡		See Note	A61										
8BK	Vol.	18	M				12804	13	CN152					1A6, ^{2}1A4, 1F6, 1B4, 30, ^{2}49	460	
	Tone	41	N													
8BK6	Vol.	18	M				12804	13	CN152		30	W285	C3	1A6, ^{2}1A4, 1B4, 1F6, 30, ^{2}49	460	10
	Tone	41	N				11387	12	RS215							
							.02-.02		Buffer	B14						
8BT	Vol.	18	M				12804	13	CN152					1A6, ^{2}1A4, 1F6, 30, ^{2}49, 1B4	460	
	Tone	41	N													
8BT6	Vol.	18	M				12804	13	CN152		30	W285	C3	1A6, ^{2}1A4, 1B4, 1F6, 30, ^{2}49	460	10
	Tone	41	N				11387	12	RS215							
							.02-.02		Buffer	B14						
8K, 8T	Vol.	20	TRP613				11240	1	RS215					6L7, 6J7, 6K7, 6H6, 6F5, 6F6, 5Z4, 6E5	460	1
	Tone	22	SRP288	6	See Note	A59	5212	1	RS216							
8K11	Vol.	20	TM248-SS1				11240	1	RS215					^{2}6K7, 6A8, 6H6, 6F5, 6E5, 6F6, 5Z4	460	1
							5212	1	RS216							
8T2, 8T11	Vol.	20	TM248-SS1				11240	1	RS215					^{2}6K7, 6A8, 6H6, 6F5, 6E5, 6F6, 5Z4	460	1
							5212	1	RS216							
8U	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6A8, 6H6, 6F5, 6F6, 5Z4, 6E5	460	1
	Phono.	‡	Order from	Mfr.			5212	1	RS216							
							11387	14	RS215							
8U2	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6A8, 6H6, 6E5, 6F5, 6F6, 5Z4	460	1
	Phono.	63	Order from	Mfr.			5212	1	RS216							
							11387	13	RS215							
C8-15, C8-17	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6F6, 5Z3	460	1
	Tone	34	L				5212	1	RS216							
							11248	14	RS211							
C8-19, C8-20	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6A8, 6H6, 6F5, 6F6, 5Z4, 6E5	460	1
							5212	1	RS216							
							11387	1	RS215							
D8-28	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6A8, 6H6, 6F5, 6F6, 6E5, 5Z4	460	1
	Phono.	‡	Order from	Mfr.			5212	1	RS216							
							11387	14	RS215							
R8 (AC)	Vol.	99	SRP153				7342	4/13	See Note	B158				^{2}35, 24A, ^{3}27, 47, 80	175	3
	Tone	21	K12	6												
R8 (DC) (230V.)	Vol.	7	SRP134											37, ^{2}39, 36, ^{2}71A	175	
	Tone	41	N													
T8-14, T8-16	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6F6, 5Z3	460	1
	Tone	34	L				5212	1	RS216							
							11248	14	RS211							
T8-18	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6A8, 6H6, 6F5, 6F6, 5Z4, 6E5	460	1
							5212	1	RS216							
							11387	14	RS215							
9K	Vol.	20	TRP621				12467	25	WE3540					^{2}6K7, 6L7, 6H6, 6F5, 6F6, 6J7, 5Z4, 6E5	460	1
	Tone	34	L				5212	25	RS216							
9K1	Vol.	20	TRP624	6		A59	12467	25	WE3540					^{2}6K7, 6L7, 6J7, 6H6, 6G5, 6F5, 6F6, 5Z4	460	1
	Tone	150	SRP288				5212	25	RS216							
9K2	Vol.	20	TRP621				12467	30	WE3540					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6L6, 6E5, 5Z4	460	1
	Tone	34	L				5212	30	RS216							
							12872	15	TS102							
9K3	Vol.	20	TRP621				12467	‡	WE3540					^{2}6K7, 6L7, 6J7, 6H6, 6G5, 6F5, 6L6, 5Z4	460	1
	Tone	34	L				5212	‡	RS216							
9T	Vol.	20	TRP621				30-30	30	WE3540					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6L6, 6E5, 5Z4	460	1
	Tone	34	L				18	30	RS216							
							20	15	TS102							
9U, 9U2	Vol.	20	TRP621				12467	30	WE3540					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6E5, 6L6, 5Z4	460	1
	Tone	34	SRP284	8			5212	30	RS216							
	Phono.	63	Order from	Mfr.			12872	15	TS102							
C9-4	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6F6, 6E5, 5Z3	460	1
	Tone	34	L				5212	1	RS216							
C9-6	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6F6, 5Z3, 6E5	460	1
	Tone	34	L				5212	1	RS216							
							11248	14	RS211							
CRD9 (AC) Counter Demonstrator	Phono.	16	TRP603				10-4-10	4/17	See Note	B158				30, ^{2}47, 80		1
CRD9 (DC) Counter Demonstrator	Vol.	16	TRP603				6383	12/15	See Note	B160				37, ^{2}89		
D9-19	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6F6, 5Z3, 6E5	460	1
	Tone	34	L				5212	1	RS216							
	Phono.	‡	Order from	Mfr.			11248	14	RS211							
R9 (AC) Superette	Vol.	7	SRP134				2957	4	RS215					^{2}35, ^{2}27, 24, ^{2}45, 80	175	1
	Tone	41	N				3057	4	RS211							
R9 (DC) Superette	Vol.	7	SRP134											24A, ^{2}35, ^{2}27, ^{2}45	175	
	Tone	41	N													
T9-7, T9-8	Vol.	20	TRP613				12055	25/13	RM257					^{2}6K7, 6A8, 6H6, 6F5, ^{2}25A6, 6E5, 25Z6	460	
							12056	25/15	RN232/TS101							
T9-9	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6F6, 5Z3, 6E5	460	1
	Tone	34	L				5212	1	RS216							
							11248	14	RS211							
T9-10	Vol.	20	TRP613				11240	1	RS215					^{2}6K7, 6L7, 6J7, 6H6, 6F5, 6F6, 6E5, 5Z4	460	1
	Tone	34	L				5212	1	RS216							
Victor 9-18	Vol.	59	SRP141				‡	‡	See Note	B2				^{8}27, 50, ^{2}81	180	30
	Sen.	1	D12													
	Phono.	63	‡		See Note	A61										
Victor 9-54	Vol.	59	SRP141				‡	‡	See Note	B2				^{8}27, 50, ^{2}81	180	30
	Sen.	1	D12													
	Phono.	63	‡		See Note	A61										
Victor 9-56 (Radiola 64)	Vol.	59	SRP141				‡	‡	See Note	B2				^{8}27, ^{2}81, 50	180	30
	Sen.	1	D12													
	Phono.	63	‡		See Note	A61										

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
R. C. A.—Continued																
10K, 10T	Vol.	20	TRP621				12467	30	WE3540					^{3}6K7, 6L7, 6J7, 6H6,		
	Tone	34	SRP284	8			5212	30	RS216					6F5, 6L6, 5Z4, 6E5	460	1
							12872	15	TS102							
							12873	15/13	TS102/CS121	B12						
10K1, 10T (2nd Prod.)	Vol.	20	TRP621				12467	30	WE3540					^{3}6K7, 6L7, 6J7, 6H6,		
	Tone	34	SRP284	8			5212	30	RS216					6E5, 6F5, 6L6, 5Z4	460	1
R10 (AC)	Vol.	99	SRP153				10-4-4	4/13	See Note	B158				^{2}35, 24A, 47,^{3}27, 80	175	3
	Tone	21	K12	6												
R10 (DC)	Vol.	7	SRP134											24,^{2}35, 45,^{2}27	175	
	Tone	41	N													
T10-1	Vol.	20	TRP621				11203	25	RS215					^{2}6K7, 6L7, 6H6,^{2}6C5,		
	Tone	41	N				5212	25	RS216					^{2}6F6, 6J7, 5Z3	460	1
							11215	‡	See Note	B161						
T10-3	Vol.	20	TRP621				11203	25	RS215					^{2}6K7, 6L7, 6J7, 6H6,		
	Tone	41	N				5212	25	RS216					^{2}6C5,^{2}6F6, 5Z3	460	1
							11215	‡	See Note	B161						
Victor SW10 Short Wave Adapter	Vol.	26	J											24,^{2}27	1000	
C11-1, D11-2	Vol.	20	TRP621				11203	25	RS215					^{2}6K7, 6L7, 6J7, 6H6,		
	Tone	41	N				5212	25	RS216					^{2}6C5,^{2}6F6, 6E5, 5Z3	460	1
							11215	‡	See Note	B161						
R11 (AC)	Vol.	99	SRP153				‡	26	See Note	B1				24,^{3}27,^{2}35,^{2}47, 80	175	3
	Tone	41	Y200MP	6												
T11-8	Vol.	20	TRP621				11203	25	RS215					^{2}6K7, 6L7, 6J7, 6H6,		
	Tone	41	N				5212	25	RS216					^{2}6C5,^{2}6F6, 5Z3, 6E5	460	1
							11215	‡	See Note	B161						
R12 (AC)	Vol.	99	SRP153				10-4-4	4/13	See Note	B158				24A,^{2}35,^{3}27, 47, 80	175	3
	Tone	21	K12	6												
13K	Vol.	20	Order from	Mfr.			11203	25	RS215					^{3}6K7, 6L7, 6J7, 6H6,		
	Tone	41	Order from	Mfr.			5212	25	RS216					6C5, 6E5,^{2}6L6,^{2}5Z4	460	1
							12470	15	TS102							
C13-2	Vol.	20	TRP621				11203	25	RS215					^{3}6K7, 6L7, 6J7, 6H6,		
	Tone	41	UC505				5212	25	RS216					^{3}6C5,^{2}6F6, 6E5, 5Z3	460	1
							11204	‡	See Note	B162						
Victor R14	Vol.	2/12	DRP116				.1-2-1.5	26	See Note	B1				^{4}24,^{2}45, 80		1
	Tone	44	Y													
15K	Vol.	20	Order from	Mfr.			11203	25	RS215					^{4}6K7, 6L7,^{2}6H6,^{2}6C5,		
	Fidelity	41	Order from	Mfr.			5212	25	RS216					^{2}6L6,^{2}5Z4, 6E5	460	1
	Tunlgt.	‡	UC514				5212	13	RS216							
							12470	15	TS102							
							13025	15	TN111							
15U	Vol.	20	TRP621				12467	28	WE3540					^{3}6K7, ^{2}6L7, 6J7, ^{2}6H6,		
	Fid.	41	Order from	Mfr.			11240	28	RS215					^{3}6C5, 6E5, ^{2}2A3,		
	Exp.	15	P				11496	28	RS216					5Z3	460	14
	Exp. bias	‡	A2MP				5212	13	RS216							
							12740	15	TS102							
							12472	15	TS101							
							13610	14	CS133							
							13611	15	TS102							
C15-3	Vol.	100	TRP622				11203	1	RS215					^{4}6K7, 6L7, 6J7, ^{2}6H6,		
	Tone	41	UC505				5212	1	RS216					^{3}6C5, 6E5,^{2}6F6, 5Z3	460	1
							5213	13/14/19	RN241/TS101	B163						
R15 Victor	Vol.	2/12	DRP116				‡	Order	from Mfr.					^{4}24A,^{2}45, 80		1
PT16-A1, PT16-A2	Vol.	63	SRP152													
RE16	Vol.	7	SRP134				2957	4	RS215					^{2}35,^{2}27,^{2}45, 80	175	1
	Tone	41	N				3057	4	RS211							
	Phono.	63	SRP152													
RE16A	Vol.	7	SRP134				2957	4	RS215					^{2}35, 24A,^{2}27,^{2}47, 80	175	1
	Tone	41	Y200MP	6												
	Phono.	63	SRP152													
PT17-A1, PT17-A2	Vol.	63	SRP152													
PT17-B1, PT17-B2	Vol.	‡	‡		See No	te A65										
Radiola 17	Vol.	1	SRP145				3.5-3.5	‡	See Note	B4				^{4}26, 27, 71A, 80		11
R17M	Vol.	7	UC509	6			3538	1	CN140					36, 37, 38, 39		
							3536	15	TN110							
Victor RE17	Vol.	2/12	DRP116				‡	Order	from Mfr.					^{4}24A,^{2}45, 80		1
RE18	Vol.	99	SRP153				2-4	4	See Note	B1				24A,^{3}27,^{2}35,^{2}47, 80	175	3
	Tone	41	Y200MP	6												
	Phono.	63	SRP152													
RE18A	Vol.	99	SRP153				10-4	4	CM171	B169				24A,^{3}27,^{2}35,^{2}47, 80	175	3
	Tone	41	Y200MP	6												
	Phono.	63	SRP152													
Radiola 18 (AC)	Vol.	1	SRP144				1-1-5	3	See Note	B1				^{4}26, 27, 71A, 80		11
Radiola 18 (DC)	Vol.	1	SRP144				4-2	‡	See Note	B11				^{5}12A, 71A		
R18W	Vol.	7	UC509	6			3338	9/14	CN140					78, 77, 38, 25Z5		
							6535	9	CM170							
							3536	15	TN113							
RE19 (AC) (AVC)	Vol.	99	SRP153				10-4-4	4/13	See Note	B158				24A,^{3}27,^{2}35, 47, 80	175	3
	Tone	21	K12	6												
	Phono.	63	SRP152													
RE20 Electrola	Vol.	13	K12				2-3	4	CM170	B169				^{3}35, 24A,^{3}27,^{2}47, 80	175	3
	Tone	101	N													
	Phono.	63	SRP152													
R21	Vol.	99	SRP153				2-3	4	CM170	B169				24A,^{3}27,^{2}35,^{2}47, 80	175	3
	Tone	41	Y200MP													
Radiola 21, 22	Vol.	12	K12				‡	‡	See Note	B1				^{3}22,^{2}12A, 71A		
D22-1			Radio Sectio	n.			Radio Sectio	n.								
	Vol.	100	TRP622				11203	1	RS215					^{6}6K7,^{2}6L7,^{2}6H6,^{6}6C5,		
	Tone	41	UC505				5212	1	RS216					6J7, 6E5,^{4}2A3,^{2}5Z3	460	1/14
			Phono Secti	on.			5213	13/14	RN241/TS101	B164						
	Vol.	‡	Order from	Mfr.			Dynamic A	mp. Se	ction.							
	LF. Tone	‡	M				11608	13/14	RN235							
	HF. Tone	‡	L				Power Amp.	Sectio	n.							
	Exp.	‡	O	8			11497	43	RS213							
	Exp. Bias	‡	Y5MP				11496	43	RS216							
							11498	15/19	CM162	B165						
R22	Vol.	9	A5MP	6	2		6518	9	CN142					78, 6A7, 77, 43, 25Z5	175	
							6510	9	CS123							
							6511	13/15	CM161/TS101							
RO23	Vol.	99	SRP153				4-4-10	4/13	See Note	B158				^{3}24A,^{3}27,^{2}35, 47, 80	175/	
	Tone	22	K12	6											1075	3
25 (DC) (220 V)	Vol.	7	SRP134											^{2}37,^{3}39, 89	175	
RAE26	Vol.	99	SRP153				2-4	4	See Note	B1				^{2}35, 24,^{3}27,^{2}47, 80	175	3
	Tone	41	Y200MP													
	Phono.	63	SRP152													
R27	Vol.	7	UC509	6	EX300		3538	1	CN140					36, 37, 38, 39		
							6844	15	TN113							
R28, R28BW, R28BWC, R28P	Vol.	7	D	6	1		7590	1	RS215					58, 2A7, 57, 2A5, 80	175	1
							7589	1/14	SR627							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
R.C.A.—Continued																
CE29	Phono.	63	SRP152			See Note A3	10-10-4	26	See Note	B158				30,^{2}47, 80		1
M30 Auto Radio	Vol.	8	Y50MP											^{3}36,^{4}37,^{2}12	175	
P31 Portable	Vol.	15	O				4	12	See Note	B1				^{3}34, 32,^{4}30		
M32 Auto Radio	Vol.	16	P											37,^{3}39, 85, 89		
Victor R32	Vol.	102	DRP115				3-2.5-3	3	See Note	B1				^{6}26, 27,^{2}45, 80		9
	Phono.	63	A													
PT33 Portable Turn-Table	Phono.	63	SRP152													
Radiola 33 (AC)	Vol.	1	SRP144				1-1	2	See Note	B166				^{4}26, 27, 71A, 80		11
Radiola 33 (DC)	Vol.	1	SRP133											^{5}12A,^{2}71A		
M34	Vol.	‡	SRP251	6			7600	‡	See Note	B167	24	273	C15	78, 6A7, 6B7, 89	175	10
							6192	13	Order from	Mfr.						
							6513	15	TN113							
Victor R35	Vol.	2/8	DRP250				2-2-2	3	See Note	B1				^{4}24, 27,^{2}45, 80		3
	Tone	22	P													
	Phono.	63	SRP152													
R37, R37P, R38, R38P	Vol.	19	TRP607				7590	1	RS215					^{2}58, 2A7, 2B7, 2A5, 80	175	1
	Tone	103	N	6			6187	1/14/15	SR624							
R39	Vol.	2/8	DRP250				2-2-2	3	See Note	B1				^{4}24A, 27,^{2}45, 80		3
	Tone	22	P													
	Phono.	63	SRP152													
RE40, RE40P	Vol.	7	A3MP	6	1		7590	1	RS215					58, 2A7, 57, 2A5, 80	175	1
	Phono.	87	E12	8		See Note A66	7589	1/14	SR627							
Radiola 41 (AC)	Vol.	1	SRP145				2-2	1	See Note	B1				^{4}26, 27, 10		8
Radiola 41 (DC)	Vol.	1	SRP143											^{6}12A,^{4}71A		
Radiola 42	Vol.	2/12	DRP116				2-1	26	See Note	B1				^{4}24A,^{2}45, 80		1
	Tone	44	Y													
R43	Vol.	54	K12				2957	12	RS215					^{3}32,^{4}30	175	
	Tone	41	K12													
Radiola 44 (AC)	Vol.	12	SRP142			See Note A67	2-2-2	3	See Note	B1				^{3}24, 45, 80		3
Victor RE45	Vol.	102	DRP115				3-2.5-3	3	See Note	B1				^{6}26, 27,^{2}45, 80		9
	Phono.	63	A													
Radiola 46 (AC)	Vol.	12	SRP142			See Note A67	2-2-2	3	See Note	B1				^{3}24A, 45, 80		3
Radiola 46 (DC)	Vol.	12	SRP150											^{2}22,^{2}12A,^{2}71A		
Radiola 47	Vol.	12	SRP142				2-2-2	3	See Note	B1				^{3}24A, 45, 80		3
	Phono.	63	SRP152													
48 Radiola	Vol.	2/12	DRP116				1-2	4	See Note	B1				^{4}24A,^{2}45, 80		1
R50	Vol.	13	K12				4-4	4	See Note	B1				^{3}35,^{3}24A, 27,^{2}47, 80	175	3
	Tone	101	N													
Radiola 50	Vol.	1	SRP145				3.5-3.5	‡	See Note	B4				^{4}26, 27, 71, 80		11
Radiola 51 (AC)	Vol.	1	SRP144				1-1-.5	3	See Note	B1				^{4}26, 27, 71, 80		11
Radiola 51 (DC)	Vol.	1	SRP144											^{5}12, 71		
R51B	Vol.	20	Order from Mfr.				6548	12	CS123					^{3}34,^{7}30	175	
	Tone	41	UC505													
Victor R52	Vol.	102	DRP115				3-2.5-3	3	See Note	B1				^{6}26, 27,^{2}45, 80		9
	Phono.	63	A													
R53B	Vol.	20	Order from Mfr.				6548	12	CS123					^{7}30,^{3}34	175	
	Tone	41	UC505													
R55	Vol.	13	K12				4-4	4	See Note	B1				^{3}35, 24A,^{3}27,^{2}47, 80	175	3
	Tone	101	N													
RE57	Vol.	2/8	DRP250				2-2-2	3	See Note	B1				^{4}24A, 27,^{2}45, 80		3
	Tone	22	P													
	Phono.	63	SRP152													
RAE59	Vol.	13	K12				2-3	4	See Note	B1				^{3}35, 24A,^{3}27,^{2}47, 80	175	3
	Tone	101	N													
	Phono.	63	SRP152	6												
Radiola 60	Vol.	8	SRP138				2-2	2	See Note	B1				^{7}27, 71A, 80	180	3
Radiola 62	Vol.	8	SRP138				3.5-3.5	2	See Note	B1				^{7}27, 71A, 80	180	3
Radiola 64	Vol.	54	SRP141				4-4-4	26	See Note	B2				^{8}27, 50,^{2}81	180	30
	Sen.	1	D12													
Radiola 66	Vol.	8	SRP139				2-2-4	3	See Note	B1				^{6}27, 45, 80	175	1
Radiola 67	Vol.	8	SRP141				2-4-4	26	See Note	B1				^{7}27, 50,^{2}81	175	30
	Tone	21	N													
	Phono.	63	SRP152													
67M	Vol.	56	UM157-SS11				13687	1	CN151		35	294	C3	6D6, 6A8, 6K7, 6B7, 42, 84	260	10
							.01-.01		Buffer	B14						
67M1, 67M2, 67M3	Vol.	17	TM242-SS11				12234	1	RS213		19	249	C3	6D6, 6A8, 6K7, 85, 6C5, 6A6	260	10
	Tone	22	MR39				12238	1/15	CS133/TN111							
							.01-.01		Buffer	B14						
RAE68	Vol.	8	Y5MP				3-3-3	26	See Note	B1				^{4}24,^{2}27,^{2}45, 80	175	1
	Tone	34	K12													
	Phono.	63	SRP152													
R70	Vol.	8	F				10-8-4	4	See Note	B158				^{3}58,^{2}56, 47, 80	175	1
	Tone	21	N	6												
R71	Vol.	8	Y50MP				10-8-4	4	See Note	B158				^{3}58,^{2}56, 47, 80	175	3
	Tone	21	K12	6												
R71B	Vol.	20	TRP611				8	12	CS123	B169				^{3}34, 32,^{4}30	175	
	Tone	41	UC502													
R72	Vol.	8	Y50MP				10-8-4	4	See Note	B158				^{3}58,^{3}56, 47, 80	175	3
	Tone	21	K12	6												
R73 (with 47's)	Vol.	8	A10MP				10-10-8-8	4	See Note	B169				^{3}58, 56, 55,^{2}47, 80	175	3
	Tone	41	P	6												
Victor RE73	Vol.	2/8	DRP250				2-2-2	3	See Note	B1				^{4}24A, 27,^{2}45, 80		3
	Tone	22	P													
	Phono.	63	SRP152													
R73A (2A5 Output)	Vol.	18	P				10-10-8-8	4	See Note	B169				^{3}58, 56, 55,^{2}2A5, 80	175	1
	Tone	41	P	6												
	Supp.	7	F		5											
R74	Vol.	105	K				10-10-7	2/14	CM175	B169				^{3}58,^{4}56,^{2}46, 82	175	7
	Tone	21	L	6			10-10	15/19	CM162	B169						
R75 (47 Output)	Vol.	104	G				10-8-10	4/15	CM175	B169				^{3}58, 55, 56,^{2}47, 80	175	3
	Sen.	104	G													
	Tone	41	P	6												
R75 (2A5 Output)	Vol.	17	P				10-8-10	4/15	CM175	B169				^{3}58, 56, 55,^{2}2A5, 80	175	1
	Tone	21	P	6												
	Sen.	7	F		5											
Victor RE75	Vol.	102	DRP115				3-2.5-3	3	See Note	B1				^{6}26, 27,^{2}45, 80		9
	Phono.	63	A													
R76, R77	Vol.	105	K				10-10-7	2/14	CM175	B169				^{3}58,^{4}56,^{2}46, 82	175	7
	Tone	21	L	6			10-10	15/19	CM162	B169						
R78 (Less Noise Suppressor)	Vol.	7/20	Order from Mfr.				8910	4	CM172	B169				^{4}58,^{3}56,^{2}46, 82	175	3
	Tone	‡	N													
R78 (With Noise Suppressor)	Vol.	20	TRP601				8910	4	CM172	B169				55,^{4}58,^{4}56,^{2}46, 82	175	3
	Supp.	7	Order from Mfr.													
	Tone	‡	N													
RAE79	Vol.	13	K12			See Note A61	4-4	4	CM170	B169				^{3}35, 24A,^{3}27,^{4}47,^{2}80	175	3
	Tone	101	N													
	Phono.	87	‡			See Note A5										

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
R.C.A.—Continued																
Radiola 80	Vol.	7	A5MP		See Note A76		2-3-3	26	CM173	B169				^{4}24,^{2}27,^{2}45, 80	175	1
							3	26	CS131	B12						
RE80	Vol.	8	A10MP				10-8-10	4	See Note	B158				^{3}58, 56, 55,^{2}47, 80	175	3
	Tone	41	P	6												
	Sil.	9	G													
	Phono.		Order from	Mfr.												
RE81	Vol.	8	K				10-10-10	2/14	CM175	B169				^{3}58,^{4}56,^{2}46, 82	175	7
	Tone	21	N	6			10-10	15/19	CM162	B169						
	Phono.	16	TRP603													
Radiola 82, 82 (with Remote Control)	Vol.	8	Y5MP				2-3-3	26	See Note	B1				^{4}24A,^{2}27,^{2}45, 80	175	1
	Tone	101	K12													
RAE84	Vol.	100	TRP601				10-10	4	See Note	B2				^{4}58,^{4}56,^{2}46, 55, 82	175	3
	Tone	21	N													
	Supp.	7	A5MP	6												
84BT	Vol.	17	MR55	M27			14287	13	CN140					1C6, 1A4, 1F6, 1F4	460	
84BT6	Vol.	18	MR44	M26			13046	46	RS203		53	722A	C3	6A7, 6D6, 75, 42	460	10
							14310	46/15	RN232/TS101							
							.01-.01		Buffer	B14						
85BK, 85BT	Vol.	17	MR55				14403	12	CN142					1C6, 1A4, 1F6, 30, 19	460	
85BT6	Vol.	18	MR44	M26			11203	1	RS215		54	728A	C3	6A8G, 6K7G, 6Q7G, 6K6G, 5Y3G	460	10
							30657	1/13/15	RN242/TS101							
							.01-.01		Buffer	B14						
85E	Vol.	18	MR44	M26			14814	25	RS215					6A7, 6D6, 75, 42, 80	460	1
							14813	25/13	RN245							
85T	Vol.	18	MR44	M26			14669	1/19	RN245					6A7, 6D6, 75, 41, 80	460	1
85T1	Vol.	18	MR44	M26			11203	25	RS215					6A7, 6D6, 75, 42, 80	460	1
							5212	25	RS216							
							14377	13	RS216							
85T5	Vol.	17	TM249-SS1				11240	25	RS215					6D6, 6A7, 75, 42, 80	460'	1
							5212	25	RS216							
							14377	13	RS216							
Radiola 86	Vol.	8	Y5MP				2-3-3	26	See Note	B1				^{4}24A,^{2}27,^{2}45, 80	175	1
	Tone	101	K12													
	Phono.	63	SRP152													
86BK, 86BT	Vol.	17	TM249-SS1				14403	12	CN142					^{2}1A4, 1C6, 1F6, 30, 19	460	
86E	Vol.	20	TM249-SS1				11240	25	RS215					6A8, 6K7, 6H6, 6F5, 6F6, 5W4	460	1
							5212	25	RS216							
							30105	13	RS216							
86K, 86K7	Vol.	20	TM249-SS1				11240	25	RS215					6A8, 6K7, 6H6, 6F5, 6F6, 5W4	460	1
							5212	25	RS216							
							14377	13	RS216							
86T, 86T1	Vol.	20	TM249-SS1				11240	25	RS215					6A8, 6K7, 6H6, 6F5, 6F6, 5W4	460	1
							5212	25	RS216							
							14377	13	RS216							
86T2, 86T3	Vol.	45	TM220-SS1				30577	1/19	RM252					6A8, 6K7, 6H6, 6F5, 6F6, 5W4	460	1
	Tone	22	MR53	M26			5212	1	RS216							
							11203	13	RS215							
86T4, 86T44	Vol.	17	TM249-SS1				11203	25	RS215					6A7, 6D6, 75, 42, 80	460	1
							5212	25	RS216							
							14377	13	RS216							
86X	Vol.	18	MR44	M26			14643	6	RS207					6A7, 6D6, 75, 43, 25Z5, 135K1	460	
							14644	6/13	UR194							
							14767	6/13	UR194							
86X4	Vol.	18	MR44	M26			30297	1	RS208					6A7, 6D6, 6Q7G, 25L6, 25Z5	460	
							30298	1/14	RM257							
87EY	Vol.	20	TM249-SS1				14621	1	RM257					6A8, 6K7, 6H6, 6J7, 25L6, 25Z5	460	
							14622	1/13	RM257							
							14624	19	TS101							
87K, 87T	Vol.	20	TM249-SS1				11240	25	RS215					6A8, 6K7, 6H6, 6F5, 6F6, 6G5, 5W4	460	1
							5212	25	RS216							
							14377	13	RS216							
87K1, 87K2, 87T2	Vol. & Tone	20/22	SMD501				11203	1	RS215					6A8, 6K7, 6H6, 6F5, 6F6, 5W4, 6U5	460	1
							5212	1	RS216							
							30577	19	RM252							
87T1	Vol.	45	TM220-SS1				30577	1/19	RM252					6A8, 6K7, 6H6, 6U5, 6F5, 6F6, 5W4	460	1
	Tone	22	MR53	M26			5212	1	RS216							
							11203	13	RS215							
87X, 87Y	Vol.	20	TM249-SS1				14621	1	RM257					6A8, 6K7, 6H6, 6J7, 25L6, 25Z5	460	
							14622	1/13	RM257							
							14624	19	TS101							
88K	Vol.	17	TM249-SS1				11203	25	RS215					^{2}6K7, 6L7, 6J7, 6Q7, 6F6, 6G5, 5W4	460	1
							5212	25	RS216							
R90, R90P	Vol.	100	TRP622				6443	4	RS215					^{4}58,^{3}56,^{2}2A5, 80	175	1
	B. Tone	‡	Y200MP				6430	4/13	CM170	B169						
	T. Tone	41	UC505													
	Supp.	7	E													
91B	Vol.	7	Y200MP		EX350		6832	12	CS121					78, 77, 38		
							6844	15	TN113							
R92 Recorder	Vol.	16	N				7590	1	RS215					^{2}56, 53, 80		1
							4498	1	CS133							
							3536	15	TN113							
R93 Phonograph	Vol.	63	Y													
R95 Electrola	Vol.	63	Y				11867	9/15	UR190/CM161	B171				77, 43, 25Z5		
R96, R97	Vol.	‡	Order from	Mfr.			11203	1	RS215					6C6, 42, 80		1
	Tone	34	L	6			5212	1	RS216							
R99 High Fidelity Electrola	Vol.	16	Order from	Mfr.			12467	28	WE3540					6L7, ^{2}6C5, 6H6,^{2}2A3, 5Z3		14
	Tone	41	UC505	6			11240	28	RS215							
	Exp.	15	P				11496	28	RS216							
	Exp. Bias	7	A2MP				5212	13	RS216							
							12470	15	TS102							
							12472	15	TS101							
100, 101	Vol.	7	E	6	2		6661	1/15	SR625					6A7, 6F7, 38, 1V	460	29
M101	Vol.	17	M	6			4961	1	RS213		32	287M	C3	^{2}6D6, 6A7, 6B7, 41	175	10
							4958	24/15	CN150/TS101		32	G287M	C16			
							.02-.02		Buffer	B14						
102 Victor	Vol.	7	UC509	6			6823	1	CN140					37, 77, 78, 38		
							6824	15	TN113							
U102E	Vol.	18	TM220-SS1	M26			14814	25	RS215					6A7, 6D6, 75, 42, 80	460	1
	Phono.	63	Order from	Mfr.			14813	25/13	RN245							
103	Vol.	7	E	6	2		6661	1/15	SR625					6A7, 6F7, 41, 1V	460	29
U101, U103	Vol.	18	TM220-SS1	M26			14814	25	RS215					6A7, 6D6, 75, 42, 80	460	1
	Phono.		Order from	Mfr.			5212	25	RS216							
							14377	13	RS216							
M104	Vol.	17	M	6			4961	1	RS213		32	287M	C3	^{2}6D6, 6A7, 6B7, 41	175	10
							4958	24/15	CN150/TS101		32	G287M	C16			
							.02-.02		Buffer	B14						
M105	Vol.	17	SRP251	6			4-4	1	CN150	B169	24	273		78, 6A7, 6B7, 41	175	10
							6192	13	Order from	Mfr.						
							3536	15	TN113							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
R. C. A.—Continued																
U105, U107	Vol.	15	Order from	Mfr.			14531	25	WE2545					^{2}6K7, 6L7, 6H6, 6N7,		
	P.U. Volt	‡	MR48				5212	25	RS216					6J7, ^{2}6F6, 6G5, 5T4	460	1
M107	Vol.	19	TRP603	6	See No	te A68	7776	1	RN241		20	253	C3	^{2}6D6, 6A7, 75, 41, 84	175	10
							6963	15	TN111		20	G253	C16			
							.02-.02		Buffer	B14						
M108	Vol.	17	M	6			4961	1	RS213		32	287M	C3	^{2}6D6, 6A7, 6B7, 41	175	10
							4958	21/15	CN150/TS101		32	G287M	C16			
M109	Vol.	17	M	6			5069	1	CN152		35	294	C3	^{2}6D6, 6A7, 6B7, 76,		
							5054	15	TS101					6A6, 84	175	10
U109	Vol.	20	TRP624	6			14531	28	WE2545					^{5}6K7, ^{2}6L7, ^{2}6J7, ^{2}6H6,		
	Fid.	41	UC505	7			11203	28	RS215					^{2}6C5, 6F5, ^{2}2A3,		
	P.U. Adj.	‡	MR44				11496	28	RS216					6G5, 5Z3	460	14
	Exp. bias	7	C				5212	13	RS216							
							14273	15	TS102/TS101							
							14773	14	RS216							
							12682	15	TS101							
110, 111	Vol.	8	D	6	1		7590	1	RS215					58, 2A7, 57, 2A5, 80	175	1
	Tone	34	L				7589	1/14	SR627							
112, 112A (DC-220V)	Vol.	8	A5MP				6728	25/15	UR189	B172				78, 6A7, 77, 43, 12Z3	175	
114	Vol.	8	E	6	2		6783	9/15	UR190/CM161	B171				78, 6A7, 77, 43, 25Z5	175	
115	Vol.	7	A3MP	6	1		7590	1	RS215					58, 2A7, 57, 2A5, 80	175	1
	Tone	34	L				7589	1/14	SR625							
M116	Vol.	‡	M				6738	1	RS213		24	273	C15	78, 6A7, 6B7, 41, 1V	175	10/25
	Tone	34	O				6782	1	CS131							
							6781	13	Order from	Mfr.						
							3536	15	TN113							
117, 118, 119	Vol.	19	TRP603	6			7790	1	RS215					6A7, 6D6, 6B7, 41, 80	460	1
							4428	1	RS213							
							7589	13	SR627							
							3796	15	TS105							
120	Vol.	19	TRP607				7590	1	RS215					2A7, 2B7, ^{2}58, 2A5, 80	175	1
	Tone	34	L	6			6487	13/14	SR624							
121, 122	Vol.	19	TRP603				6571	1	RS215					^{2}58, 2A7, 2B7, 2A5, 80	370	1
	Tone	34	L	6			6703	1/13	CN155							
							3796	15	TS105							
M123	Vol.	18	M	6	See No	te A68	7738	1	See Note	B173	7	224		^{2}6D6, 6A7, 75, 41, 79	175	10
	Tone	41	K12				6963	15	TN111							
	Supp.	7	A2MP													
124	Vol.	19	TRP607				7590	1	RS215					^{2}58, 2A7, 2B7, 2A5, 80	175	1
	Tone	34	L	6			6487	1/13	SR624							
125	Vol.	19	TRP603	6			7790	1	RS215					6A7, ^{2}6D6, 6B7, 41, 80	460	1
							5101	1/14	RN245							
126B	Vol.	9	Y50MP				4349	12	See Note	B174				1A6, 34, 32, ^{2}30	460	
127	Vol.	19	TRP603				6986	12	RM257	B11				^{2}6D6, 6A7, 75, ^{2}41	370	
	Tone	44	L	6			6985	13	RN231							
							3796	15	TS105							
128, 128E	Vol.	19	TRP603				7790	1	RS215					^{2}6D6, 6A7, 6B7, 41, 80	460	1
	Tone	34	L				4428	1	RS213							
							7589	13	SR627							
							4525	15	TS101							
135B	Vol.	45	M				4498	12	CS123					1C6, ^{2}34, ^{2}30, 32, 19	460	
	Tone	41	N													
ACR136	Vol.	18	TRP603				7790	1	RS215					^{5}6D6, 6A7, 6B7, 41, 80	460	1
	Tone	34	L				4498	1	RS213							
	Sen.	7	SRP134				7589	14	SR627							
							4525	15	TS101							
140, 141, 141E	Vol.	19	TRP603				6571	1	RS215					^{3}58, 2A7, 2B7, 56, 53,		
	Tone	21	O	6			6609	1	RS216					80	445	1
							6626	14/15	CS121/TN111							
140, 141, 141E (Revised)	Vol.	19	TRP603				6889/6609	1	RS216					^{2}58, 2A7, 2B7, 56, 53,		
	Tone	21	UC505	6			6626	13/15	CS121/TN111					80	445	1
142B	Vol.	9	Y50MP				6548	12	CS123					^{2}34, ^{3}30	175	
143	Vol.	19	TRP603				7790	1	RS215					^{2}6D6, 6A7, 75, 76, ^{2}42,		
	Tone	41	O	6			4626	13/15	RN245	B177				5Z3	460	1
	Sen.	7	UC500				4619	15	TS101/TP441							
ACR175	Vol.	17	P				10	1	RS215					^{2}6J7, ^{3}6K7, 6L7, 6H6,		
	Sen.	7	G				18	1	RS216					6F5, 6F6, 5Z4, 6E5	460	1
							4	14	RS211							
210	Vol.	8	D	6	1		7590	1	RS215					58, 2A7, 57, 2A5, 80	175	1
	Tone	34	L				7589	1/14	SR627							
211, 214	Vol.	19	TRP603	6			7790	1	RS215					6A7, 6D6, 6B7, 41, 80	460	1
							4428	1	RS213							
							7589	13	SR627							
							3796	15	TS105							
220	Vol.	19	TRP603				6571	1	RS215					^{2}58, 2A7, 2B7, 2A5, 80	175	1
	Tone	34	L	6			6691	13/15	SR626							
221	Vol.	19	TRP603				6571	1	RS215					^{2}58, 2A7, 2B7, 2A5, 80	370	1
	Tone	34	L	6			6703	1/13	CN155							
							3796	15	TS105							
222	Vol.	19	TRP603				6571	1	RS215					^{2}58, 2A7, 2B7, 2A5, 80	175	1
	Tone	34	L	6			6691	13/15	SR626							
223	Vol.	19	TRP607				6859	13/15	CN150/CN141	B176	Order	from M	fr.	^{2}6D6, 6A7, 6B7, 38, 84	175	10
	Tone	34	L													
224, 224E	Vol.	19	TRP603				7790	1	RS215					^{2}6D6, 6A7, 6B7, 41, 80	460	1
	Tone	34	L				4428	1	RS213							
							7589	13	SR627							
							4525	15	TS101							
225	Vol.	19	TRP603	6			7790	1	RS215					6A7, ^{2}6D6, 6B7, 41, 80	460	1
							5101	1/14	RN245							
226	Vol.	19	TRP603				7790	1	RS215					^{2}6D6, 6A7, 6B7, 42, 80	460	1
	Tone	44	L				4428	1	RS213							
							7589	13/14	SR627							
							4525	15	TS101							
235B	Vol.	45	M				4498	12	CS133					1C6, ^{2}34, ^{2}30, 32, 19	460	
	Tone	41	N													
236B	Vol.	45	M				4498	12	CS133					1C6, ^{2}34, ^{2}30, 32, 19	460	
240	Vol.	19	TRP603				6571	1	RS215					^{3}58, 2A7, 2B7, 56, 53,		
	Tone	21	O	6			6609	1	RS216					80	445	1
							6626	14/15	CS121/TN111							
240 (Revised)	Vol.	19	TRP603				6889/6609	1	RS216					^{3}58, 2A7, 2B7, 56, 53,		
	Tone	21	UC505	6			6626	14/15	CS121/TN111					80	445	1
241B	Vol.	9	Y50MP				6548	12	CS123					^{2}34, ^{3}30	175	
242, 243	Vol.	19	TRP603				7790	1	RS215					^{2}6D6, 6A7, 75, 76, ^{2}42,		
	Tone	41	O	6			4626	13/15	RN245	B177				5Z3	460	1
	Sen.	7	UC500				4619	15/13	TS101/TP441							
260, 261	Vol.	100	TRP622				6443	4	RS215					^{4}58, ^{3}56, ^{2}2A5, 80	175	1
	B. Tone	‡	Y200MP				6430	4/13	CN150	B169						
	T. Tone	41	UC505													
	Supp.	7	A5MP													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
R. C. A.—Continued																
262 (Two Types)	Vol.	45	TM221-SS16				7790	1	RS215					^{2}6D6, 6A7, ^{4}76, ^{2}42, 5Z3	460	1
	B. Tone	‡	Y200MP				7788	1	RS216							
	T. Tone	34	O				7833	15/14/								
	Sen.	7	UC500					19	RN231/TS101	B178						
262, 263 (1935 Pro-	Vol.	19	TM221-SS16				7790	1	RS215					^{2}6D6, 6A7, 85, ^{2}76, ^{2}42,		
duction)	B. Tone	‡	UC509				7788	1	RS216					80	460	1
	T. Tone	34	O				4831	14/19	CM171							
	Sen.	7	UC500													
280	Vol.	100	TRP622				6571	2	RS215					^{4}58, ^{4}56, 55, ^{2}59, 5Z3	175	1
	B. Tone	‡	Y200MP				6574	13/14	CN152							
	T. Tone	41	UC505													
	Supp.	7	A5MP													
281	Vol.	100	TRP622				7790	1	RS215					^{4}6D6, 6A7, 85, ^{3}76, ^{2}42,		
	B. Tone	‡	Y200MP				7788	1	RS216					5Z3	460	1
	T. Tone	41	UM165-SS16				7789	13/14/	RN241/							
								19	TS106	B179						
	Supp.	7	UC500													
300	Vol.	7	K	6	EX150		6587	9/15	See Note	B180				78, 77, 38, 25Z5		
	Phono.	64	E12													
301	Vol.	7	E	6			6661	1/15	SR625					6A7, 6F7, 41, 1V	460	‡
	Phono.	16	O				6832	13	CS121							
310	Vol.	7	D	6	1		7590	1	RS215					58, 2A7, 57, 2A5, 80	175	1
	Tone	34	L				7589	1/14	SR627							
	Phono.	63	E12	8	See Note A66											
Duo 320, Duo 321	Vol.	19	TRP603				6571	1	RS215					^{2}58, 2A7, 2B7, 2A5, 80	370	1
	Tone	34	L	6			6703	1/13	CN155							
	Phono.	‡	Order from	Mfr.			3796	15	TS105							
322, Duo 322,																
322E, Duo 322E	Vol.	19	TRP603				7790	1	RS215					^{2}6D6, 6A7, 6B7, 41, 80	460	1
	Tone	34	L				4428	1	RS213							
	Phono.	‡	Order from	Mfr.			7589	13	SR627							
							4525	15	TS101							
327	Vol.	19	TRP603				6986	24	RM257	B11				^{2}6D6, 6A7, 75, ^{2}41	370	
	Tone	41	L	6			6985	13	RN231							
	Phono.	‡	Order from	Mfr.			3796	15	TS105							
330, 331	Vol.	19	TRP607				7590	25	RS215					^{2}58, 2A7, 55, 56, 80, 53	175	1
	Tone	21	N	6			6555	25/13	CN151							
	Phono.	63	TRP609	6			3536	15	TN113							
340, 340E	Vol.	19	TRP603				6571	1	RS215					^{3}58, 2A7, 2B7, 56, 53,		
	Tone	21	O				6609	1	RS216					80	445	1
	Phono.	‡	Order from	Mfr.			6626	13/15	CS121/TN111							
340, 340E "All Wave																
Duo"	Vol.	19	TRP603				6609/6889	1	RS216					^{3}58, 2A7, 2B7, 56, 53,		
	Tone	21	UC505				6626	13/15	CS121/TN111					80	445	1
	Phono.	‡	Order from	Mfr.												
341, 342	Vol.	19	TRP603				7790	1	RS215					^{2}6D6, 6A7, 75, 76, ^{2}42,		
	Tone	41	O	6			4626	13/15	RN245	B177				5Z3	460	1
	Sen.	7	UC500				4619	15	TS101/TP441							
	Phono.	‡	Order from	Mfr.												
Duo 380, Duo 380 HR	Vol.	100	TRP622	6			6571	2	RS215					^{4}58, ^{4}56, 55, ^{2}59, 5Z3	175	1
	T. Tone	41	UC505				6574	13/14	CN152							
	B. Tone	‡	Y200MP				6797	15	TS101							
	Supp.	7	A5MP													
	Phono.	‡	Order from	Mfr.												
Duo 381	Vol.	100	TRP622				7790	1	RS215					^{4}6D6, 6A7, ^{3}76, 85, ^{2}42,		
	T. Tone	41	UM165-SS16				7788	1	RS216					5Z3	460	1
	B. Tone	‡	Y200MP				7789	13/19	RN241/TS106	B179						
	Supp.	7	UC500													
810K, 810K1, 810T	Vol.	20	TM249-SS1				14531	25	WE2545					^{2}6K7, 6L7, 6J7, 6H6,		
							5212	25	RS216					6N7, ^{2}6F6, 6G5, 5T4	460	1
810T4	Vol.	20	TM249-SS1				14531	25	WE2545					^{2}6K7, 6L7, 6J7, 6H6,		
							5212	25	RS216					6N7, ^{2}6F6, 6G5,		
														5U4G	460	1
811K	Vol.	20	TRP613				14531	25	WE2545					^{2}6K7, 6L7, ^{2}6J7, 6H6,		
	Fid.	22	N	7			5212	25	RS216					6N7, ^{2}6F6, 6G5,		
							14829	13/14	RS216/TS102					5T4	460	37
812K	Vol.	20	TRP621				14531	25	WE2545					^{3}6K7, 6L7, ^{2}6J7, 6H6,		
	Fid.	22	SRP285	8			5212	25	RS216					6N7, 6G5, ^{2}6F6,		
							14829	13/14	RS216/TS102					5T4	460	37
813K	Vol.	20	TRP621				14531	30	WE2545					^{3}6K7, 6L7, ^{2}6J7, 6H6,		
	Fid.	22	SRP285	8			5212	30	RS216					6C5, ^{2}6F6, 6G5, 5T4	460	37
							14377	14	RS216							
							13611	19	TS102							
							14902	15	TN111							
816K	Vol.	20	TRP621				14531	30	WE2545					^{4}6K7, 6L7, ^{2}6J7, ^{2}6H6,		
	Fid.	22	SRP285	8			5212	30	RS216					6C5, 6F6, ^{2}6L6,		
							14377	14	RS216					6G5, ^{2}5T4	460	37
							14902	15	TN111							
							13611	19	TS102							
ER-1240-A2	Vol.	7	SRP134				10	4	RS215					^{2}35, ^{2}27, 24A, ^{2}45, 80,		
	Tone	41	N				4	4	RS211					81, 50	175	1
	Mike	‡	V													
AR-4229	Vol.	18	SRP251	6			4-4	1	CN150	B169	24	273		78, 6A7, 6B7, 41	175	10
							6492	13	Order from	Mfr.						
							3536	15	TN113							
23590-2	Vol.	9	A5MP	6			6728	25/15	UR189	B172				78, 6A7, 77, 43, 12Z3	175	
RADIO ELECTRIC SERVICE (Resco)																
Resco 3	Vol.	12	K12											34, ^{2}30		
Resco SW5 (AC)	Vol.	16	N				8-8	2	See Note	B3				^{2}58, ^{2}56, 80		1
	Regen.	12	K12													
R. P. C. (Radio Products Corp.)																
A1	Vol.	18	N	6			P950	1	CN151					6A8, 6K7, 6Q7, 6F6,		
	Tone	34	N											5W4	456	1
B2	Vol.	19	MR48	M26			P337	6	CN145					6A7, 6D6, 75, 43,		
							P304	15	TS101					25Z5, L49B	456	
L2	Vol.	45	MR48				4	32	RS211					6A7, 6K7, 6H6, 6F5,		
	Tone	34	N				8-4	32	CN151					6F6, 80	456	1
L4	Vol.	45	MR48				4	32	RS211					6A8, 6K7, 6H6, 6A6,		
	Tone	44	L				8-4	32	CN151					^{2}6F6, 80	456	1
L5	Vol.	18	N	6			P474	32	RS211					6F5, 6F6, 6H6, 6K7,		
	Tone	34	L				P160	32	CN151	B81				6L7, 5Z4	456	1
							P304	15	TS101							
L6	Vol.	18	N	6			P474	32	RS211					6C5, ^{2}6F6, 6K7, 6L7,		
	Tone	44	L				P160	32	CN151	B81				^{2}6Q7, 5Z4	456	1
							P304	15	TS101							
L7	Vol.	45	N	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{3}30, ^{2}34	456	10
	Tone		L				.01-.01		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
R. P. C.—Continued																
U6	Vol.	17	UC514	6			8-6	4	CM172		35	294	C3	6D6, 6A7, 75, 6F6, 84,	175	10
	Tone	22	MR39				5	15	TS105					6K7		
							.0075		Buffer	B14						
Z3	Vol.	45	MR48	M26			P950	1	CN151					6A8, 6K7, 6H6, 6F5,		
	Tone	34	‡			See Note A5								6F6, 5W4	456	1
Z4	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275	7			P958	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
RADIO RECEPTOR CO.																
AR3	Vol.	7	SRP134											^{4}24A, ^{2}27	175	
"C" Announcer	Vol.	16	N				8-8	4	RS213	B3				27, 47, 80		1
Ser. 70 Power Amp.	Vol.	16	L				8-8-8-8	3	See Note	B3				^{2}56, ^{2}2A5, 80		1
Ser. 150 Power Amp.	Vol.	16	L				8-8-8-8	3	See Note	B3				^{2}56, ^{2}2A3, ^{2}82		12
RADIO TRADING CO.																
S307 Doerle Band-Spread	Vol.	12	K12											57, 2A5		
308 "19" Twinplex	Reg.	11	K12											19		
	Fil.	29	T													
2115 "53" Twinplex	Vol.	16	M											53		
	Regen.	11	Y25MP													
2177 Doerle 3 Tube (AC)	Vol.	7	J											78 or 58, 77 or 57, 37 or 57		
RADIOTROPE (Also see U. S. Radio and Television)																
G Console	Vol.	6	F7	6			8, 8, 8	28	RS213					^{3}24A, ^{2}27, ^{2}45, 80		1
	Tone	41	N													
R Console	Vol.	7	UC501				8, 8, 8	28	RS213					^{3}24A, ^{2}27, ^{2}45, 80		1
	Tone	41	N													
S2 (Two Types)	Vol.	8	A400P				1-3-1	3	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80		3
	Tone	41	N													
27R (Early & Late)	Vol.	8	UC500			See Note A27	8, 8	1	RS213					^{2}24A, 27, 45, 80		1
	Vol.	6	F7			See Note A4										
62, 64	Vol.	6	F7				8, 8, 8	28	RS213					^{3}24A, 27, ^{2}45, 80		1
	Tone	41	N													
70R	Vol.	15	O				2803	1	CS133					^{3}35, ^{3}27, ^{2}47, 80	262	3
	Tone	44	UC502				2719	13	CS123							
							2852	14	CS123							
71R, 72R, 73R	Vol.	15	O				2803	1	CS133					^{3}35, ^{2}27, 47, 80	262	3
	Tone	34	UC502				2852	17	CS123							
74R (First Type)	Vol.	6	F7				8, 8	1	RS213					^{3}24A, 45, 80		1
74R (Second Type)	Vol.	6	F7				8, 8	1	RS213					^{3}24A, 47, 80		1
RADOLEK																
Marvelo & Monroe "6-7-8-9"	Vol.	10	D12				2-1-1-2-1	3	See Note	B1				^{4}26, 27, 71A, 80		11
Marvelo 30, SR222, Monroe	Vol.	8	A5MP				4-4-2	3	See Note	B1				^{2}35, ^{2}56, ^{2}47, 80		3
SR223 Marvelo & Monroe (Trio Tone Dynamic)	Vol.	12	A5MP				2-3-2-2	3	See Note	B1				^{3}35, ^{2}56, ^{2}47, ^{2}80		3
SR224 Little Leader	Vol.	6	E7		4		4-4	1	CN150	B3				^{2}24A, 47, 80		1
SR225 Marvelo "6" Midget	Vol.	12	A5MP				4-4-4	3	CM173	B3				^{2}35, ^{2}56, 47, 80		3
	Tone	22	G12													
SR227 Batt. Super	Vol.	62	N											^{3}34, ^{6}30	456	
	Tone	22	UC502													
SR228 Marvelo	Vol.	8	F				8-8	1	See Note	B3				^{2}35, ^{2}24A, 47, 80	175	1
	Tone	22	K12													
SR229 10 Tube Super	Vol.	6	G12				10-10	1	See Note	B3				^{3}56, ^{2}57, ^{2}58, 47, ^{2}80	175	1
	Tone	22	K12													
SR230 (1933—12 Tube Super)	Vol.	45	Z12				8-8-4	3	See Note	B3				^{4}58, ^{3}56, ^{2}57, ^{2}46, 82	175	3
	Tone	41	UC502				8	19	TS106							
	Supp.	12	E12													
SR231 "1933" Compact 5 Tube	Vol.	6	G7		2		8-4	25	CM171					57, 58, 55, 47, 80	‡	1
SR232 "Little Master"	Vol.	7	G		2		8-4	4	CM171	B3				58, 57, 47, 80		1
SR233 (1933—12 Tube Super)	Vol.	16	N				8-8-8	3	CN155	B3				^{4}56, ^{2}57, ^{2}58, ^{2}47, ^{2}80	‡	3
	Tone	22	K12				4	15	TS105							
SR234 (1933—10 Tube Super)	Vol.	15	N				8-8-8	3	CN155	B3				^{2}56, ^{3}58, 55, ^{2}47, 80	‡	3
	Tone	44	K12													
	Supp.	12	G12													
SR235 (1933—5 Tube Super)	Vol.	17	N				8-8	1	CN152	B3				57, 58, 55, 47, 80	‡	1
SR236 Marvelo (1932 9 Tube)	Vol.	62	N				12-8	34	See Note	B3				^{2}35, ^{2}24A, ^{2}27, ^{2}47, 80	‡	1
	Tone	22	K12													
SR237 DeLuxe 5 Tube	Vol.	6	G7		2		8-4	4	CM171	B3				^{2}57, 58, 47, 80	‡	1
	Tone	22	K12													
SR243 "1933" 7 Tube Super	Vol.	56	N				8-8	1	CN152	B3				56, 57, ^{2}58, 55, 47, 80	‡	1
	Tone	22	K12													
SR248 Monroe	Vol.	10	D12				1-2-1-1-2	3	See Note	B1				^{4}26, ^{2}27, ^{2}71A, 80		11
SR249 Marvelo	Vol.	1	D12				‡	‡	See Note	B4				^{4}26, ^{2}27, ^{2}50, ^{2}80		1/11
	Tone	22	G12													
SR270 (1934) 15 Watt Amp. (AC)	Vol.	16	M				8, 8, 8	30	RS213					57, 56, ^{2}2A3, 5Z3		1
	Tone	41	M				10	15	TS101							
SR271 (1934—30 Watt Amp.)	Vol.	16	M				8-8-8	30	See Note	B3				57, 56, ^{4}2A3, 5Z3		1
	Tone	41	M				10	15	TS101							
SR274 (1934) 15 Watt Amp. (DC)	Vol.	16	M				8, 8	24	RS213					39, 37, ^{2}2A3		
							10	15	TS101							
SR280 (3 Watt Amp.)	Vol.	16	M				8-8	1	RS213					57, 2A5, 80		1
	Phono.	16	K12				10	15	TS101							
SR287 Octomatic	Vol.	17	M				8, 8	1	See Note	B3				^{2}58, 2A7, 2A6, 2A5, 80	‡	1
	Tone	22	K12				10	20	TS101							
							25	15	TS103							
951	Vol.	6	H7	6	2		9442	11	UR182	B31				6A7, 78, 75, 43, 25Z5	265	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
RADOLEK—Continued																
956, 958	Vol.	17	M	6			9659	1	CN152	B3				[2]57, 58, 2A6, 2A5, 80	465	1
	Tone	22	K12				8876	15	TS101							
10926	Vol.	18	MR48	M26			16-12-8	11	UR182	B3				6A7, 6D6, 75, 43,		
														25Z5	456	
10927	Vol.	45	MR48	M26			8-8	23	CM172	B3				6A8, 6K7, 6H6, 6F5,		
														6F6, 80	456	1
10928	Vol.	18	MR48				6-10	23	CM172	B3				6A7, 6D6, 75, 42, 80	456	1
10931	Vol.	6	MR21	M26	EX200		16-12	23	CM164	B3				6D6, 6C6, 43, 25Z5		
10943, 10944, 10946	Vol.	45	MR48				4	32	RS211					6A7, 6K7, 6H6, 6F5,		
	Tone	34	N				8-4	32	CN151					6F6, 80	456	1
10951	Vol.	6	H7	6	2		9442	11	UR182	B31				6A7, 78, 75, 43, 25Z5	262	
10953	Vol.	7	K		EX150		7-4	1	CN151					58, 57, 2A5, 80		1
							5	15	TS101							
10956	Vol.	17	M	6			9659	1	CN152	B3				[2]57, 58, 2A6, 2A5, 80	465	1
	Tone	22	K12				8876	15	TS101							
10962	Vol.	6	G7		2		4-4	4	See Note	B3				78, 77, 42, 80		1
	Tone	22	L													
10963, 10964	Vol.	15	M				4-4	4	See Note	B3				6A7, 78, 75, 42, 80	465	1
	Tone	22	L				5	19	TS105							
							5	15	TS101							
10966	Vol.	6	G7		2		4-4	4	See Note	B3				[2]6D6, 6C6, 42, 80		1
							5	19	TS105							
							5	15	TS101							
10967	Vol.	6	L		EX400		20-4-5-5	6/15	UR189	B98				78, 44, 43, 25Z5	456	
10968 (32 Volt)	Vol.	15	M				6-10	1	CN152	B3	34	F292	C3	6A7, 78, 75, 42, 84	456	10
	Tone	22	L				5-5	15	TN110							
							.05-.05		Buffer	B14						
10969	Vol.	54	M				5	19	TS105					1A6, 34, 32, 30, 19	456	
	Tone	22	L													
10970	Vol.	17	N				4-8-4	26	CM175	B3				[3]78, 37, 85,[2]42, 80	456	1
	Tone	41	L													
K16700	Vol.	6	H12	6			20-12	27	UR182	B115				6D6, 6C6, 25A7		
K16701	Vol.	18	N	6			20-12	27	UR182	B115				6A7, 6D6, 75, 25A7	456	
K16702	Vol.	18	N	7			8-8	1	See Note	B3	48	See Note	C8	1C6, 1A4, 75, 30, 19	456	10
							.005		Buffer	B14						
K16703	Vol.	18	N	7			8-8	1	See Note	B3	48	See Note	C8	1C6,[2]34,[3]30, 19	456	10
							.005		Buffer	B14						
K16705	Vol.	17	N	6			311	27	CN145	B8				6A7, 6D6, 75, 43,		
							312	27	CS125					25Z5, 6E5	456	
K16706	Vol.	18	N	‡			10-10-4	1/15	CN151/TS101	B3				6A7, 6D6, 76, 42, 80,	456	1
	Tone	22	L											75, 6E5		
K16722	Vol.	17	N				8-8	4	CM172	B3				6A7, 6K7, 76, 6F5,		
	Tone	34	L				5	15	TS105					42, 80	456	1
K16725	Vol.	45	N				4-8	1	CN151	B3				6K7, 6A8, 6D6, 76,		
	Tone	22	N				5	15	TS105					6B5, 80	456	1
K16728	Vol.	17	N				20-4-5-5	6/15	UR189	B98				6A7, 6K7, 75, 43,		
	Tone	22	L											25Z5	456	
K16740	Vol.	17	N	6			P337	6	CN145	B124				6A7, 6D6, 75, 43,		
							P304	15	TS105					25Z5	456	
K16743	Vol.	45	SRP275	7			P958	1	RN232	B90	14	245C	C3	1C6, 34,[2]30, 32, 19	456	10
	Tone	44	L				.01-.01		Buffer	B14						
K16746	Vol.	18	N	7			P958	1	RN232	B90	14	245C	C3	1C6,[2]34,[3]30, 19	456	10
	Tone	22	O				.01-.01		Buffer	B14						
K16747	Vol.	18	N	6			P950	1	CN151					6A8, 6K7, 6Q7, 6F6,		
	Tone	34	L											5W4	456	1
K16748	Vol.	18	N	6			P160	1	CN151					6A7, 6D6, 75, 42, 80	456	1
K16749	Vol.	18	N	7			P958	1	RN232	B90	14	245	C3	1C6, 34, 1B5, 1F4	456	10
K16751	Vol.	17	N	6			8	3	WE847					[3]6K7, 6A8, 6Q7, [2]6L6,		
	Tone	22	O				4-8	3	CN151	B181				6G5,[2]5W4G	456	1
							4	13	CS131							
							5	15	TS101							
K16753	Vol.	15	O	6			Tuner Section							[4]6K7, 6A8, 6H6, 6C5,		
	Tone	22	L				P1156	3	WE3540					6G5,[2]5W4, 85, 6D6,		
							P1158	14	WE3540					42,[4]45, 80, 83V	456	1/‡
							P1155	3	CS135							
							P1043	13	CS131							
							P301	15	TS101							
							Amplifier Section									
							P1156	2	WE3540							
							P950	13	CN151							
							P1208	‡	Order from	Mfr.						
							P304	15	TS101							
K16756	Vol.	18	N	6			P950	1	CN151	B81				6A8, 6K7, 6H6, 6F5,		
	Tone	34	‡		See Note	A5								6F6, 5W4	456	1
K16759	Vol.	17	N	6			8	3	WE847					[2]6K7, 6A8, 6Q7, 6L6,		
	Tone	22	O				4-8	3	CN151	B181				[2]5W4, 6G5	456	1
							5	15	TS105							
K16772	Vol.	18	N				1477	25	RS215	B3				6A7, 6K7, 75, 6C5,		
	Tone	44	K12	6			1476	25	RS216					[2]6F6, 80, 6G5	465	1
K16773	Vol.	18	N											6A7, 6D6, 75, 76,[2]48	465	1
	Tone	22	L	6												
K16777	Vol.	20	500M No. 1		See Note	A19	3167	25	WE2545					[2]6K7, 6L7, 6J7, 6H6,		
	Tone	22	K12	6			1476	25	RS216					6C5,[2]6F6, 5Z3, 6E5	465	1
							3170	19	TS106							
							1110	13	CS131							
							8876	15	TS105							
K16780	Vol.	45	750M No. 1		See Note	A19	3060	1	CN152		30	285	C3	[3]15, 6A7,[2]76, 19, 6E5	465	10
	Tone	44	K12	6			3159	13	CS121							
							8876	15	TS105							
K16790	Vol.	18	N	6			8-8	23	RM262	B50				6C6, 6D6, 75, 42, 76,	465	1
														6G5, 80	465	1
K16825	Vol.	17	UC514	6			P795	4	CM172		35	294	C3	6D6, 6A7, 6K7, 75,		
	Tone	22	MR39				G864	15	TS101					6F6, 84	175	10
							.0075		Buffer	B14						
N16700	Vol.	6	H12	6	EX500	A4	4801A	74	UR192					6D6, 6C6, 25A7, 25A6		
	Vol.	6	H12		EX500	A27										
N16702	Vol.	18	N	7			8-8	1	CN152	B3	48	See Note	C8	1C6, 1A4, 75, 30, 19	456	10
							.005		Buffer	B14						
N16704	Vol.	45	N	7			8-8	1	CN152	B3	14	245C	C3	1C6,[2]34,[3]30, 19	‡	10
							.005		Buffer	B14						
N16729	Vol.	6	H12	6			20-12	4	UR192					6A7, 6C6, 43, 25Z5	456	
N16730	Vol.	6	MR21	M26			A-7-1	4/13	UR182	B250				6D6, 6C6, 43, 25Z5		
N16731	Vol.	17	MR48	M26			20-12-5	4/15	UR182	B259				6A7, 6D6, 75, 25B6G,		
														25Z5, 6G5	456	
N16762, N16763	Vol.	140	1 Meg No. 1		See Note	A19	P1825	1/13	RN245					6A7, 6D6, 75, [2]76,		
	Tone	140	MR48				P1783	15	TS101					[2]42, 80	456	1
N16765	Vol.	18	MR53	M26			P1511	23	RM262					6A7, 6D6, 75, 41, 80	456	1
N16782	Vol.	20	TM251-SS16				3167	25	WE2545					[2]6K7, 6A8, 6J7, 6H6,		
							3041	25/13	RN241					[3]6C5,[2]6F6, 80	465	1
							1110	13	CS131							
							1693	20	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
RELIANCE																
L5	Vol.	18	N	6			P474	32	RS211					6F5, 6F6, 6H6, 6K7, 6L7, 5Z4	456	1
	Tone	34	L				P160	32	CN151	B81						
							P304	15	TS101							
L6	Vol.	18	N	6			P474	32	RS211					6C5, ^{2}6F6, 6K7, 6L7, ^{2}6Q7, 5Z4	456	1
	Tone	44	L				P160	32	CN151	B81						
							P304	15	TS101							
L7	Vol.	45	N	7			P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, ^{2}34	456	10
	Tone		L				.01-.01		Buffer	B14						
Z4	Vol.	45	SRP275				P391	1	RN232	B90	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275	7			P958	1	RN232	B90	14	245C	C3	1C6, ^{2}30, 19, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
REMLER																
10	Vol.	58	H				8-8	4	See Note	B3				35, ^{2}24A, 27, 47, 80	180	1
10-3 "Cameo"	Vol.	6	H12	6	EX300		8-8	4	See Note	B3				27, ^{2}58, 57, 47, 80	250	1
	Tone	22	H12													
10-3 "Cameo" (With 2A5 Output)	Vol.	6	H12	6			8-8	4	See Note	B3				27, ^{2}58, 57, 2A5, 80	250	1
	Tone	22	Y													
10-4	Vol.	76	N	6			8-8	4	CM172	B3				6A7, ^{2}78, 6B7, 42, 80	450	1
	Tone	76	N													
11	Vol.	6	Y		EX400		8-4-2	3	MN275					^{3}24A, 47, 80		3
	Tone	34	H12													
14	Vol.	6	Y		EX400		8-4-2	3	MN275					^{3}24A, 27, 45, 80		3
	Tone	34	H12													
15	Vol.	58	H		3		8, 8	4	See Note	B3				^{2}51, ^{2}24A, 27, 47, 80	180	1
15-3	Vol.	13	N				8, 8	4	RS213					^{2}56, ^{3}58, ^{2}57, 47, 82	180	3
	Tone	22	H12	6			4	13	CS131							
	Supp.	12	N													
17	Vol.	6	Y				8-42	1/17	MN275					^{4}24A, ^{2}27, 45, 80	180	3
	Tone	34	H12													
19	Vol.	15	N				8-6-8	3	MN275					^{2}35, ^{2}24A, ^{3}27, ^{2}47, 80	180	‡
	Tone	44	Y													
	Sen.	7	H													
21 Minuette	Vol.	6	H7	6	3		8-8	4	CM172	B3				35, 24A, 47, 80		1
21-3	Vol.	14	N				8-4	4	CM171	B3				^{2}57, 47, 82	250	1
	Tone	22	Y													
21-4	Vol.	18	N	6			8-8	4	CM172	B3				2A7, 58, 2B7, 2A5, 80	450	1
	Tone	76	‡		See Note A5											
26 (First Type) "Scotty"	Vol.	6	H12	6			8-8	1	CN142	B3				77, 78, 43, 25Z5	450	
							10	15	TS101							
26 (Above 54760) "Scotty"	Vol.	6	H12	6			8-8	6	CN142	B3				6A7, 78, 77, 43, 25Z5	450	
							10	15	TS101							
27 "Scotty"	Vol.	17	N	6			8-8	1	CN152	B3	34	292		6A7, 78, 6B7, 89, 1V, 84	465	10
							10	15	TS101							
28	Vol.	6	G12	6	See Note A14		10-10	4	CN145					6A8, 6K7, 6J7, 25A6, 25Z6, K49B	450	
29	Vol.	12	N											^{4}22, ^{3}01A, 12	‡	
	Bias	9	X													
	Fil.	29	R	6												
30	Vol.	6	H12	6			4-4	1	CN150	B3				6A7, 6F7, 41, 84	450	25
35 Auto	Vol.	18	UM154		See Note A96		8-4	1	CN151	B3	34	292		6A7, ^{2}78, 75, 41, 84	450	10
	Tone	22	‡		See Note A5		10-10	15	TN111							
36 Auto Radio	Vol.	18	N	6			4-4	4	CM160					^{2}6D6, 6A7, 75, 76, 41	250	
							8	14	CS123							
37 Police	Vol.	18	UM154-SS17	M26			4-4	4	CM170					^{2}6K7, 6A8, 6Q7, 6C5, 6F6	250	MG
	Tone	22	Y				8	13	CS123							
40	Vol.	6	H12	6			4-4	1	CN150	B3				6A7, 6F7, 41, 84	450	25
41	Vol.	6	G12	6			4-4	1	CN150	B3				6A8, 6K7, 6J7, 6F6, 5Z4	450	1
42	Vol.	18	N	6			8-8	4	CM172	B3				^{2}6D6, 6A7, 75, 42, 80	450	1
45	Vol.	15	MR48	M26			10-10	25	CM172	B3				6L7, 6C5, 6K7, 6H6, 6F5, 6F6, 5Z4	450	1
	Tone	22	MR33				10	15	TS101							
46	Vol.	6	G12	6	EX200		4-4	23	CM170					6A8, 6K7, 6J7, 6F6, 5Z4	450	1
47	Vol.	17	MR48	M26			4-4	25	CM170					6A8, 6K7, 6Q7, 6F6, 5Z4	450	1
51	Vol.	6	G12	6			4-4	23	CM170					78, 77, 42, 80		1
53 (Above 54862)	Vol.	6	H12	6			8-4	1	CN151	B3				6A7, 6D6, 53, 42, 80	450	1
53C (Above 56208)	Vol.	6	H12	6			8-4	1	CN151	B3				6A7, 6D6, 76, 42, 80	450	1
60	Vol.	17	MR48	M26			4-4	23	CM170					6A7, 6D6, 75, 42, 80	450	1
64	Vol.	15	MR48	M26			10-10	25	See Note	B3				6A8, 6K7, 6H6, 6F5, 6F6, 5Z4	450	1
							10	15	TS101							
71	Vol.	15	MR48	M26			10-10	25	See Note	B3				^{3}6K7, 6L7, 6C5, 6F6, 5Z4	450	1
	Tone	22	Y													
91	Vol.	18	MR48				10	20	TS101					1C6, 1A4, 1F6, 33, 1A1	450	
REPUBLIC INDUSTRIES																
Sky Hawk Patrician	Vol.	6	G12	6			965	8	UR182	B3				78, ^{2}77, 43, 25Z5	175	
							928	15	TS102							
MS & Jr.	Vol.	6	G12				4-4	4	See Note	B3				^{2}57, 58, 47, 80	175	1
RC5, RC6 "Sky-hawk"	Vol.	18	N				4-4-4-8-8-4	‡	See Note	B3				^{2}78, 6A7, 75, 42, ^{2}25Z5	175	
	Tone	76	M													
SL5D "Skyhawk"	Vol.	76	N	6			496	4	See Note	B3				6A7, 78, 75, 42, 80	175	1
	Tone	76	M				928	19	TS102							
SL6 "Skyhawk"	Vol.	6	G12	6			1085	8	UR182	B3				^{2}77, 78, 43, 25Z5	115	
	Tone	22	M				928	15	TS102							
SL6D "Skyhawk"	Vol.	18	N	6			1085	8	UR182	B3				^{2}78, 6A7, 75, 43, 25Z5	175	
	Tone	21	M													
BP5E	Vol.	6	G12	6			4-10-4	8	UR182	B182				^{2}77, 78, 43, 25Z5	115	
							25	15	TS103							
CS6	Vol.	17	N	6			4-4	4	See Note	B3				77, 78, 76, 75, 42, 80	115	1
	Tone	21	M				25	19	TS103							
TL6C	Vol.	17	N				4-4	4	See Note	B3				^{2}78, 6A7, 75, 42, 80	175	1
	Tone	21	M				25	19	TS103							
TR5B	Vol.	17	N	6			8-4	25	See Note	B3				6A7, 78, 75, 42, 80	175	1
							25	19	TS103							
42	Vol.	17	MR48	M26			18-2003	8	CN145	B3				6A7, 78, 75, 43, 25Z5	175	
							18-928	15	TS103							
51	Vol.	17	MR48	M26			18-2003	8	CN145	B3				6A7, 78, 75, 43, 25Z5	175	
							18-928	15	TS103							
56C, 56T	Vol.	15	MR48	M26			12-6	1	CN155		14	245C	C3	34, 6A7, 32, 30, 38	465	10
							10	15	TS101							
							.01-.01		Buffer	B14						
76C, 76T	Vol.	15	MR48				12-6	1	CN155		14	245C	C3	^{2}34, 30, 6A7, 32, 76, 19	465	10
							10	15	TS101							
							.01-.01		Buffer	B14						

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
REPUBLIC INDUSTRIES—Continued																
632C, 632T	Vol.	18	N	6										6C6, 6A7, 6D6, 85, ^{2}48		
732C, 732T	Vol.	15	N	6			12-6	1	CN155		35	F294	C3	^{2}6D6, 6A7, 6C6, 76, 42,		
							10	15	TS101					84	465	10
							.01-.01		Buffer	B14						
REX—See Airking																
RK RADIO LABORATORIES																
4 Tube B'cast & Long Wave	Vol.	6	SRP263	6	EX500		12-8-5	6/15	CN145/TS105					6D6, 6C6, 43, 25Z5		
RKP4 (AC-DC)	Vol.	6	SRP263		EX500		12-8-5	6/15	CN145/TS105					6D6, 6C6, 43, 25Z5		
RKS5 Radio Keg	Vol.	6	G7	6	3		12-8-5	6/15	CN145/TS105					6C6, 6D6, 85, 43,		
														25Z5	175	
RK60G	Vol.	15	N				8-8	1	CN152					2A7, 58, 55, 56, 2B6,		
														80	175	3
RK60L	Vol.	17	N	6			8-8	1	CN152					2A7, 58, 55, 56, 2B6,		
														80	115	3
421, 422, 423, 424	Vol.	6	SRP263				25-10	27	UR182	B115				6D6, 6C6, 43, 25Z5		
425, 426, 427, 428	Vol.	6	SRP263		EX500		4-4	1	CN150					6D6, 6C6, 42, 80		1
521, 522	Vol.	18	N				25-10-5	27/15	UR182	B95				6A7, 6D6, 75, 43,		
														25Z5	465	
534	Vol.	18	N				8-8	4	CM172	B3				6A7, 6D6, 75, 42, 80	465	1
	Tone	22	G12													
631, 633	Vol.	18	N				8-8	4	CM172	B3				6A7, ^{2}6D6, 75, 42, 80	465	1
	Tone	22	G12													
ROCKE INTERNATIONAL																
Arlab 51	Vol.	56	N				8-8	1	See Note	B3				56, ^{3}58, 55, 2A5, 80	‡	1
							25	15	TS103							
ROOTS AUTO RADIO																
55	Vol.	18	UM147		See Note A96		10-10	15	TN111					^{2}78, 6A7, 85, 41, 79	‡	
ROYAL																
9A	Vol.	7	J				4-4	6	CN140	B3				78, 77, 43, 25Z5		
							5	15	TS101							
SARGENT																
20	Vol.	15	N	6			8, 8, 8	7	RS213					^{3}6D6, ^{2}6C6, 85, 76, 42,	525	1
	Sen.	12	K12											80		
SAVIL RADIO ENGINEERING																
557	Vol.	6	G7		2		4-4	4	See Note	B3				^{2}58, 57, 47, 80		1
	Tone	34	M													
589	Vol.	7	G7		2									^{2}39, 36, ^{2}89		
	Tone	31	M													
715	Vol.	6	G7		2		4-8	4	See Note	B3				^{2}57, 56, ^{2}58, 47, 80	‡	1
E. H. SCOTT RADIO LAB.																
"All Wave Super" 145 Pwr	Vol.	12	L				8, 8, 8	3	RS213					^{5}24A, ^{4}27, ^{2}45, 80	470	3
"Worlds Record" SG-AC 10	Vol.	7	Z											^{4}27, ^{3}22, ^{2}45, 80	‡	
1933 DeLuxe AVC Super	Vol.	20	500M No. 1		See Note A19		8, 8, 8	3	WE847	B3				^{4}58, 57, Wunderlich,		
	Tone	22	‡		See Note A5									^{3}56, ^{2}45, 80	‡	3
SEARS-ROEBUCK CO. "Silvertone" (Also see Colonial).																
FF	Vol.	4	G12				‡	‡	See Note	B1				^{3}26, 27, 12A		11
J	Vol.	4	G12				3-2	1	See Note	B1				^{4}26, 27, ^{2}71A		11
9 Tube Super AVC	Vol.	14	N	6			7051	34	RS213					^{2}35, ^{2}24, ^{2}27, ^{2}47, 80	175	1
	Tone	44	K12				7078	34	RS215							
36	Hum.	66	SRP266				8	1	RS213					^{3}24, ^{2}45, 80		3
36P	Hum.	66	SRP266				D4758P	1	RS213					^{2}35, 24A, ^{2}45, 80		3
37							5734A	4	RS216					^{3}35, 24A, ^{2}45, 80		3
37P							16	4	RS216					^{3}35, 24A, ^{2}45, 80		3
39-125							4758P	4	RS213					^{2}35, 24A, 45, 80		1
41, 41P, 42							5734A	4	RS216					^{3}24A, ^{2}45, 80		1
44, 45	Vol.	29	R											^{4}01A, 12A		
44 (Late)	Vol.	6	H7		1		4758	4	RS213					^{2}35, 24A, 27, 47, 80	175	1
47, 48	Vol.	6	H7		2		4758	4	RS213					^{3}35, 24A, ^{2}47, 27, 80	175	3
49, 50	Vol.	‡	G12				1-2-1-1	3/13	See Note	B1				^{3}26, ^{2}27, 71A, 80		11
50 AVC	Vol.	7	H				4758P	4	RS213					^{4}35, 24A, 27, ^{3}47, 80	175	7
51	Vol.	6	G12				1-2-2-2	3/14	See Note	B1				^{2}27, ^{3}26, ^{2}71A, 80		11
52	Vol.	6	G7				1-2-1-2	3/14	See Note	B1				^{6}27, ^{2}45, 80		3
53, 54 (Factory Model 94)	Vol.	6	G7				1-2-1-2	3/14	See Note	B1				^{6}27, ^{2}45, 80		3
56	Vol.	6	G12				1-2-1-2	3/14	See Note	B1				^{2}24A, ^{2}27, ^{2}45, 80		3
62	Vol.	6	H7	6			8	25	RS213					57, ^{2}58, 24A, 47, 80	175	3
	Tone	57	N				4	13	See Note	B3						
65, 69	Tone	31	N				8	12	See Note	B3				^{2}30, ^{4}32, 33, Ballast		
							20	19	TS102					No. 31	175	
94, 95, 99	Vol.	6	G7				1-2-1-2	3/14	See Note	B1				^{6}27, ^{2}45, 80		3
100	Vol.	6	G12				1-2-1-2	3/14	See Note	B1				^{2}24A, ^{2}27, ^{2}45, 80		3
107HA62	Vol.	18	UC512				8-8	1	RN242	B3	19	249	C3	^{2}6D6, 6L7, 76, 75, 6B5	465	10
	Tone	22	L				.005		Buffer	B14						
108	Vol.	6	G12				2-2-2-2-2	3/14	See Note	B1				^{2}27, ^{3}26, ^{2}71A, 80		11
109	Vol.	6	G12				8-8-8	46	MN275					^{3}24A, 27, ^{2}45, 80		3
110	Vol.	71	‡		See Note A5		8-8-8	46	MN275					^{6}27, ^{2}45, 80		3
111, 112	Vol.	6	H12				8-8-8	46	MN275					^{4}24A, ^{2}27, ^{2}45, 80		3
114	Hum.	66	SRP266				8	1	RS213					^{3}24A, ^{2}45, 80		3
218	Vol.	6	‡		See Note A5		8-8-8	46	MN275					^{3}24A, 27, ^{2}45, 80		3
566	Vol.	18	UC512	6			119-20	4	CM171	B93	35	294	C3	6A8, 6K7, 75, 41, 84-		
							.01		Buffer	B14				6Z4	465	10
666	Vol.	18	UC512				119-21	1	CN151	B92	35	294	C3	^{2}6K7, 6A8, 6Q7, 6N6,		
							.01		Buffer	B14				84-6X5	465	10
1130	Vol.	6	G12				15-5	2	MN273					^{3}24A, 27, ^{2}45, 80		3
1150	Hum.	66	SRP266				D4758P	1	RS213					^{3}24A, ^{2}45, 80		3
1152							R5734A	4	RS216					^{3}24A, ^{2}45, 80		1
1170	Hum.	66	SRP266				D4758P	1	RS213					^{3}24A, ^{2}45, 80		3
1250							R4758P	4	RS213					^{3}24A, 45, 80		1
1252							4758A	4	RS213					24A, or ^{2}35, 47, 80		1
							4758P	4	RS213							
1260	Hum.	66	SRP266				D4758P	1	RS213					^{3}24A, ^{2}45, 80		3
1280, 1282	Vol.	6	L				8-16	31	See Note	B3				^{4}24A, 27, 45, 80	175	1
	Tone	22	K12													
1310, 1312							R5734A	4	RS216					^{3}35 or 24A, ^{2}45, 80		3
1320, 1322, 1324	Vol.	6	H7		1		4758A	4	RS213					^{3}35, 24A, ^{2}47, 27, 80	175	3
							4758P	4	RS213							
1370	Vol.	7	H				R6122	4	RS213					35, 24A, 47, 80		1
1370, 1371 /W/ Tap Field	Vol.	7	F				8-8	4	See Note	B3				24A, 35, 47, 80		1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
SEARS-ROEBUCK—Continued																
1386	Vol.	6	H7		1		4758	4	RS213					^{3}35, 24A, ^{2}47, 27, 80	175	3
1390, 1400, 1402, 1404, 1406	Vol.	6	H7		1		4758	4	RS213					^{2}24A, 35, 47, 27, 80	175	3
1420							5734A	1	RS216					^{2}24A or ^{3}35, ^{2}45, 80		1
1430	Vol.	7	H				4758	4	RS213					24A, 27, ^{4}35, ^{3}47, 80	175	7
1450	Vol.	6	H7		1		4758	4	RS213					^{3}35, 24A, ^{2}47, 27, 80	175	3
1462	Tone	21	N				4758	25	RS213					^{3}35, 24A, 47, ^{2}27, 80	175	3
1480, 1482, 1484	Vol.	7	H				4758	23	RS213					^{3}35, 24A, 27, 47, 80	175	3
	Tone	57	N													
1506	Vol.	8	E		2		1-1-1	26	See Note	B1				^{2}51, ^{2}24A, 47, 80	175	1
1510	Vol.	7	H				4758	4	RS213					27, ^{4}35, 24A, ^{3}47, 80	175	7
1512X, 1520, 1522, 1522X	Vol.	109	N				7078	4	RS215					^{3}27, ^{2}35, ^{2}24A, ^{2}47, 80	175	1
	Tone	22	K12				7051	4	RS213							
1560, 1562, 1564	Vol.	15	N				8	12	CS123					^{3}30, ^{3}32, 33	175	
	Tone	57	N				5	17	TS101							
1570, 1572, 1574	Tone	22	N				8	12	See Note	B3				^{2}30, ^{4}32, 33	175	
							20	19	TS102							
1580, 1582, 1584, 1586	Vol.	6	H12				8, 8	25	RS213					57, ^{2}58, 24A, 47, 56, 80	175	3
	Tone	57	N				4	13	See Note	B3						
1590, 1592	Vol.	6	H12				4758P	23	RS213					57, 58, ^{2}24A, 47, 80	175	1
	Tone	57	N													
1597, 1598	Vol.	6	H12				8, 8	23	RS213	B3				39, ^{2}36, ^{2}89, 80	175	1
	Tone	57	MR48													
1600							4-4	1	See Note	B3				24A, ^{2}27, 80	1000	1
1620, 1622	Vol.	29	U	6										30, ^{3}32 or 34, 33		
1626	Vol.	15	N				8876	15	TS105					^{2}39, 36, 85, 41	175	
1630	Vol.	6	H12				7236	23	RS215					^{2}57, ^{2}58, ^{3}46, 56, ^{2}80	175	3
	Tone	57	N				4958	23	RS213							
1640	Tone	22	UC506				8, 8	34	WE847					^{3}57, ^{3}58, ^{4}46, 83	175	7
	Phantom	7	W													
1650	Vol.	15	O				8, 8	23	RS213					^{3}58, ^{2}56, 27, ^{2}47, 80	175	3
	Tone	57	N													
1652, 1654	Vol.	15	O				14	‡	WE1647					^{4}58, ^{2}56, 27, ^{3}46, ^{2}80	175	3
	Tone	57	N				8	‡	WE847							
1660	Vol.	6	H12				8, 8	23	RS213					39, ^{2}36, 89, 80	175	1
1670 (Early)	Vol.	15	O				8, 8	23	RS213					^{4}58, ^{2}56, 27, ^{2}47, ^{2}80	175	3
	Tone	57	N													
1670 (Late) "B"	Vol.	15	O				8, 8	23	RS213					^{3}58, ^{2}56, 27, ^{2}47, 24A, ^{2}80	175	3
	Tone	57	N													
1700	Vol.	68	D12	6			9150	29	CM165	B51				6A7, 6B7, 77, 43, 25Z5	175	
							5	15	TS101							
1703	Vol.	6	UC509	6	EX300		R8313	23	CM161					78, 77, 43, 1V		
1704	Vol.	56	N	6			R8431	4	CM162					6A7, 78, 6B7, 43, 1V	480	
1705	Vol.	19	Order from	Mfr.			R8624	23	RS213					6A7, ^{2}78, 41, 85, 84	175	1
	Tone	57	O													
	Sen.	7	A550P		‡											
1706, 1707	Vol.	18	N	6			R8488	23	RS213					41, 75, 78, 6A7, 84	480	1
1708, 1709	Vol.	18	N				R7236	23	RS215					^{2}78, 6A7, 75, ^{2}45, 37, 80	175	3
	Tone	57	N				R8488	23	RS213							
	Sen.	7	UC500													
1708A	Vol.	62	N				R8488	23	RS213					6A7, ^{2}78, ^{3}37, 42, 83V	175	1
	Tone	‡	N													
1710	Vol.	29	U				R8389	13/19	CS123/TS102					30, 940, ^{3}951, Ballast No. 52	175	
1711	Vol.	29	U				R8357	13/19	CS123/TS102					950, ^{3}951, 30, Ballast No. 52	175	
1711A	Vol.	29	U				R8357	13/19	CS123/TS102					^{3}951, 30, 950, Ballast No. 52	480	
1712, 1713	Tone	22	N				R8449	12/13/19	CN142/TS104	B183				^{4}951, ^{2}30, 33, Ballast No. 31	175	
1714	Vol.	15	O				R8707	12/13/19	CN142/TS101	B184				^{3}951, ^{3}30, ^{2}950, Ballast No. 31	175	
	Tone	34	N													
1715	Vol.	7/18	DRP317											^{2}78, 6A7, 75, ^{2}41	175	MG
	Tone	57	N	6												
1720	Vol.	7/18	DRP317				R7236	23	RS215					^{2}78, 6A7, 75, ^{2}45, 37, 83V	175	3
	Tone	57	N				D4758P	23	RS213							
							R1114	‡	CS131							
1721	Vol.	7/15	DRP317				R7236	4	RS215					^{3}78, ^{4}37, ^{2}2A3, 56, 83V	175	31
	Tone	34	N				R8780	13/14	CN151							
1722	Vol.	7/15	DRP317				R7236	4	RS215					^{3}78, ^{3}37, ^{2}2A3-H, ^{2}6B7, 56, 83V	175	31
	Tone	34	N				R8780	13	CN151							
	Hum.	‡	SRP266													
1722 (Revised)	Vol.	7/17	DRP317				R7236	4	RS215					^{4}78, 85, 56, 37, ^{2}2A3, ^{2}6B7, 5Z3	175	31
	Tone	34	N				R8780	13/14	CN151							
	Hum.	‡	SRP266													
1722X	Vol.	7/17	DRP317				R7236	4	RS215					^{4}78, 85, 56, 37, ^{2}2A3, ^{2}6B7, 83V		
	Tone	34	N				R8780	13/14	CN151							
	Hum.	‡	SRP266													
1724	Vol.	6	H12				R9150	29	CM165	B51				78, 77, 43, 25Z5		
	Tone	57	N	6												
1725	Vol.	7/18	DRP317				R7236	23	RS215					^{2}78, 75, 37, ^{2}45, 6A7, 83V	175	3
	Tone	57	N				D4758P	23	RS213							
							R1114	‡	CS131							
1726X	Vol.	7/17	DRP317				R7236	4	RS215					^{4}78, 56, 85, 37, ^{2}2A3, 5Z3	175	31
	Tone	34	N				R8780	13/14	CN151							
	Hum.	‡	SRP266			A67										
1728A	Vol.	58	UC509				5-12-5	8	UR182	B3				78, 77, 43, 25Z5		
							10	15	TS101	B6						
1729	Vol.	64	TRP609				D4758P	23	RS213					^{2}78, 6A7, ^{2}37, 41, 80	175	1
	Tone	22	N	6												
1730	Vol.	56	UM154	6	See No	te A96	R10086	‡	CS131					^{2}78, 6A7, 85, 41	175	MG
	Tone	22	N													
1731	Vol.	18	N				8-4	1	CN151	B3				2A7, 58, 2A6, 2A5, 80	456	
1732	Vol.	7/15	DRP317				R7236	4	RS215					^{3}78, ^{3}37, ^{2}2A3-H, ^{2}6B7, 56, 83V	175	31
	Tone	34	N				R8780	13	CN151							
	Hum.	‡	SRP266													
1732 (Revised)	Vol.	7/17	DRP317				R7236	4	RS215					^{4}78, 56, 85, 37, ^{2}2A3, ^{2}6B7, 5Z3	175	31
	Tone	34	N				R8780	13	CN151							
	Hum.	‡	SRP266													
1732X	Vol.	7/17	DRP317				R7236	4	RS215					^{2}78, 56, 85, 37, ^{2}2A3, ^{2}6B7, 83V	175	31
	Tone	34	N				R8780	13	CN151							
	Hum.	‡	SRP266													
1733	Vol.	56	N	6			R8451	40	RS213		‡ Or	der from	Mfr.	6A7, 78, 6B7, 38, 1V	480	10
	Tone	107	N													
1743	Vol.	18	N	6			8-4	1	CN151	B3				2A7, 58, 2A6, 80, 2A5	456	1
							10	15	TS101							
1743A	Vol.	18	MR48				8-4	1	CN151					2A7, 58, 2A6, 2A5, 80	456	1
							10	15	TS101							

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
SEARS-ROEBUCK—	Continued															
1744, 1745	Vol.	29	U				R8357	13/19	CS123/TS102					^{3}951, 30, 950, Ballast		
														No. 52	480	
1750	Vol.	56	N	6			R9070	29	RN235	B8				6A7, 78, 6B7, 37,^{2}43,		
	Tone	22	N				R9071	29	RS205					25Z5	175	
							R9072	29	RS205							
1760	Vol.	62	N	6			R4758P	23	RS213					6A7, ^{2}78, ^{2}37, 42, 83V	480	1
1800	Vol.	6	SRP263	6	EX300		8-4	1	CN151	B3				58, 57, 2A5, 80		1
							10	15	TS101							
1801, 1801A	Vol.	18	N	6			‡5-16-5	11	RM257	B185				6A7, 78, 75, 43, 25Z5	456	
1802, 1802A, 1803,																
1803A	Vol.	18	N	6			8-8	1	RN242					2A7, 58, 2A5, 2A6, 80	445	1
							2	13	CS130	B3						
1804, 1805	Vol.	106	N	6			D4758P	23	RS213					^{3}78, 75, 47, 41, 80	480	14
	Tone	106	N				R8488	23	RS213							
1805A	Vol.	106	N				R7236	23	RS215					^{2}58, 2A6, 47,^{2}56, 80	175	1
	Tone	106	N				R8488	23	RS213							
1806	Vol.	18	N				R7236	23	RS215					^{2}78, 6A7, 75, 37,^{2}47, 80	445	14
	Tone	107	O				R8488	23	RS213							
							R9237	13	CS131							
1807	Vol.	18	N	6			8-8	1	RN242					2A7, 58, 2A6, 2A5, 80	445	1
							2	13	CS130							
1808	Vol.	106	N	6			D4758P	23	RS213					^{3}78, 75, 41, 47, 80	480	14
	Tone	106	N				R8488	23	RS213							
1808A	Vol.	106	N				R7236	23	RS215					^{2}58, 2A6, 47,^{2}56, 80	175	1
	Tone	106	N				R8488	23	RS213							
1809, 1811	Vol.	106	N				R7236	23	RS215					^{2}58, 2A6, 47,^{2}56, 80	175	1
	Tone	106	N	6			R8188	23	RS213							
1820	Vol.	106	N	6			D4758P	23	RS213					^{3}78, 75, 47, 41, 80	480	14
	Tone	106	N				R8488	23	RS213							
1821	Vol.	106	N	6			R7236	23	RS215					^{3}78, 85,^{3}37,^{2}47, 41, 80	480	14
	Tone	106	N				R8488	23	RS213							
1822	Vol.	106	O				4758P	28	RS213					^{3}78, 75,^{6}45,^{2}37, 41, 5Z3	445	32
	Tone	106	O				R9237	13	CS131							
1823	Vol.	18	N				R7236	23	RS215					6A7,^{2}78, 75,^{2}47, 37, 80	445	14
	Tone	107	O				R8488	23	RS213							
							R9237	13	CS131							
1824	Vol.	106	O				D4758P	28	RS213					^{3}78, 75,^{4}45, 37, 41, 80	445	32
	Tone	106	O				R9237	13	CS131							
1825	Vol.	106	N	6			R7236	23	RS215					41,^{3}78, 75,^{6}45,^{2}37, 5Z3	480	31
	Tone	106	N				R8488	23	RS213							
							R8217	17	CS130							
1825A	Vol.	106	N	6			R7236	23	RS215					^{3}78, 75,^{6}45,^{3}76, 5Z3	175	31
	Tone	106	N				R8488	23	RS213							
1826	Vol.	106	N	6			D4758P	23	RS213					^{3}78, 75, 41, 47, 80	480	14
	Tone	106	N				R8488	23	RS213							
1826A	Vol.	106	N				R7236	23	RS215					^{2}58, 2A6, 47,^{2}56, 80	175	1
	Tone	106	N				R8488	23	RS213							
1827	Vol.	106	N	6			R7236	23	RS215					^{3}78, 85,^{3}37,^{2}47, 41, 80	480	14
	Tone	106	N				R8488	23	RS213							
1828	Vol.	106	N	6			R7236	23	RS215					^{3}78, 75,^{6}45, 37, 41, 5Z3	480	31
	Tone	106	N				R8488	23	RS213							
							R8217	13	CS130							
1829	Vol.	18	N				R7236	23	RS215					^{2}78, 75,^{2}47, 37, 6A7, 80	445	14
	Tone	107	O				R8488	23	RS213							
							R9237	13	CS131							
1830	Vol.	106	O				D4758P	28	RS213					^{3}78, 75,^{4}45, 37, 41, 80	445	32
	Tone	106	O				R9237	13	CS131							
1831	Vol.	106	O				4758P	28	RS213					^{3}78, 75,^{6}45,^{2}37, 41, 5Z3	445	32
	Tone	106	O				R9237	13	CS131							
1832	Vol.	106	N	6			R7236	23	RS215					^{3}78,^{3}37,^{2}47, 85, 41, 80	480	14
	Tone	106	N				R8488	23	RS213							
1832A	Vol.	106	N	6			R7236	23	RS215					^{3}78, 85,^{3}37,^{2}47, 41, 80	445	14
	Tone	106	N				R8488	23	RS213							
1833	Vol.	106	N				R7236	23	RS215					^{2}58, 2A6, 47, 56, 80	175	1
	Tone	106	N	6			R8488	23	RS213							
1835	Vol.	45	MR48				14	23	RS216					^{3}58, ^{3}56, 57, 2A5, 80	456	1
	Tone	147	MR48				8	23	RS213							
1840	Vol.	106	N	6			R7236	23	RS215					^{3}58,^{3}56, 57, 2A5, 80	480	1
	Tone	106	N				R8488	23	RS213							
1841	Vol.	106	N				R7236	23	RS215					^{2}58, 2A6, 47,^{2}56, 80	175	1
	Tone	106	N				R8488	23	RS213							
1845	Vol.	106	N				R7236	23	RS215					^{2}58,^{2}56, 2A6, 47, 80	175	1
	Tone	106	N	6			R8488	23	RS213							
1850, 1851	Vol.	29	U				R10673	13/19	CN142/TS104	B183				^{2}951, 32, 33, 30, Ballast		
	Tone	34	N											No. 30	480	
1852, 1853	Vol.	29	U				R8357	13/19	CS123/TS102					951, 30, 950, Ballast		
														No. 52	480	
1854	Vol.	64	N				R10555	13/19	CN142/TS101	B184				^{3}951,^{2}950,^{4}30, Ballast		
	Tone	41	N											No. 31	175	
1855	Vol.	56	N				R8488	40	RS213		35	F294	C13	6A7, 78, 6B7, 38, 84	480	10
	Tone	107	N	6			.03-.03		Buffer	B14	38	F297	C14			
1857	Tone	34	N	7			R10546	13/19	CN142/TS101	B184				^{4}951, ^{2}30, 33, Ballast		
														No. 31	175	
1857A	Vol.	68	D12				R11178	13/19	CN142/TS102	B187				^{3}951, 32, 33,^{2}30, Ballas		
														No. 31	175	
1858	Vol.	56	UM154		See Note A96		R10086	12	CS131	B3				^{2}78, 6A7, 85, 41	175	MG
	Tone	22	N													
1859A	Vol.	17	UM154		See Note A96		1138	1	CN152	B3	24	271		6A7, 6D6, 6B7, 41	370	10
							9328	15	TN110							
1862	Vol.	29	U				R10673	13/19	CN142/TS104	B183				^{2}951, 32, 33, 30, Ballast		
	Tone	34	N											No. 30	480	
1863	Vol.	17	MR48											^{2}6D6, 6A7, 85,^{2}48	175	
	Tone	149	K12													
1864	Vol.	17	UM163		See Note A96		4-12	12/15	CS131/TS102					^{2}78, 6A7, 85, 41	175	MG
	Tone	22	N													
1868	Vol.	29	U				R10673	13/19	CN142/TS104	B183				^{2}951, 32, 30, 33, Ballast		
	Tone	34	N											No. 30	460	
1869X	Vol.	18	UM154		See Note A96		‡	1	See Note	B3	35	294	C3	77, 78, 75, 41, 84	456	10
1870	Vol.	29	U				R10673	13/19	CN142/TS104	B183				^{2}951, 32, 30, 33, Bal-		
	Tone	34	N											last No. 30	480	
1903	Vol.	18	MR48				16-16-8	8	UR182					6A7, 6D6, 75, 43,		
														25Z5	456	
1904, 1904A							8, 8	23	RS213					6A7, 6K7G, 75, 6F6G,		
														6C5G, 84	175	25
1905	Vol.	18	MR48				25	23	WE2545					6D6, 41, 6K7MG, 75,		
							8	23	RS213					6C5MG, ^{2}6F6MG,		
														80	175	1
1906							8, 8	23	RS213					6A7, 6K7G, 75, 6F6G,		
														6C5G, 84	175	25
1909	Vol.	18	MR48				14	23	RS216					6A8MG, 6K7MG,		
							8	23	WE847					6Q7MG, 6C5MG,		
														^{2}6F6MG, 5Z4MG	175	1

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Cir-cuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replace-ment	*Note	Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
SEARS-ROEBUCK—Continued																
1912	Vol.	18	MR48				14	23	RS216					6A8MG, 6K7MG, 6Q7MG, 6C5MG, ^{2}6F6MG, 5Z4MG	175	1
							8	23	WE847							
1914							8, 8	23	RS213					6A7, 6K7G, 75, 6F6G, 6C5G, 84	175	25
1915	Vol.	18	MR48				25	23	WE2545					6D6, 41, 6K7MG, 75, 6C5MG, ^{2}6F6MG, 80	175	1
							8	23	RS213							
1917	Vol.	124	MR53				14	23	RS216					^{2}78, ^{2}6K7G, 76, 75, 6C5G, ^{2}6F6G, 5Z3	385	1
							8	23	WE847							
1918	Vol.	108	MR53				16, 16, 16	30	RS216					6D6, 6A7, ^{2}6K7G, 75, ^{2}6C5G, ^{4}45, 5Z3	385	14
	Tone	108	MR53													
1918A	Vol.	108	O				16	30	RS216					^{3}6K7MG, 6A8MG, 75, ^{4}45, ^{2}6C5MG, 5Z3	385	14
	Tone	108	O	6												
1920	Vol.	9	H12											1C6, 1A4, 32, 950, 1B1 Ballast	480	
1922A	Vol.	68	Order from	Mfr.			6-6-25	13/19	CN142/TS103	B188				1C6, 1A4, 32, 950, 30, 1G1 Ballast	175	
	Tone	34	N													
1923	Vol.	68	Order from	Mfr.			25	19	TS103					1C6, ^{2}1A4, 32, 30, 950, 1E1	175	
	Tone	34	MR48													
1924	Vol.	45	MR48				2272	1	CM164		30	285	C3	1C6, ^{2}34, ^{2}30, 19	465	10
	Tone	22	MR33	M27			.02		Buffer	B14						
1925	Vol.	18	MR48											6A7, 6D6, 75, 76, ^{2}48	456	
	Tone	44	N													
1926	Vol.	9	H12											1C6, 1A4, 32, 950, 1B1 Ballast	480	
1927X	Vol.	45	MR48				2289	12	CS121					1C6, ^{2}34, ^{2}30, 19	456	
	Tone	22	MR33	M24												
1928	Vol.	‡	MR29											1C6, 1A4, 951 or 32, 950, 1B1	480	
1930	Vol.	18	MR48				8-8	23	CM172	B3				6A7, 6K7, 76, 6C5, 75, 6F6, 80	175	1
	Tone	34	K12				10	19	TS101							
1932A	Vol.	68	Order from	Mfr.			6-6-25	13/19	CN142/TS103	B188				1C6, 1A4, 32, 950, 30, 1G1 Ballast	175	
	Tone	34	N													
1933	Vol.	68	Order from	Mfr.			25	19	TS103					1C6, ^{2}1A4, 32, 30, 950, 1E1	175	
	Tone	34	MR48													
1933A	Vol.	15	MR48				25	19	TS103					1C6, 1A4, 1B5, ^{2}30, 950, 1E1	175	
	Tone	57	MR53													
1934	Vol.	45	MR48				2272	1	CM164		30	285	C3	1C6, ^{2}34, ^{2}30, 19	465	10
	Tone	22	MR33	M27			.02		Buffer	B14						
1935	Vol.	18	MR48											6A7, 6D6, 75, 76, ^{2}48	456	
	Tone	44	N													
1936	Vol.	68	D12				12	19	TS101					1C6, ^{2}1A4, ^{3}30, 32 or 951, ^{2}950	175	
1937X	Vol.	45	MR48				2289	12	CS121					1C6, ^{2}34, ^{2}30, 19	456	
	Tone	22	MR33	M24												
1940	Vol.	18	MR48				8-8	23	CM172	B3				6A7, 6K7, 76, 6C5, 75, 6F6, 80	175	1
	Tone	34	K12				10	19	TS101							
1941	Vol.	15	MR53				‡	25	See Note	B3				^{3}6K7, 6L7, 6H6, 6C5, ^{2}6F6, 5Y3	262.5	1
1942	Vol.	18	MR48				14	23	RS216					6A8MG, 6K7MG, 6Q7MG, 6E5, 6C5MG, ^{2}6F6MG, 5Z4MG	175	1
							8	23	WE847							
1944	Vol.	18	MR48				14	23	RS216					6A8MG, 6K7MG, 6Q7MG, 6E5, 6C5MG, ^{2}6F6MG, 5Z4MG	175	1
							8	23	WE847							
1945	Vol.	124	MR53				25	23	WE2545					^{2}6K7MG, 6L7MG, 6Q7MG, ^{2}6C5MG, 6E5, ^{2}6F6MG, 5Z4MG	385	1
	Tone	22	MR48	M26			14	23	RS216							
1946	Vol.	20	TM230-SS1				14	30	RS216					^{3}6K7MG, 6L7MG, ^{4}6C5MG, 6E5, 6F5MG, ^{2}6F6MG, 5Z4MG	385	1
	Tone	22	MR42			A4	8-8	15/19	TN111							
	Sen.	105	X													
1953	Vol.	18	MR48				16-16-8	8	UR182					6A7, 6D6, 75, 43, 25Z5	456	1
1954							8, 8	23	RS213					6A7, 6K7G, 75, 6F6G, 6C5G, 84	175	25
1954X	Vol.	45	MR48				P474	32	RS211					6A7, 6K7G, 6C5G, 75, 6F6G, 80	456	1
							P160	32	CN151	B3						
1955	Vol.	18	MR48				25	23	WE2545					6D6, 41, 6K7MG, 75, 6C5MG, ^{2}6F6MG, 80	175	1
							8	23	RS213							
1956	Vol.	18	MR48				8-8	23	CM172	B3				6A7, 6K7, 76, 6C5, 75, 6F6, 80	175	1
	Tone	34	K12				10	19	TS101							
1962	Vol.	18	MR48				14	23	RS216					6A8MG, 6K7MG, 6Q7MG, 6C5MG, ^{2}6F6MG, 5Z4MG	175	1
							8	23	WE847							
1964, 1964A							8, 8	23	RS213					6A7, 6K7G, 75, 6F6G, 6C5G, 84	175	25
1965	Vol.	18	MR48				25	23	WE2545					6D6, 41, 6K7MG, 75, 6C5MG, ^{2}6F6MG, 80	175	1
							8	23	RS213							
1967	Vol.	124	MR53				14	23	RS216					^{2}78, ^{2}6K7G, 76, 75, 6C5G, ^{2}6F6G, 5Z3	385	1
							8	23	WE847							
1967A	Vol.	124	MR53				14	23	RS216					6K7MG, 6L7MG, 6C5MG, ^{2}6K7G, 75, 6C5G, ^{2}6F6G, 5Z3	385	1
							8	23	WE847							
1968	Vol.	108	MR53				16, 16, 16	30	RS216					6D6, 6A7, ^{2}6K7G, 75, ^{2}6C5G, ^{4}45, 5Z3	385	14
	Tone	108	MR53													
1968A	Vol.	108	O				16	30	RS216					^{3}6K7MG, 6A8MG, 75, ^{2}6C5MG, ^{4}45, 5Z3	385	14
	Tone	108	O	6												
1970A	Vol.	18	MR48				8-8	23	CM172	B3				6A7, 6K7, 76, 6C5, 75, 6F6, 80	175	1
	Tone	34	K12				10	19	TS101							
1972	Vol.	18	MR48				14	23	RS216					6A8MG, 6K7MG, 6Q7MG, 6E5, 6C5MG, ^{2}6F6MG, 5Z4MG	175	1
							8	23	WE847							
1978, 1980A	Vol.	‡	MR29											1C6, 1A4, 951 or 32, 950, 1B1	480	
1980	Vol.	9	H12											1C6, 1A4, 32, 950, 1B1 Ballast	480	
1981, 1981C	Vol.	15	MR53				‡	25	See Note	B3				^{3}6K7, 6L7, 6H6, 6C5, ^{2}6F6, 5Y3	262.5	1
1982A	Vol.	68	Order from	Mfr.			6-6-25	13/19	CN142/TS103	B188				1C6, 1A4, 32, 950, 30, 1G1 Ballast	175	
	Tone	34	N													
1983	Vol.	68	Order from	Mfr.			25	19	TS103					1C6, ^{2}1A4, 32, 30, 950, 1E1	175	
	Tone	34	MR48													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
SEARS-ROEBUCK—Continued																
1983A	Vol.	15	MR48				25	19	TS103					1C6, 1A4, 1B5, [2]30,		
	Tone	57	MR53											950, 1E1	175	
1985	Vol.	18	MR48											6A7, 6D6, 75, 76, [2]48	456	
	Tone	44	N													
1986, 1987	Vol.	45	MB44	M26		A27	16	23	RS216					6A7, 78, 6H6G, 6F5G,		
	Vol.	15	MR53	M26		A4	8	23	RS213					6B5, 84	262	35
	Tone	15	MR53	M26												
1988	Vol.	17	MR53				8-8	1	CN152					6A7, 6D6, 75, 6B5, 1V	465	29
							16	1	RS216							
1989	Vol.	12	Y25MP	7			10	19	TS101					1C6, 1A4, 951, 1F4	465	
1992A	Vol.	68	Order from	Mfr.			6-6-25	13/19	CN142/TS103	B188				1C6, 1A4, 32, 950,		
	Tone	34	N											30, 1G1	175	
1992X	Vol.	18	MR48				2289	12	CS121					1C6, 34, 1B5, 30, 19	456	
	Tone	22	MR33													
1993	Vol.	68	Order from	Mfr.			25	19	TS103					1C6, [2]1A4, 32, 30,		
	Tone	34	MR48											950, 1E1	175	
1993X	Vol.	18	MR48				2289	13	CS121					1C6,[2]34,[2]30, 19	465	
	Tone	22	MR33	M24												
1995	Vol.	18	MR48											6A7, 6D6, 75, 76,[2]48	456	
	Tone	44	N													
1996	Vol.	68	D12				12	19	TS101					1C6, [2]1A4, [3]30, 32 or		
														951,[2]950	175	
1998	Vol.	18	MR44				14	23	RS216					6A8MG, 6K7MG,		
							8	23	RS213					6Q7MG, 6C5MG,		
														[2]6F6MG, 5Z4MG	262	1
4400	Vol.	18	UM154-SS3				8-8	1	RN242	B3	19	249	C3	[2]6D6, 6L7, 76, 75, 6B5	465	10
	Tone	22	MR39				.005		Buffer	B14						
4401, 4402	Vol.	17	MR53				8-8	1	CN152					6A7, 6D6, 75, 6B5, 1V	465	29
							16	1	RS216							
4403	Vol.	45	MR44	M26		A27	16	23	RS216					6A7, 78, 6H6G, 6F5G,		
	Vol.	15	MR53	M26		A4	8	23	RS213					6V5, 84	262	35
	Tone	57	MR48													
4404	Vol.	15	MR48	M26			6-6	13	CN142					[2]1A4, 1C6, 1B5, 30,		
	Tone	57	MR48											1F4	465	
4405	Vol.	15	MR48				8-8	1	CN152		35	294	C3	6A8G, 1D5G, [2]1H4G,		
	Tone	57	MR48	M26			.006		Buffer	B14				1F5G, 6X5G	465	10
4406	Vol.	15	MR48	M26			6-6	13	CN142					[2]1A4, 1C6, 1B5, 30,		
	Tone	57	MR48											1F4	465	
4407	Vol.	15	MR48				8-8	1	CN152		35	294	C3	6A8G, 1D5G, [2]1H4G,		
	Tone	57	MR48	M26			.006		Buffer	B14				1F5G, 6X5G	465	10
4408	Vol.	12	Y25MP	7			10	19	TS101					1C6, 1A4, 951, 1F4	465	
4409, 4413	Vol.	15	MR48	M27			6-6	13	CN142					1C6, 1A4, 1B5, 1F4,		
	Tone	57	MR48											30, 1P1	465	
4420	Vol.	12	Y25MP	7			10	19	TS101					1C6, 1A4, 951, 1F4	465	
4424	Vol.	15	MR48	M26			6-6	13	CN142					[2]1A4, 1C6, 1B5, 30,		
	Tone	57	MR48											1F4	465	
4428	Vol.	15	MR48				8-8	1	CN152		35	294	C3	6A8G, 1D5G, [2]1H4G,		
	Tone	57	MR48	M26			.006		Buffer	B14				1F5G, 6X5G	465	10
4428A	Vol.	17	MR55				18-8-6	1/13	CS136/CN152		15	246	C3	[2]6S7G, 6D8G, 1H4G,		
	Tone	57	MR48				.012-.012		Buffer	B14				6Q6G, 6K6G	465	10
4442, 4443	Vol.	15	MR48	M27			6-6	13	CN142					1C6, 1A4, 1B5, 1F4,		
	Tone	57	MR48											30, 1P1	465	
4444	Vol.	15	MR48	M26			8-8	13	CN142					[2]1A4, 1C6, 1B5, 30,		
	Tone	57	MR48											1F4	465	
4448	Vol.	15	MR48				8-8	1	CN152		35	294	C3	6A8G, 1D5G, [2]1H4G,		
	Tone	57	MR48	M26			.006		Buffer	B14				1F5G, 6X5G	465	10
4448A	Vol.	17	MR55				18-8-6	1/13	CS136/CN152		15	246	C3	[2]6S7G, 6D8G, 1H4G,		
	Tone	57	MR48				.012-.012		Buffer	B14				6Q6G, 6K6G	465	10
4461, 4462	Vol.	17	MR53				8-8	1	CN152					6A7, 6D6, 75, 6B5, 1V	465	29
							16	1	RS216							
4463	Vol.	45	MR44	M26		A27	16	23	RS216					6A7,78,6H6G,6F5G,		
	Vol.	15	MR53	M26		A4	8	23	RS213					6B5, 84	262	35
	Tone	57	MR48													
4484	Vol.	45	MR44	M26		A27	16	23	RS216					6A7, 78, 6H6G, 6F5G,		
	Vol.	15	MR53	M26		A4	8	23	RS213					6B5, 84	262	35
	Tone	57	MR48													
4520	Vol.	12	Y25MP	7			10	19	TS101					1C6, 1A4, 951, 1F4	465	
4522, 4523	Vol.	15	MR48	M27			6-6	13	CN142					1C6, 1A4, 1B5, 1F4,		
	Tone	57	MR48											30, 1P1	465	
4524	Vol.	15	MR48	M26			6-6	13	CN142					[2]1A4, 1C6, 1B5, 30,		
	Tone	57	MR48											1F4	465	
4528A	Vol.	17	MR55				18-8-6	1/13	CS136/CN152		15	246	C3	[2]6S7G, 6D8G, 1H4G,		
	Tone	57	MR48				.012-.012		Buffer	B14				6Q6G, 6K6G	465	10
4542, 4543	Vol.	15	MR48	M27			6-6	13	CN142					1C6, 1A4, 1B5, 1F4,		
	Tone	57	MR48											30, 1P1	465	
4544	Vol.	16	MR48	M26			6-6	13	CN142					[2]1A4, 1C6, 1B5, 30,		
	Tone	57	MR48											1F4	465	
4548	Vol.	15	MR48				8-8	1	CN152		35	294	C3	6A8G, 1D5G, [2]1H4G,		
	Tone	57	MR48	M26			.006		Buffer	B14				1F5G, 6X5G	465	10
4548A	Vol.	17	MR55				18-8-6	1/13	CS136/CN152		15	246	C3	[2]6S7G, 6D8G, 1H4G,		
	Tone	57	MR48				.012-.012		Buffer	B14				6Q6G, 6K6G	465	10
4563, 4564	Vol.	45	MR44	M26		A27	16	23	RS216					6A7, 78, 6H6G, 6F5G,		
	Vol.	15	MR53	M26		A4	8	23	RS213					6B5, 84	262	35
	Tone	57	MR48													
4584	Vol.	45	MR44	M26		A27	16	23	RS216					6A7, 78, 6H6G, 6F5G,		
	Vol.	15	MR53	M26		A4	8	23	RS213					6B5, 84	262	35
	Tone	57	MR48													
4666	Vol.	17	TM246-SS1	M26			25	1	WE2545					[2]6K7G, 6A8G, [2]6Q7G,		
	Sil.	‡	A1MP				30	1	WE3540					6U5, 6J5G, [2]6V6G,		
							10	‡	TS106					5Y3G	465	1
4686	Vol.	17	TM246-SS1	M26			25	1	WE2545					[2]6K7G, 6A8G, [2]6Q7G,		
	Sil.	‡	A1MP				30	1	WE3540					6U5, 6J5G, [2]6V6G,		
							10	‡	TS106					5Y3G	465	1
4687	Vol.	20	TM246-SS1	M26			25	‡	WE2545					6B8G, 6L7G, 6J5G,		
							30	‡	WE3540					6J7G,[2]6K7G,6H6G,		
														6U5, 6C8G, [2]6V6G,		
														5X4G	465	1
4688	Vol.	20	TM240-SS16	M26			16, 16	3	RS216					[3]6K7G, 6L7G, [3]6C5G,		
							30	3	WE3540					[2]6H6G, 6J7G, 6U5,		
							20	15	TS102					[2]6V6G, 5U4G	465	1
							10	15	TS101							
4766	Vol.	17	TM246-SS1	M26			25	1	WE2545					[2]6K7G, 6A8G, [2]6Q7G,		
	Sil.	‡	A1MP				30	1	WE3540					6U5, 6J5G, [2]6V6G,		
							10	‡	TS106					5Y3G	465	1
4786	Vol.	17	TM246-SS1	M26			25	1	WE2545					[2]6K7G, 6A8G, [2]6Q7G,		
	Sil.	‡	A1MP				30	1	WE3540					6U5, 6J5G, [2]6V6G,		
							10	‡	TS106					5Y3G	465	1
4787	Vol.	20	TM246-SS1	M26			25	‡	WE2545					6B8G, 6L7G, 6J5G,		
							30	‡	WE3540					6J7G,[2]6K7G,6H6G,		
														6U5, 6C8G, [2]6V6G,		
														5X4G	465	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Cir-cuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replace-ment	*Note	Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
SEARS-ROEBUCK—Continued																
4788	Vol.	20	TM240-SS16	M26			16, 16 30 20 10	3 3 15 15	RS216 WE3540 TS102 TS101					^{3}6K7G, 6L7G, ^{3}6C5G, ^{2}6H6G, 6J7G, 6U5, ^{2}6V6G, 5U4G	465	1
4791, 4792	Vol. Sil.	17 ‡	TM246-SS1 A1MP	M26			25 30 10	1 1 ‡	WE2545 WE3540 TS106					^{2}6K7G, 6A8G, ^{2}6Q7G, 6U5, 6J5G, ^{2}6V6G, 5Y3G	465	1
4799	Vol.	20	TM240-SS16	M26			16, 16 30 20 10	3 3 15 15	RS216 WE3540 TS102 TS101					^{3}6K7G, 6L7G, ^{3}6C5G, ^{2}6H6G, 6J7G, 6U5, ^{2}6V6G, 5U4G	465	1
7000, 7001, 7002, 7012	Vol. Tone	109 22	N K12				7078 7051	4 4	RS215 RS213					^{3}27, ^{2}35, 24A, ^{2}47, 80	175	1
7042	Vol.	6	G7	6	2		9110-0	25	CM171	B3				55, 57, 58, 47, 80	175	1
7043, 7044, 7045, 7046, 7047	Vol. Tone	15 34	UC503 L	 6			1-2-8	26	See Note	B1				^{2}51 or ^{2}35, 57, ^{2}27, 56, ^{2}47 or PZ, 80	175	1
7048	Vol.	6	G12				8-4	23	CM171	B3				57, 58, 47, 80	175	1
7049	Vol. Tone	8 22	E L	 6			‡	26	See Note	B1				^{2}51, 24A, 57, 47, 80	175	1
7050	Vol. Tone	6 57	H12 MR48				8, 8	23	RS213	B3				39, ^{2}36, ^{2}89, 80	175	1
7057, 7058	Vol.	6	H7	6	2		9442	11	UR182	B31				6A7, 78, 75, 43, 25Z5	265 or 465	
7062	Vol.	68	D12	6			9150 5	29 15	CM165 TS101	B51				6A7, 6B7, 77, 43, 25Z5	175	
7064	Vol.	6	UC509	6	EX300		R8313	23	CM161					78, 77, 43, 1V		
7065	Vol. Tone	7/18 57	DRP313 N				R7236 D4758P R1114	23 23 ‡	RS215 RS213 CS131					^{2}78, 75, 37, ^{4}45, 6A7, 83V	175	3
7066	Vol. Tone	15 21	UC503 L				8-12	34	See Note	B3				^{2}58, 57, ^{3}56, ^{3}46, 80	175	3
7070, 7071, 7072, 7073, 7074	Vol.	56	N	6			R8431	4	CM162					6A7, 78, 6B7, 43, 1V	480	
7075, 7076, 7077, 7078	Vol.	56	N	6			R8952	29	CM165	B51				6A7, 78, 6B7, 43, 25Z5	480	
7090	Vol.	29	U				R8357	13/19	CS123/TS102					^{3}951, 30, 950, Ballast No. 52	175	
7090A	Vol.	29	U				R8357	13/19	CS123/TS102					^{3}951, 30, 950, Ballast No. 52	480	
7091, 7092, 7093, 7094	Vol.	56	N	6			R8952	29	CM165	B51				6B7, 43, 78, 6A7, 25Z5	480	
7106	Vol.	6	SRP263	6			106	11	UR182	B31				75, 6D6, 78, 6A7, 43, 25Z5	456	
7108	Vol.	6	H12				9925 9328	12 15	CS133 TN110					^{2}78, 77, 38, 37	465	
7110	Vol.	7	UC509	6			12-8-10	24/15	UR189	B189				78, 77, 38, 12Z3		
7111X, 7112, 7114	Vol.	6	SRP263	6			106	11	UR182	B31				6A7, 75, 6D6, 78, 43, 25Z5	456	
7117	Vol.	17	UM154		See Note	A96	1138 9328	1 15	CN152 TN110	B3	24	271		6A7, 6D6, 6B7, 41	370	10
7118	Vol. Tone	62 ‡	N N				R8488	23	RS213					^{2}78, ^{3}37, 42, 6A7, 83V	175	1
7121	Vol.	6	SRP263	6	EX300		8-4	1	CN151	B3				58, 57, 2A5, 80		1
7124	Vol. Tone	18 22	N K12	 6			156 307	1 15	CN151 TS101	B3				^{2}58, 57, 2A6, 56, 2A5, 80	456	1
7126	Vol.	7	UC509		EX300		12-8-10	24/15	UR189	B189				77, 78, 38, 12Z3		
7128	Vol.	56	UM154		See Note	A96	R10264 .01-.01	23	CM172 Buffer	 B14	35 37	294 296	C20 C20	^{2}78, 6A7, 85, 41, 84	175	10
7130, 7132 AC-DC Midget	Vol.	7	UC509				70	24/15	UR189	B189				78, 77, 38, 12Z3		
7136, 7137	Vol.	18	MR48				8-4	1	CN151					2A7, 58, 2A6, 2A5, 80	456	1
7140	Vol.	18	MR48				8-4 10	1 15	CN151 TS101					2A7, 58, 2A6, 2A5, 80	456	1
7141, 7142	Vol.	18	N				5-12-5	8	CN145					43, 75, ^{2}6D6, 6A7, 25Z5	456	
7144	Vol.	18	MR48				8-4	1	RN241					6A7, 6D6, 75, ^{2}42, 80	456	1
7150	Vol.	18	MR48				12-4 10	1 15	RN245 TS101					6A7, 6D6, 75, 42, 80	456	1
7153	Vol.	6	Y				8-4 10	1 15	CN151 TS101					58, 57, 2A5, 80		1
7154	Vol.	‡	N	6			504 10	‡ 15	RN245 TS101					6A7, 6D6, 75, ^{2}42, 80	456	1
7155	Vol. Tone	18 22	MR48 K12				650 10	1 15	RN242 TS101					6A7, 6D6, 75, ^{2}42, 80	456	1
7157	Vol.	18	UM154		See Note	A96	‡	1	See Note	B3	35	294	C3	77, 78, 75, 41, 84	456	10
7158	Vol.	18	MR48				12-4 10	1 15	RN245 TS101					6A7, 6D6, 75, ^{2}42, 80	456	1
7165, 7165X	Vol.	7	UC509			A14	12-5 10	24 15	CN145 TS101	B3				6D6, 6C6, 38, 12Z3		
7166, 7166X	Vol.	98	UC509				16-8 5	6 15	CN155 TS101					6K7 or 6D6, 6C6, 43, 25Z5		
7167	Vol.	18	UM154		See Note	A96	6-3 10 .03	1 15	CN151 TS101 Buffer	 B14	35	294	C3	6A7, 6D6, 75, 41, 84	456	10
7168	Vol.	6	H12	6	EX300		8812 3003	4 15	CM164 TS101					^{2}6D6, 6J7, 43, 25Z5		
7172	Vol. Tone	18 34	N Y	 6			12-4	4	CM175					6A7, 6D6, 75, 42, 80	456	1
SENTINEL RADIO CORP. (Also see Erla)																
8, 9	Vol.	6	H12				2-1-1	3	See Note	B1				^{4}24A, 27, ^{2}45, 80		3
11, 12, 15, 16	Vol.	6	G12				15-5	2	MN273					27, ^{2}45, ^{3}24A, 80		3
31, 33	Vol.	10	D12				.5-1-2	3	See Note	B1				^{4}26, 27, 45, 80		11
31B, 34B	Vol. Tone	45 22	N N	 7			2272 .02	1	CN155 Buffer	B3 B14	30	285	C3	1C6, ^{2}34, ^{2}30, 19	465	10
35B	Vol. Tone	45 22	N K12	 14			2289	12	RS201					1C6, ^{2}34, ^{2}30, 19	465	
50B	Vol. Tone	45 22	N K12				8-20 .02	1	CM164 Buffer	 B14	30	285	C3	1C6, ^{2}34, ^{3}30, 19	465	10
52A	Vol. Tone	18 22	MR48 MR33	 M26			2627	1/15	CN151/TS101					6A7, 6D6, 75, 41, 80	465	1
53A	Vol. Tone	18 44	MR48 K12				1477 1476	1 1	RS215 WE1647					6A7, 6K7, 75, 6E5, 6C5, ^{2}6F6, 80	465	1
65B	Vol. Tone	18 22	N Y	 14			3150	12	RN232	B8				1C6, 34, 1F6, 30, 19, 5H1	465	
104	Vol.	6	G12				15-5	2	MN273					27, ^{2}45, ^{3}24A, 80		3
106B	Vol. Tone	6 34	G12 K12				16-8	2	CN155	B3				^{3}24A, ^{2}27, ^{2}45, 80	175	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
SENTINEL RADIO CORP.—Continued																
108	Vol.	6	L				8-16	31	See Note	B3				^{4}24A, 27, 45, 80	175	1
	Tone	22	K12													
108A	Vol.	7	F				8-8	34	See Note	B3				^{2}35, 27, ^{2}24A, 47, 80	175	1
	Tone	22	K12													
109	Vol.	7	F				16-8	34	See Note	B3				^{2}24, 27, ^{2}35, ^{2}47, 51, 80	175	1
	Tone	22	K12													
110	Vol.	7	F				8-8	34	See Note	B3				27, ^{2}35, ^{2}24A, 47, 80	175	1
	Tone	22	K12													
111	Vol.	7	F				8-8	4	See Note	B3				47, 24A, 35, 80		1
114	Vol.	15	N	6			7078	34	RS215					^{2}47, ^{2}24A, ^{2}35, ^{2}27, 80	175	1
	Tone	44	K12				7051	34	RS213							
116	Vol.	6	F12		EX200		8-8	4	CM172	B3				^{2}24, 35, 47, 80	465	1
118	Vol.	109	N	6			7078	34	RS215					^{3}27, ^{2}35, ^{2}24A, ^{2}47, 80	175	1
	Tone	22	K12				7051	34	RS213							
125	Vol.	64	N				6-4-4	3	See Note	B3				^{2}24A, ^{3}35, 27, 47, 80	175	1
	Tone	22	K12				20	16	TS102							
261	Vol.	15	N				8876	15	TS105					^{2}39, 36, 85, 41	175	
264	Vol.	15	N	6			9110-0	1	CM171	B3				^{2}58, 57, 55, 47, 80	175	1
							8876-O	17	TS105							
440, 441	Vol.	6	G12				‡	‡	See Note	B1				^{2}24A, ^{2}27, 45, 80		3
501, 502	Vol.	70	H12											^{2}32, 34, 33, 30	465	
	Fil.	29	R													
513	Vol.	6	G7	6	2		9110-0	25	CM171	B3				57, 58, 55, 47, 80	175	1
521	Vol.	15	N				8876	15	TS105					^{2}39, 36, 85, 41	175	
550, 560, 561	Vol.	6	H7	6	2		9355	8	CN145					^{2}36, 39, 38, 25Z5	265	
							9328	15	TN110							
570	Vol.	6	H7	6	2		9442	11	UR182	B31				6A7, 78, 75, 43, 25Z5	265 or 465	
590	Vol.	6	H7	6	2		9442	11	UR182	B31				6A7, 75, 78, 43, 25Z5	465	
599	Vol.	6	H7	6	2		9442	11	UR182	B31				6A7, 78, 75, 43, 25Z5	265	
600, 602	Vol.	17	UM154	M26	See Note A96		9532	1	CN155	B3	34	292	C3	^{2}78, 6A7, 75, 41, 84	265	10
							9328	15	TN110							
							.02		Buffer	B14						
603	Vol.	17	UM154	M26	See Note A96		1247	1	CN152	B3	34	292	C3	^{2}78, 6A7, 75, 41, 84	265	10
							9328	15	TN110							
							.02		Buffer	B14						
610	Vol.	7	F				8, 8	34	RS213					^{2}51, 27, ^{2}24A, 47, 80	175	1
	Tone	22	K12													
614	Vol.	15	N	6			9110-0	1	CM171	B3				^{2}58, 57, 55, 47, 80	175	1
							8876	17	TS105							
622, 623	Vol.	17	M	6			9659	1	RN242					^{2}57, 58, 2A6, 2A5, 80	465	1
	Tone	22	K12				8876	15	TS105							
630	Vol.	17	M	6			9659	1	RN242					^{2}57, 5A8, 2A5, 2A6, 80	456	1
	Tone	22	K12				8876	15	TS105							
634, 635	Vol.	17	M	6			9659	1	RN242					^{2}57, 58, 2A6, 2A5, 80	465	1
	Tone	22	K12				8876	15	TS105							
660	Vol.	70	H12											^{2}32, 34, 33, 30, 5B1	465	
666C	Vol.	6	G7				‡	‡	See Note	B1				^{4}24A, ^{2}27, ^{2}45, 80		3
1020, 1030	Vol.	15	N	6			9193	3	CN155	B3				^{3}58, ^{2}57, 55, ^{3}59, 80	115	3
	Tone	22	K12				8876	15	TS105							
1020A, 1030A	Vol.	15	N	6			9739	3	RS215					^{3}58, 57, ^{3}56, ^{2}2A3, 80	115	3
	Tone	22	K12				9736	3/15	CN152/TN111							
	Supp.	7	C	8												
1040	Vol.	15	N	6			9739	3	RS215					^{3}58, 57, 2B7, ^{2}56, ^{2}2A3,		
	Tone	22	K12				9736	3/15	CN152/TN111					5Z3	465	3
	Supp.	7	G	8												
4100B	Vol.	6	G12	6			9982	11	UR182	B31				6D6, 6C6, 43, 25Z5		
							1693	15	TS101							
4300	Vol.	7	H	6			9982	11	UR182	B31				6A7, 6F7, 38, 25Z5	465	
4500	Vol.	6	SRP263	6	EX200		1258	25	RS213					42, 6C6, 6D6, 80		1
							1260	25	RS211							
4800	Vol.	110	H12	6			9982	11	UR182	B31				6D6, 6C6, 43, 25Z5		
							8876	15	TS101							
5000, 5100	Vol.	6	H12				9925	12	CS133					^{2}78, 77, 38, 37	465	
							9328	15	TN110							
5200	Vol.	18	N	6			9982	11	UR182	B31				6A7, 78, 75, 43, 25Z5	465	
5500	Vol.	17	UM154	M26	See Note A96		1188	1	CN152		35	294	C3	6A7, 6D6, 6B7, 41, 84	370	10
							9328	15	TN110							
							.01-.01		Buffer	B14						
5600	Vol.	18	N				1258	1	RS213		20	F253	C3	6A7, 6D6, 75, 38, 84	465	10
	Tone	22	Y	6			1260	1	RS211							
							9328	15	TN110							
							.01-.01		Buffer	B14						
5700	Vol.	18	N	6			9659	1	RN242					58, 2A7, 2A6, 2A5, 80	465	1
							1100	13	CS130							
5700B	Vol.	18	N	6			9659	1	RN242					2A5, 2A6, 2A7, 58, 80	465	1
	Tone	21	N				1108	13	CS130							
5721	Vol.	18	N	6			9659	1	RN242					58, 2A7, 2A6, 2A5, 80	465	1
							1100	13	CS130							
5800	Vol.	18	MR48	M26			9659	1	RN242					2A7, 58, 2A6, 2A5, 80	465	1
6100, 6101, 6102	Vol.	6	H12				9925	12	CS133		34	F292	C3	77, ^{2}78, 38, 37, 25Z5,		
							9328	15	TN110					84	465	10
							.02-.02		Buffer	B14						
6200, 6234, 6241	Vol.	45	N											1A6, 34, 30, 33, 32, 5B1	465	
6300	Vol.	18	N	6			9659	1	RN242					2A7, 2A6, 2A5, ^{2}58, 80	465	1
	Tone	22	K12				8876	15	TS105							
6315, 6317, 6321	Vol.	17	M	6			9659	1	RN242					2A7, ^{2}58, 2A6, 2A5, 80	465	1
	Tone	22	K12				1110	13	CS131							
							8876	15	TS101							
6700	Vol.	45	MR48	M26			5	15	TS101					1C6, 34, ^{2}30, 15, 19	465	MG
6800	Vol.	17	MR48	M26			20-8-8	8	See Note	B3				^{2}6D6, 6A7, 75, 43,		
							5	15	TS101					25Z5	465	
7100	Vol.	17	MR48	M26			1477	1	RS215	B3				^{2}6D6, 6A7, 75, 76, 41,		
	Tone	22	K12				1476	1	WE1647					80	465	1
							5	15	TS101							
7100B	Vol.	17	MR48	M26			1477	1	RS215					^{2}6D6, 6A7, 75, 76, 41,		
	Tone	21	MR44				1476	1	WE1647					80	465	1
							8876	15	TS101							
7200	Vol.	17	MR48	M26			1477	1	RS215					^{2}6D6, 6A7, 75, 76, 41,		
	Tone	22	K12				1476	1	RS216					80	465	1
7200B	Vol.	17	N	6			1477	1	RS215					^{2}6D6, 6A7, 75, 76, 41, 80	465	1
	Tone	21	K12				1476	1	RS216							
							1110	13	CS131							
							8876	15	TS105							
7700, 7732, 7741	Vol.	45	N	7			1291	12	RS201					1C6, 34, ^{2}30, 32, 19	465	
8100B	Vol.	15	MR48	M26			1477	3	RS215					^{2}6D6, 6A7, 76, 75, ^{2}41,		
	Tone	21	MR44				9659	3	RN242					5Z3	465	1
							1110	14	CS131							
							8876	15	TS101							
8200B	Vol.	15	N	6			1477	3	RS215					^{2}6D6, 6A7, 76, 75, ^{2}41,	465	1
	Tone	22	M				9659	3	RN242	B3				5Z3		
							1110	14	CS131							
							8876	15	TS105							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
	Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	Original Part	Cir-cuit	Correct Replacement	*Note	Vibr. Conn.	Replace-ment	*Note			
SENTINEL RADIO CORP.—Continued																
9100	Vol.	45	MR18											^{3}34, 1C6, ^{3}30, 6-1	465	
	Tone	22	MR33													
5 Tube Superhet	Vol.	6	G7	6	2		9110-0	25	CM171	B3				57, 58, 55, 47, 80	262	1
7 Tube Super-Het. (with 45)	Vol.	6	G12				8	31	See Note	B3				27,^{4}24A, 45, 80	175	1
	Tone	22	K12				16	31	See Note	B3						
7 Tube Superhet. (with 47)	Vol.	7	F				8, 8	4	RS213	B3				^{2}51, 27,^{2}24, 47, 80	175	1
	Tone	22	K12													
8 Tube Superhet	Vol.	7	F				16-8	34	CN155	B3				^{4}24, 27,^{2}47, 80	175	1
	Tone	22	K12													
SHAMROCK	Vol.	26	‡			See Note A73	‡	1	See Note	B1				^{4}27,^{2}71A, 80		2
SILVER KING (See Appel & Henderson)																
SILVER-MARSHALL																
A	Vol.	8	A5MP	6			13177	46	CS131					24A,^{3}35, 47, 80,^{2}27	175	1
	Tone	22	N				13181	46	CS133							
B	Vol.	8	Y10MP				13181	46	CS133					^{2}24A, 27, 35, 47, 80	175	1
	Tone	57	N				13177	46	CS131							
							13203	17	TS101							
C	Vol.	8	A5MP				13181	3	CS133					24A,^{5}27,^{3}35,^{2}47, 80	175	1
	Tone	‡	Y				13177	3	CS131							
C w/AVC	Vol.	‡	Y				13177	34	CS131					^{3}35, 24A,^{5}27,^{2}47, 80	175	1
	Tone	‡	N				13181	34	CS133							
D, E	Vol.	8	A5MP				4-4-4	3	CM173					24A,^{2}27,^{3}35,^{2}47, 80	175	1
	Tone	34	N													
F	Vol.	8	A5MP				4-4-4	3	CM173					24A,^{2}35, 47, 80,^{2}27	175	1
	Tone	22	N													
G	Vol.	8	A5MP	6			13120	3	CM173					24A,^{3}27,^{3}35,^{2}47, 80	175	3
	Tone	‡	O				13177	13	CS131							
J, JT	Vol.	8	A5MP	6			13181	3	CS133					24A,^{2}27,^{3}35,^{2}47, 80	175	1
	Tone	22	N				13177	3	CS131							
KB	Vol.	9	L											^{5}30, 32,^{2}34	175	
	Tone	57	N													
Q with push-pull 47's	Vol.	100	L	6			13181	7	CS133					24A,^{4}27,^{2}35,^{2}47, 80	165	1
	Tone	22	N				13177	7	CS131							
Q with parallel 47's	Vol.	15	M	6			3162	28	CS135					24A,^{4}27,^{2}35,^{2}47, 80	165	1
	Tone	‡	L				13181	28	CS133							
							13177	28	CS131							
Q DeLuxe	Vol.	15	M	6			3162	34	CS135					^{4}56,^{3}58,^{3}45, 82	465	1
	Tone	95	L				13177	34	CS131							
	Sen.	7	D				13326	19	CS123							
R, RT	Vol.	15	M	6			3162	4	CS135					24A,^{4}27,^{2}35,^{2}47, 80	465	1
	Tone	95	L				13181	4	CS133							
							13177	14	CS131							
V	Vol.	15	M	6			3162	34	CS135					^{3}56,^{3}58,^{3}45, 82	465	1
	Tone	95	L				13177	34	CS131							
	Sen.	7	D				13326	19	CS123							
X	Vol.	15	M	6			3162	34	CS135					^{3}58,^{3}56,^{3}45, 82	465	1
	Tone	95	L				13177	34	CS131							
							13326	19	CS123							
Y	Vol.	56	M	6			13181	4	CS133					^{3}51, 56, 55,^{2}47, 80	465	1
	Tone	57	N				13177	4	CS131							
Z10	Vol.	15	N				8-8	2	RN242					2A7, 58, 2B7, 56,^{2}2A5, 5Z3	465	1
	Tone	57	M	6			8	14	CS123							
							4	15	TS105							
Z13	Vol.	45	N	6			8	34	CS133					^{3}58,^{6}56,^{2}59, 5Z3, 57	472.5	1
	Tone	85	E12				12	34	CS135							
Z DeLuxe	Vol.	45	N				12	34	CS135					^{6}56,^{3}58,^{2}2A5, 5Z3, 57	472.5	1
	Tone	85	E12				8	34	CS133							
Bearcat Midget	Vol.	8	G				8, 8	1	RS213					^{3}24A,^{2}27,^{2}45, 80	175	1
	Tone	22	O													
30	Vol.	12	A10MP				2-2-4-1	3	See Note	B1				^{4}24A, 27,^{2}45, 80		3
30B	Vol.	12	A10MP				2-1-2-4	3	See Note	B1				^{3}24A, 27,^{2}45, 80		3
34A (with 33A Pwr. Unit)	Vol.	9	A3MP				4-4-4	34/40	CM173					^{3}24A,^{2}45, 80, 27		3
	Tone	34	G12				12-8-4	2/19	CN155	B12						
35A (with 33A Pwr. Supply)	Vol.	‡	‡			See Note A74	4-4-4	34/40	CM173					^{4}24A,^{2}27,^{2}45, 80		3
							12-8-4	2/19	CN155	B12						
36A	Vol.	58	D				4-4-4	3	CN151					^{5}24A, 27,^{2}45, 80	175	1
37, 38, 39 Midget	Vol.	8	A10MP				8, 8	1	RS213					^{3}24A,^{2}27,^{2}45, 80	175	1
	Tone	22	O													
684 P.E. Amplifier	Vol.	15	O				13181	3	CS133					24A, 27,^{2}47, 80		1
							13203	19	TS101							
685 P.A. Amplifier	Vol.	16	N				2-6-4	2/19	See Note	B1				27, 26, 50,^{2}81		8
686 Portable P.A. Amplifier	Vol.	15	O				13181	3	CS133					24A, 27,^{2}47, 80		1
							13203	19	TS101							
690 Amplifier	Vol.	16	L				‡	3	See Note	B1				27,^{2}26,^{2}50,^{2}81		‡
692 Amplifier	Vol.	15	N				‡	‡	See Note	B1				24A, 45,^{2}50,^{2}81		8
710 Sargent-Rayment	Vol.	12	A3MP											^{4}22,^{2}01A, 12A or 71A		
712 Tuner	Vol.	12	A10MP											^{3}24A, 27		
714 Tuner	Vol.	58	D											^{4}24A,^{2}27	175	
716 Tuner with 683 Amplifier	Vol.	12	A5MP				13181	3	CS133					24A,^{2}27,^{3}35,^{2}47, 80	175	3
	Tone	‡	G12				13177	3	CS131							
							13023	15	TS101							
720 AC	Vol.	12	A3MP											^{3}24A,^{2}27, 45		
720 Battery	Vol.	12	A3MP											^{3}22,^{2}01A, 12A		
722	Vol.	12	A10MP				‡	3	See Note	B1				^{3}24A, 27,^{2}45, 80		3
722 DC (Battery)	Vol.	12	A10MP											^{3}22, 01A,^{2}12A		
724 AC	Vol.	58	A3MP				4-4-4	3	CM173					^{5}24A, 27,^{2}45, 80	175	3
724 DC	Vol.	9	Y50MP				2-2	12	See Note	B3				^{4}32,^{2}30,^{2}31	175	
726 (S.W. & Broad-cast)	Vol.	8	A5MP	6			13120	3	CM173					^{2}24A,^{3}35,^{3}27,^{2}47, 80	175	1
727 DC	Vol.	9	L											^{5}30, 32,^{2}34	175	
	Tone	57	N													
727 SW	Vol.	15	M	6			3162	4	CS135					24A,^{2}35,^{4}27,^{2}47, 80	465	1
	Tone	‡	L				13181	4	CS133							
728 SW	Vol.	15	N 6				3162	34	CS135					^{3}58,^{5}56,^{3}45, 82	465	1
	Tone	95	L				13177	34	CS131							
	Sen.	7	D				13326	19	CS123							
729 SW	Vol.	45	N	6			8	34	CS133					^{3}58,^{6}56,^{2}2A5, 5Z3	465	1
	Tone	22	E12				12	34	CS135							
738 Converter							8-8	1	CN152					24A, 27, 26	1000	1
739 Converter							4-4	1	CN150					24A, 27, 80	650	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
SILVER-MARSHALL—Continued																
Sheridan 750, 750BS	Vol.	4	D12				2-2-.5	3	See Note	B1				^{3}26, ^{2}27, ^{2}45, 80		28
760	Vol.	4	D12				1-1-1-.5	‡	See Note	B1				^{3}26, ^{2}27, 45, 80		28
770 Auto Set	Vol.	7	J											^{3}24A, 12A, 71A		
773 B'cast/Long Wave	Vol.	8	A5MP	6			13120	3	CM173					24A, ^{2}35, ^{2}27, ^{2}45, 80	115	1
	Tone	22	N													
782 Midget	Vol.	8	A10MP				8-8	1	RS213	B66				^{3}24A, ^{2}27, ^{2}45, 80	175	1
	Tone	22	O													
1022 (724 AC)	Vol.	58	A3MP				1-1-1	3	CM173					^{5}24A, 27, ^{2}45, 80	175	3
4801, 4802	Vol.	15	UC503				12-8	34	CM175					^{3}58, ^{3}56, ^{3}59, 5Z3	Early 465	
	Tone	21	L	6			5-5	15	TN110							
	Sen.	12	Y												Late 175	3
McMURDO SILVER																
5D	Vol.	15	N				16	3	RS216					6B7, 6C6, ^{4}6D6, ^{2}76, 42, 5Z3	465	1
	Tone	21	O				18	3	RS216							
	Sen.	7	G				12	3	RS215							
World Wide Nine	Vol.	18	O				8	2	See Note	B3				2A7, ^{4}58, 55, ^{2}2A5, 5Z3	465	1
	Tone	57	Z12				12	2	See Note	B3						
							4	14	See Note	B3						
SILVERTONE (See Sears-Roebuck Co.)																
SIMPLEX RADIO CO.																
AA	Vol.	‡	UC513				2	12	CS121					1A6, ^{2}1B4, 1F4	456	
							5	15	TS101							
D	Vol.	4	‡			See Note A5	‡	‡	See Note	B2				^{2}10, 27, ^{2}26, 80		8
	Sen.	‡	‡			See Note A5										
D (420,001 and up)	Vol.	17	MR48				20-4	6	See Note	B3				6A7, 6K7, 75, 43, 25Z5	456	
	Tone	22	L				5	15	TS101							
D (428,001 and up)	Vol.	17	MR48				20-20	6	CM164					6A7, 6K7, 75, 6G5, 43, 25Z5	456	
	Tone	22	L				5	15	TS101							
DB, DF (500,001 and up)	Vol.	17	N				10-20	1	RN245		14	245C	C3	6D8G, 6S7G, 6Q6G, 6G5, 38	456	10
	Tone	22	L	6			.01		Buffer	B14						
DB, DF (775,001 and up)	Vol.	17	N				10-20	1	RN245		14	245C	C3	1C6, 34, 1B5, 38	456	10
	Tone	22	L	6			.01		Buffer	B14						
G	Vol.	‡	Order from Mfr.				‡	3	See Note	B3				45, 27, 24A, 80		1
	Tone	44	‡			See Note A5										
G (703,001 and up)	Vol.	15	MR48				8-8	4	CM172	B3				6A7, 6K7, 76, 6F5, 42, 80	456	1
	Tone	34	L				5	15	TS101							
G (707,001 and up)	Vol.	15	MR48				16-16-8-5	9/13	See Note	B3				6L7, 6D6, 6H6, 6G5, 75, 25B5, 25Z5	456	
	Tone	34	L				5	15	TS101							
GB (779,001 and up)	Vol.	17	MR48				8-8	1	CN152	B3	14	245C	C3	1C6, 1A4, 1B5, 30, 19	456	10
	Tone	22	MR48				.01		Buffer	B14						
GH (691,001 and up)	Vol.	15	MR48				24-8	‡	See Note	B3				6A7, 6K7, 76, 6F5, 43, 25Z5	456	
	Tone	34	L				5	15	TS101							
H	Vol.	12	A20MP	6			8-8	1	See Note	B3				^{3}24A, 45, 80		3
	Tone	22	N													
H AC	Vol.	7	D	6			8-8	1	See Note	B3				^{3}24A, 45, 80		3
	Tone	‡	N													
J	Vol.	6	D12	6			8-8	1	See Note	B3				^{2}35, ^{2}24A, 47, 80		1
	Tone	22	L													
K	Vol.	6	G12				8-4	4	See Note	B3				^{2}24A, 35, 47, 80	175	1
L	Vol.	‡	Y50MP				4-4-4	26	See Note	B3				^{3}35, ^{2}24A, 47, 80	175	1
	Tone	22	L													
N	Vol.	6	G12				8-4	4	See Note	B3				^{2}24A, 35, 47, 80	175	1
	Tone	22	L													
N DC	Vol.	6	G12											^{2}39, 36, ^{2}38	175	
	Tone	22	L													
NT (902,001 and up)	Vol.	20	TM231-SS1				8, 8	2	CS133					6K7, 6L7, 6D6, ^{2}76, 75, ^{2}6B5, 80, 6G5	456	1
	Tone	34	MR48				5	15	TS101							
P AC	Vol.	15	N				4-4-10	4/19	See Note	B3				57, 58, 55, 47, 80	175	1
	Tone	22	L	‡												
P AC (Above serial No. 162500)	Vol.	15	N				4-4	4	CM170					57, 58, 55, 47, 80	175	1
	Tone	22	L	‡			10	19	TS101							
P AC (Above serial No. 330001)	Vol.	15	M				4-4	4	CM170					6A7, 78, 75, 42, 80	456	1
	Tone	22	L	7		See Note A75	5	19	TS105							
P Battery	Vol.	9	Y10MP				8	12	See Note	B3				^{2}34, ^{2}32, 33	175	
	Tone	22	L				10	19	TS101							
PB, PF (Serial No. 352001 and up)	Vol.	‡	N				20-10-4	1/13	RM259	B191	14	245C	C3	‡	‡	10
	Tone	‡	L	6			.01		Buffer	B14						
PH (690,001 and up)	Vol.	17	MR48				15-8-8	11	RM257	B3				6A7, 6D6, 75, 43, 25Z5	‡	
	Tone	22	L				5	15	TS101							
P 32V (No. 350001 and up)	Vol.	15	M				6-10	1	See Note	B3	34	F292	C3	6A7, 78, 75, 42, 84	456	10
	Tone	22	L	7		See Note A75	5	15	TS101							
							.05-.05		Buffer	B14						
P Dual Band (Above serial No. 600001)	Vol.	17	N				8-8-4	4/13	RM265	B192				6A7, 6D6, 75, 42, 80	456	1
	Tone	22	L	6			5	15	TS105							
P Battery (Above serial No. 173501)	Vol.	9	Y250MP				5	19	TS105					1A6, 34, 32, 19, 30	456	
	Tone	22	L													
P1931	Vol.	6	G12				8-4	4	See Note	B3				^{2}24A, 35, 47, 80	175	1
	Tone	22	L	8												
Q 1931	Vol.	6	G12		EX350		8-4	4	See Note	B3				^{2}24A, 35, 47, 80	175	1
	Tone	22	L													
Q (378,001 and up)	Vol.	17	UM154			See Note A96	10-6	1	CN152	B3	35	294	C3	6K7, 6A8, 78, 75, 6N6, 0Z4	175	10
							5	15	TS101							
							.01-.01		Buffer	B14						
R	Vol.	6	G12		EX350		8-4	4	See Note	B3				58, 57, 47, 80		1
	Tone	22	L	7		See Note A75										
R AC (Above No. 320001)	Vol.	6	G12				AB108	4	CM170					78, 77, 42, 80		1
	Tone	22	L	7		See Note A75										
R DC	Vol.	6	G12		‡	A11								39, 36, ^{2}38		
	Tone	22	L	7		See Note A75										
RJH (300,001 and up)	Vol.	17	MR48				20-20	1	CM164	B3				6A7, 6K7, 6Q7, 25B5, 25Z5MG	456	
							5	15	TS101							
RK (760,001 and up)	Vol.	6	L		EX300		15-8	6	CN145	B3				6D6, 6C6, 43, 25Z5MG		
							5	15	TS101							
T	Vol.	17	UM154			See Note A96	6-10	1	SR601		34	292	C3	78, 6A7, 75, 41, 84	‡	10
							5	15	TS101		14	245C	C14			
							.05-.05		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
SIMPLEX—Continued																
TA	Vol.	17	UM154	M26	See Note	A96	8-8	1	See Note	B3	18	248	C3	6A7, 78, 6B7, 41	456	10
							5	15	TS101							
							.0125-.0125		Buffer	B14						
U AC-DC Receiver	Vol.	6	UC510		‡	A14	20-4	6	See Note	B3				78, 44, 77, 43, 25Z5	456	
							5	15	TS101							
U AC-DC (Late)	Vol.	17	N				5-20-8	11	UR182	B3				75, 6A7, 6D6, 43,		
							5	15	TS101					25Z5	456	
UE, AC-DC Serial 215001	Vol.	17	N				5-20-8	11	UR182	B3				6A7, 6D6, 75, 43,		
							5	15	TS101					25Z5	456	
UX52	Vol.	17	MR48				4-8	30	CN151	B3				^{2}6D6, 6A7, 75,^{3}42, 80	‡	1
	Tone	22	L				8-8	30	See Note	B3						
							5	15	TS101							
V AC-DC Receiver	Vol.	7	UC510				20-4	6	See Note	B3				44, 77, 43, 25Z5		
							5	15	TS101							
V All-Wave	Vol.	12	N				40-8	6	See Note	B3				6F7, 77, 43, 25Z5		
							5	15	TS101							
W All-Wave	Vol.	17	N				4-8-4	26	See Note	B3				^{3}78, 85, 37,^{2}42, 80	456	1
	Tone	41	L													
X	Vol.	6	G12		EX200		4-4	4	CM170					^{2}6D6, 6C6, 42, 80		1
							5	15	TS105							
							5	19	TS105							
Z, ZS, ZE (321,001 and up)	Vol.	6	L		EX300		15-8-5-5	24/15	UR189	B3				6D6, 6C6, 12A7		
5DE (780,001 and up)	Vol.	17	MR48				20-4-5-5	6/15	UR189					6A7, 6D6, 75, 43,		
	Tone	22	L											25Z5	456	
6A	Vol.	12	‡	6	See Note	A5	‡	3	See Note	B1				45, 27,^{3}24A, 80		3
8J (765,001 and up)	Vol.	17	MR48				4-8	30	RN241					^{2}6D6, 6A7, 75,^{3}42, 80	‡	1
	Tone	22	L				8	30	CS133							
							5	15	TS101							
8J (765,361 and up)	Vol.	17	MR48				4-8	1	RN241					^{2}6D6, 6A7, 75, 76,^{2}6B5,		
	Tone	22	MR39				8	13	CS133					80	456	1
							5	15	TS101							
8JM	Vol.	‡	L			A17	4-8	1	CN141	B3				^{2}6K7, ^{2}6A8, ^{3}6F6, 5Z4	‡	1
	Tone	22	L				8	13	CS133							
							5	15	TS101							
SKY HAWK—See Airking																
SKY KING—See Airking																
SKY ROVER	Vol.	6	G12				4-8	4	CM171					35, 24, 47, 80		1
SOLAR																
062	Vol.	45	N				4	15	TS105		1	206		^{3}39, 36, 37, 38	262	
062A	Vol.	45	N				4	15	TS105		1	206		^{3}39, 36, 37, 41	262	
	Tone	34	UC502													
SONGBIRD—See Airking																
SONORA																
A30, A32	Vol.	10	SRP283				2-1-1-3	3/13	See Note	B1				‡		‡
	Sen.	7	2M		See Note	A3										
A36	Vol.	10	SRP283				2-2-1-3	37	See Note	B1				‡		‡
	Sen.	7	2M		See Note	A3										
A40	Vol.	10	SRP283				2-1-1-3	3/13	See Note	B1				‡		‡
	Sen.	7	2M		See Note	A3										
	Phono.	63	‡		See Note	A5										
A46	Vol.	10	SRP283				2-3-1-3	37	See Note	B1				‡		‡
	Sen.	7	2M		See Note	A3										
B31 (25 cycle)	Vol.	12	A2MP				8-8	1	See Note	B3				^{4}24, 27,^{2}45, 80		1
E AC	Vol.	14	N				2-2-7	3	See Note	B1				^{4}26, 27, 71A, 80		9
P101	Vol.	‡	N				16-8	1	CN155	B3				6C6, 6A3, 83		1
	Tone	57	L				10	15	CS124							
P300	Vol.	15	N				60	1	RS208					6C5,^{2}25L6,^{2}25Z5		
	Tone	21	L				16	1	RN232	B8						
							8	13	CS123							
PR101, PR202 (AC)	Vol.	18	MR48				5-5	23	CM172	B3				6A7, 6D6, 75, 41, 84	456	1
PR101, PR300, PR400 (AC-DC)	Vol.	17	MR48				8-16	1	CN145	B3				6A7, 6D6, 75, 25L6,		
	Tone	147	MR53				5	15	TS101					25Z5	456	
2RP (25 cycle)	Vol.	10	SRP283				2-1-1-3	3/13	See Note	B1				‡		‡
	Sen.	7	2M		See Note	A3										
	Phono.	63	‡		See Note	A5										
3RP	Vol.	10	SRP283				3-2-1-3	37	See Note	B1				‡		‡
	Sen.	7	2M		See Note	A3										
	Phono.	63	‡		See Note	A5										
3R, 4R	Vol.	10	SRP283				2-1-1-3	3/13	See Note	B1				‡		‡
	Sen.	7	2M		See Note	A3										
5R (Areturus Tubes)	Vol.	10	SRP283				2-3-1-3	37	See Note	B1				‡		‡
	Sen.	7	2M		See Note	A3										
7P Elec. Phonograph	Phono.	63	‡		See Note	A5	2-3-1-3	37	See Note	B1				‡		‡
DeLuxe 44	Vol.	10	SRP283				2-3-1-3	37	See Note	B1				^{4}RA1,^{2}DE1,^{2}SO2,^{2}RE2		‡
	Sen.	7	2M		See Note	A3										
	Phono.	63	‡		See Note	A5										
64	Vol.	6	F12		EX350		8-8-8	28	RM265					^{3}24A, 27,^{2}45, 80		1
	Tone	41	N													
70	Vol.	15	O				8-8	1	CN152	B3				^{3}35,^{3}27, 47, 80	262	3
	Tone	34	UC502													
71, 72, 73	Vol.	15	O				8-8	1	CN152	B3				^{3}24, 27,^{3}35, 47, 80	262	3
	Tone	44	UC502				8	15	CS123							
							8	13	CS123							
74	Vol.	6	F12		EX350		8, 8	1	RS213					^{3}24, 47, 80		1
84, 85	Vol.	6	F12		EX350		4-8	1	CN151					^{2}24A, 35, 47, 80	262	1
86, 87	Vol.	15	N				4-2-4	28	CM173					^{2}35,^{3}24A, 27, 47, 80	262	2
	Loc'lzr.	‡	Y200MP													
	Tone	34	UC502													
SPARKS-WITHINGTON—See Sparton.																
SPARTON																
AC7	Vol.	7	SRP154				2-2-2	3	See Note	B1				^{5}C401, ^{2}71A or C181,		
														BH		1
AR19	Vol.	11	Order from	Mfr.										^{4}24A, 12A		
AR50, AR50A	Vol.	11	Order from	Mfr.										^{3}24A, 27, 12A		
AC62, AC63	Vol.	7	SRP154				2-2-2	3	See Note	B1				^{5}C401 or C373, ^{2}71A or		
														C181, BH		1
5, 9	Vol.	8	Order from	Mfr.			A6610	1	CS131					^{2}35, 27, 45, 80		1
							A6611	11	CS133							
9-30	Vol.	7	SRP154				‡	46	See Note	B1				‡		2

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
SPARTON—Continued																
9A	Vol.	24	DRP246	6			B2327	1	MN273					^{2}24A, 27, ^{2}483, 80		2
9X	Vol.	109	M		RS244		A8123-1	4	HD680					58, 24A, 56, 47, 80	172.5	1
	Tone	34	K12	6	RS244		A9019A	4	CS133							
	Supp.	7	D													
10	Vol.	7	A2MP		RS244	A24	B2748A	1	MN275					^{3}35, ^{2}27, 47, 80	172.5	1
	Tone	22	K12		RS244	A24										
12	Vol.	4	DRP169		RS244		4	4	CS131					^{2}24A, 35, 47, 80	172.5	1
	Tone	22	K12		RS244		7	4	CS133							
13, 14, 14A	Vol.	109	M		RS244		A8123-1	4	HD680					^{2}58, 24A, ^{3}56, 47, 80	172.5	1
	Tone	22	K12	6	RS244		A9019A	4	CS133							
	Supp.	7	D													
15	Vol.	7	UC500		RS244		B2748A	1	MN275					^{3}35, ^{3}27, 47, 80	172.5	1
	Tone	22	K12		RS244		A6611	‡	CS133							
15X	Vol.	109	M		RS244		A8123-1	4	HD680					^{2}58, 24A, ^{3}56, 47, 80	172.5	1
	Tone	34	K12	6	RS244		A9019A	4	CS133							
	Supp.	7	D			A77										
16, 16AW	Vol.	111	G				A8123-1	26	HD680					^{3}27, ^{3}35, ^{2}47, 80	172.5	1
	Tone	44	K12				A6611A	26	CS133							
17, 18	Vol.	111	G		RS244		A8123-1	26	HD680					^{2}58, 24A, ^{4}56, ^{2}47, 80	172.5	1
	Tone	22	L		RS244		A6611A	26	CS133							
	Supp.	‡	UC508			A94										
25, 26, 26AW	Vol.	32	A5MP	6	RS244		8-8-8	28	RM265					^{4}35, ^{3}27, ^{2}45, 80	172.5	3
	Tone	44	K12		RS244											
27	Vol.	111	C		RS244		A8123-1	26	HD680					^{2}58, 24A, ^{4}56, ^{4}47, ^{2}80	172.5	3
	Tone	22	L		RS244		A6611A	26	CS133							
	Supp.	32	UC508			A94										
27A	Vol.	111	G		RS244		A8123-1	26	HD680					^{2}58, 24A, ^{4}56, ^{4}47, ^{2}80	172.5	3
	Tone	22	L		RS244		A6611A	26	CS133							
	Supp.	32	UC508			A94										
28	Vol.	111	G		RS244		A8123-1	26	HD680					^{2}58, 24A, ^{4}56, ^{4}47, ^{2}80	172.5	3
	Tone	22	L		RS244		A6611A	26	CS133							
	Supp.	32	UC508			A94										
30, 30A, 30B	Vol.	111	A5MP		RS244		A6884	28	RM265					^{4}35, ^{3}27, ^{2}45, 80	172.5	3
	Tone	44	K12		RS244											
	Phono.	63	SRP259													
31, 32	Vol.	12	UC507											^{4}32, 30, 31		
33	Vol.	83	M				A8907	1	CS133		34	292	C3	^{2}39, 36, 85, 41, 84	172.5	10
							A9308	15	TS102							
							.02		Buffer	B14						
33A, 33B	Vol.	15	M	6			A10277	1	CN152		34	292	C3	^{2}78, 36, 75, 41, 84	172.5	10
							A9308	15	TS102							
							.02		Buffer	B14						
34	Vol.	15	M											^{2}39, 36, 70, ^{2}38	172.5	
35	Vol.	111	E				2-4-1	3	See Note	B2				^{4}35, ^{5}27, ^{2}50, ^{2}81	172.5	5
	Tone	44	K12													
	Phono.	63	K12													
36	Vol.	83	M	6			A10001	46	CN145		5	222		^{2}78, 36, 85, 37, 89, 79	172.5	10
							A10308	15	TN111							
40 Auto	Vol.	15	M											^{4}36, 37, 38		
41 Police Auto	Vol.	7	J											^{3}36, 37, 38		
41A	Vol.	7	J											^{3}39, 36, 12		
42	Vol.	15	M											^{3}39, 36, 38, 37		
43 Police Auto	Vol.	15	M											^{3}39, 36, 37, 38		
43S, 43S-1600, 43S-2400	Vol.	15	M											37, ^{3}39, 36, 41 or 42		
45	Vol.	111	A5MP	6	RS244		8-8-8	28	RM265					^{4}35, ^{3}27, ^{2}45, 80	172.5	3
	Tone	44	K12		RS244											
	Phono.	63	W													
49	Vol.	26	K											^{6}C486, ^{2}01A, 71A		
51, 52	Vol.	12	UC507											^{4}32, 30, 31		
	Tone	22	K12		See Note A4											
53 AC-DC	Vol.	17	N	6			A11093-1	11	UR193	B31				^{2}78, 75, 43, 25Z5	456	
54	Vol.	56	M				A8907	12	CS123					^{2}34, 25S, ^{4}30	172.5	
	Tone	44	K12	7												
55 Police Desk	Vol.	26	UC513				B2918	1	MN275					^{3}24A, 27, C183, 80		1
	Relay	‡	‡		See Note A5											
56	Vol.	7	C	6			B2748A	1	MN275					^{3}35, ^{2}27, 47, 80	172.5	1
	Tone	22	K12													
57 AC-DC	Vol.	17	N	6			A11093	11	UR193	B31				^{2}78, 75, 43, 25Z5	456	
58	Vol.	40	Y		RS244		A10318	12	CS130					1A6, ^{2}32, 30, 33	456	
60 S.W. Converter							5-5	1	CN150	B3				^{2}24A, 27, 80		1
61, 62	Vol.	15	M	6			A9550	11	UR182	B31				^{2}78, 75, 43, 25Z5	456	
65, 66, 65T, 66T	Vol.	17	M	6			A11093	11	UR193	B31				^{3}78, 75, 43, 25Z5	456	
67, 68	Vol.	17	M	6			A11223-1	1	RN242					^{2}78, 6A7, 75, 42, 80	345	1
							A11224-1	13	CS121							
							A10377	15	TS101							
69	Vol.	7	SRP154				‡	‡	See Note	B1				^{6}C484, 585, 80		5
70	Vol.	15	UM147-SS2	M27			A11623	12	CS123					^{3}34, 1C6, 1A6, 30, 19	345	
							A10377	19	TS101							
71, 71B	Vol.	18	UM147-SS2	M26			A9754	4	RM262	B73				^{2}6D6, 6C6, 75, 42, 80	456	1
72	Vol.	56	M	6		A77	A9754	4	RM262	B73				^{3}6D6, 85, 42, 37, 80	172.5	1
	Supp.	58	E			A77										
72PQ (Police)	Vol.	56	M	6		A77	A9754	4	RM262					^{3}6D6, 37, 85, 6C6, 42,		
	QAVC	12	K12			A77	A10377	‡	TS101					80	172.5	1
73	Vol.	17	M	6	RS244	A24	A9754	4	RM262					^{2}6D6, 37, 75, 42, 80	456	1
73AX, 73BX	Vol.	17	M	6	RS244		A9754	4	RM262					^{3}78, 75, 42, 80	456	1
74	Vol.	109	M		RS244		A10018	35	CS133					^{2}58, 24A, ^{3}56, ^{2}2A5, 80	172.5	1
	Tone	22	K12	6	RS244		A10118	35	CN151							
	Supp.	7	E		RS244											
75A	Vol.	83	M		RS244		A8123	4	CS131					^{3}58, 56, 57, 55, 47, 80	456	1
	Tone	22	K12	6	RS244		A9019A	4	CS133							
	Supp.	7	UC510		RS244											
75AX	Vol.	83	M		RS244		A8123	4	CS131					^{3}58, 57, 56, 55, 47, 80	456	1
	Tone	22	K12	6	RS244		A9019A	4	CS133							
76	Vol.	15	M	6		A77	A8123-1	26	CS131					^{3}58, 57, ^{4}56, ^{4}2A5, 5Z3	456	3
	Tone	22	L			A77	A6611A	26	CM173							
	Supp.	7	UC510			A77	A10609-1	13	CS130							
77	Vol.	15	UM147-SS2	M27			A11623	12	CS123					^{3}34, 1C6, 1A6, 19	345	
							A10377	19	TS101							
78	Vol.	62	M	6			A9754	4	RM262	B73				^{3}6D6, ^{2}37, 42, 80	172.5	1
	Sen.	7	E													
79, 79A	Vol.	7	SRP154				‡	‡	See Note	B1				^{6}C484, 585, 80		5
80	Vol.	56	M	6			11223	1	RN242					^{3}78, 6A7, 76, 85, 42, 80	456	1
	Tone	22	L				A10377	15	TS101							
	Voltage	26	A5MP													
	Supp.	58	UC510													
81, 81A	Vol.	40	Y				A10318	12	CS130					1A6, ^{2}32, 30, 33	456	
	Fil.	29	Q													
82	Vol.	40	Y				A10318	12	CS130					1A6, ^{2}32, 30, 19	456	
	Fil.	29	Q													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
SPARTON—Continued																
83, 84, 85X, 86X	Vol.	56	M	6			11223	1	RN212					^{3}78, 6A7, 76, 85, 42, 80	456	1
	Tone	22	L				A10377	15	TS101							
	Voltage	26	A5MP													
	Supp.	58	UC510													
89, 89A	Vol.	7	SRP154				‡	‡	See Note	B1				^{6}C484, 585, 80		5
99	Vol.	7	SRP154				‡	‡	See Note	B1				^{6}484, 26, ^{2}50, ^{2}81		5
101	Vol.	7	SRP154				1-4-1	26	See Note	B1				^{6}484, 27, ^{2}26, ^{2}585, ^{2}81		4
	Phono.	63	SRP259													
103	Vol.	98	SRP258				1-4-1	26	See Note	B1				^{7}484, ^{2}485, ^{2}C586, ^{2}81		5
104	Vol.	56	M	6			A11223-1	1	RN212					^{3}78, 6A7, ^{2}76, 85, ^{2}42,		
	Tone	22	L				A10377	15	TS101					5Z3	456	1
	Voltage	26	UC510													
	Supp.	98	Y200MP													
109 DeLuxe	Vol.	7	SRP154				‡	‡	See Note	B1				^{6}484, or 485, ^{2}585, 586,		
														^{2}81		5
110, 111 (DeLuxe)																
(Two Types)	Vol.	7	SRP154				1-4-1	3	See Note	B1				^{6}484, ^{2}26, ^{2}50, ^{2}81		8
111A	Vol.	7	SRP258				1-4-1	3	See Note	B1				^{7}484, ^{2}26, ^{2}C586, ^{2}81		8
111X	Vol.	111	G		RS244		A8123-1	26	HD680					^{2}58, 24A, ^{4}56, ^{2}47, 80	172.5	1
	Tone	22	L		RS244		A6611A	26	CS133							
	Supp.	‡	UC508			A94										
134, 136	Vol.	15	M	6	RS244		A8123-1	37	HD680					^{3}58, 2A7, ^{4}56, ^{2}2A5, 5Z3	456	3
	Tone	22	L		RS244		A6611A	37	CS133							
	Sen.	7	UC510		RS244		A10609-1	13	CS130							
	Voltage	26	E				A6316-1	19	CS125							
							A10377	15	TS101							
							A11582	15	TS101							
235	Vol.	58	SRP258				15-5	1	MN273					^{7}484, ^{2}C183, 80		2
	Phono.	63	SRP259													
301 AC	Vol.	7	SRP154				2-2	1	See Note	B1				^{6}484, ^{2}50, ^{2}81		5
301 DC	Vol.	7	SRP154				3	‡	See Note	B11				^{6}484, ^{2}182		
333	Vol.	17	UC511	6			A10277	1	Order from	Mfr.	34	292	C3	6F7, 78, 75, 41, 84	456	10
							A9308	15	TS102							
							.02		Buffer	B14						
400	Vol.	24	DRP246				15-5	1	MN273					^{2}24A, 27, ^{2}C183, 80		2
410 AC (Junior)	Vol.	24	DRP246				B2327	1	MN273					^{2}24A, 27, ^{2}C183, 80		2
410 DC (Junior)	Vol.	24	DRP246											^{2}24A, 27, ^{2}C183		
420 AC (Jewell)	Vol.	24	DRP246				B2327	1	MN273					^{2}24A, 27, ^{2}C183, 80		2
420 DC (Jewell)	Vol.	24	DRP246											^{2}24A, 27, ^{2}C183		
427X	Vol.	7	UC501	6			A14101	1/15	RN245					6A7, 6F7, 42, 80	456	1
437X	Vol.	7	UC501	6			A14101	1/15	RN245					6A7, 6F7, 42, 80	456	1
457X	Vol.	7	UC501	6			A14101	1/15	RN245					6A7, 6F7, 42, 80	456	1
475A	Vol.	83	M		RS244		A8123	4	HD680					^{3}58, 57, 55, 56, 47, 80	456	1
	Tone	22	K12	6	RS244		A9019A	4	CS 133							
	Sen.	58	UC510		See Note	A77										
475AX, 478AX	Vol.	83	M		RS244		A8123	4	HD680					^{3}58, 57, 56, 55, 47, 80	456	1
	Tone	22	K12	6	RS244		A9019A	4	CS133							
478	Vol.	62	M	6	See Note	A77	A9754	4	RM262	B73				^{3}6D6, ^{3}37, 42, 80	172.5	1
	Supp.	58	E		RS244											
478A	Vol.	83	M		RS244		A8123	4	HD680					^{3}58, 57, 56, 55, 47, 80	456	1
	Tone	22	K12		RS244		A9019A	4	CS133							
	Sen.	58	UC510			A94										
506	Vol.	17	N	6			A11093-1	11	UR193	B31				^{2}78, 75, 43, 25Z5	456	
516, 516X	Vol.	17	N	6			A12307	4	CM170					6A7, 78, 75, 42, 80	456	1
	Tone	147	M													
517	Vol.	15	O	6			A14102	1/15	RN245					6A7, 78, 75, 42, 80	456	1
518, 518X	Vol.	18	N				A14428	1/15	RN245					6A8G, 6K7G, 6Q7G,		
	Tone	22	O	6										6F6G, 5Y3G	456	1
528-2	Vol.	18	N	6										1C7G, ^{2}1D5G, 1H6G,		
	Tone	22	L											33	456	
536, 536X	Vol.	17	O	6			A12048	1/15	RN245/TS101					6A7, 6K7, 75, 6F6, 80	345	1
537	Vol.	15	O	6			A14102	1/15	RN245					6A8G, 6K7G, 6Q7G,		
	Tone	22	O											6F6G, 5Y3G	456	1
538, 538X	Vol.	18	N				A14073	25	RS216					6A8G, 6K7G, 6Q7G,		
	Tone	22	O				A14072	25	WE3540					6E5, 6F6G, 5Y3G	456	1
546X	Vol.	17	N	6			A12307	4	CM170					6A7, 78, 75, 42, 80	456	1
547X	Vol.	15	O	6			A14102	1/15	RN245					6A8G, 6K7G, 6Q7G,		
	Tone	22	O											6F6G, 5Y3G	456	1
557	Vol.	15	O	6			A14102	1/15	RN245					6A7, 78, 75, 42, 80	456	1
558B, 558BX,																
558C, 558CX	Vol.	18	N				A14428	1/15	RN245					6A8G, 6K7G, 6Q7G,		
	Tone	22	O	6										6F6G, 5Y3G	456	1
564	Vol.	7	SRP258				2-2-2	3	See Note	B1				^{6}484, ^{2}C586, ^{2}81		5
564 DC	Vol.	7	SRP258				3	‡	See Note	B11				^{7}484A, ^{2}182A		
567	Vol.	15	O	6			A14102	1/15	RN245					6A7, 78, 75, 42, 80	456	1
568, 568X	Vol.	18	N				A14228	1/15	RN245					6A8G, 6K7G, 6Q7G,		
	Tone	22	O	6										6F6G, 5Y3G	456	1
570	Vol.	7	SRP258				2-2-2	3	See Note	B1				^{7}C484, ^{2}C586, ^{2}81		5
570 DC	Vol.	7	SRP258				3	‡	See Note	B11				^{7}484A, ^{2}182A		
574	Vol.	7	SRP258				1-4-1	3	See Note	B1				^{7}484, ^{2}26, ^{2}5C86, ^{2}81		8
577	Vol.	17	O	6			A14102	1/15	RN245					6A8G, 6K7G, 6Q7G,		
	Tone	22	O											6F6G, 5Y3G	456	1
578	Vol.	98	SRP258				1-4-1	26	See Note	B1				^{7}484, ^{2}485, ^{2}C586, 81		5
588-2	Vol.	18	N	6										1C7G, ^{2}1D5G, 1H6G,		
	Tone	22	L											33	456	
589	Vol.	7	SRP258				15-5	1	MN273					^{7}484, ^{2}182, 80		2
591, 593	Vol.	7	SRP154				15-5	1	MN273					^{6}484, ^{2}C182B, 80		2
594	Vol.	17	N	6			A11093-1	11	UR193	B31				^{2}78, 75, 43, 25Z5	456	
600	Vol.	7	SRP258				15-5	1	MN273					^{7}484, ^{2}183, 80		2
600 DC	Vol.	7	SRP258				3	‡	See Note	B11				^{7}484A, ^{2}182A		
608, 608B	Vol.	18	MR48	M26			A14500	1	Order from	Mfr.				6A8G, 6K7G, 6Q7G,		
														25L6G, 25Z6G,		
														BK49B	456	
610	Vol.	7	SRP258				15-5	1	MN273					^{7}484, ^{2}183, 80		2
610 DC	Vol.	7	SRP258				3	‡	See Note	B11				^{7}484A, ^{2}182A		
616, 616X,																
616M, 616MX	Vol.	17	O	6			A12048	1/15	RN245/TS101	B193				78-6K7, 6A7, 42-6F6,		
														80	345	1
617, 617X	Vol.	77	N				A14073	25	RS216					^{2}6K7G, 6A8G, 6Q7G,		
	Tone	22	N	6			A14072	25	WE3540					6F6G, 5Y3	345	1
620	Vol.	7	SRP258				15-5	1	MN273					^{7}484, ^{2}183, 80		2
620 DC	Vol.	7	SRP258				3	‡	See Note	B11				^{7}484A, ^{2}182A		
620X	Vol.	109	M		RS244		A8123-1	4	HD680					^{2}58, 24A, ^{3}56, 47, 80	172.5	1
	Tone	34	K12	6	RS244		A9019A	4	CS133							
	Supp.	7	D			A94										
628, 628X	Vol.	18	N	6			A14073	25	RS216					6A8G, 6K7G, 6Q7G,		
	Tone	22	O				A17072	25	WE3540					6E5, 6F6G, 5Y3G	456	1
636MX	Vol.	15	O	6			A12048	1/15	RN245/TS101					78, 6A7, 6K7, 75, 6F6,		
														5Y3	345	1
638-6	Vol.	18	MR48	M27			A14326	1	CN152	B3	13	215	C3	1C7G, ^{2}1D5G, 1H6G,		
	Tone	149	MR48				A14273	12	CS123					1H4G, 1E7G	456	10
							.009		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Cir-cuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replace-ment	*Note	Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
SPARTON—Continued																
655	Vol.	17	M	6			A11093	11	UR193	B31				^{3}78, 75, 43, 25Z5	456	
666, 666X	Vol.	17	O	6			A12048	1/15	RN245/TS101	B193				^{2}78-6A7, 75, 42-6F6, 80	345	1
667, 667X	Vol.	77	N				A14073	25	RS216					^{2}6K7G, 6A8G, 6Q7G,		
	Tone	22	N	6			A14072	25	WE3540					6F6, 5Y3	345	1
668	Vol.	18	N	6			A14073	25	RS216					6A8G, 6K7G, 6Q7G,		
	Tone	22	O				A14072	25	WE3540					6E5, 6F6G, 5Y3G	456	1
678	Vol.	18	N	6			A14073	25	RS216					6A8G, 6K7G, 6Q7G,		
	Tone	22	O				A14072	25	WE3540					6E5, 6F6G, 5Y3G	456	1
688-6	Vol.	18	MR48	M27			A14326	1	CN152	B3	13	245	C3	1C7G, ^{2}1D5G, 1H6G,		
	Tone	149	MR48				A14273	12	CS123					1H4G, 1E7G	456	10
							.009		Buffer	B14						
691	Vol.	17	M	6			A11223-1	1	RN242					^{2}78, 6A7, 75, 42, 80	345	1
							A11224	13	CS121							
							A10377	15	TS101							
716, 716X	Vol.	17	M	6			A12048	1/15	RN245/TS101	B193				^{3}78, 6A7, 75, 42, 80	456	1
							A10377	15	TS101							
727X, 727XD	Vol.	15	M				A14073	25	RS216					^{2}6K7, 6A8, 6Q7G,		
	Tone	107	N				A14072	25	WE3540					^{2}6F6G, 5Y3	456	1
737	Vol.	7	SRP258				B2948	1	MN273					^{7}484, ^{2}182, 80		2
740	Vol.	7	SRP258				2-2-2	3	See Note	B1				^{7}484, ^{2}C586, 81		5
740 DC	Vol.	7	SRP258				3	‡	See Note	B11				^{7}484A, ^{2}182A		
750 AC	Vol.	7	SRP258				2-2-2	3	See Note	B1				^{7}484, ^{2}C586, ^{2}81		5
750 DC	Vol.	7	SRP258				3	‡	See Note	B1				^{7}484A, ^{2}182A		
750A, 750X	Vol.	111	G		RS244		A8123-1	26	HD680					^{2}58, 24A, ^{4}56, ^{2}47, 80	172.5	1
	Tone	22	L		RS244		A6611A	26	CS133							
	Supp.	‡	UC508			A94										
766, 766X, 766XP, 766XS	Vol.	17	M	6			A12048	1/15	RN245/TS101	B193				^{3}78, 6A7, 75, 42, 80	456	1
							A10377	15	TS101							
768, 768X	Vol.	18	M				A14073	25	RS216					^{2}6K7G, 6A8G, 6Q7G,		
	Tone	22	O				A14072	25	WE3540					6E5, 6F6G, 5Y3	456	1
							A14403	13	WE2545							
778, 778X	Vol.	18	M				A14073	25	RS216					^{2}6K7G, 6A8G, 6Q7G,		
	Tone	22	O				A14072	25	WE3540					6E5, 6F6G, 5Y3	456	1
							A14403	13	WE2545							
827X, 827XD	Vol.	83	500M		See Note	A19	A14122	25	RS216					^{3}6K7, 6A8, 6Q7G,		
	Tone	22	N	6			A14113	25	WE2545					6J7G, 6N6G, 6E5,		
														5Y3	456	1
835	Vol.	56	M	6			11223	1	RN242					^{3}78, 6A7, 76, 85, 42, 80	456	1
	Tone	22	L				A10377	15	TS101							
	Voltage	26	A5MP													
	Supp.	58	UC510													
867	Vol.	77	M				A14073	25	RS216					6K7, 6A8, 6K7G,		
	Tone	107	N				A14072	25	WE3540					6Q7G, ^{2}6F6G, 5Y3,		
														6E5	456	1
870	Vol.	7	SRP258				1-4-1	3	See Note	B1				^{7}484, ^{2}26, ^{2}C586, ^{2}81		8
870A, 870X	Vol.	111	G		RS244		A8123-1	26	HD680					^{2}58, 24, ^{4}56, ^{2}47, 80	172.5	1
	Tone	22	L		RS244		A6611A	26	CS133							
	Supp.	‡	UC508			A94										
877X	Vol.	15	M				A14073	25	RS216					^{2}6K7, 6A8, 6Q7G, 6E5,		
	Tone	107	N				A14072	25	WE3540					^{2}6F6G, 5Y3	456	1
930 AC	Vol.	7	SRP154				‡	‡	See Note	B1				^{6}C484, ^{2}182, 80		2
931 AC	Vol.	7	SRP154				B2327	1	MN273					^{6}C484, ^{2}C182B, 80		2
931 DC	Vol.	7	SRP154				3	‡	See Note	B11				^{6}C484A, ^{2}C182A		
966, 966X	Vol.	15	M	6			A12215	1	RN245					^{3}6K7, 6A7, 6H6, 6E5,		
														6C5, ^{2}42, 5Z3	456	1
968, 968X	Vol.	18	M				A14122	25	RS216					^{2}6K7G, 6A8G, ^{2}6Q7G,		
	Tone	22	N	6			A14113	25	WE2545					6E5, 6C5G, 6V6G,		
							A14516	13	WE2545					5Y3G	456	1
987	Vol.	77	500M No. 1		See Note	A19	A14122	25	RS216					^{2}6K7, 6A8, 6K7G,		
	Tone	22	K12	6			A14113	25	WE2545					6Q7G, 6J7G, 6N6G,		
														5Y3G, 6E5G	456	1
997X	Vol.	83	500M		See Note	A19	A14122	25	RS216					^{3}6K7, 6A8, 6Q7G,		
	Tone	22	N	6			A14113	25	WE2545					6J7G, 6N6G, 6E5,		
														5Y3G	456	1
1068, 1068X, 1078, 1078X	Vol.	18	MR44				A14122	25	RS216					^{3}6K7G, 6A8G, 6H6G,		
	Tone	22	N	6			A14113	25	WE2545					6J7G, 6Q7G,		
							A14516	13	WE2545					6V6G, 5Y3G	456	1
1116X	Vol.	15	N	6			A12330	1	RN245					^{3}6K7, 6L7, ^{2}6C5, 6H6,		
	Tone	22	L				A11223-1	24	RN242					^{2}6F6, 5Z3, 6E5	456	1
	Supp.	7	UC510				A10377	15	TS101							
1166, 1166XP, 1166XS	Vol.	15	N	6			A12330	1	RN245					^{3}6K7, 6L7, ^{3}6C5, 6H6,		
	Tone	22	L				A11223-1	24	RN242					^{2}6F6, 5Z3, 6E5	456	1
	Supp.	7	UC510				A10377	15	TS101							
1167	Vol.	83	500M		See Note	A19	A14073	‡	RS216					^{3}6K7, 6A8, 6Q7G,		
	Tone	‡	‡		See Note	A5	A14138	‡	RS216					6C5G, 6J7G, ^{2}45,		
							A14139	‡	RS216					5Y3	456	14
							A14184	‡	CN155	B8						
1176, 1176XP, 1176XS, 1186, 1196	Vol.	15	N	6			A12330	1	RN245					^{3}6K7, 6L7, ^{3}6C5, 6H6,		
	Tone	22	L				A11223-1	24	RN242					^{2}6F6, 6E5, 5Z3	456	1
	Supp.	7	UC510				A10377	15	TS101							
1268	Vol.	18	TRP608				A14073	‡	RS216					^{3}6K7G, 6A8G, 6H6G,		
	Tone	‡	‡		See Note	A5	A14139	‡	RS216					6E5, 6J7G, 6R7G,		
							A14138	‡	RS216					6J5G, ^{2}45, 5Y3G	456	10
							A14184	‡	CN155	B8						
1288P	Vol.	18	TRP608				A14073	‡	RS216					^{3}6K7G, 6A8G, 6H6G,		
	Tone	‡	‡		See Note	A5	A14139	‡	RS216					6E5, 6J7G, 6R7G,		
							A14138	‡	RS216					6J5G, ^{2}45, 5Y3G	456	14
							A14184	‡	CN155	B8						
1568, 1588P	Vol.	18	Order from	Mfr.			A14548	1	RS216					^{4}6K7G, 6A8G, 6H6G,		
	Tone	‡	‡		See Note	A5	A14260	1	RS216					6Q7G, 6E5, 6R7G,		
							A14387-1	1	RS216					6C5G, 6J5G, 5Y3G,		
							A14545-1	1	RS216					^{2}2A3, 5X4G	456	1/1
							A14184	1	CN155	B8						
							A14259	17	RS207	B3						
SPENCER (See Truevalue)																
SPLITDORF (See Thomas A. Edison Inc.)																
STANDARD RADIO CORP.																
Standardyne 29 AC	Vol.	14	H12				2-1-5	3	See Note	B1				^{5}26, 27, 71A, 80		11
STAR																
All Star Junior	Vol.	8	J	6			4-4-4	3	CM173	B3				6F7, 6A7, 77, 42, 80	‡	1
All Star Senior	Vol.	8	G				8-8-8	3	RS213	B66				2A7, 58, 56, 2A5, 80	‡	3
	Tone	21	L													
062, 062A	Vol.	45	N	6			4	15	TS101		1	206		^{5}39, 36, 37, 38	262	

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Cir-cuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replace-ment	*Note	Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
STAR—Continued																
6U	Vol.	18	M				10-10	1	CN152		20	253	C3	^{2}78, 77, 75, 41, 84	262.5	10
	Tone	22	UC502				12-12	15	TN111							
							.01		Buffer	B14						
STAR RAIDER (See Continental Radio Corp.)																
STEINITE RADIO CO.																
10	Vol.	7	Z		EX450		2-2-1-3	37	See Note	B1				^{3}24A, 27, ^{2}45, 80		3
10 Chassis No. 15	Vol.	7	Z		EX450		8-8	1	See Note	B3				^{3}24A, 27, 71, 80		11
20 (Chassis No. 22)	Vol.	6	G7		EX450		‡	3	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80	175	1
	Tone	22	‡		See Note	A5										
25 (8 tube Pentode)	Vol.	6	G7				8-2-4	3	See Note	B3				‡		1
26	Vol.	7	E				8-2-4	3	See Note	B3				^{2}51, 24A, 27, 47, 80	175	1
	Tone	44	D12													
28	Vol.	6	E7				8-8	4	See Note	B3				^{2}51, 24A, 47, 80		1
40, 40A	Vol.	7	Z				2-3-2	3	See Note	B1				^{5}27, ^{2}71A, 80		‡
40C	Vol.	7	Z				2-3-3	3	See Note	B1				^{2}45, ^{5}27, 80		7
50, 50A	Vol.	7	Z				1-2-4	3	See Note	B1				^{5}27, ^{2}50, ^{2}81		‡
	Phono.	63	K12													
60C	Vol.	7	Z				2-3-3	3	See Note	B1				^{2}45, ^{5}27, 80		7
70, 80, 95 (Chassis No. 10)	Vol.	7	Z				2-2-1-3	37	See Note	B1				^{3}24A, 27, ^{2}45, 80		3
102, 102A	Vol.	7	Z				1-2-4	3	See Note	B1				^{5}27, ^{2}50, ^{2}81		‡
	Phono.	63	K12													
102C	Vol.	7	Z				2-3-3	3	See Note	B1				^{5}27, ^{2}45, 80		7
203 (Chassis No. 22)	Vol.	6	G12				‡	3	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80	175	1
	Tone	22	‡		See Note	A5										
261, 262, 263, 264, 265	Vol.	10	G12				1-1-1-1	3/13	See Note	B1				^{4}26, 27, 71A, 80		11
420 (Chassis No. 15)	Vol.	7	Z				8-8	1	See Note	B3				^{3}24A, 27, 71, 80		11
420 (Chassis No. 17)	Vol.	7	Z				2-2-3	3	See Note	B1				^{3}24A, 27, ^{2}45, 80		3
421, 425 (Chassis No. 21)	Vol.	6	Z	6			8-8-8	3	CN155	B3				^{3}24A, ^{2}45, 80		1
423 (Chassis No. 23)	Vol.	6	Z				8-8	1	CN152					^{3}24A, 45-47, 80		1
450 (Chassis No. 15)	Vol.	7	Z		EX450		8-8	1	See Note	B3				^{3}24, 27, 71, 80		11
450 (Chassis No. 17)	Vol.	7	Z				2-2-3	3	See Note	B1				^{3}24A, ^{2}45, 27, 80		3
600, 605, 630, 635, 642, 643, (Chassis No. 22)	Vol.	6	G12		EX450		‡	3	See Note	B1				^{2}27, ^{3}24A, ^{2}45, 80	175	1
	Tone	22	‡		See Note	A5										
642B, 700 (Chassis No. 26)	Vol.	7	E				8-2-4	3	See Note	B3				^{2}27, ^{2}51, 24, ^{2}47, 80	175	1
	Tone	39	D12													
700, 701 (Chassis No. 28)	Vol.	6	E7				8-8	4	See Note	B3				^{2}51, 24A, 47, 80		1
705, 706, 725, (Chassis No. 26)	Vol.	7	E				8-2-4	3	See Note	B3				^{2}51, 24A, ^{2}27, ^{2}47, 80	175	1
	Tone	44	D12													
STERLING MFG. CO.																
A (DC)	Vol.	25	DRP119	6			4	‡	See Note	B11				^{3}32, 30, ^{2}31		
3A	Vol.	12	G12				7350	3	RS213					^{3}51, ^{2}27, ^{2}45, 80		1
B3	Vol.	12	G12											^{3}24, ^{2}27, ^{2}45		
B	Vol.	12	G12											^{3}24, ^{2}27, ^{2}45		
4	Vol.	12	G12				8-8	1	See Note	B3				^{3}35, ^{2}27, ^{2}45, 80		25
B4	Vol.	12	G12											^{3}24, ^{2}27, ^{2}45		
C	Vol.	40/12	DRP119	6			1-2	1	See Note	B1				^{4}24, 45, 80		7
F	Vol.	24	DRP119	6			1-2	1	See Note	B1				^{3}24, 45, 80		3
Miniature	Vol.	25	DRP119	6			1-2	1	See Note	B1				^{3}24, 45, 80		7
M, N, P, Q	Vol.	24	DRP119	6			8237	1	RS211					^{3}24, 45, 80		3
							8238	1	RS213							
8 Tube Receiver	Vol.	25	DRP119	6			8-8-8	3	See Note	B3				^{4}24, 27, ^{2}45, 80		25
	Tone	41	O													
VA	Vol.	6	H12				8573	4	CS133					^{2}24, 51, 47, 80	175	1
STEWART RADIO CORP.																
50, 60	Vol.	17	UM154		See Note	A96	6-10	1	CN152	B3	34	292	C3	6D6 or 78, 6A7, 75, 41, 6Z5	262	10
							5-5	15	TN110							
STEWART-WARNER CORP																
R100A, B, E (AC)	Vol.	113	SRP245				66170	3	CN152					^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	22	Z12													
R100C, R100CF (DC)	Vol.	‡	Order from	Mfr.										12A, 01A, ^{3}22, ^{2}71A		
	Tone	22	Z12													
R101A, R101B	Vol.	6	E12				67265	4	RS211					51 or 35, 24, 47, 80		1
							67264	4	RS211							
R102A, B and E	Vol.	6	F12				67328	5	RS213					^{2}24A, 51 or 35, 47, 27, 80	177.5	1
	Tone	22	Z12				67588	26	RS213	B12						
R104A, B and E	Vol.	15	N				67328	5	RS213					57, 58, 47, 56, 80	177.5	1
	Tone	114	Z12				67588	26	RS213	B12						
105 Series (50 to 59)	Vol.	100	Z12				81347	26	RS213					^{2}57, ^{3}58, ^{2}56, 27, ^{2}47, 80	177.5	3
	Tone	22	L	6			81367	26	RS215	B12						
							67328	26	RS213							
R106	Vol.	56	N				67328	2	RS213					^{3}58, 55, 59, 56, 80	177.5	1
	Sen.	7	A10MP	6												
108, 108X, (10 to 20 incl.)	Vol.	6	UC509	6	EX100		81678	1	CN140					39, 36, 38, 12Z3		
							81698	15	TN110							
109*(1090-1099)	Vol.	56	N	6			81347	1	RS213					^{2}58, 55, 56, 2A5, 80	177.5	1
R110, R110B, R110C	Vol.	56	N	6			81347	1	RS213					^{3}58, 55, ^{2}27, ^{2}2A5, 80	177.5	1
							81901	14	CS123							
R111	Vol.	17	N	6			81959	11	UR193	B31				^{2}78, 6B7, 43, 37, 25Z5	456	
							83394	11	CS125							
R112 (1121, 1122, 1123)	Vol.	18	UM154	M26	See Note	A96	83111	1/15	CN152/TN110		34	292	C3	6A7, 78, 75, 41, 84	456	10
							83118	‡	Order from	Mfr.						
							.02-.02		Buffer	B14						
R115	Vol.	17	N	6			81959	11	UR193	B31				^{2}78, 37, 6B7, 43, 25Z5	456	
							83394	11	CS125							
R116, R116X, R116XH, R116AL, R116XL	Vol.	17	N	6			83613	1	RS213					6A7, 78, 75, 42, 80	456	1
R117 (1171, 1172)	Vol.	17	UC512	6			83734	4	CM172		35	294	C3	^{2}78, 6A7, 75, 42, 84	177.5	10
	Tone	22	K12				83803	15	TS101							
							.015-.015		Buffer	B14						
R118 (1181, 1182, 1183)	Vol.	17	UM154	M26	See Note	A96	83734	4	CM172		35	294	C3	^{2}78, 6A7, 41, 75, 84	177.5	10
	Tone	22	K12				83803	15	TS101							
							.015-.015		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
STEWART-WARNER CORP.—Continued																
R119, R119A, R119EF	Vol.	56	N	6			81347	1	RS213					^{2}78, 6A7, 85, 42, 80	177.5	1
							67328	1	RS213							
							80537	15	TS101							
R120 (1201-1209)	Vol.	56	N				81347	4	RS213					^{2}57, ^{3}58, 55, ^{2}2A5, ^{3}56, 80	177.5	3
	Tone	39	Y	6			67328	4	RS213							
R123 (1231-1239)	Vol.	6	F7	6	3		83960	1	RS213					6A7, 6F7, 41, 80	456	1
							83962	1/15	CS133/TS101							
R125, R125A and R125X (1251-1259)	Vol.	56	N	6			84193	25	RS216					6A7, 6D6, 75, 41, 80	456	1
R126, Series R126A, R126P, R126X (1261-1269)	Vol.	19	TRP606				84288	25	RS215					6C6, ^{2}6D6, 75, 42, 76, 80	456	1
	Tone	107	M	6			84286	25/13	RN241							
R127, R127X (1271-1279)	Vol.	18	N	6			84192	25	RS216					6A7, 6D6, 75, 41, 80	456	1
	Tone	107	M				84193	25	RS216							
R128D (Batt. 1281D-1289D)	Vol.	18	N	13										1C6, 34, 25S, 30, 33	456	
	Tone	57	M													
R130 (1301-1309)	Vol.	18	N	6			84193	25	RS216					6A7, 6D6, 75, 42, 80	456	1
	Tone	107	M		See Note A4		85112	25	RS216							
R131 (1311-1319)	Vol.	17	N	6			84829	4	CM171		35	294	C3	^{2}78, 77, 75, 41, 84	177.5	10
							83803	15	TS101							
							.03-.03		Buffer	B14						
R132 (Firestone R1322)	Vol.	1	UC511	6			85237	1	CN152	B3	33	289Y	C3	^{2}78, 77, 85, ^{2}41	177.5	10
	Tone	44	Z12				83803	15	TS101							
							85216	15	TS106							
							.005		Buffer	B14						
R133 (Firestone 1332)	Vol.	17	N	6			84961	4	CM171		35	294	C3	6A7, 6D6, 75, 41, 84	456	10
							83803	15	TS101							
							.03-.03		Buffer	B14						
R134 (1341-1349)	Vol.	18	M	6			85792	25	RS216					^{2}6D6, 6A7, 75, 42, 80	456	1
	Tone	107	N				85793	25	RS216							
R136 (1361-1369)	Vol.	46	M	6			85431	25	RS216					^{2}6K7, 6A8, 6H6, 6J7, 6F6, 5Z4	456	1
	Tone	107	N				85430	25	RS216							
R137 (1371-1379)	Vol.	15	M	6			85583	31	RS216					^{2}6K7, 6A8, 6H6, ^{2}6C5, ^{2}2A3, 83V	456	14
	Tone	57	N				85584	31	RS216							
							85588	31	RS216							
							85565	18	TS108							
							83803	15	TS101							
R138 (1381-1389)	Vol.	15	M	6			85583	31	RS216					^{3}6K7, 6A8, ^{2}6H6, 6C5, ^{2}2A3, 6J7, 83V	456	14
	B. Tone	‡	N				85584	31	RS216							
	T. Tone	57	O				85588	31	RS216							
							85565	18	TS108							
							85692	14	CS121							
							83803	15	TS101							
R139D	Vol.	18	N	7										1A6, 34, 1B5, ^{3}30, Ballast—1G1	456	
R140 (1401-1409)	Vol.	18	MR48	M26			84193	25	RS216					6A7, 6D6, 75, 42, 80	456	1
							85112	25	RS216							
R142A, R142AS, (1421-1429)	Vol.	6	SRP263	6			88033	25	RS213					6K7, 6J7, 6F6, 6X5	456	25
							88007	25	RS213							
R143 (R1431)	Vol.	17	UM154-SS11	M26			88256	4	CM171		36	294SW	C3	^{2}6D6, 77, 75, 41, 84	456	10
							88170	15	TS101							
							.01		Buffer	B14						
R144AS (1441-1449)	Vol.	6	Y	6			88007	25	RS213					^{2}6D6, 6C6, 41, 84	456	25
							88033	25	RS213							
R145 (1451-1459)	Vol.	18	TRP623	6			88512	25	RS216					6A8, 6K7, 6H6, 6F5, 6F6, 5Z4	456	1
	Tone	57	N				88511	25	RS216							
R146 (1461-1469)	Vol.	18	TRP623	6			85431	25	RS216					6K7, 6A8, 6H6, 6F5, 6F6, 5Z4	456	1
	Tone	57	N				88033	25	RS213							
							88576	13	RS203							
R147 (1471-1479)	Vol.	18	TRP623	6			85431	25	RS216					6K7, 6A8, 6H6, 6F5, 6L6, 5Z4	456	1
	Note	57	N				88033	25	RS213							
							88576	13	RS203							
R148 (1481-1489)	Vol.	45	TRP623	6			85583	25	RS216					^{2}6K7, 6A8, 6H6, ^{2}6C5, ^{2}6L6, 6G5, 5Y4G	456	1
	Tone	41	N				88511	25	RS216							
							88007	13	RS213							
							89053	19	TS101							
R149 (1491-1499)	Vol.	20	TRP608	6			85583	54	RS216					^{2}6K7, 6A8, ^{2}6H6, ^{2}6C5, 6J7, 6G5, ^{2}6L6, 5V4G	456	1
							88511	54	RS216							
							89186	54	RS201							
							88007	13	RS213							
							83803	15	TS101							
R160 (1601-1609)	Vol.	17	UM154-SS11	M26			88256	4	CM171		36	294SW	C3	^{2}6D6, 77, 75, 41, 84	456	10
							88170	15	TS101							
							.01		Buffer	B14						
R161D (1611D-1619D)	Vol.	18	N	7										1C7G, 1D5G, 1H6G, ^{2}1H4G, 1R1G—Ballast	456	
R162D (1621D-1629D)	Vol.	18	N	7										1C7G, 1D5G, 1H6G, ^{2}1H4G, 1R1G—Ballast	456	
	Tone	57	N													
R163D (1631D-1639D)	Vol.	18	N	6			89147	25	RS203	B3	Order	from Mf	r.	1C7G, 1D5G, 1H6G, ^{3}1H4G	456	10
							89145	‡	Order from	Mfr.						
							88170	19	TS101							
							.005		Buffer	B14						
R164D (1641D-16490)	Vol.	18	N	6			89147	25	RS203	B3	Order	from Mf	r.	1C7G, 1D5G, 1H6G, ^{3}1H4G	456	10
	Tone	57	N				89145	‡	Order from	Mfr.						
							88170	19	TS101							
							.005		Buffer	B14						
R166	Vol.	45	TRP623	6			88512	25	RS216					6A8, 6K7, 6H6, 6F5, 6F6, 6G5, 5Z4	456	1
	Tone	57	N				88511	25	RS216							
							89755	13	CS121							
R167S, R168 (1671-1689)	Vol.	6	Y	6			88033	25	RS213					^{2}6K7G, 6J7G, 6K6G, 6X5G	456	25
							88007	25	RS203							
R169 (1691 to 1695)	Vol.	18	MR44	M26			88512	25	RS216					6A8G, 6K7G, 6Q7G, 6K6G, 5Y4G	262	1
	Tone	57	MR48				88511	25	RS216							
R171 (1711 to 1719)	Vol.	17	MR48	M26			89954	27	CM164					6A7, 6D6, 75, 43, 25Z5	465	
R172 (1721 to 1729)	Vol.	18	MR44	M26			88512	25	RS216					6A8G, 6K7G, 6Q7G, 6G5, 6K6G, 5V4G	262	1
	Tone	57	MR48				88511	25	RS216							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
STEWART-WARNER CORP.—Continued																
R173 (1731-1739)	Vol.	18	TRP623	6			88512	25	RS216					6A8, 6K7, 6H6, 6F5,		
	Tone	57	N				88511	25	RS216					6F6, 6G5, 5Z4	456	1
							89755	13	CS121	B3						
R1781	Vol.	17	TM229-SS3				110376	4	CM171		36	294SW	C3	^{2}6K7, 6J7, 6Q7, 6F6,		
	Tone	21	Order from	Mfr.			.01		Buffer	B14				6X5	262	10
R180 (1801 to 1809)	Vol.	18	MR53	M26			110497	4	CM172					6A8G, 6U7G, 6Q7G,		
	Tone	57	MR48											6K6G, 5W4G	456	1
R181 (1811 to 1819)	Vol.	18	MR53	M26			89937	25	WE3540					6L7G, 6C5G, 6U7G,		
	Tone	57	MR48				110768	25	RS213					6Q7G, 6K6G,		
							110377	19	TS101					5W4G	456	1
							112113	19	TS106							
R182 (1821 to 1829)	Vol.	45	TRP608	6			89927	25	WE3540					6L7G, 6U7G, 6C5G,		
	Tone	57	N				110768	25	RS213					6H6G, 6K5G,		
							110377	19	TS101					6V6G, 5W4G	465	1
R183 (1831 to 1839)	Vol.	20	TRP623	6			89937	25	WE3540					^{2}6K7, 6L7, 6C5, 6H6,		
							111098	25/19	RM262					6F5, 6L6, 5Y3G	465	1
							110377	15	TS101							
R184 (1841 to 1849)	Vol.	20	TM240-SS16	M26			89937	25	WE3540					^{3}6K7, 6L7, 6C5, 6J7,		
							111469	25	RS216					6H6, 6F5, 6L6,		
							110377	15	TS101					5U4G	465	1
							112113	19	TS106							
R185 (1851 to 1859)	Vol.	20	TM240-SS16	M26			89937	1	WE3540					^{3}6K7, 6L7, ^{2}6C5, 6J7,		
							88680	1/13	RS213					6H6,^{2}6V6G, 5U4G	465	1
							111468	15	TN111							
R186 (1861 to 1869)	Vol.	20	TM240-SS16	M26			111469	1	RS216					^{3}6K7, ^{3}6C5, 6L7, 6J7,		
							89937	1/13	WE3540					^{2}6H6,^{2}6V6, 5W4	465	1
							111652	13	CS125							
							110377	15	TS101							
R188 (1881 to 1889)	Vol.	17	MR48	M26			112270	27	UR182					6A7, 6D6, 75, 43,		
	Tone	22	MR33											25Z5, M49B	465	
R189	Vol.	18	N	6			8-8	22/13	See Note	B3	31	285XS	C3	^{2}1C6,^{2}34, 33	370	10
	Tone	57	N				.01		Buffer	B14						
R190D (1901 to 1909)	Vol.	17	MR48											1C6, 34, 1F6, 33, 5E1	465	
R191D (1911 to 1919)	Vol.	15	MR48				110804	1	RN232		13	245	C3	6A8G, ^{2}6S7G, 6L5G,		
	Tone	22	MR33				89053	15	TS101					41	465	10
							.03		Buffer	B14						
R192D (1921 to 1929)	Vol.	15	MR48				112244	1	RN232		13	245	C3	6A8G, ^{2}6S7G, ^{2}6L5G,		
	Tone	22	MR33	M26			110377	15	TS101					19	465	10
							.03		Buffer	B14						
304 (3041 to 3049)	Vol.	18	MR48	M26			112604	23	CM172					6A8G, 6K7G, 6Q7G,		
														6K6G, 5Y4G	465	1
715, 720	Vol.	3	F12											^{4}26, 27, 71A		
750	Vol.	112	Y10MP				‡	3	See Note	B1				^{4}26, 27,^{2}12A, 80		9
801, 802	Vol.	84	UC501				‡	3	See Note	B1				^{4}26, 27, 71A, 80		9
801, 801A, 811, 811A	Vol.	116	Y10MP				‡	3	See Note	B1				^{4}26, 27,^{2}12A, 80		9
900, 901, 902, 903, 911, 912, 913	Vol.	7	Z		See Note	A10	61303	3	CN152					^{5}27,^{2}45, 80		3
950 Series (AC)	Vol.	113	SRP245		See Note	A80	66170	3	CN152					^{3}24A,^{2}27,^{2}45, 80		3
971, 972, 973 (DC)	Vol.	‡	Order from	Mfr.			61303	‡	CN142	B11				12A, 01A,^{3}22,^{2}71A		
STORY & CLARK																
36	Vol.	6	G12				‡	3	See Note	B1				^{3}24, 45,^{2}27, 80		3
43, 51	Vol.	6	G12				‡	3	See Note	B1				^{3}24,^{2}45,^{2}27, 80		7
	Supp.	‡	A5MP													
C108 Clock Model	Vol.	6	‡		See Note	A5	8	53	RS213					^{3}24, 27,^{2}45, 80		3
STRATFIELD—See Electrical Specialties Export Co.																
STROMBERG-CARLSON																
10, 11	Vol.	9	SRP260				2-2-2	3	See Note	B1				^{4}24,^{2}45, 80		3
	Hum.	30	SRP253													
12, 14	Vol.	115	SRP213				2-2-2	3	See Note	B1				^{2}45,^{3}27,^{3}24A,^{2}80		7
	Hum.	30	SRP253													
	Phono.	63	‡		See Note	A5										
16, 17 (DC)	Vol.	9	SRP260				1-6	4	See Note	B11				^{2}45,^{2}27,^{3}24A		
19, 20 (AC)	Vol.	‡	Order from	Mfr.			2-2-3-3	3	See Note	B1				^{2}27,^{4}35,^{2}45, 80	175	3
	Hum.	30	SRP253													
22, 22A	Vol.	15	SRP216				2-3-4	3	See Note	B1				^{2}45,^{3}27,^{4}35, 80	175	3
	Hum.	30	SRP253													
25, 26 (AC)	Vol.	9	SRP260				2-2-2	3	See Note	B1				^{4}24,^{2}45, 80	175	3
	Hum.	30	SRP253													
27 (AC)	Vol.	‡	SRP213				2-2-2	3	See Note	B1				^{3}24,^{3}27,^{2}45,^{2}80	175	7
	Hum.	30	SRP253													
29	Vol.	15	N	8			6-2-1	3	See Note	B1				^{2}45,^{4}35,^{2}27, 80	175	3
	Tone	44	N	6												
	Hum.	30	SRP253													
33	Vol.	15	UC514	6			P23538	1	CN155		12	236		78, 6A7, 6B7, 37,^{2}41	175	26
	Tone	44	O													
33A	Vol.	15	UC514				P23538	1	CN155		12	236		78, 6A7, 6B7, 37,^{2}41	175	26
37	Vol.	15/15	MM				22701	22	CN155					^{4}58,^{2}45,^{2}56, 80	175	3
	Tone	34	UC503													
	Hum.	30	SRP253													
38, 39, 40, 41 (1st type)	Vol.	15/15	MM	8			4-7-3	22	CN155	B3				^{4}58,^{2}56,^{2}45, 80	175	3
	Tone	34	UC503	6												
	Hum.	30	SRP253													
38, 39, 40, 41 (2nd type)	Vol.	15/15	MM	8			4-7-6	22	CN155	B3				^{3}58,^{2}55,^{2}45, 56, 57, 80	175	3
	Tone	34	UC503	6												
	Supp.	‡	SRP266													
	Hum.	30	SRP253													
48, 49, 50, 51	Vol.	‡	DRP245				4-5-6-4	‡	See Note	B1				^{3}58, 55, ^{3}56, ^{2}2A3, 57,		
	B. Tone	‡	Order from	Mfr.										5Z3	175	3
	T. Tone	44	M	6												
	Hum.	30	SRP253													
52, 54	Vol.	‡	DRP245				4-5-6	3	CN155	B3				^{2}35, 2B7, 55,^{2}56,^{2}2A3,		
	B. Tone	‡	Order from	Mfr.										57, 27, 5Z3	175	3
	T. Tone	44	M	6												
	Hum.	30	SRP253													
55, 56	Vol.	8	G				8-8-4	22	CN155	B3				58, 78,^{2}2A5, 55, 2B7,		
	Tone	34	M											6A7, 5Z3	175	3
	Hum.	30	SRP265													
58L, 58LB, 58T, 58TB, 58W, 58WB	Vol.	17	O				P25479	1	RN242					^{2}6D6, 6A7, 75, 42, 80	465	1
	Tone	21	UC513	6			P25480	13	RS201							
							P25510	15	TN111							
60	Vol.	15	P				P24190	3	RN245					6D6, 6A7, 6B7, 37,		
	Tone	34	H12	6			P24207	15	TS106					^{2}41, 80	370	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
STROMBERG-CARLSON—Continued																
61 Series (AC)	Vol.	15	O				8-8	1	RN242					[2]6K7, 6A8, 6H6, 6F5,		
	Tone	57	UC513	6			10	15	TS101					6F6, 80	465	1
61, 61Y, 61Z																
(AC-DC)	Vol.	18	O				P25907	1	RS207					[2]6K7, 6A8, 6Q7, 43,		
	Tone	57	N	6			P25934	6	RN232					[2]25Z5	465	
							P25459	13	CS121							
							P25498	15	TN111							
62, 63, 62B, 63B	Vol.	15	P				P22757	3	RS213					[3]6K7, 6A8, 6H6, [2]6F6,		
	Tone	22	P	6			P25757	3/13	RN245					5Z3	465	1
							P25158	3	RS216							
							P25788	13	CS130							
							P25459	13	CS121							
							P24207	15	TS101							
64	Vol.	15	P				16-8-8-4-4	3/13	See Note	B195				78, 6A7, 6B7, 37, [3]42,		
	Tone	34	UC509	6										5Z3	175	1
65, 66, 67	Vol.	8	UC501				16-8-8-8							[2]78, 6A7, 6B7, 85, [3]42,		
	Tone	34	UC509			A90	4-4-4	3/13/15	See Note	B247				80	465	3
68	Vol.	8	G				16-8-8-4-4	3/13	See Note	B195				[2]6D6, 6A7, 76, 6B7,		
	Tone	22	UC509	6										85, [3]42, 5Z3	370	3
69 All Wave Selector							24567	1	RN242					6D6, 6A7, 76, 84	545	25
70, 70B, 72, 72B,																
72D, 74, 74B, 74D	Vol.	‡	Order from	Mfr.			P24835	‡	See Note	B195				[4]6D6, 76, 6A7, 6B7,		
	Tone	22	P	6										[2]6C6, 42, [2]2A3, 5Z3	370	3
80	Vol.	15	P				8-8-16	3	See Note	B3				[2]6K7, 6A8, 6J7, 6H6,		
	Tone	22	P	6			4	13	See Note	B3				[2]6F6, 5Z3	465	1
							10	15	TS101							
82, 82B	Vol.	20	1.5 Meg. No. 1		See Note	A19	P22757	3	RS213					[3]6D6, 6A7, 76, [3]42, 5Z3	465	1
	Tone	22	P	6			P22789	3	RS213							
							P22758	3	RS216							
							P22759	13	RN245							
							P22760	14	TS108							
							P24207	15	TS101							
83, 83B	Vol.	20	1.5 Meg. No. 1		See Note	A19	P22757	3	RS213					[3]6K7, 6A8, 6C5, 6H6,		
	Tone	22	P	6			P22789	3	RS213					[3]6F6, 5Z3	465	1
							P22758	3	RS216							
							P22759	13	RN245							
							P22760	14	TS108							
							P24207	15	TS101							
84, 84B	Vol.	20	2 Meg. No. 1		See Note	A19	P22757	3	RS213					[3]6K7, 6A8, 6C5, 6H6,		
	Tone	22	P	6			P22789	3	RS213					6J7, [3]6F6, 5Z3	465	1
							P22758	3	RS216							
							P22759	13	RN245							
							P22760	14	TS108							
							P24207	15	TS101							
115	Vol.	17	O				P26049	1	RN242		13	245	C3	[2]34, 1C6, 1B5, 30, [2]49	465	10
							P25480	13	RS201							
							.005		Buffer	B14						
125 (AC-DC)	Vol.	18	N				26162	6	RS207					6A8, 6K7, 6Q7, 43,		
							26163	6	RS208					25Z5	465	
							26164	13/15	RN235							
126 (AC-DC)	Vol.	124	O				26163	1	RS208					[2]6K7, 6A8, 6Q7, [2]43,		
	Sen.	‡	‡		See Note	A5	26164	13/15	RN232/TS101					25Z5	465	
							26872	13	CN140							
127 (AC-DC)	Vol.	124	O				27014	3	RS208					[2]6K7, 6A8, 6Q7, [2]48,		
	Sen.	‡	‡		See Note	A5	26162	3	RS207					[2]25Z5	465	
							26164	13/15	RN232/TS101							
130 Series	Vol.	15	N				26403	1	WE2545					[2]6K7, 6A8, 6H6, 6F6,		
	Sen.	‡	G12				25458	1	RS216					6F5, 80	465	1
							24207	15	TS101							
140 Series	Vol.	17	N				22757	3	RS213					[3]6K7, 6A8, 6Q7, 6E5,		
	Sen.	‡	G12				22789	3	RS213					[2]6F6, 5Z3	465	1
							25458	3	RS216							
							26048	15	TN111							
							25788	13	CS130							
145 Series	Vol.	17	N				22757	3	RS213					[3]6K7, 6J7, 6A8, 6Q7,		
	Tone	39	‡		See Note	A5	22789	3	RS213					6E5, [2]6L6, 5Z3	465	1
							25458	3	RS216							
							26693	13	CS131							
							25788	13	CS130							
							24207	19	TS101							
							26048	15	TN111							
150	Vol.	20	TRP611				22757	3	WE847					[4]6K7, 6J7, 6A8, [2]6H6,		
	Fid.	‡	Order from	Mfr.			26773	3	RS216					[2]6L6, 6E5, 5Z3	465	1
							24580	13	CS131							
							26693	13	CS131							
							24207	15	TS101							
							25498	15	TN111							
160	Vol.	20	‡		See Note	A19	22757	3	RS213					[4]6K7, [2]6J7, 6A8, [2]6H6,		
	Tone	21	‡		See Note	A3	26510	3	RS216	B12				6E5, 6F6, [2]6L6, 5Z3	465	1
							26773	3	RS216							
							24580	13	CS131							
							26693	13	CS131							
							26772	15	TS101							
							25498	15	TN111							
							25788	13	CS130							
180	Vol.	17	TRP608				22757	3	RS213					[5]6K7, [3]6J7, 6A8, [2]6H6,		
	T.Tone	21	P				26510	3	RS216	B12				6E5, [2]6F6, [2]6L6, 5Z3	465	1
	B.Tone	15	O				26773	3	RS216							
							22759	13	RN245							
							26693	13	CS131							
							26797	15/19	2-TN111/TS107							
							25788	13	CS130							
225 (AC-DC)	Vol.	18	MR48				27014	6	RS208					6A8, 6K7, 6Q7,		
	Tone	57	MR48	M26			26162	6	RS207					25A6G, 25Z6G	465	
							26164	13/15	RN235							
228	Vol.	17	TM240-SS1				27552	1	RN242					6A8, 6K7, 6Q7, 6G5,		
	Tone	‡	MR50	M26			27553	13	RS216					6F6G, 5Y4G	465	1
							27554	13	RN232	B8						
							27619	15	TN111							
229P	Vol.	20	TRP610				26403	1	WE2545					[2]6K7, 6A8, 6H6, 6F5,		
	Tone	‡	MR50	M26			25458	1	RS216					6F6, 80	465	1
	Sen.	‡	‡		See Note	A5	26880	13	RS216							
							27554	13	RN232	B8						
							24207	15	TS101							
230 Series	Vol.	20	1 Meg. No. 1		See Note	A19	27122	1	WE2545					6A8, 6K7, 6H6, 6G5,		
	Tone	‡	Y1000MP	6			27123	1	RS216					6F5, 6F6, 5Y4G	465	1
							27124	13/15	CS131/TS101							
							27595	13	RS216							
							27685	15	TS101							
231 Series	Vol.	20	1 Meg. No. 1		See Note	A19	27399	1/15	RN245/TS101					6A8, 6K7, 6H6, 6G5,		
	Tone	‡	Y1000MP	6			27611	1	RS216					6F5, 6F6, 5Y4G	465	1
							27398	13	RN245							
							27685	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
STROMBERG-CARLSON—Continued																
240	Vol.	20	TRP621				27622 27336 27537 27123 25498	30 30 30/13 13 15	RS216 RS216 RN245 RS216 TN111					^{2}6K7, 6A8, 6H6, ^{2}6C5, 6G5, 6F5, ^{2}6F6, 5U4G	465	1
250	Vol.	20	‡			A19	27753 27754 27755 27756 27757 25498 27759	30 30 30 13 13 15 15	RS213 RS216 WE1647 RS216 CN140 TN111 TS101					^{2}6K7, 6A8, ^{2}6J7, 6B8, 6G5, 6H6, 6F5, 6C5, ^{2}6L6, 5U4G	465	1
260	Vol. Tone	124 22	TRP621 ‡		See Note A5		28256 28257 28258 28259 28260	30 30 30 13 13/15/19	RS213 RS216 WE1647 RS216 CN140/TS101/TS106					^{5}6K7, 6A8, ^{2}6J7, ^{2}6H6, 6G5, 6Q7, 6C5, ^{2}6L6, 5U4G	465	1
635 (DC)	Vol. Vol.	3 10	SRP961 SRP901		Front Rear		4-1	1	See Note	B11				‡		
635, 636	Vol. Vol.	3 10	SRP961 SRP901		Front Rear		3-10	4	See Note	B1				71A, ^{5}27, 80		11
638 (AC)	Vol. Vol.	3 10	SRP961 SRP269		Front Rear		5-9	4	See Note	B1				^{2}71A, ^{5}27, 80		‡
638 (DC)	Vol. Vol.	3 10	SRP961 SRP269		Front Rear		4-1	1	See Note	B11				^{5}01A, ^{4}71A		
641	Vol. Vol.	8 3	SRP960 SRP900		Front Rear		2-1-2-1	3	See Note	B1				45, ^{3}24A, 27, 80		3
642	Vol. Vol.	8 3	SRP960 SRP900		Front Rear		2-2-2-2	3	See Note	B1				45, ^{3}24A, 27, 80		3
645 (DC)	Vol. Vol.	3 8	SRP900 ‡		Front Rear	 A78	6	‡	See Note	B11				24A, 27, 45		
652, 654	Vol. Vol.	8 3	SRP960 SRP900		Front Rear		2-1-2-1	3	See Note	B1				45, ^{3}24A, 27, 80		3
726X	Vol.	17	M				16 8	1 1	RS216 RS213	B3 B3				78, 6A7, ^{2}6K7, 75, 6F6, 6E5, 80	465	1
734, 734B, 744	Vol.	12	Y50MP											^{5}01A, 10, 00A		
744B	Vol. Phono.	12 63	Y50MP H12											^{5}01A, 10, 00A		
776, 776X	Vol.	17	M				16 8	1 1	RS216 RS213	B3 B3				78, 6A7, ^{2}6K7, 75, 6E5, 6F6, 80	465	1
846, 848	Vol. Vol.	115 3	SRP962 SRP900		Front Rear		‡	3	See Note	B1				^{2}45, ^{3}27, ^{3}24A, 80		7
STUDEBAKER LABORATORIES																
31	Vol.	6	D12				8-8	1	CN152	B3				51, ^{2}24A, 47, 80		1
42	Vol.	6	Y				8-8	1	CN152	B3				^{3}51, 27, 24A, 47, 80		1
SUNGLOW																
Melody-Chest	Vol.	40/12	GE				‡	‡	See Note	B1				‡		‡
SUPERTONE PRODUCTS CO., INC.																
Superba	Vol.	17	N				8-16	4	See Note	B3				57, ^{2}58, 2A5, 56, 2A6, 80	465	1
L5	Vol. Tone	18 34	N L	6			P474 P160 P304	32 32 15	RS211 CN151 TS101	 B81				5Z4, 6F5, 6F6, 6H6, 6K7, 6L7, 6C5	456	1
L6	Vol. Tone	18 44	N L	6			P474 P160 P304	32 32 15	RS211 CN151 TS101	 B81				5Z4, 6C5, ^{2}6F6, 6K7, 6L7, ^{2}6Q7	456	1
L7	Vol. Tone	45 ‡	N L	7			P391 .01-.01	1	RN232 Buffer	B90 B14	14	245C	C3	1C6, 19, ^{3}30, ^{2}34	456	10
Z4	Vol. Tone	45 44	SRP275 L	7			P391 .01-.01	1	RN232 Buffer	B90 B14	14	245C	C3	1C6, 19, ^{2}30, 32, 34	456	10
Z5	Vol. Tone	45 44	SRP275 L	7			P958 .01-.01	1	RN232 Buffer	B90 B14	14	254C	C3	1C6, 19, ^{2}30, 32, 34	456	10
A31	Vol.	18	N				8-4	4	See Note	B3				6A7, 6D6, 75, 42, 80	456	1
SYNCHROPHASE (See A. H. Grebe & Co.)																
L. TATRO PRODUCTS CORP.																
AK54 (Mayor) AM54 (Senator)	Vol. Tone	17 44	N N				10	15	TS101					6A7, 78, 75, ^{2}38	175	
A525, B525	Vol. Tone	17 22	N N	 6			4L-5 4L11	15 15	TS101 TS101					77, 78, 75, ^{2}38	456	
C625, D625	Vol. Tone	17 22	N N	6			4L3 4L5 4L11 .005	1 15 15	RS213 TS101 TS101 Buffer	 B14	20	F251	C3	^{2}78, 6A7, 75, 38, 84	177.5	10
E83	Vol. Tone	117 41	E12 N								1	F204		^{4}44, 37, ^{2}38, 85		
EN64	Vol. Tone	56 57	MR48 MR48	 M26			6N-2 6N-1 .005	1 19	CN152 TS101 Buffer	 B14	15	246	C3	1C6, 1A4, 1B5/25S, 1F4	457	10
F725	Vol. Tone	17 34	N N	6			4L3 4L4 4L14 4L5 4L11 .005	1 1 ‡ 15 15	RS213 RS216 2-TS108 TS101 TS101 Buffer	 B196 B14	20	F251	C3	^{2}78, 6A7, 75, ^{2}41, 84	177.5	10
F913	Vol. Tone	117 41	E12 N								1	F204		^{4}44, 85, ^{2}41, 37		
H465, I465	Vol. Tone	17 22	N N	6			4L1 4L5 4L11	1 15 15	RS203 TS101 TS101		27	275		^{2}15, 75, 38	456	10
1N25	Vol. Tone	18 57	MR48 MR48				6N-4 6N-5 6N-1 .02-.02	1 15 15	CN152 TS101 TS101 Buffer	 B14	20	F251	C3	6A7, 78, 75, 38, 84	457	10
J665	Vol. Tone	17 22	N N	6			4L1 4L5 4L6	1 15 19	RS203 TS101 TS102		27	275		^{2}15, 6A7, 75, 30, 19	177.5	10
K54	Vol.	17	N				10	15	TS101					77, 78, 75, 38	175	
K665	Vol. Tone	17 22	N N	6			4L1 4L5 4L6	1 15 19	RS203 TS101 TS102		27	275		^{2}15, 6A7, 30, 75, 19	177.5	10
L54	Vol. Tone	17 41	N N				8 16 20	1 1 ‡	CS123 CS126 2-TS108	 B196	2	F211		78, 6A7, 75, 41	177	26

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
L. TATRO PRODUCTS CORP.—Continued																
L74 (Lt. Governor)	Vol.	17	N				8	1	CS123		20	F251	C3	6A7, ^{2}78, 75, ^{2}41, 84	175	10
	Tone	41	N				16	1	CS126							
							20	‡	2-TS108	B196						
							10	‡	2-TS102	B196						
							‡		Buffer	B14						
L525	Vol.	15	O											6A7, 78, 12A7, ^{2}48	456	
	Tone	22	L	6												
M54	Vol.	17	N				10	15	TS101					77, 78, 75, ^{2}38	‡	
M4616	Vol.	18	N				4L1	1	RS203		31	285XS	C22	6A7, 15, 75, 33	456	10
	Tone	57	N	6			.005		Buffer	B14						
N54	Vol.	17	N				8	1	CS123		2	F211		6A7, 78, 75, ^{2}41	177	26
	Tone	41	N				16	1	CS126							
							20	‡	2-TS108	B196						
N74 (Governor)	Vol.	17	N				8	1	CS123		20	F251	C3	^{2}78, 6A7, 75, ^{2}41, 84	175	10
	Tone	41	N				16	1	CS126							
							20	‡	2-TS108	B196						
							10	‡	2-TS102	B196						
							‡		Buffer	B14						
NH44	Vol.	17	N				10	15	TS101					77, 78, 75, ^{2}38	‡	
O84	Vol.	17	N				8	1	CS123		2	F211		78, 6A7, 75, ^{2}41	177	26
	Tone	41	N				16	1	CS126							
	Supp.	7	J		EX800		10	15	TS101							
							20	‡	2-TS108	B196						
O94 (President)	Vol.	17	N				8	1	CS123		20	F251	C3	^{2}78, 6A7, 37, 75, ^{2}41, 84	175	10
	Tone	41	N				16	1	CS126							
	Supp.	7	J		EX800		10	15	TS101							
							20	‡	2-TS108	B196						
							‡		Buffer	B14						
O4626	Vol.	18	N				4L1	1/13	RS203		31	285XS	C22	6A7, 15, 75, 33	456	10
	Tone	57	N	6			.01		Buffer	B14						
P54	Vol.	17	N				8-8	1	See Note	B3	20	F251	C3	6A7, 75, 78, 38, 84	177.5	10
							10	15	TS101							
							10	‡	2-TS107	B196						
							‡		Buffer	B14						
P4626	Vol.	18	N				4L1	1/13	RS203		31	285XS	C22	6A7, 15, 75, 33	456	10
	Tone	57	N	6			.01		Buffer	B14						
Q5636, R5636, S5636	Vol.	17	O				4L1	1/13	RS203		31	285XS	C22	^{2}15, 6A7, 75, 33	456	10
	Tone	57	N	6			4L6	15	TS102							
							‡		Buffer	B14						
T6216	Vol.	17	N				4L3	1	RS213		20	F251	C3	^{2}78, 6A7, 75, 38, 84	177.5	10
	Tone	22	N	6			4L5	15	TS101							
							4L11	15	TS101							
							4L14	‡	2-TS108	B196						
							.005		Buffer	B14						
U5226, V5226	Vol.	18	N				4L3	56	RS213		20	F251	C3	6A7, 78, 75, 38, 84	456	10
	Tone	57	N	6			4L1	13	RS203							
							4L14	‡	2-TS108	B196						
							.005		Buffer	B14						
W6236, X6236, Y6236	Vol.	17	O				4L3	1	RS213		20	F251	C3	^{2}78, 6A7, 12A5, 25Y5, 75	456	10
	Tone	57	N	6			4L1	13	RS203							
							4L6	15	TS102							
							4L11	15	TS101							
							4L15	‡	2-TS108	B196						
							.005		Buffer	B14						
TELETONE																
5 Tube TRF	Vol.	6	E12	6			4-6	4	RM262	B3				‡		
	Tone	22	K12													
TEMPLE CORP.																
8-60, 8-80, 8-90	Vol.	4	E12				1-4-2	3	See Note	B1				^{6}27, ^{2}45, 80		3
	Hum.	37	HU20				.15		See Note	B9						
8-61, 8-81, 8-91	Vol.	6/16	DRP240				2-4-2	3	See Note	B1				^{2}45, ^{4}27, ^{2}24A, 80		3
	Hum.	37	HU20				.15		See Note	B9						
TIFFANY TONE—(See Herbert H. Horn)																
TOBE DEUTSCHMANN																
Browning 35	Vol.	45	N				8, 8	1	RS213					^{2}6K7, 6A8, 6F5, 6C5, 6H6, 6F6, 5Z4	456	1
	Sen.	7	G				.10	15	TS101							
TOM THUMB—See Automatic Radio																
TONE MASTER—See Airking																
TRANSFORMER CORP. of America (TCA) (Clarion)																
C10	Vol.	‡	TRP609				8	3	RS213	B3				^{2}6C6, 6B5, 83V		1
	Vol.	‡	N			A4	8-8	3	RN242	B3						
C16	Vol.	‡	TRP609				8, 8	1	RS213	B3				6C6, 76, 6A6, ^{2}6B5, 83V		1
	Vol.	‡	N			A4	1	13	CS130							
							5	15	TS101							
C17	Vol.	‡	TRP609				8, 8	1	RS213	B3				6C6, 76, 6A6, ^{2}6B5, 83V		1
	Vol.	‡	N			A4	1	13	CS130							
							5	15	TS101							
TC20, TC21	Vol.	56	N	6			9659	1	RN242					58, 2A7, 2A6, 2A5, 80	465	1
							1108	13	CS130							
C21	Vol.	‡	TRP609				8, 8, 8	‡	RS213	B3				^{2}6J7, ^{3}6C5, ^{2}6L6, 83		1
	Tone	57	N				20	15	TS107							
							5	15	TS101							
C27	Vol.	‡	TRP609				8, 8	2	WE847					^{2}2A6, ^{2}53, 59, ^{2}46, 83		3
	Tone	57	N				10	15	TS101							
							5	15	TS101							
TC30	Vol.	6	‡		See Note A5		12-16	4	UR190	B3				6D6, 6C6, 43, 12Z3,		
C33	Vol.	‡	TRP609				8-4	1	CN151					^{2}75, 6A6, 76, 6E6, ^{2}79		MG
	Tone	57	N				1	13	CS130							
							12	15	TS101							
							5	15	TS101							
40	Vol.	8	A5MP	6	1		1-4	25	See Note	B1				^{2}51, 24A, 47, 80		1
TC40	Vol.	6	G12				4-4	4	CM170					^{2}6D6, 6C6, 42, 80		1
							5	19	TS105							
							5	15	TS101							
TC50	Vol.	18	UM154	M26	See Note A96		6-6	1	CN152	B3	35	294	C20	^{2}78, 77, 75, 41, 84	175	10
							928	15	TS103		37	296	C20			
							.015		Buffer	B14						
AC51, 53, 55	Vol.	12	Y	8			1-1.5-1-1.5	37	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80		3
TC52	Vol.	6	G12	6			1295	8	CN145	B3				^{2}77, 78, 43, 25Z5	115	
	Tone	‡	G12				928	15	TS103							
AC60 (25-60)	Vol.	12	Y	6			1.5-1.5-.5	3	See Note	B1				^{3}24A, ^{2}45, 80		1
TC60	Vol.	7	G				TCG1018	6	UR182	B3				6A7, ^{2}6D6, 75, 43, 25Z5	456	
	Tone	22	L				TCG1019	13	CS121							
							TCG1020	15	TN111							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
TRANSFORMER CORP.—Continued																
AC61 (25-61)	Vol.	6	H12				1.5-1.5-1	3	See Note	B1				^{3}24, ^{2}45, 80		1
AC70	Vol.	6	H12				1.5-1.5-1	3	See Note	B1				^{3}24, 27, ^{2}45, 80		1
AC80, 81	Vol.	8	G				8	25	RS213					^{3}51, 24A, 47, 27, 80	175	1
AC84, 85	Vol.	8	G				2-2-2.5	28	See Note	B1				^{3}51, 24, 27, 47, 80	175	1
	Tone	34	H12	6												
88	Vol.	8	G				2-2-2.5	28	See Note	B1				^{3}51, 27, 24A, 47, 80	175	1
	Tone	34	H12	6												
AC90, 90A, 91, 91A, (25-90, 25-91)	Vol.	8	A400P				8, 8	28	RS213					^{3}35, ^{2}24A, 27, 47, 80	175	3
	Tone	34	H12	6												
92, AC94 (25-94)	Vol.	8	A400P				8, 8	28	RS213					27, ^{3}51, ^{2}24A, 47, 80	175	3
	Tone	34	H12	6												
AC100 Series	Vol.	8	A5MP	6			1-1-1	26	See Note	B1				^{2}35, ^{2}24A, 47, 80	175	1
100AR	Vol.	15	L				P4767	4	CM172		35	294		6A7, 78, 6B7, 89, 6Z4	465	10
120-139	Vol.	8	G				2-2-2.5	28	See Note	B1				^{3}51, 24A, 47, 27, 80	175	1
	Tone	34	L	6												
AC160 (25-160), 160AVC	Vol.	8	A1MP	6			8, 8	28	RS213					^{3}51, 27, ^{2}24, 47, 80	175	3
	Tone	44	L	6												
AC220 (25-220)	Vol.	8	A5MP				1-1-1	26	See Note	B1				^{2}35, 57, 47, 24A, 80	175	1
	Tone	22	L	6												
AC240	Vol.	15	UC503				2-2-2.5	28	See Note	B1				24A, ^{2}51, 56, 58, 27, 47, 80	490	1
	Tone	22	L	6												
241	Vol.	15	UC503				2-2-2.5	28	See Note	B1				^{2}51, ^{2}56, 27, 47, 80	175	1
	Tone	22	L	6												
AC260	Vol.	15	UC503				8	26	See Note	B3				^{2}51, 57, ^{3}27, 56, ^{2}47, 80	175	1
	Tone	22	L	6												
AC280 (25-280)	Vol.	15	UC503				8	26	See Note	B3				^{2}51, ^{3}27, 57, 56, ^{4}46, 80	175	1
	Tone	22	L	6												
AC300	Vol.	6	500M No. 1		See Note	A19	6-8	34	See Note	B3				^{4}58, ^{7}56, ^{2}46, 82	175	3
	Tone	22	L	6												
	Supp.	20	G12													
AC320	Vol.	6	G12				8-4	23	CM171	B3				^{2}57, 58, 47, 80	175	1
AC340	Vol.	15	UC503				P4514	23	CM175					^{2}58, 57, ^{2}56, ^{2}47, 80	175	1
	Tone	22	L	6												
360	Vol.	15	UC503				P4514	23	CM175					^{2}58, 57, ^{3}56, ^{3}46, 82	175	3
	Tone	21	L	6												
400 AC-DC	Vol.	7	H				8-8	6	CN142					39, 36, ^{2}38, 25Z5		
							5-5	15	TN110							
AC420	Vol.	17	N				2-16-8	11	UR182	B31				6A7, 78, 75, 43, 25Z5	‡	
							10	15	TS101							
422, 423, 425	Vol.	98	J				P4633	11	CS121					6A7, 78, 77, 43, 25Z5	465	
							P4717	11	CS126							
							P4632	11	CS123							
440	Vol.	98	J				P4709	11	UR182	B31				6A7, 77, 43, 25Z5	465	
450	Vol.	56	N				P4737	29	UR190	B72				^{2}78, 6A7, 85, 43, 25Z5	465	
470, 472	Vol.	17	UC503				P4443	23	CM171					^{2}58, 2A6, 47, 56, 80	465	1
	Tone	22	L				P4724	15	TS101							
480	Vol.	15	UC503				P4514	34	CM175					^{3}58, ^{3}56, ^{3}59, 5Z3	465	3
	Tone	21	L	6			P4585	15	TN113							
	Sen.	12	Y													
490	Vol.	56	UC503				P4961	28	CM173	B3				^{3}58, 55, 53, ^{2}56, 80	175	3
	Tone	22	L													
500	Vol.	15	UC503											^{2}34, 1A6, ^{3}30, 19	175	
	Tone	22	L													
TRANSITONE—See Philco Radio & Television Corp.																
TRAV-LER RADIO & TELEVISION CORP.																
AC-SG-DX	Vol.	6	G12				2-1-1	30	See Note	B1				^{4}24A, 45, 80		3
	Screen	12	A5MP													
C	Vol.	12	A5MP				2-1-1	3	See Note	B1				^{4}24A, 45, 80		3
K	Vol.	6	E12				8-8	1	See Note	B3				24, ^{2}51, 47, 80		1
SG-AC-Super	Vol.	100	L				4-2	4	See Note	B1				^{2}35, ^{3}27, ^{2}47, 24, 80	‡	1
	Tone	41	N													
SG-DC	Vol.	8	Y50MP				8-8	3	See Note	B11				‡		
SG-DX	Vol.	6	G12				2-1-1	3	See Note	B1				^{4}24A, 45, 80		3
Trav-Lette	Vol.	6	L				4-4	4	CM170					51, 24A, 47, 80		1
6 Tube TRF	Vol.	6	E12				2-1-1	30	See Note	B1				^{3}26, 24, 45, 80		28
	Tone	34	K12													
	Screen	12	A5MP													
8 Super	Vol.	6	G				8-8-2	30	See Note	B3				^{2}51, 24A, ^{2}27, ^{2}47, 80	‡	1
	Tone	41	K12													
S8	Vol.	8	G				8-8-2	30	See Note	B3				^{2}51, 24A, ^{2}27, ^{2}47, 80	175	1
	Tone	41	K12													
S9	Vol.	100	L				4-2	4	See Note	B1				^{2}35, ^{3}27, ^{2}47, 80	175	1
	Tone	41	N													
50A	Vol.	6	H12				16-12	27	RM257	B3				6D6, 6C6, 43, 25Z5		
51	Vol.	18	N				4-8	23	CM171	B3				6A7, 6D6, 75, 42, 80	‡	1
53	Vol.	18	N				6-10	23	CM172	B3				6A7, 6D6, 75, 42, 80	‡	1
54	Vol.	18	UM154		See Note	A96	6-10	4	RM262		35	294	C3	6A7, 6D6, 75, 42, 84	456	10
							.02		Buffer	B14						
56	Vol.	116	K12				4	12	CS121					^{2}34, 32, 33, 1E1		
60A	Vol.	18	N				8-16-12	11	UR182	B31				6A7, 6D6, 75, 43, 25Z5	456	
63A	Vol.	18	N				8, 8	23	RS213					6A8, 6K7, 6H6, 6F5, 6F6, 5Z4, or 6A7, 6D6, 75, 42, 80		1
64	Vol.	18	UM154		See Note	A96	6-10	4	See Note	B3	35	294	C3	6A7, ^{2}6D6, 75, 42, 84	456	10
							.02		Buffer	B14						
76	Vol.	18	N				8-8	1	CN142	B3	15	216	C3	34, 1B5, 1E1, 1C6, 30	‡	10
							.02		Buffer	B14						
112	Vol.	15	MR53	M26			8	46	RS213					^{3}6K7G, 6L7G, ^{2}6C5G, 6H6G, 6G5, ^{2}6V6G, ^{2}5Y3G	465	1
							25	46	WE2545							
							8-16	46/13	RN245							
115	Vol.	15	MR53	M26			8	46	RS213					^{3}6K7G, 6L7G, ^{3}6C5G, 6H6G, 6G5, ^{4}6V6G, ^{2}5Y3G	465	1
							25	46	WE2545							
							8-16	46/13	RN245							
							4	13	CS131							
136	Vol.	18	MR48				7-32	1	CN152					6A7, 76, 6D6, 75, 41, 80	456	1
							5	15	TS101							
137	Vol.	18	MR48				30-20	27	Order from	Mfr.				6A7, 6D6, 75, 76, 25L6G, 25Z5	456	
							5	20	TS101							
138	Vol.	18	MR48	M26			8	1	RS213					6A7, ^{2}76, 6D6, 85, ^{2}6V6G, 80	456	1
							12	1	RS215							
							4	13	CS130							
173	Vol.	45	MR48				8-8	1	CN152	B3	15	246	C3	1C6, ^{2}34, ^{3}30, 19	456	10
							.005		Buffer	B14						
179	Vol.	18	MR48				8-8	1	CN152		35	294	C3	6D8G, 6S7G, 6T7G, ^{2}6L5G, 6Z7G, 6ZY5G	456	10
							5	15	TS101							
							.01-.01		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
TRAV-LER—Continued																
180	Vol.	18	MR48				8-8 5 .01-.01	1 15	CN152 TS101 Buffer	 B14	35	294	C3	6D8G, 6S7G, 6T7G, ^{2}6L5G, 6Z7G, 6ZY5G, 6N5	456	10
250	Vol.	45	MR48											1A6, 1A4, 30, 1B4, 1F4	456	
440, 445	Vol.	6	MR33	M26			20-12	4	CM164	B3				6D6, 6C6, 25A7		
450, 452	Vol.	6	MR33	M26			20-20-8 5	‡ 15	See Note TS101	B3				6D6, 6C6, 43, 25Z5		
470, 471, 472, 473	Vol.	6	MR33	M26			20-20-8 5	‡ 15	See Note TS101	B3				6D6, 6C6, 43, 25Z5		
500	Vol.	18	MR48	M26			8-8 10	25 19	CM172 TS101					6A7, 6D6, 75, 41, 1V	456	38
512	Vol.	18	MR48				16-12-8	11	See Note	B3				6A8, 6K7, 6B6, 25A6, 25Z6	456	
525	Vol.	18	MR48				8-8 .005	1	CN152 Buffer	B3 B14	15	246	C3	1C6, 1A4, 75, 30, 19	456	10
526, 527	Vol.	18	MR48				8-8-8 5	‡ 19	CM175 TS101					6A7, 6D6, 75, 41, 80	456	1
542	Vol.	18	UM154		See Note	A96	8-4 .01	4	CM171 Buffer	B3 B14	35	294	C3	6A7, 6D6, 75, 6B5, 84	456	10
600	Vol.	45	MR48				8-8 .005	1	CN152 Buffer	 B14	15	246	C3	1A6, 1A4, 30, 6N5, 1B4, 1F4	456	10
622, 623	Vol.	18	MR48				16-12-8	11	See Note	B3				6A7, 6D6, 75, 43, 25Z5	456	
626, 627	Vol.	18	MR48				30-20 5	27 20	See Note TS101	B3				6A7, 6D6, 75, 43, 25Z5	456	
630	Vol.	18	MR48				7-32 5	1 15	CN152 TS101					6A7, 76, 6D6, 75, 41, 80	456	1
633, 634	Vol.	45	MR48				8-8	23	CM172					6A7, 6D6, 76, 75, 42, 80	456	1
642	Vol.	18	UM154		See Note	A96	8-8 .01	4	CM172 Buffer	B3 B14	35	294	C3	^{2}6D6, 6A7, 75, 6B5, 0Z4	‡	10
650	Vol.	45	MR48				8-8 .005	1	CN152 Buffer	 B14	15	246	C3	1A6, 1A4, 30, 1B4, 1F4	456	10
679	Vol.	18	MR48				8-8 5 .01-.01	1 15	CN152 TS101 Buffer	 B14	35	294	C3	6D8G, 6S7G, 6T7G, ^{2}6L5G, 6Z7G, 6ZY5G	456	10
680	Vol.	18	MR48				8-8 5 .01-.01	1 15	CN152 TS101 Buffer	 B14	35	294	C3	6D8G, 6S7G, 6T7G, ^{2}6L5G, 6Z7G, 6ZY5G, 6N5	456	10
730	Vol.	18	MR48				30-20 5	27 20	Order from TS101	Mfr.				6A7, 6D6, 75, 76, 25L6G, 25Z5	456	
733	Vol.	45	MR48				8-8 .005	1	CN152 Buffer	B3 B14	15	246	C3	1C6, ^{2}34, ^{2}30, 19	456	10
6300	Vol.	18	MR48				7-32 5	1 15	CN152 TS101					6A7, 76, 6D6, 75, 41, 80	456	1
TRIANGLE ELECTRIC CO.																
5M17	Vol.	6	K12	6			B16973 B17042	27 27	RS207 RS207					6D6, 6C6, 43, 25Z5		
6M27	Vol. Tone	17 ‡	O M	6			B17041-3 B17197	4 4	RS208 RS208					6A8G, 6K7G, 6Q7G, 25B6G, 25Z6G	456	
6P	Vol. Tone	18 22	UM154-SS11 L				8-8 .005	1	CN152 Buffer	 B14	19	249	C3	^{2}6D6, 6L7, 76, 75, 42	465	10
6U107, 6L137, 6C607	Vol. Tone	18 34	N UC502	6			B16466 B16467-2	4 4	RS216 WE847					6A8G, 6K7G, 6Q7G, 6G5, 6K6G, 5Y3	456	1
7U117, 7L147, 7C707	Vol. Tone	18 34	N UC502	6			B16466 B16467-2	4 4	RS216 WE847					6L7G, 6C5G, 6K7G, 6Q7G, 6G5, 6F6G, 5Y3	456	1
8C807	Vol. Tone	18 44	N UC502	6			A15236-3 A15237-2	25 25	WE2545 RS213					6A8G, 6K7G, 6Q7G, 6G5, 6C5G, ^{2}6F6G, 5Y3	456	1
8U127	Vol. Tone	18 44	N SRP284	6 8			A15236-3 A15237-2	25 25	WE3540 RS213					6A8G, 6K7G, 6Q7G, 6G5, 6C5G, ^{2}6F6G, 5Y3	456	1
10C1007	Vol. Tone	17 22	TRP618 UC502	6			B16554-3 B15427 B16551-4	1 1 15	WE3540 WE1647 TN111					^{2}6K7G, 6L7G, 6C5G, 6Q7G, 6G5, ^{2}6F6G, 5Z3	456	1
TROPIC-AIRE																
06W	Vol. Tone	56 44	N UC502				8-16 4 4	1 13 15	CN155 CS121 TS101		2 12	210 237	C5 C5	^{2}78, 77, 85, ^{2}41	262	26
TROY RADIO MFG.																
4	Vol.	6	G12				4-4	23	CM170	B3				6D6, 6C6, 42, 80		1
4 Tube TRF	Vol.	6	H12		EX250		4-4	23	CM170	B3				58, 57, 2A5, 80		1
5L5, 5U5	Vol.	17	N	6			4-4	23	CM170	B3				6A7, 6D6, 85, 80, 42	465	1
14	Vol.	6	G12				4-4	23	CM170	B3				58, 57, 2A5, 80		1
15, 15-5	Vol.	17	N	6			4-4	23	CM170	B3				2A7, 58, 55, 2A5, 80	465	1
40	Vol.	6	G12				4-4	23	CM170	B3				58, 57, 2A5, 80		1
42	Vol. Tone	6 22	G12 L		EX300		4-4	23	CM170	B3				6A7, 6F7, 42, 80	465	1
46	Vol.	17	UM154		See Note	A96	4-4 5-5	4 15	CM170 TN110	B3				6A7, 6D6, 75, 42	465	MG
51B5	Vol. Tone	17 22	MR48 MR33											1A6, 34, 25S, 30, 19	465	
52	Vol. Tone	17 22	N K12	6			4-4 10	23 15	CM170 TS101	B3				2A5, 2A6, 2A7, 58, 80	465	1
53	Vol. Tone	17 22	N K12	6			4-4 10	23 15	CM170 TS101					6A8, 6K7, 6Q7, 6F6, 5Y3	465	1
54	Vol. Tone	17 22	N K12				8-8	23	CM172	B3				2A5, 2A6, 2A7, 58, 80	465	1
55	Vol.	6	UC501				4-4	23	CM170					6A7, 6D6, 76, 41, 80	465	1
56	Vol.	17	UM154		See Note	A96	4-4 5-5	1 15	CN150 TN110	B3				^{2}6D6, 6A7, 75, 42	175	MG
57	Vol.	18	MR48				4-4	23	CM170					6A7, 6D6, 75, 42, 80	465	1
62BC, 62BU	Vol. Tone	17 22	N K12											^{2}34, 1C6, 25S, 30, 19	465	
62C, 62PC, 62L, 62U	Vol. Tone	17 21	N K12				8-8 10	23 15	CM172 TS101	B3				^{2}6D6, 6A7, 75, 42, 80	465	1
67	Vol.	18	MR48				4-4	23	CM170					6A7, 6D6, 75, 6G5, 42, 80	465	1
67SW	Vol.	18	MR48				4-4	23	CM170					6A7, 6D6, 75, 6G5, 42, 80	465	1
68	Vol. Tone	17 22	UM154 K12			A96	8-8 10 .01	1 15	CN152 TS101 Buffer	B3 B14	35	294	C3	6A8, 6K7, 6Q7, 6F6, 84	465	10
75	Vol.	18	MR48				4-4	23	CM170					6A7, 6D6, 75, 42, 80	465	1

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS: Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS: Original Part	Circuit	Correct Replacement	*Note	VIBRATORS: Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
TROY RADIO MFG.—Continued																
75B	Vol.	18	MR48											1A6, 1A4, 1B5, 33	465	
	Tone	22	MR33													
77	Vol.	‡	MR48				8-8	23	CM172					^{2}6K7, 6A8, 6Q7, 6E5, 6F6, 5Y3	465	1
	Tone	22	K12													
79	Vol.	18	MR48				8-4	23	CM171					6A7, 6D6, 75, 6G5, 42, 80	465	1
	Tone	22	K12													
84	Vol.	17	N				8-8	1	CN152	B3				2A7,^{2}58, 55, 53,^{2}45, 80	465	3
	Tone	22	L				10	15	TS101							
84C, 84PC, 84U	Vol.	118	N				16-16	4	See Note	B3				^{2}6D6, 6A7, 85,^{2}42, 76, 80	465	1
	Tone	22	K12				4	13	CS131							
							10	15	TS101							
TR86	Vol.	17	UM154		See Note A96		8-8	1	CN152	B3	37	296	C3	^{2}6D6, 6A7, 75, 41, 84	465	10
	Tone	22	K12				10-10	15	TN111							
							.01		Buffer	B14						
95	Vol.	15	MR48				8-8	23	CM172	B3				6A8,^{2}6K7, 6H6, 6G5, 6F5, 6F6, 5Y3	465	1
	Tone	22	MR44				10	15	TS101							
100	Vol.	18	MR48				8-4	23	CM171					6A7, 6D6, 75, 42, 80	465	1
151-5	Vol.	17	N				16-8-10-10	6/15	UR189	B98				6A7, 6D6, 75, 43, 25Z5	465	
	Tone	22	K12													
153	Vol.	17	MR48				4-12-16	8	UR193	B3				6A8, 6K7, 6Q7, 25A6, 25Z6	465	
	Tone	22	K12				10	15	TS101							
162C, 162U	Vol.	17	N				16-12	6	CN145	B3				^{2}6D6, 6A7, 75, 43, 25Z5	465	
	Tone	22	K12				10-10	15	TN111							
175	Vol.	18	MR48				16-12-4	8	UR182	B3				6A7, 6D6, 75, 43, 25Z5	465	
	Tone	22	K12				10	15	TS101							
179	Vol.	17	MR53				16-12	6	CM164	B3				6A7, 6D6, 75, 6G5, 25L6, 25Z5	465	
	Tone	22	MR33				10	15	TS101							
TRUETONE—See Western Auto Supply Co.																
TRUEVALUE																
6U	Vol.	18	UC511				P81028	1	CN152		20	253	C3	^{2}78, 77, 75, 41, 84	262.5	10
	Tone	22	UC502				P81021	15	TN111							
							.01		Buffer	B14						
TURNER CO.																
M8	Vol.	15	M				8-8	1	See Note	B3				57, 2A5, 5Z3		1
	Tone	21	M				8	13	CS123							
							25	15	TS103							
M16	Vol.	15	M				8-8	1	See Note	B3				^{2}56,^{2}2A5, 80		1
							8	13	CS123							
							25	15	TS103							
MC16	Vol.	15	M				8-8	1	See Note	B3				57,^{2}56,^{2}2A5, 80		1
							8	13	CS123							
							25	15	TS103							
5780	Vol.	15	M				8-8	1	See Note	B3				^{2}57, 80		1
							8	13	CS123							
							25	15	TS103							
TWINPLEX—See Radio Trading.																
TYRMAN ELECTRIC CORP.																
Imperial 80	Vol.	29	Z				‡	3	See Note	B3				^{4}27,^{3}22, 50,^{3}81		‡
ULTRAMAR																
306	Vol.	18	MR48				20	1	RS207					6A8G, 6K7G, 6Q7G, 25L6G, 25Z5	465	
							40	1	RS208							
307	Vol.	17	MR53				14	25	RS216					^{2}6K7G, 6J7G, 6Q7G, 6C5G, 6G5, 6F6G, 5Y3G	465	1
	Tone	22	N				16	25	RS216							
309	Vol.	18	MR44				40	11	RS208					^{2}6K7G, 6A8G, 6R7G, 6G5, 25B6G,^{2}25Z5	465	
	Tone	22	K12				30-30	11/13	Order from	Mfr.						
316	Vol.	18	MR48				20	1	RS207					6A8G, 6K7G, 6Q7G, 25L6G, 25Z5	465	
							10	1	RS208							
317	Vol.	17	MR53				14	25	RS216					^{2}6K7G, 6J7G, 6Q7G, 6C5G, 6G5, 6F6G, 5Y3G	465	1
	Tone	22	N				16	25	RS216							
319	Vol.	18	MR44				40	11	RS208					^{2}6K7G, 6A8G, 6R7G, 6G5, 25B6G,^{2}25Z5	465	
	Tone	22	K12				30-30	11/13	Order from	Mfr.						
325, 335	Vol.	18	MR48				8, 8	25	RS213					6A8G, 6K7G, 6Q7G, 6F6G, 80	456	1
345, 355	Vol.	17	MR53				8-8	1	CN152	B3	15	246	C3	6D8G, 6S7G, 6T7G, 6AB5, 6L5G, 19	465	10
	Tone	57	MR48	M27			.005		Buffer	B14						
366, 376	Vol.	17	MR53				8, 8	25	RS216					6A8G, 6K7G, 76, 6Q7G, 6E5, 6F6G, 80	465	1
	Tone	22	N													
UNITED AIR CLEANER—See Sentinel.																
UNITED AMERICAN BOSCH																
Model T	Vol.	6	G12				3-3	25	See Note	B1				^{3}36, 37, 33		
04	Vol.	7	J	6			CE9520	6/15	UR189	B98				6D6, 6C6, 43, 25Z5, 185R8—Ballast		
05	Vol.	17	N	6			CE9519	6/15	UR192/TN111	B197				6A7, 6D6, 75, 43, 25Z5	465	
4 (Essex)	Vol.	6			See Note A5		1-8	25	CM171	B198				^{2}224, 47, 80		1
5A	Vol.	7	G	6			SA102553	25	CM171	B199				^{2}51, 24, 47, 80		1
5 (AC)	Vol.	6	G12				4-8	25	CM171	B198				^{3}24, 47, 80		1
7, 7C (DC)	Vol.	6	G12				3-3	25	See Note	B11				^{3}36, 37, 33		
10 (Essex)	Vol.	15	N				8-8-4	30	See Note	B3				51,^{2}58,^{4}27,^{2}45, 80	175	1
	Tone	22	N													
20, 20J, 20K, 20L	Vol.	6	A10MP	6			2-3.5-2	26	See Note	B1				^{3}51,^{2}27,^{2}47, 80	175	1
	Tone	22	‡		See Note A5											
28 (AC)	Vol.	13	SRP179				2-4	1	See Note	B1				^{4}26, 27,^{2}71, 80		11
29 (AC)	Vol.	13	SRP179				2-4	1	See Note	B2				^{4}26, 27,^{2}10, 81		34
31, 32 (AC)	Vol.	6	G12	6			3.5-3.5	25	See Note	B1				^{2}51, 24, 47, 27, 80	175	1
							.08		See Note	B9						
36, 36A & B, 37	Vol.	6	G12	6			8-4	25	CM171	B199				^{2}51, 24, 47, 80, 27	175	1
							8	14	CS123	B3						
38	Vol.	13	SRP179				2-4	1	See Note	B1				^{4}26, 27,^{2}71, 80		11
40, 41 (AC)	Vol.	15	N	6			8-8-4	56	CM175	B205				^{3}51,^{3}27, 47, 80	175	1
	Tone	22	N													
45A, 45C	Vol.	18	N	6			SA-106878	1	CN152		24	271		^{2}77, 78, 75, 41	175	10
							SA105741	15	TS101							
46 (AC)	Vol.	14	N											71A,^{4}26, 27, 80		
48, 49 (AC)	Vol.	40/12	GK		Early	A79	4-2-1	3	See Note	B1				^{2}45, 27,^{3}24, 80		3
	Vol.	40/12	GE		Late	A79										
54 (DC)	Vol.	40/8	CE			A54	4-4	1	See Note	B11				^{2}27,^{3}24,^{2}71		
56 (Battery)	Vol.	40/12	GK											^{3}22,^{2}201A,^{2}112A		
58 (AC)	Vol.	8	D				2-2-4	3	See Note	B1				^{4}24, 27,^{2}45, 80		3
	Tone	41	N													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
UNITED AMERICAN BOSCH—Continued																
60, 60D, 60E, 61	Vol.	15	N				2-2-4-2	3	See Note	B1				^{5}24, 27, ^{2}45, 80		7
	Tone	41	N													
62 (DC)	Vol.	8	D				4-4	1	See Note	B11				^{4}24, 27, ^{2}45		
	Tone	41	N													
63 (DC)	Vol.	15	N				4-4	1	See Note	B11				^{5}24, 27, ^{2}45		
	Tone	41	N													
66 (AC)	Vol.	14	N											^{4}26, 27, 71		
73, 74	Vol.	6	G12	6			2-2-4	26	See Note	B1				^{5}24, 27, ^{2}45, 80		1
	Tone	‡	K12													
79C	Vol.	18	N	6			SA106536	4	CM172		20	253	C3	^{2}77, 78, 75, 42, 84	175	10
	Tone	22	N				.008		Buffer	B14						
80, 84	Vol.	7	A20MP											^{4}24, 12A		
91, 92	Vol.	15	N	6			16	25	CS136	B39				^{2}51, ^{2}24, 47, 27, 80	175	1
	Tone	22	N				4	25	CS131	B39						
							SA103037	14	CS123							
96 (AC)	Vol.	14	N											^{4}26, 27, 71, 80		
96 (DC)	Vol.	14	N											^{7}26		
100 (Adv. 9-20 Auto)	Vol.	‡	‡		See Note A5		4-6	24	CN151					^{3}36, 37, ^{3}38	175	MG
107 (AC)	Vol.	14	N											^{5}26, 27, 71		
113	Vol.	15	N											^{3}39, 85, 89, ^{2}52		
	Sen.	7	J													
113X	Vol.	18	N											^{3}39, 75, 89, ^{2}52		
114	Vol.	15	N											^{3}39, 85, 89, ^{2}52		
	Sen.	7	J													
116 (AC)	Vol.	14	N											^{4}26, 27, 71		
119 (Police Motorcycle Radio)	Vol.	18	UM154		See Note A96		1-4	1	See Note	B3				^{2}78, 6A7, 75, 41	456	MG
							5	15	TS101							
123	Vol.	15	N											^{3}39, 85, 89, ^{2}52		
	Sen.	7	J													
123X	Vol.	18	N											^{3}39, 75, 89, ^{2}52		
126 (AC)	Vol.	14	N											71, ^{4}26, 27		
129 (Police Motorcycle Radio)	Vol.	18	UM154		See Note A96		4-4	1	See Note	B3				^{2}78, 6A7, 75, 41	456	MG
							5	15	TS101							
133	Vol.	6	G12	6			2-2-4	26	See Note	B1				^{5}24, 27, ^{2}45, 80		1
	Tone	‡	K12													
136 (AC)	Vol.	14	N											^{4}26, 27, 71		
139 (Types H, L, HT, LT, HC, LC, HTC, LTC)	Vol.	18	N	6	RS246		CE9510	1	Order from	Mfr.				78, 6A7, 75, 41, 77	456	MG
							SA105910	15	BN225							
139 (Types V, VC, VT, VTC)	Vol.	18	N	6	RS246		CE951	4	Order from	Mfr.	20	253Y	C3	78, 6A7, 75, 41, 84	456	10
							SA-105910	15	BN225							
							.008		Buffer	B14						
140A	Vol.	18	‡		See Note A5		8-8	1	See Note	B3	24	271		^{2}78, 6A7, 75, 41	456	10
							10	15	TS101							
146	Vol.	14	N											71, 27, ^{4}26		
149 (Types H, L, HT, LT, HC, LC, HTC, LTC)	Vol.	18	N	6	RS246		CE9510	1	Order from	Mfr.				78, 6A7, 75, 41	456	MG
							SA105910	15	BN225							
149 (Types V, VC, VT, VTC)	Vol.	18	N	6	RS246		CE951	4	Order from	Mfr.	20	253Y	C3	78, 6A7, 75, 41, 77, 84	456	10
							SA105910	15	BN225							
							.008		Buffer	B14						
150 (Type 1)	Vol.	18	N				SA105456	1	CN152		2	219		^{2}36, 39, 85, ^{2}41	175	26
							SA104614	1	CS123							
150 (Type 2)	Vol.	18	N				SA105456	1	CN152		24	271		^{2}77, 78, 85, ^{2}41	175	10
156 (DC)	Vol.	14	N											^{7}26		
160	Vol.	18	UM154		See Note A96		8-8	1	CN152		24	271		^{2}77, 78, 85, ^{2}41	175	10
166, 176 (AC)	Vol.	14	N											71, 27, ^{4}26		
200, 201 (AC)	Vol.	7	G	6			SA101881	25	CM171	B199				^{2}51, 24, 47, 80		1
205, 205A, 206 (5A)	Vol.	7	G	6			SA102553	25	CM171	B199				^{2}51, 24, 47, 80		1
224	Vol.	6	G7	6			3-3	25	See Note	B11				^{4}39, 71A, ^{2}52, 37	175	
	Tone	21	N				.01		See Note	B9						
226	Vol.	16	N											^{2}32, ^{2}34, ^{2}30, ^{2}49	175	
	Tone	114	‡	14	See Note A5											
236, 237 (AC)	Vol.	6	G12				8-4	25	CM171	B199				^{2}51, 57, 47, 27, 80	175	1
							8	14	CS133							
239AA	Vol.	6	G12				8-4	25	CM171	B199				^{2}51, 24, 27, 47, 80	175	1
	Tone	22	N				8	14	CS123							
242, 243 (AC)	Vol.	15	N	6			SA103595	30/14	UR191	B200				^{5}56, ^{3}58, 47, 80	175	1
	Tone	22	N													
250, 251	Vol.	15	N	6			SA103950	3/13	UR191	B201				^{4}58, ^{3}56, ^{2}45, 80	175	3
	Tone	120	L				SA103740	1	CN152	B12						
260, 261	Vol.	20	500M No. 1	6	See Note A19		SA103950	3/13	UR191	B201				^{4}58, ^{3}56, ^{2}45, 80	517.5	3
	Tone	120	L													
305A	Vol.	6	G12	6			SA102768	25	CM171	B199				^{2}57, 58, 47, 80	456	1
305 Ed. 2	Vol.	18	N	6			SA105237	25/19	CM171/TS102	B202				57, 58, 2A6, 47, 80	456	1
307	Vol.	56	N	6			SA105165	25/19	CM171/TS102	B202				57, ^{3}58, 55, 24, 80	175	3
	Tone	22	N													
310A	Vol.	15	N	6			SA104122	30	CM175	B206				^{3}58, ^{3}27, ^{2}45, 56, 80	175	1
	Tone	22	N				SA103037	15	CS123							
	Sil.	‡	A10MP													
312, 313 (AC)	Vol.	118	L	6			SA103740	57	CN155	B203				^{5}58, 57, ^{2}56, ^{3}46, 82	175	3
	Tone	122	L				SA103595	57	CS131/CN152	B204						
							SA103037	16	CS123							
350, 352	Vol.	18	N				SA106340	25/19	CM172/TS102	B202				2A7, 58, 2A6, 2A5, 80	175	1
	Tone	22	N	6												
355, 357	Vol.	18	N				SA105700	8/15	RM257/TS101	B207				6A7, 78, 75, 43, 25Z5	175	
	Tone	22	N	6												
360, 361, 364	Vol.	18	N				CE954	25/19	RM261/TS102	B213				2A5, 2A6, ^{3}58, 56, 80	456	1
	Tone	22	N	6												
370, 371	Vol.	18	N				SA105817	3	RN242					2A7, ^{2}58, 2B7, ^{2}53, 83	265	1
	Tone	22	L	6			SA105818	3/13/15	CM173/TS107	B208						
376, 376BT, 376F, 376S	Vol.	4/9	GG				SA107029	12/13	RN231	B209				1A6, ^{2}34, 33, 32	456	
	Tone	121	N													
385	Vol.	4/9	GG				CE959	12/13	RN231	B209				1A6, ^{2}34, 33, 32	463	
386	Vol.	45	N				CE959	12/13	RN231	B209				1C6, ^{2}34, 30, 32, 33	463	
402 Ed. 1, 2	Vol.	18	N	6			SA105722	8/15	UR182/TS101	B210				6F7, 78, 75, 43, 25Z5	456	
402 Ed. 3	Vol.	18	N	6			CE957	8	UR182	B210				6F7, 78, 75, 43, 25Z5	456	
							CE958	15	TS101	B210						
405	Vol.	18	N	6			SA105237	25/19	CM171/TS102	B202				57, 58, 2A6, 47, 80	456	1
420, 421	Vol.	18	N	6			SA107288	1/15	RN245	B211				6F7, 6D6, 75, 42, 80	456	1
	Tone	121	M	6												
430, 430J, 430T, 431, 431J, 431T, 434, 434J, 434T	Vol.	18	N	6			SA107239	1	RS213					6A7, 6D6, 75, 42, 80-83V	450	1
							SA107288	1/13/15	RN245	B212						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
UNITED AMERICAN BOSCH—Continued																
440C, 440T, 441C, 441T, 444C, 444T	Vol.	18	N				SA106665	25/19	RM261/TS102	B213				6A7, ^{2}6D6, 75, 42, 80	456	1
	Tone	121	M	6			SA107239	13	RS213							
450L, 450H, 451L, 451H	Vol.	18	N	6			SA107239	1	RS213					6A7, ^{2}6D6, 75, 42, 80	450	1
							SA107288	1/13/15	RN245	B212						
454L, 454H	Vol.	18	N	6			SA107239	1	RS213					6A7, ^{2}6D6, 75, 42, 83V	450	1
							SA107288	1/13/15	RN245	B212						
460, 460A-B-R, 461A-B-R (Ed. 1 and 2), 464A-B-R	Vol.	18	N				SA106665	25/19	RM261/TS102	B213				^{3}58, 2A6, 2A5, 56, 80	456	1
	Tone	121	M	6												
462A, 462Y	Vol.	18	N	6										^{3}78, 76, 85, ^{2}48	456	
	Tone	22	‡		See Note A5											
470G-U, 471G-U, 474G-U	Vol.	18	N				CE954	25/19	RM261/TS102	B213				^{3}58, 2A6, 2A5, 56, 80, (83V)	456	1
	Tone	121	M	6												
480 (Early)	Vol.	18	N				SA107510	59	RN245					^{3}78, 77, 6B7, 42, ^{2}6A6, 76, 83V	456	1
	Tone	121	M	6			SA107516	15	BN226	B8						
480 (Ed. 1 and 2), 481, 484	Vol.	18	N				CE955	59	RN242					^{3}78, 77, 42, ^{2}6A6, 76, 83V	456	1
	Tone	121	M	6			SA107510	59/13	RN245							
	Supp.	7	G				SA107516	15	BN226	B8						
500	Vol.	18	N	6			SA105309	11/15	UR182/TS101	B214				^{2}78, 75, 43, 25Z5	456	
501, 502 (AC-DC)	Vol.	18	N	6			SA105722	8/15	UR182/TS101	B210				6F7, 78, 75, 43, 25Z5	456	
503	Vol.	18	N	6			SA106487	25/19	CM172/TS101	B112				6F7, 78, 75, 43, 12Z3		
505, 510, 510E	Vol.	18	N	6			CE9512	25	RS215					6F7, 6D6, 75, 42, 80	465	1
							CE9511	25	RS213							
							CE958	19	TS101							
524A (Ed. 1, 2, 2D, 2G)	Vol.	18	N	6	RS246		CE951	4	Order from	Mfr.	22	253Y	C3	6A7, 78, 75, 42, 84	456	10
							.008		Buffer	B14						
536	Vol.	18	N	6	RS246		CE951	4	CM172		35	294	C3	6A7, 78, 75, 42, 84	456	10
							.008		Buffer	B14						
565W, 565K	Vol.	18	N	6			CE9512	1	RS215					6L7, 6K7, 75, 6F6, 6C5, 80	465	1
							CE9511	1	RS213							
							CE958	19	TS101							
575F, 575Q	Vol.	18	N				CE954	25/19	RM261/TS102	B213				^{2}6K7, 6H6, 6F5, 6F6, 6A8, 80	465	1
	Tone	121	N	6			CE9511	14	RS213							
585, 585Y, 585Z, 586	Vol.	18	N				CE954	25/19	RM261/TS102	B213				^{2}6K7, 6H6, 6F5, 6F6, 6A8, 6C5, 80	465	1
	Tone	121	N	6			CE9518	14	RS213							
							CE9515	15	TS101							
595M, 595P	Vol.	15	O				CE9516	59	RS213					^{3}6K7, 6A8, 6C5, 6H6, ^{2}6F5, 6F6, 5Z3	465	1
							CE9517	59	RS216							
							SA107913	15	BN226							
600	Vol.	18	N	6			CE9541	1/15	Order from	Mfr.	13	245	C3	6A7, 6D6, 75, 41	465	10
							.008		Buffer	B14						
601	Vol.	18	MR48	M23			CE9542	12	CS131					1C6, 1A4, 1B5, 30, 19	465	
602	Vol.	18	MR48	M24										1C6, ^{2}1A4, 1B5, 30, 1J6G	465	
	Tone	22	‡		See Note A5											
604	Vol.	27	‡	6	See Note A5		CE9533	6	RS215					6A7, 6C6, 43, K55C—Ballast, 25Z5	465	
							CE9534	6	RS216							
							CE9515	15	TS101							
605, 605C	Vol.	18	N	6			CE9536	1	RS215					6A8, 6K7, 75, 6F6, 5Y3	465	1
							CE9535	1	RS216							
							CE9515	19	TS101							
610	Vol.	18	MR48	M26			CE9545	27	RS207	B3				6A7, 6D6, 75, 43, 25Z5, K49C	465	
							CE9546	27	RS205	B3						
620	Vol.	18	500M No. 1	6	See Note A19		CE9539	27	Order from	Mfr.				6A8, 6K7, 6H6, 6F5, 25A6, 25Z6, K42C, —Ballast	465	
	Tone	22	‡		See Note A5		CE9538	27	RS216							
							CE9540	13	RS201							
625	Vol.	18	500M No. 1	6	See Note A19		CE9539	27	Order from	Mfr.				6A8, 6K7, 6H6, 6F5, 25A6, 25Z6, K42E —Ballast	465	
	Tone	22	‡		See Note A5		CE9538	27	RS216							
							CE9540	13	RS201							
634A, 634A (Ed. 2), 636, 637	Vol.	18	N	6	RS246		CE951	4	Order from	Mfr.	22	253Y	C3	^{2}77, 78, 75, 42, 84	175	10
	Tone	121	N				.008		Buffer	B14						
640, 650	Vol.	18	TRP607	6			CE9536	25	RS215					6A8, 6K7, 6H6, 6F6, 6F5, 5Z4 or 5Y3	465	1
	Tone	125	MR24				CE9535	25	RS216							
							CE9537	13/15	RN241	B217						
660T, 660C	Vol.	18	TRP606				CE9536	25	RS215					^{2}6K7, 6H6, 6F5, 6A8, 6F6, 5Z4 or 5Y3	465	1
	Tone	121	N	6			CE9535	25	RS216							
							CE9528	14	RS213							
							CE9526	15	TN111							
670S, 670C	Vol.	18	N				CE9536	25	RS215					^{2}6K7, 6H6, 6C5, 6F5, 6A8, ^{2}6F6, 5Z4	465	1
	Tone	22	L	6			CE9535	25	RS216							
							CE9528	14	RS213							
							CE9526	15	TN111							
680	Vol.	15	MR53				CE9528	30	RS213					^{4}6K7, 6A8, 6C5, ^{2}6H6, 6F5, ^{2}6L6G, 5Y3, 5Z3	465	1/1
							CE9536	30	RS215							
							CE9548	30	RS213							
							CE9547	15	TN111							
							CE9549	3	CS133							
							CE9548	3	CS133							
736, 737, 738	Vol.	18	M		RS246		CE951	4	Order from	Mfr.	35	294	C3	6J7, 6A8, 6K7, 6H6, 6F5, 6F6, 0Z4	175	10
	Tone	121	M				CE9524	19	TS101							
							.005		Buffet	B14						
838	Vol.	45	UM147		See Note A96		CE951	4	Order from	Mfr.	35	294	C3	^{2}6K7, 6A8, 6H6, 6F5, ^{2}6F6, 0Z4	175	10
	Tone	22	‡		See Note A5		CE9524	19	TS106							
							.005		Buffer	B14						
UNITED MOTORS SERVICE "DELCO" (Buick, Olds, Pontiac)																
A1, B1	Vol.	56	N				8, 8	1	RS213					^{2}58, ^{2}57, 56, 55, ^{2}47, 80	‡	1
	Tone	21	N													
	Sen.	7	F													
A3, B3	Vol.	45	N				2	‡	See Note	B11				^{2}39, ^{2}36, 37, ^{2}38	175	
	Tone	22	N													
A5A3 (Auburn)	Vol.	18	UC514	6			W32759	1	RS213		16	247	C3	^{2}78, 6F7, 6B7, 42	181.5	10
							W32802	1/15	SR605	B23						
							.005		Buffer	B14						
A255 (Cord)	Vol.	15	UC514				W38473A	1	RN242		25	273C		6D6, 6A7, 6B7, 76, 6B5	450	10
A355 (Graham-Paige)	Vol.	15	UC514				W38473A	1	RN242		25	273C		6D6, 6A7, 6B7, 76, 6B5	450	10
A455 (Cord)	Vol.	126	UC514				38478A	1	RN242		25	273C		^{2}6D6, 6A7, 6B7, 6B5	450	10
A555 (Graham-Paige)	Vol.	126	UC514				38473A	1	RN242		25	273C		^{2}6D6, 6A7, 6B7, 6B5	450	10
626 (Delco)	Vol.	18	UC514				1209285	22/15	RN245		25	273C		^{2}6D6, 6A7, 6B7, 42	262	10
	Tone	21	M				4	15	TS101							
627 (Delco)	Vol.	15	UC514				1209285	22/15	RN245		25	273C		6D6, 6A7, 6B7, ^{2}6E6	262	10

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
UNITED MOTORS SERVICE—Continued																
628 (Delco)	Vol.	62	UC514				1209283	1	RS215		25	273C		[3]6D6, 6A7, 85, 6A6	262	10
	Tone	44	L				1209284	1/15	RS213/TN111	B5						
629 (Delco) (Below No. 40100)	Vol.	45	UC514				1209285	1/15	RN245		25	273C		6F7, 6B7, 6D6, 42	262	10
629 (Delco) (Above No. 40100)	Vol.	62	UC514				1209285	1/15	RN245		25	273C		6F7, 6A7, 6B7, 42	262	10
630 (500) (Delco)	Vol.	62	UC514				1209806	4	CM171		35	294	C3	6A7, 6B7, 6D6, 42, 84	262	10
							.01		Buffer	B14						
631 (Delco)	Vol.	18	UC514				1210556	1	CN152		35	294	C3	6A7, 6B7, 6D6, 6B5,		
							.05		Buffer	B14				84	262	10
631A (Delco)	Vol.	73	UC511				1211247	4	RM262	B73	35	294	C3	[2]6D6, 6A7, 6B7, 42, 84	262	10
							.005		Buffer	B14						
632 (Delco)	Vol.	126	UC514				1210215	1	RN242		35	294	C3	[2]6D6, 6A7, 6B7, 6B5,		
	Tone	21	O				.005		Buffer	B14				84	262	10
633 (Delco)	Vol.	126	UC514				1210220	1	RN242		35	294	C3	[2]6D6, 6A7, 6B7, 6B5,		
	Tone	21	O				.005		Buffer	B14				84	262	10
634 (Delco)	Vol.	15	UM162-SS14				1210926	1/15	RN245/TS101	B193	25	273C		[2]6D6, 6A7, 85, [2]41	262	10
	Tone	21	M													
635 (Delco)	Vol.	20	TM242-SS14				1210926	1/15	RN245/TS101	B193	25	273C		[2]6D6, 6A7, 85, [2]6F6	262	10
R640 Delco	Vol.	18	UM150-SS14				7230164	4	RM262		51	294C	C3	[2]6K7G, 6A8G, 6Q7G,		
	Tone	22	MR44				.005		Buffer	B14				6F6G, 6X5G	262	10
R641 Delco	Vol.	18	UM150-SS14				7231521	4	RM262		51	294C	C3	[2]6K7G, 6A8G, 6Q7G,		
	Tone	22	MR39				.005		Buffer	B14				6V6G, 6X5G	262	10
R642 Delco	Vol.	18	TM241-SS3				1212038	4	RM261		51	294C	C3	[2]6K7, 6J7, 6Q7, 6F6,		
							.005		Buffer	B14				6X5	262	10
R643 Delco	Vol.	18	UM150-SS11				7231521	4	RM262		51	294C	C3	[2]6K7G, 6A8G, 6Q7G,		
	Tone	22	MR39				.005		Buffer	B14				6V6G, 6X5G	262	10
R644 Delco	Vol.	20	TM241-SS14				7231605	1	RN245		51	294C	C3	[2]6K7G, 6A8G, [2]6R7G,		
	Tone	22	MR39				.005		Buffer	B14				[2]6V6G, 0Z4	262	10
1101 (Delco)	Vol.	56	N	6			1208786	11/15	Order from	Mfr.				6F7, 78, 6B7, 43,		
														25Z5	181.5	
1102, 1103 (Delco)	Vol.	15	N				1208317	4	RS215					6D6, 6A7, 6B7, 76,		
	Tone	22	Z12	6			1208316	4/14	RN245					42, 80	456	1
1104 (Delco)	Vol.	‡	N				1208317	4	RS215					6D6, 6A7, 6B7, 6F7,		
	Tone	34	Z12	6			1208316	4/14	RN245					42, 80	456	1
1105	Vol.	6	G12	6	EX200		8-6	1	RN242					[2]6D6, 76, 6B5, 80	456	1
1106	Vol.	18	N	6			12	25	RS215					6D6, 6A7, 75, 42, 80	456	1
	Tone	22	Y				20	25	RN245							
1107	Vol.	15	O	6			8-8-8	13/25	RN245					[2]6D6, 6A7, 76, 42, 80	456	1
1108	Vol.	18	TRP623	6			12	4	RS215					[2]6D6, 6A7, 75, 42, 80	456/	
							18	4	RS216						490	1
							10	13	RS205							
1109	Vol.	20	TRP608	6			12	1	RS215					[2]6D6, 6A7, [2]6C5, [2]6F6,		
							18	1	RS216					80	455	1
							10	13	RS205							
1110	Vol.	15	TRP608				12	31	RS215					6D6, 6A7, 6K7, [3]6C5,		
							18	31	RS216					6F6, [2]45, 5Z3	455	3
							12-12	15	TN111							
							25	15	TS107							
R1115	Vol.	7	E	6			8-4	1	RN241					6A7, 6D6, 76, 41, 80,		
							8	1	RS213					or [2]6D7G, 6C5G,		
														6F6G, 6X5G	465	1
R1116	Vol.	45	TRP623	6			16	25	RS216					6A8G, 6K7G, 6H6G,		
	Tone	57	N				16	25	RS216					6F5G, 6F6, 5Z4	456	1
R1117	Vol.	45	TRP623	6			16	25	RS216					6A8G, 6K7G, 6H6,		
	Tone	57	N				16	25	RS216					6F5G, 6F6, 6G5,		
														5Z4	456	1
R1118	Vol.	45	TRP623	6			16, 16	25	RS216					[2]6K7, 6A8, 6H6, 6G5,		
	Tone	41	N				8	13	RS213					[2]6C5, [2]6F6, 5V4G	456	1
							10	19	TS106							
							12	15	TS101							
R1119	Vol.	15	TRP608	6			16, 16	25	RS216					[2]6K7, 6A8, [2]6H6, 6J7,		
							8	13	RS213					[2]6C5, 6G5, [2]6L6,		
							10	19	TS106					5V4G	456	1
							12	15	TS101							
R1120	Vol.	18	N	6			8-4	1	RN241					6A8G, 6K7G, 6Q7G,		
							10	19	TS106					6K6G, 5Y4G	465	1
R1125	Vol.	18	MR48	M26			5-5	23	RM262					6A7, 78, 75, 41, 80	465	1
R1126	Vol.	17	MR48	M26			8-8	1	CN152					6A7, 6D6, 75, 41,		
														6G5, 80	465	1
R1127	Vol.	18	MR53	M26			30	25	RS207					6A8G, 6U7G, 6Q7G,		
							8-8	25	RN242					6K6G, 6U5, 5W4G	465	1
							10	19	TS106							
R1128, R1129	Vol.	18	MR53	M26			8, 8	23	RS213					6L7G, 6C5G, 6K7G,		
														6Q7G, 6G5, 6F6G,		
														5Y3G	465	1
R1130	Vol.	45	TM230-SS1	M26			30	25	WE3540					6L7G, 6K7, 6H6, 6F5,		
							8	25	RS213					6C5G, 6U5, 6V6G,		
							10	19	TS106					5W4G	465	1
R1131	Vol.	20	TRP608	6			30	25	WE3540					[2]6K7, 6L7, 6C5, 6H6,		
							16	25	RS216					6F5, 6L6, 6U5,		
							10-10	15	TN111					5Y3G	465	1
R1132	Vol.	20	TRP611				30	1	WE3540					[3]6K7, 6L7, 6J7, [2]6C5,		
							8	1	RS213					6H6, [2]6V6, 6U5,		
							25	15	TS107					5U4G	456	1
							10-10	15	TN111							
							4	13	CS131							
2017, 2018 (Delco)	Vol.	25	GK				1202264	4	RS215					[1]24A, 45, 80		1
	Tone	22	G12				1201400	4	RS213							
2035 (Revised)	Vol.	17	UC512	6			1207584	1	CN152		4	221	C3	36, [2]39, 85, 89	262	10
	Tone	44	K12				1207616	15	TS105							
							.015		Buffer	B14						
R2050	Vol.	18	MR48											1C6, 34, 1F6, 33, 5E1	465	
R2055	Vol.	17	MR48											1C6, 34, 1F6, 33, 5E1	465	
3201, 3202 (Below 800,000)	Vol.	17	N	6										[2]6D6, 6A7, 85, [2]48	262.5	
3201, 3202 (Delco) (Above 800,000)	Vol.	17	N	6										[2]6D6, 6A7, 85, [2]48	456	
3203, 3204 (Delco)	Vol.	15	N				1208892	1	RS205/TS106		17	F247	C3	6D6, 6A7, 6B7, 6F7,		
	Tone	44	Z12	6			1208891	1/14	RN245/TS101					[2]43	456	10
							1208890	14	RS203							
							.01		Buffer	B14						
3205	Vol.	17	UC504	6										[2]6D6, 6A7, 85, [2]48	456	
	Sen.	6	E12													
3206, 3207	Vol.	18	MR53											[2]6D6, 6A7, 85, 76, [4]48	465	
	Tone	34	MR36	M26												
	Sen.	1	MR18													
R3208, R3209	Vol.	18	MR53											[2]6D6, 6A7, 85, 76, [4]48	465	
	Tone	34	MR36	M26												
	Sen.	1	MR18													
R3210	Vol.	17	MR48											6D6, 6A7, 75, 76, [2]48	465	
	Tone	22	MR33	M26												

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
UNITED MOTORS SERVICE—Continued																
4036 (B. O. P.)	Vol.	17	UC512	7			1207830	1	CS133		4	221	C3	[2]36, 39, 85, 89, 84	262	10
	Tone	44	K12				.015		Buffer	B14						
4037	Vol.	17	UM154-SS11	M26			1207995	1/15	CN142/TN110		5	222		[2]78, 6F7, 75, 41	262	10
	Vol.	17	UC512		See Note A4											
4038	Vol.	17	UM154-SS11	M26			1208241	1	CN152		5	222		[2]78, 6F7, 85, 41	262	10
	Tone	44	N													
4048	Vol.	6	Y				4-12-4	11	UR182	B31				6F7, 78, 75, 43, 25Z5	455	
4049, 4050	Vol.	15	UC504				W29978	1	CS125		6	F223	C3	[2]78, 6B7, 37, 75, 43	181.5	10
	Tone	22	K12				8-8-8	24/15	CN155							
							12-2.5	‡	Order from	Mfr.						
							.01		Buffer	B14						
4051 (32 volt)	Vol.	6	E7		1		12	1	CS135		6	F223	C3	[3]78, 77, 43	181.5	10
							8	1	CS133							
							6	15	TS101							
							12-2.5	‡	Order from	Mfr.						
4052 (AC-DC)	Vol.	17	UC504				8-25-16	11	UR182	B31				6A7, 78, 6B7, 43,		
							6	15	TS101					25Z5	456	
4053, 4053A	Vol.	15	UC504				W23705A	3	RS215					[3]56, [3]58, [2]A5, 80	181.5	1
	Tone	44	Z				W29097A	3/14	RN245	B57						
4054	Vol.	17	N	6										6A7, 6D6, 85, 48	262	
6010	Vol.	18	MR48	M27			8-20	1	UR193		13	245	C3	1C6, 34, 1B5, 38	456	10
	Tone	57	MR48				5	15	TS105							
							.03		Buffer	B14						
R6011 (Delco)	Vol.	18	N				8-8	1	RN242		30	285	C3	6A7, [2]15, 76, 19	465	10
	Tone	22	K12	6			10	15	TS101							
							.01		Buffer	B14						
R6012	Vol.	45	TM230	M26			8-8	1	CN152		30	295	C3	[3]15, 6A7, [2]76, 19	465	10
	Tone	44	MR33				5	15	TS105							
							.01		Buffer	B14						
R6015	Vol.	18	UM154-SS16				8-8	1	CN152		30	295	C3	6D8G, [2]6S7G, [2]6L5G,		
	Tone	22	MR33	M26			10	15	TS101					19	465	10
							.03		Buffer	B14						
364441 (Chevrolet)	Vol.	17	O	7	FS253		1207695	1	CN152		4	221	C3	[2]36, 39, 85, [2]89, 84	262	10
	Tone	44	K12				1207901	15	TN110	B169						
							.015		Buffer	B14						
393884 (Oldsmobile)	Vol.	15	UM154-SS3				1209047	1/15	CN155		25	273C		6F7, 6A7, 6B7, 42	262	10
393885	Vol.	17	UM154-SS3		EB247		1209144	1/15	CN152/TN110	B220	25	273C		78, 6A7, 6F7, 85, [2]41	262	10
	Tone	44	MR48													
405045	Vol.	127	UM154-SS3		EB247		1209144	1/15	CN152/TN110	B220	25	273C		78, 6A7, 6F7, 85, [2]41	262	10
	Tone	44	K12													
405046	Vol.	15	UM154-SS3				1209047	1/15	SR622		25	273C		6F7, 6A7, 6B7, 42	262	10
405047, 405062	Vol.	15	UC512				1209388	1	CN152		25	273C		6F7, 6A7, 6B7, [2]41	172	10
	Tone	128	N													
405063 (Oldsmobile)	Vol.	15	UC512				1209531	1/15	CN155		25	273C		6F7, 6A7, 6B7, 42	‡	10
544245 (Buick-Pontiac)	Vol.	15	UM154-SS3		EB247		1209047	1/15	SR622		25	273C		6F7, 6A7, 6B7, 42	262	10
544246	Vol.	127	UM154-SS3		EB247		1209144	1/15	CN152/TN110	B220	25	273C		78, 6A7, 6F7, 85, [2]41	262	10
	Tone	44	K12													
544267	Vol.	15	UM154-SS3				1209047	1/15	SR622		25	273C		6F7, 6A7, 6B7, 42	262	10
544268	Vol.	127	UM154-SS3		EB247		1209144	1/15	CN152/TN110	B220	25	273C		78, 6A7, 6F7, 85, [2]41	262	10
	Tone	44	K12													
544289 (Pontiac) (Above 1,750,000)	Vol.	15	UC512				1209531	1/15	CN155		25	273C		6F7, 6A7, 6B7, 42	262	10
544290-1 (Pontiac)	Vol.	15	UC514				1209819	1	RN245		25	273C		6F7, 6A7, 6B7, [2]42	‡	10
	Tone	22	M													
600153 (Chevrolet)	Vol.	17	N		See Note A27		1207995	1/15	CN142/TN110		5	222		‡	262	10
	Vol.	17	UC512		See Note A4											
600249 (Chevrolet)	Vol.	17	UC512				1208241	1	CN152		5	222		[2]78, 6F7, 85, [2]41	262	10
	Tone	44	K12													
600565 (Chevrolet)	Vol.	17	Order from	Mfr.			1208241	‡	CN152		5	222		[2]78, 6F7, 85, [2]41	262	10
600566 (Chevrolet)	Vol.	17	Order from	Mfr.			1207995	1/15	CN142/TN110		5	222		[2]78, 6F7, 75, 41	262	10
601038 (Chevrolet)	Vol.	18	N	7			1208584	1	CN152		25	273C		78, 6A7, 6F7, 85, [2]41	175	10
	Tone	44	N													
601176 (Chevrolet)	Vol.	17	UM154-SS3		EB247		1209144	1/15	CN152/TN110	B220	25	273C		78, 6A7, 6F7, 85, [2]41	262	10
601177 (Chevrolet)	Vol.	15	UM154-SS3		EB247		1209047	1/15	SR622		25	273C		6F7, 6A7, 6B7, 42	262	10
601525 (Chevrolet)	Vol.	17	500M No. 1		See Note A19		1209144	1/15	CN152/TN110	B220	25	273C		78, 6A7, 6F7, 85, [2]41	262	10
601574 (Chevrolet)	Vol.	15	UC512				1209531	1/15	CN155		25	273C		6F7, 6A7, 6B7, 41	175	10
	Tone	‡	N													
601586	Vol.	15	UM154-SS3				1209047	1/15	SR622		25	273C		6F7, 6A7, 6B7, 42	262	10
601662 (Chevrolet)	Vol.	15	UC514				1209285	1/15	RN245		25	273C		6F7, 6A7, 6B7, 42	262	10
	Tone	21	N													
601814 (Chevrolet)	Vol.	20	UC514		EB247		1210065	1/15	CN152/TN110	B220	25	273C		6D6, 6A7, 6F6, 85, 41	‡	10
	Tone	41	K12													
980393	Vol.	17	UC512	6			1207830	1	CS133		4	221	C3	[2]36, 39, 85, [2]89, 84	262	10
	Tone	44	K12				.015		Buffer	B14						
980455 (B. O. P.)	Vol.	17	UM154-SS11	M26			1207995	1/15	CN142/TN110		5	222		[2]78, 6F7, 75, 41	262	10
980459 (B. O. P.)	Vol.	18	UM154-SS11	M26			1208241	1	CN152		5	222		[2]78, 6F7, 85, [2]41	262	10
	Tone	44	K12													
980507-8 (Buick)	Vol.	17	TM241-SS4	Mfr.			1210537	1/15	CN152/TN110		26	273D		[2]6D6, 6A7, 85, 76, 6A6	262	10
	Tone	22	O													
980509 (Buick)	Vol.	17	TM241-SS4				1210885	1/15	CN152/TN113		26	273D		[2]6D6, 6A7, 75, 42	262	1
	Tone	22	O													
980525 (Buick)	Vol.	20	TM241-SS3				1211167	1	CN152		26	273D		[2]6D6, 6A7, 85, 76, 6A6	262	10
							1211166	15	TN111							
980526 (Buick)	Vol.	20	TM241-SS3				1211167	1	CN152		26	273D		[2]6D6, 6A7, 75, 42	262	10
							1211215	15	TS101							
980529 (Buick)	Vol.	20	TM241-SS3				1211167	1	CN152		26	273D		[2]6D6, 6A7, 75, 42	262	10
							1211215	15	TS101							
980534-5 (Buick)	Vol.	20	TM249-SS2	M26			1211570	1	RN242		50	514	C3	6K7, 6A7, 6D6, 85,		
	Tone	22	MR44				1211572	15	TN111					76, 6A6	262	10
							.01-.01		Buffer	B14						
982006 (Oldsmobile)	Vol.	17	UM154-SS3				1210514	1/15	SR622		25	273C		[3]6D6, 75, 76, 42	262	10
	Tone	22	N													
982007, 982008 (Oldsmobile)	Vol.	17	UM162-SS3				1210515	1/15	CN152/TN111		25	273C		[3]6D6, 85, 76, 6E6	262	10
	Tone	22	N													
982043 (Oldsmobile)	Vol.	20	TM241-SS4				7230264	1	RN242		35	294	C3	[2]6K7G, 6A8G, 6Q7G,		
							.005		Buffer	B14				6N6G, 6X5G	262	10
982044 (Oldsmobile)	Vol.	20	TM229-SS3				1211580	1/15	CN152/TS101		51	294C	C3	[2]6U7G, 6A8G, 6Q7G,		
							.005		Buffer	B14				6F6G, 6X5G	‡	10
982045 (Oldsmobile)	Vol.	17	TM229-SS3				8-8	1	RN242		51	294C	C3	[3]6U7G, [3]6J5G, 6V7G,		
							5-5	15	TN110					6N7G, 6X5G	262	10
							.005		Buffer	B14						
982083 (Oldsmobile)	Vol.	17	TM229-SS3				8-8	1	CN152		51	294C	C3	[2]6U7G, 6A8G, 6B8G,		
							10	15	TS101					6V6G, 0Z4G	262	10
							.005		Buffer	B14						
982084 (Oldsmobile)	Vol.	20	TM229-SS3				8-8-2-5-5	1/13/15	CN145/TN110		51	294C	C3	[2]6U7G, 6A8G, [2]6J5G,		
							.005		Buffer	B14				6Q7G, 6N7G, 0Z4G	262	10
982085 (Oldsmobile)	Vol.	20	TM229-SS3				8-8	1	RN242		51	294C	C3	[2]6K7G, 6A8G, 6B8G,		
							12	15	TS101					6V6G, 0Z4G	262	10
							.005		Buffer	B14						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
UNITED MOTORS SERVICE—Continued																
983506 (Pontiac)	Vol.	17	UM162-SS3				1210528	1/15	CN152/TN111		25	273C		[2]6D6, 6A7, 85, 76, 6E6	262	10
	Tone	22	N													
983507 (Pontiac)	Vol.	17	UM154-SS3				1210511	1/15	CN152/TS101		25	273C		[2]6D6, 6A7, 75, 42	262	10
	Tone	22	N													
983526 (Pontiac)	Vol.	20	TM229-SS3				1210548	1	CN152		51	294C	C3	[2]6U7G, 6A8G, 6V7G,		
							1210549	15	TN110					6J5G, 6N7G,		
							.005		Buffer	B14				6X5G	‡	10
983527 (Pontiac)	Vol.	20	TM229-SS3				1211580	1/15	CN152/TS101		51	294C	C3	[2]6U7G, 6A8G, 6Q7G,		
							.005		Buffer	B14				6F6G, 6X5G	‡	10
983534 (Pontiac)	Vol.	20	TM241-SS4				7230264	1	RN242		51	294C	C3	[2]6K7G, 6A8G, 6Q7G,		
							.005		Buffer	B14				6N6G, 6X5G	262	10
983569 (Pontiac)	Vol.	17	TM229-SS4				8-8-2-5-5	1/13/15	CN145/TN110		51	294C	C3	[2]6U7G, 6A8G, 6R7G,		
							.005		Buffer	B14				6J5G, 6N7G, 0Z4G	262	10
983570 (Pontiac)	Vol.	18	TM229-SS4				4-8	4	RM261		51	294C	C3	[2]6K7G, 6J7G, 6Q7G,		
							.01-.01		Buffer	B14				6F6G, 0Z4G	262	10
985200 (Chevrolet)	Vol.	20	1 Meg. No. 1		See Note A3		W38363	4	RM255	B64	35	294	C3	6D6, 6A7, 6B7, 76,		
							.01		Buffer	B14				42, 84	262	10
985252 (Chevrolet)	Vol.	18	UM150-SS3				6-6	1	RN242		51	294C	C3	[2]6K7G, 6A8G, 6Q7G,		
							.005		Buffer	B14				6F6G, 6X5G	262	10
985253 (Chevrolet)	Vol.	17	TM241-SS3				8-8	1	RN242		51	294C	C3	[2]6K7G, 6A8G, 6Q7G,		
	Tone	22	MR39				.005		Buffer	B14				6N6G, 6X5G	262	10
985254 (Chevrolet)	Vol.	17	TM229-SS3				8-8	1	CN152		51	294C	C3	[2]6U7G, 6A8G, 6Q7G,		
	Tone	‡	MR48				.005		Buffer	B14				6F6G, 6X5G	262	10
985255 (Chevrolet)	Vol.	17	TM232-SS3				8-8-4-12	1/13/15	RN245/TS101		51	294C	C3	[2]6K7G, 6A8G, 6R7G,		
	Tone	22	MR44				.005		Buffer	B14				[2]6N6G, 6X5G	262	10
985283 (Chevrolet)	Vol.	18	TM252-SS3				1212314	1/15	RN242/TS101		51	294C	C3	[2]6U7G, 6A8G, 6R7G,		
	Tone	22	MR44				1212313	15	TS105					[2]6V6G, 0Z4	262.5	10
							.01-.01		Buffer	B14						
985284 (Chevrolet)	Vol.	18	TM219-SS3				7233092	1	RN242		51	294C	C3	[2]6K7G, 6J7, 6R7G,		
							7231831	15	TS101					6J5G, 6N7G, 0Z4G	262	10
							.01-.01		Buffer	B14						
985285 (Chevrolet)	Vol.	17	TM229-SS3				1212441	1/13	CN145		51	294C	C3	[2]6U7G, 6A8G, 6Q7G,		
	Tone	22	MR48				.005		Buffer	B14				6F6G, 0Z4G	262	10
985300 (Chevrolet)	Vol.	17	TM241-SS3				1210857	1/15	CN152/TN110		26	273D		[2]6D6, 6A7, 85, 76, 6A6	262	10
	Tone	119	K12													
985301 (Chevrolet)	Vol.	20	TM241-SS3				1211167	1	CN152		26	273D		[2]6D6, 6A7, 85, 76, 6A6	262	10
							1211166	15	TN111							
985400 (Chevrolet)	Vol.	20	TM241-SS3				1209285	1/15	RN245		26	273C		6D6, 6A7, 85, 41	262	10
1291344 (Buick)	Vol.	127	UM154-SS3		EB247		1209144	1/15	CN152/TN110	B220	25	273C		78, 6A7, 6F7, 85, [2]41	262	10
	Tone	44	K12													
1291345 (Buick)	Vol.	15	UM154-SS3		EB247		1209047	1/15	CN155		25	273C		6F7, 6A7, 6B7, 42	262	10
1304873 (Buick)	Vol. & Tone	22/17	SMD502				8-8	1	RN242		50	715	C3	[2]6K7G, 6A8G, 6R7G,		
							10-10	15	TN111					6J5G, 6N7G	262	10
							.01-.01		Buffer	B14						
UNITED REPRODUCERS CORP.			(Peerless)													
20 Series	Vol.	35	‡		See Note A5		2-2-2	60	See Note	B1				[3]24A, [3]27, [2]45, 80		‡
	Sen.	105	X													
45 (Arborphone)	Vol.	4	G12				‡	1/14	See Note	B1				[4]26, 27, [2]71A, 80		11
65 (Electro Static Spkr.)	Vol.	7	UC500				2-1	1	See Note	B1				[3]24A, [2]27, [2]45, 80, 99		24
70 Series (71, 72)	Vol.	6	E12		See Note A3		2-2	1	See Note	B1				[4]24A, 01A, 27, [2]45, 80		‡
	Sen.	98	X		See Note A3											
UNITED SCIENTIFIC LABS.—See Dewald.																
UNIVERSAL BATTERY CO.																
5 tube 32V	Vol.	18	MR48				10	15	TS101					6A7, 6D6, 75, 76, 48	‡	
6 tube 6 volt	Vol.	15	MR48				12-6	1	CN145	B3	Order	from Mf	r.	6A7, 34, [2]76, 75, 19	‡	10
							10	15	TS101							
							.01-.01		Buffer	B14						
7 tube 6 volt	Vol.	15	MR48				12-6	1	CN145	B3	Order	from Mf	r.	[2]34, 6A7, [2]76, 75, 19	‡	10
							10	15	TS101							
							.01-.01		Buffer	B14						
50A6	Vol.	17	MR48				4-8	1	CN151		15	246	C3	1D7G, 1D5G, 1H4G,		
	Tone	57	MR48				.01		Buffer	B14				1H6G, 1F5G	175	10
60	Vol.	18	UM157		See Note A96		18-203	‡	CM175		35	294	C3	6K7, 6A8, 6D6, 75,		
	Tone	21	‡		See Note A5		.005		Buffer	B14				41, 84	262	10
61A6	Vol.	17	MR48				4	1	CS131		14	245C	C3	6D8G, 1D5G, [3]1H4G,		
	Tone	65	MR48				20	1	CN145	B3				1J6G	465	10
							.01		Buffer	B14						
72A6	Vol.	17	MR48				4	1	CS131		14	245C	C3	[2]1D5G, 6D8G, 1H6G,		
	Tone	65	MR48				16	1	CS126					[2]1H4G, 1J6G	465	10
							.01		Buffer	B14						
613V (32 Volt DC)	Vol.	18	N											6A7, 6D6, 85, 6C6, 48	465	
636V	Vol.	15	MR48				4	1	CS131		48	See Note	C8	6D8G, 34, [3]30, 19	‡	10
	Tone	57	MR48				16	1	CS126							
							.01		Buffer	B14						
802	Vol.	18	UM154		See Note A96		4-4	4	CM170		35	294	C3	6A7, 6D6, 75, 42, 84	456	10
							.01		Buffer	B14						
803	Vol.	18	UM154		See Note A96		4-4	4	CM170		35	294	C3	[2]6D6, 6A7, 75, 42, 84	456	10
							.01		Buffer	B14						
5010	Vol.	18	MR48				12-16	4	CM164					6A8G, 6K7G, 6Q7G,		
														25A6G, 25Z6G	465	
5032	Vol.	18	MR48											6A8G, 6K7G, 6Q7G,		
														6C5G, 48	465	
6110	Vol.	18	MR48				8-8	23	RM262					6C5G, 6J7G, 6K7G,		
														6Q7G, 6F6G, 5Y3	456	1
6132	Vol.	18	MR48											6A8G, 6K7G, 6Q7G,		
														38, [2]48	465	
6310	Vol.	18	MR48				8-8	23	RM262					6C5G, 6J7G, 6K7G,		
														6Q7G, 6F6G, 5Y3	456	1
7232, 7332	Vol.	15	N				12-6	1	See Note	B3	47	See Note	C6	76, 6D6, 6C6, 6A7, 42	465	10
							10	15	TS101							
8210	Vol.	18	MR48				8, 8	3	RS213					6J7G, [2]6C5G, 6K7G,		
							4	3	CS131					6Q7G, 6G5, 6N6G,		
														5Y3G	465	1
8232, 8332	Vol.	15	MR48				8, 8	1	CS133		35	294	C3	[2]6K7G, 6A8G, 6H6G,		
							10	15	TS101					6G5, 6J7G, 6F6G,		
							.01		Buffer	B14				6X5G	465	10
8410	Vol.	18	MR48				8, 8	3	RS213					6J7G, [2]6C5G, 6K7G,		
							4	3	CS131					6Q7G, 6G5, 6N6G,		
														5Y3G	465	1
U. S. RADIO & TELEVISION		(Apex, Radiotrope)														
3	Vol.	58	F				8-8	4	See Note	B3				[2]24A, 47, 80		1
5A (AC) (Chassis 502)	Vol.	6	G12	6			4703	1	CN152					[2]57, 58, 47, 80	455	1
7 (AC)	Vol.	15	N				3366	28	CS131					[2]35, [2]24A, 27, 47, 80	262	3
	Lclzr.	‡	UC502				3529	28	CS131							
	Tone	22	UC509													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
U. S. RADIO & TELEVISION—Continued																
7D (Chassis 700)	Vol.	6	G12				8-8	1	See Note	B3				^{2}56, 57, ^{2}58, 47, 80	455	3
	Tone	34	M													
8 Series	Vol.	15	O				2803	1	CS133	B194				^{3}35, ^{3}27, 47, 80	262	3
	Tone	34	UC502				2852	17	CS123							
9 (Chassis 900, 902)	Vol.	15	M	6			8-8	28	CN152					^{2}58, ^{2}57, 56, ^{3}46, 80	262	7
	Sen.	98	F				8	28	CS133							
	Tone	95	L				4	14	CS121							
10	Vol.	15	O				2803	1	CS133					^{3}35, ^{4}27, ^{2}47, 80	262	3
	Tone	44	UC502				2719	13	CS123							
							2852	15	TS106							
10C (Chassis 1000-1001)	Vol.	15	O				2803	1	CS133					^{4}35, ^{3}27, ^{2}47, 80	262	3
	Tone	41	M				2719	13	CS123							
							2852	15	CS123							
12 (Class "B") (Chassis 1200)	Vol.	15	M		See Note	A27	4-8-8	3	See Note	B3				^{3}58, ^{3}56, ^{3}46, ^{2}57, 82	262	33
	Vol.	20	TRP606		See Note	A4	8	18	See Note	B3						
	Tone	‡	L		See Note	A27	8	17	TS106	B3						
	Tone	21	N		See Note	A4										
	Sen.	7/12	DRP316													
19 (Chassis 900, 902)	Vol.	15	M				8-8-8	28	See Note	B3				^{2}58, ^{2}57, 56, ^{3}46, 80	262	7
	Tone	95	L				4	‡	See Note	B3						
	Sen.	98	F													
20	Vol.	6	G12				8-8	25	See Note	B3				^{2}24A, 71A		1
24 (Chassis 400)	Vol.	40	Y	6			8-8	1	CN152					47, ^{2}57, 80	455	1
							4	19	TS101							
25 (Chassis 500) (2 types)	Vol.	6	G12				8-8	1	See Note	B3				^{2}57, 58, 47, 80	455	1
26	Vol.	6	G12				1942	1	RS213					^{3}24A, 45, 80		1
26P	Vol.	6	G12				2678	1	RS213					^{3}24A, 47, 80		1
27 (Early)	Vol.	42	UC500				8-8	1	See Note	B3				^{2}24A, 27, 45, 80		1
27 (Late)	Vol.	6	G12	6			8-8	1	See Note	B3				^{2}24A, 27, 45, 80		1
27P	Vol.	6	G12				8-8	1	See Note	B3				^{2}24A, 27, 45, 80		1
	Phono.	87	‡		See Note	A5										
28 (Early) (Late)	Vol.	8	A400P				1-3-1	3	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80		3
	Tone	41	N													
29	Vol.	6	G12	6			8-8-8	1/14	See Note	B3				^{3}24A, ^{2}27, ^{2}45, 80		
	Tone	41	N													
30 Auto	Vol.	7	UC501											^{2}24A, 26, 71A, 01A		
31 Apex	Vol.	6	G12	6			8, 8, 8	28	RS213					^{2}27, ^{3}24A, ^{2}45, 80		1
	Tone	41	N													
31R (Remote Control)	Vol.	7	G				8, 8, 8	28	RS213					^{2}27, ^{3}24A, ^{2}45, 80		1
	Tone	41	N													
32 Series	Vol.	6	G12				8, 8, 8	28	RS213					^{2}45, 27, ^{3}24A, 80		1
	Tone	41	N													
33 (DC)	Vol.	6	G12											^{3}64, ^{3}71A		
36, 37 Apex	Vol.	4	D12				1-1-1	3	See Note	B1				71A, ^{4}26, 27, 80		11
41 (60 Cycle)	Vol.	8	A400P				1-1.5-1	3	See Note	B1				^{5}27, ^{2}45, 80		3
42 (60 Cycle)	Vol.	8	A400P				1-1-1	3	See Note	B1				^{5}27, ^{2}45, 80		3
43 (25 Cycle)	Vol.	8	A400P				1-1.5-1	3	See Note	B1				^{5}27, ^{2}45, 80		3
44 (25 Cycle)	Vol.	8	A400P				1-1-1	3	See Note	B1				^{5}27, ^{2}45, 80		3
46, 46A, 47, 47A	Vol.	8	A400P				1-1.5-1	3	See Note	B1				^{2}27, ^{2}24A, ^{2}45, 80		3
48, 48A, 48W	Vol.	8	A400P				1-3-1	3	See Note	B1				^{2}27, ^{3}24A, ^{2}45, 80		3
	Tone	41	N													
49	Vol.	6	G12											^{2}24A, 26, 01A, 71A		
69 (Chassis 906)	Vol.	15	N				4-4	12/19	CN140	B3				^{2}32, 34, ^{6}30	262	
	Tone	44	UC502													
80 (Case)	Vol.	4	D12		See Note	A27	‡	‡	See Note	B1				^{5}26, 27, ^{2}71A, 80		11
	Vol.	40	G12		See Note	A4										
99 Series	Vol.	6	G12				3366	1	CS131					^{2}24A, 35, 47, 80	262	1
							2803	1	CS133							
120 Class "B" (Chassis 1200)	Vol.	15	M		See Note	A27	4-8-8	3	See Note	B3				^{3}58, ^{3}56, ^{3}46, ^{2}57, 82	262	33
	Vol.	20	TRP606		See Note	A4	8	18	See Note	B3						
	Tone	‡	L		See Note	A27	8	17	TS106	B3						
	Tone	21	N		See Note	A4										
	Sen.	7/12	DRP316													
160, 250 (Chassis 90)	Vol.	40	‡		See Note	A5	2-2-2	1/14	See Note	B1				^{6}27, ^{2}45, 80		25/34
482	Vol.	8	A400P				1-3-1	3	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80		3
	Tone	41	N													
1006, 1007 Class "B"	Vol.	15	M				8-8-8	28	See Note	B3				^{3}58, ^{3}56, ^{3}46, 80	262	7
	Tone	95	K12				8-8	‡	See Note	B3						
3040, 3056 (Chassis 507)	Vol.	6	Y				8-8	1	CN152	B3				47, ^{2}57, 58, 80	455	1
							4	17	TS101							
3070 (Chassis 1009)	Vol.	15	M				8-8	55	CN152	B3				^{3}58, ^{4}56, ^{2}46, 80	262	1
	Tone	41	K12				4	55	CS131							
3092 (Chassis 513)	Vol.	6	Y				4-12-4	11	UR182	B182				6F7, 78, 75, 43, 25Z5	455	
UTAH PRODUCTS CO.																
400A Series	Vol.	15	M				8-8-4-2	37	See Note	B3				^{4}58, 55, ^{2}56, 57, ^{4}47, 80	180	3
	Supp.	‡	Y250MP		See Note	A4	40	15	SR608	B3						
	Tone	41	O													
400B	Vol.	33	M				8-8-4-2-2	3	See Note	B3				55, ^{6}58, ^{3}56, 57, ^{4}2A5, 5Z3	180	7
	Tone	‡	M				40	15	SR608	B3						
	Supp.	44	UC501													
"B" Elim. (Non Sync.)							8	1	CS123		4	221	C3	84		10
							20	‡	TS102							
							.02		Buffer	B14						
VICTOR—See RCA.																
VIKING—See Ozarka.																
VOCO RADIO MFG. CO., INC.																
V41N	Vol.	6	SRP263				8-4	4	See Note	B3				35, 24A, 47, 80		1
V60	Vol.	15	N				6-6	1	CN152	B3				^{2}58, 57, 55, 47, 80	175	1
V80	Vol.	15	N				‡	1	See Note	B3				^{3}58, ^{2}56, Wunderlich, 47, 80	‡	1
V100	Vol.	15	N				‡	1	See Note	B3				^{4}58, Wunderlich, ^{2}56, ^{2}47, 80	‡	1
WALGREEN—See Aetna.																
WALTHAM																
32	Vol.	6	H12				8-8	4	See Note	B3				^{4}24A, 45, 80		1
WALTON RADIO CORP.																
Wal-Tone "EX"	Vol.	7	H		2		A403	4	CS133	B3				56, 57, ^{2}58, 47, 80	457.5	3
							A404	4	CS131	B3						

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
WARE MFG. CORP.																
B1, B2, Bantam	Vol.	8	UC500				14-2	1	MN273	B3				^{3}24A, 27, 45, 80		‡
SBB	Vol.	42	G	6			8, 8	4	RS213					^{2}51,^{2}24A, 27, 47, 80	175	1
	Tone	22	O													
SBA	Vol.	42	Y10MP	6			8-4-2	3	MN275					^{2}51, 24A, 27, 80	175	1
	Tone	22	O													
SBF, SBFa	Vol.	42	A10MP				8-8	25	See Note	B3				27,^{2}24A,^{2}35, 47, 80	175	1
	Tone	22	‡		See Note A5											
S1	Vol.	42	A400P				8-4-2	3/13	MN275					^{4}24A,^{2}27,^{2}45, 80	175	‡
	Tone	41	O													
SB7	Vol.	42	A10MP				8, 8	23	RS213					^{2}35, 27,^{2}24A, 47, 80	175	1
	Tone	22	Y200MP													
SB8	Vol.	59	G12				8, 8	23	RS213					^{2}51,^{3}24A, 47, 27, 80	175	1
	Tone	22	Y200MP													
SB45	Vol.	6	G12	6			8-4-2	3	MN275	B3				^{3}24A,^{2}27, 45, 80	175	3
	Tone	22	O													
WARWICK																
4 tube AC	Vol.	6	N			A14	12	4	RS215					6A7, 6C6, 42, 80	456	1
							16	4	RS216							
6 tube Auto	Vol.	17	UM162		See Note A96		4-4-8	4/15	CM175	B3	46	504	C3	^{2}6D6, 6C6, 75, 42, 84	262.5	10
	Tone	‡	L				.0075		Buffer	B14						
7 tube Battery	Vol.	18	MR48											1C6,^{2}34, 1B5, 30, 19	456	
	Tone	22	MR33													
419, 420	Vol.	6	H12		EX300		16-12	27	CM164					6D6, 6C6, 43, 25Z6		
							10	15	TS101							
453	Vol.	18	MR53	M26			1845	1	CN142		14	215C	C3	6D8G, 6S7G, 6T7G, 6N5, 1F5G	456	10
							.008		Buffer	B14						
501	Vol.	18	MR48				16-12	4	CM164	B3				6A7, 6D6, 75, 43, 25Z5	456	
515	Vol.	18	MR48	M26			18-102	1/15	RN245	B34				6A7, 6D6, 75, 41, 80	456	1
517	Vol.	17	MR53	M26			18-102	1/15	RN245	B34				6A7, 6D6, 75, 41, 80	456	1
518	Vol.	18	MR48	M26			18-102	1/15	RN245	B34				6A7, 6D6, 75, 41, 80	456	1
520	Vol.	6	H12				8-4-10-10	24/15	CM161/TN111					6D6, 6C6, 43, 25Z5		
521	Vol.	17	MR53	M26			18-102	1/15	RN245	B34				6A7, 6D6, 75, 41, 80	456	1
524	Vol.	6	‡	M26	See Note A5		18-212	24	Order from Mfr.					6D6, 6C6, 43, 25Z5, L55C		
530	Vol.	18	MR48				8-8	23	CM172	B3				6A7, 6D6, 75, 42, 80	456	1
536	Vol.	15	MR48	M26			16-100	20	TS101					1C6, 34, 1B5, 33, 5E1	456	
537	Vol.	18	MR48	M27			16-100	19	TS101					1D7G, 1D5G, 1H6G, 1G5G, NB1	456	
542	Vol.	6	H12		EX300		16-12	27	CM164					6D6, 6C6, 43, 25Z5		
562	Vol.	18	MR48				1845	1	CN142	B3	15	246	C3	1C6, 1A4, 6T7G, 41, 6N5	456	10
	Tone	21	‡		See Note A5		.01-.01		Buffer	B14						
601	Vol.	18	N				18-202	25	RS215					6A7, 76, 6D6, 75, 42, 80	456	1
	Tone	21	N	6			18-201	25	WE1247							
613	Vol.	17	N				18-102	1/15	RN245	B34				6A7, 6D6, 75, 41, 6G5, 80	456	1
	Tone	21	N	6												
623	Vol.	18	MR48				18-102	1/15	RN245	B34				6A7, 6D6, 75, 41, 6G5, 80	456	1
	Tone	21	MR48	M26												
633	Vol.	18	N				18-102	1/15	RN245	B34				6A7, 6D6, 75, 41, 6G5, 80	456	1
	Tone	21	N	6												
645	Vol.	18	MR48				18-102	1/15	RN245	B34				6A7, 6D6, 75, 6G5, 41, 80	456	1
	Tone	21	MR48	M26												
646	Vol.	18	UM157			A96	18-203	74/19	CM175		35	294	C3	6K7, 6A8, 6D6, 75, 41, 84	262	10
	Tone	21	MR48				.005		Buffer	B14						
651	Vol.	18	N				1845	1	CN142		15	246	C3	1A6, 30, 1A4, 6T7G, 6L5G, 19	456	10
	Tone	21	‡	7	See Note A5		16-100	15	TS101							
							.01-.01		Buffer	B14						
701	Vol.	18	N				18-202	25	RS215					6A7, 76, 6D6, 75, 42, 6G5, 80	456	1
	Tone	21	N	6			18-201	25	WE1247							
710	Vol.	17	MR53	M26			30-8	1	See Note	B3				6A7, 6D6, 6Q7G, 6G5, 25B5, 25Z5, L42B	456	
715A	Vol.	17	MR53	M26			30-8	1	See Note	B3				6A7, 6D6, 6Q7G, 6G5, 25B5, 25Z5, L42B	456	
735	Vol.	18	MR48				18-202	25	RS215					6A7, 6D6, 76, 6Q7G, 6V6G, 6G5, 80	456	1
	Tone	21	MR48	M26			18-201	25	WE1247							
741	Vol.	18	N				18-200	23	CM172					6A7, 76, 6D6, 75, 41, 6G5, 80	456	1
	Tone	21	N	6												
746	Vol.	18	UM157			A96	18-204	24/15	CN155		35	294	C3	6K7, 6A8, 6K7G, 6Q7G, 6J5G, 6N7G, 0Z4	262	10
	Tone	22	Order from Mfr.				.008		Buffer	B14						
751	Vol.	18	N				1845	1	CN142		15	246	C3	1A6, 30, 1A4, 6T7G, 6L5G, 19, 6N5	456	10
	Tone	21	‡	7	See Note A5		16-100	15	TS101							
							.01-.01		Buffer	B14						
761	Vol.	18	N				1845	1	CN142		15	246	C3	6D8G, 30, ^{2}1A4,6T7G,	456	10
	Tone	21	‡	7	See Note A5		16-100	15	TS101					6L5G, 19	456	10
							.01-.01		Buffer	B14						
780	Vol.	18	N											1A6, 1A4,^{2}30, 1F6, 19, 5H1 (Ballast)	456	
	Tone	21	‡	7	See Note A5											
846	Vol.	18	UM157			A96	18-204	24/15	CN155		35	294	C3	^{2}6K7, 6A8, 6K7G, 6Q7G, 6J5G, 6N7G, 0Z4	262	10
	Tone	22	Order from Mfr.				.008		Buffer	B14						
871	Vol.	18	MR48				18-202	1	RS215					6A7, 6D6, 75, 76,^{2}42, 6H5, 80	456	1
	Tone	21	‡	6	See Note A5		18-201	1	WE1247							
872	Vol.	18	MR48				18-202	1	RS215					6A7, 6D6, 75, 76, ^{2}42, 6G5, 80	456	1
	Tone	21	‡	6	See Note A5		18-201	1	WE1247							
881	Vol.	148	‡		See Note A5		18-202	1	RS215					6A7, 6D6, 6H6G, 6G5, 6Y7G, ^{2}6V6G, 80	456	1
	Tone	41	‡		See Note A5		18-201	1	WE1247							
885	Vol.	148	‡		See Note A5		18-202	1	RS215					6A7, 6D6, 6H6G, 6G5, 6Y7G,^{2}6V6G, 80	456	1
	Tone	41	‡		See Note A5		18-201	1	WE1247							
1101	Vol.	148	‡		See Note A5		18-214	1	RS216					^{2}6C5G, 6A8G, 6K7G, 6H6G, 6G5,^{2}6J7G, ^{2}6V6G, 80	456	1
	Tone	44	Order from Mfr.				18-215	1	RS215							
							18-216	13	CS123							
1105	Vol.	148	‡		See Note A5		18-214	1	RS216					^{2}6C5G, 6A8G, 6K7G, 6H6G, 6G5, ^{2}6J7G, ^{2}6V6G, 80	456	1
	Tone	44	Order from Mfr.				18-215	1	RS215							
							18-216	13	CS123							
WEBSTER CO.																
B53	Vol.	‡	‡		See Note A5		8-8-8	3	See Note	B3				2A6,^{2}53, 82		1
	Phono.				See Note A5		20-20	15	TS102							
							20	14	TS102							
HG417	Vol.	15	O				8-8-8-8	3/13	See Note	B3				57, 53,^{2}2A5, 5Z3		3
	Phono.	63	K12				12	15	TS102							
	Tone	41	L				8	15	TS106							
							8	14	CS123	B3						
K358A	Vol.	16	K12				8-8-8	3	See Note	B3				57, 56,^{2}2A3, 83		3
	Phono.	63	S				4	15	TS101							
							8	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
WEBSTER—Continued																
K359A	Vol.	16	K12				8-8-8	3	See Note	B3				‡, ‡,^{2}2A3, 83		1
	Mic. Adj.		M100P				4	15	TS101							
PA17	Vol.	16	L				8-8-8-8	3	RS213	B3				58, 56,^{2}2B6, 5Z3		3
	Phono.	‡	K12				20-20	15	TS102	B66						
PA42	Vol.	16	K12				8-8	1	See Note	B3				79,^{2}42, 82		1
	Phono.	63	G12				20	‡	TS102							
	Tone	34	G12				4	15	TS101							
WR85	Vol.	15	O				8-8-8	3	See Note	B3				58, 56,^{2}2A5, 80		1
	V.R.	‡	Order from Mfr.				8	13	See Note	B3						
	P.E. Adj.	‡	M50MP													
	Tone	‡			See Note A5											
WELLS-GARDNER & CO.—"Gulbransen," "Truetone"—(See Trade Names)																
A1	Vol.	45	MR48	M26			44X35	23	RS215					6J7, 6K7, 6H6, 6C5,		
	Tone	34	UC502				44X31	23	WE3540					6G5, 6F5, 6F6, 5Y3,		
														or glass equivalents	456	1
A2	Vol.	45	TM228-SS1	M26			44X30	25	RS216					^{2}6K7, ^{2}6J7,^{2}5C5, 6H6,		
	Tone	34	MR53				44X11	25	WE1847					6G5,^{2}6F6, 5Y3, or		
							45X223	13	CS121					glass equivalents	456	1
							45X222	19	T103							
00A	Vol.	62	O				80891B	12	CS121					^{3}34,^{6}30	175	
	Tone	44	UC502													
00B	Vol.	15	P	6			P80990	2	RS216					^{4}58,^{3}56,^{2}45, 80	175	3
	Tone	41	UC504				P81000	2/13	CN151							
0C Series (20C5)	Vol.	15	P	6			P81039	2	RS216					^{4}6D6,^{3}76,^{2}45, 80	456	3
	Tone	41	UC504				P81018	2/13	CM173							
0DM	Vol.	7/15	DRP315	6	See Note A59		44X10	4	RS216					^{4}6K7,^{3}76,^{2}45, 80	456	3
	Tone	41	UC504				44X11	4	RS216							
							44X18	13	RS201							
OEL	Vol.	62	2 Meg. No. 1	6	See Note A19		44X10	25	RS216					^{4}6K7,^{3}6C5, 6G5, ^{2}6F6,		
	Tone	65	Order from Mfr.				44X11	25	RS216					5Z4, MG	456	1
							44X213	13/15	CS121/TS101							
OF Series	Vol.	64	2 Meg. No. 1	13	See Note A19		P45X214	12	CM173	B3				^{6}30, 32,^{3}34	456	
	Tone	44	UC502													
02A	Vol.	17	P	6			P80984	2/13	CN155/CN142	B120				^{4}58, 55,^{3}56,^{3}45, 82	175	21
	Tone	41	UC504													
02AA	Vol.	17	P	6			P80984	2/13	CN155/CN142	B120				^{4}58, 55,^{3}45,^{3}56, 82	175	21
	Tone	41	UC504													
022	Vol.	45	Z12				8	58	HD682					^{4}58,^{3}56,^{2}57,^{2}46, 82	175	3
	Tone	41	UC502				8	58	RS213							
	Supp.	8	E				4	58	RS211							
							4	19	CS121							
05A	Vol.	6	G12	6	EX300		P80944	11	SR631					^{2}77, 78, 43, 25Z5	262	
							80878C	19	CS121							
							80936C	15	TS101							
05AA	Vol.	6	H12	6			80944E	11	SR631					6C6,^{2}6D6, 43, 25Z5	262	
05BA	Vol.	6	H12	6			80944E	11	SR631					6C6,^{2}6D6, 43, 25Z5	262	
052 Series	Vol.	6	H12	6	EX300		8-8	4	CM172					^{2}57, 35, 47, 80	262	1
06A	Vol.	97	TRP602				P80968	12	CS121					32,^{2}34, 19, 30	175	
06W	Vol.	18	UM154			A96	P80939	2	CN155		1	210	C5	^{2}78, 77, 85,^{2}41	262	26
	Tone	44	UC502				P80965	14	CS121	B3	12	237	C5			
							.01		Buffer	B14						
06Z	Vol.	18	N				P80956	25/19	RM262/TS102	B126	34	292	C12	^{2}78, 77, 75, 41, 84	262	10
							P80937	14/15	RN231	B127						
							.02		Buffer	B14						
062 (Auto Set)	Vol.	45	N				4	13	CS121		1	206		^{3}39, 37, 36, 38	262	
							4	15	TS105							
062A	Vol.	45	N				4	13	CS121		1	206		^{3}39, 36, 37, 41	262	
							4	15	TS105							
07A	Vol.	15	O	6			P80990	25	RS216					^{2}6D6, 6C6, ^{2}37, 42, 80	175	1
	Tone	22	UC502				P80916	25	RS213							
072	Vol.	18	N				P80902	13/15	See Note	B145	2	211		^{3}39, 36, 37,^{2}38	262	
	Tone	44	UC502													
073	Vol.	15	N				4	13	CS121					^{2}36,^{3}39,^{2}41	175	
	Tone	22	K12													
092 Series Battery	Vol.	45	N				P80878C	12	CS121					^{3}34,^{6}30	175	
	Tone	22	UC502													
2B Series (22B5)	Vol.	15	P	6			P81058	2	RS216					^{4}6D6,^{3}76,^{3}42, 80	456	1
	Tone	21	UC502				P81039A	2	RS216							
							P81056	13	CN151							
							P82000	19	TS108							
2CM	Vol.	7/15	DRP315	6			P44X21	25	WE3540					^{4}6K7,^{3}76,^{3}6F6,^{2}80	456	1
	Tone	22	UC504				P44X11	25	RS216							
							P44X20	19	Order from Mfr.							
2DL	Vol.	20	TM247-SS1	M26			44X21	30	WE3540					^{4}6K7, 6H6, ^{3}6C5, ^{2}6L6,		
	Tone	65	Order from Mfr.				44X11	30	RS216					^{2}5Z4MG, 6G5	456	1
							44X216	13	CS121							
							44X209	19	TS101							
5B	Vol.	6	G12	6	EX300		P80944	11	SR631					^{2}77, 78, 43, 25Z5	262	
							P80878C	19	CS121							
							P80936C	15	TS105							
5D Series	Vol.	6	H12	6			P82004	23	RS215					6C6,^{2}6D6, 42, 80	456	1
							P82003	23	RS213							
5E Series (25E1, 25E5)	Vol.	97	TRP602				P80968	12	CS121					32,^{2}34, 30, 19	175	
5F, 5FL	Vol.	18	MR48				12	23	RS215					6A8, 6K7, 6Q7, 6G5,		
							16	23	RS216					6F6, 5W4	456	1
5G Series (35G510, 35G560)	Vol.	97	TRP617	14			P45X28	12	CS121					32,^{2}34, 30, 19	175	
5 Tube D. C. Model	Vol.	6	H12											^{2}24A,^{2}01A, 71A		
	Tone	21	O													
Series 5H	Vol.	18	MR53	M26			45X218	46	RM259		15	246	C3	1C6,^{2}34, 1B5, 1F4	456	10
							.01		Buffer	B14						
5K, 5KL	Vol.	18	MR48				12	23	RS213					6A8, 6K7, 6Q7, 6G5,		
							16	23	RS216					6F6, 5W4	456	1
5Y Series (25Y1)	Vol.	17	P	6			P82002	1/15	CM173		32	286S	C3	^{2}6D6, 6C6, 75, 41	175	10
							.007		Buffer	B14	32	G286S	C16			
6B Series (26B1, 26B5)	Vol.	56	N				P81016	23	CM172		20	F253	C3	6F7, 6D6, 6B7, 12A5,		
	Tone	34	UC502				.015		Buffer	B14				^{2}12Z3	175	10
6C Series	Vol.	17	P				P81042	23	RS215					^{2}6D6, 6A7, 42, 6B7, 80	456	1
	Tone	34	UC502				P81043	23	RS216							
							P81003	15	TS101							
6C1	Vol.	18	UM147-SS3	M26			45X210	4	CM171		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	UC502				.0075		Buffer	B14						
6D	Vol.	18	MR48				25	12	CN145	B8				^{2}6D6, 6A7, 85, 43, 6A6	175	
	Tone	44	L				30	13	RS207							
							12	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
WELLS-GARDNER & CO.—Continued																
6F	Vol.	7/15	Order from	Mfr.			P44X22	3	WE3540					^{4}6K7, ^{3}76, 6B7. 6F7,		
	Tone	34	O				P44X23	13	RS206					^{4}2A3, 45, ^{2}5Z3	456	‡
							P45X205	13/‡	CN140/CS126							
							P44X26	13	CS135							
6G	Vol.	18	O	14			45X212	12	CS121					1C6, 34, 1B5, ^{3}30	456	
6J	Vol.	56	TM220-SS3	M26			45X219	1/15	RN242/TS101		18	248	C3	^{2}6K7, 6J7, 6B7, 41,		
	Tone	22	MR53				.0055		Buffer	B14				6A6	175	10
6K	Vol.	56	TM230-SS3	M26			E45X211B	1/15	SR601/TS101		18	248	C3	6K7, 6J7, 6B7, 41,		
	Tone	22	O				.005		Buffer	B14				6A6	175	10
6L	Vol.	18	UM154-SS3	M26			45X210	4	CM171		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	UC502				.0075		Buffer	B14						
6N, 6R	Vol.	17	UM163	M26		A96	E45X206C	4/15	CM171/TS105		35	294	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	34	UC502				.0075		Buffer	B14						
6S (26S1)	Vol.	17	UC511	6			45X204	1	CN152		20	253	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	L				45X203	15	TN111							
							.01		Buffer	B14						
6 Tube 32 Volt	Vol.	56	N				P81016	23	CM172		20	F253	C3	6F7, 6D6, 6B7, 12A5,		
	Tone	34	UC502				.015		Buffer	B14				^{2}12Z3	175	10
6U Series (26U1)	Vol.	18	UC511	6			P81028	1	CN152		20	253	C3	^{2}78, 77, 75, 41, 84	262	10
	Tone	22	UC502				P81021	15	TN111							
							.01		Buffer	B14						
7C Series (27C1, 27C5)	Vol.	45	O				P81014	12	CM164					^{3}34, ^{3}30, 19	175	MG
7D Series (27D1, 27D5)	Vol.	56	N	6			P81043	4	RS216	B10				76, ^{3}6D6, 6B7, 42, 80	456	1
	Tone	34	UC502				P81042	4	RS216	B10						
							P80916	4	RS213							
							P81032	4	RS213							
7E	Vol.	45	MR53				P44X17	40	RS207					^{3}34, 1C6, ^{2}30, 19	456	MG
	Tone	44	UC502													
7F, 7FL	Vol.	17	TM246-SS1				44X10	23	RS216					^{3}6K7, 6C5, 6Q7, 6G5,		
	Tone	34	UC502				44X11	23	WE1847					6F6, 5Z4MG	456	1
							45X209	15	TS101							
7GM Series (37G508, 37G566)	Vol.	7/56	DRP314	6	See Note A59		44X10	23	RS216					^{3}6K7, 6B7, 6F6, 76, 80	456	1
	Tone	34	UC502				44X11	23	RS216							
7H Series (37H508, 37H566)	Vol.	45	O	14			20	12	CS126					^{3}34, 1C6, ^{2}30, 19	456	
	Tone	44	UC502													
7J	Vol.	56	N				44X11	23	RS216					^{3}6D6, 6B7, 76, 42, 80	456	1
	Tone	34	UC502				44X10	23	RS216							
7K	Vol.	7/56	DRP314	6			44X10	23	RS216					^{2}6K7, 76, 6B7, 6F6, 80	456	1
	Tone	34	UC502				44X11	23	RS216							
7L	Vol.	20	TM246-SS1	M26			44X10	23	RS216					^{3}6K7, 6C5, 6Q7, 6F6,		
	Tone	34	Order from	Mfr.			44X11	23	RS216					6G5, 5Z4, MG	456	1
							44X209	15	TS101							
7P	Vol.	18	N	6			45X217	12/15	TS107/TS101					^{3}6K7, 6A8, 6A6, 85, 43	456	
	Tone	44	Z12													
7Q	Vol.	45	MR53				P45X215	1/13	RM259		Order	from Mf	r.	^{3}34, 1C6, ^{2}30, 19	456	10
	Tone	44	UC502				P44X17	1	RS207							
							.01		Buffer	B14						
8T (AC)	Vol.	2/7	GG				‡	‡	See Note	B1				24A, 27, 45, 80		3
	Tone	41	O													
9 in Line	Vol.	1/15	DRP241				2-1-1-1.5	3	See Note	B1				^{5}26, 24A, ^{2}45, 80		9
9B Series (29B5)	Vol.	15	P				P82001	24	CN141					^{4}34, ^{4}30, 19	456	
	Tone	41	K12													
9C	Vol.	15	MR55				4-8	13	CN141					^{4}34, ^{4}30, 19	456	
	Tone	44	UC502													
10-7 Tube Super	Vol.	7	F		2		80848	23	RS213					^{2}35, ^{2}24A, 47, 27, 80	175	3
	Tone	103	O	6			80849	23	RS213							
20 Series	Vol.	78	N				8, 8, 8	30	RS213					^{4}35, ^{3}27, ^{2}47, 80	175	1
	Tone	41	P	6												
40	Vol.	111	Y5MP				P80896	30	CM173					^{3}35, ^{2}24A, 47, 27, 80	175	3
	Tone	34	UC502				P80878	13	CS121							
40A	Vol.	14	N				P80896	30	CM173					^{3}35, ^{2}24A, 47, 27, 80	175	3
	Tone	34	UC502				P80878	13	CS121							
50	Vol.	‡	SRP271				P80196	4	RS213					^{2}35, ^{3}24A, 47, 80	175	7
	Tone	34	UC502				P80878C	13	CS121							
60, 63	Vol.	6	TRP600	7			P80849	25	RS213					^{4}24A, 45, 80		1
							P80848	25	RS213							
72	Vol.	6	H12				‡	‡	See Note	B1				^{3}24A, 27, ^{2}45, 80		1
	Tone	41	O													
80	Vol.	2/7	GG				‡	‡	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80		3
	Tone	41	O													
80A, 82	Vol.	‡	D	6			‡	‡	See Note	B1				^{3}24A, ^{2}27, ^{2}45, 80		3
	Tone	41	O													
90, 91, 92, 93	Vol.	4	DRP241				4	12	CS121					^{4}32, 33	175	
161, 162	Vol.	97	TRP600	7			P80849	25	RS213					^{4}24A, 45, 80		1
							P80848	25	RS213							
200, 291, 292, 295	Vol.	1/15	DRP241				2-1-1-1.5	3	See Note	B1				^{5}26, 24A, ^{2}45, 80		9
322	Vol.	45	Z12				8	30	HD682					^{4}58, ^{3}56, ^{2}57, ^{2}46, 82	175	3
	Tone	41	UC502				8	30	RS213							
	Supp.	8	E				4	30	RS211							
							4	19	CS121							
352 Series	Vol.	6	H7	6	3		8-8	4	CM172	B3				^{2}57, 35, 47, 80	175	1
502	Vol.	15	N	6			P80923A	30	CN155					^{3}58, ^{2}57, ^{2}56, ^{2}47, 80	175	1
	Tone	22	O				80873	30	CS131							
							80878C	13	CS121							
572 (AC)	Vol.	‡	SRP271				80894B	4	CM172					^{2}58, ^{3}57, 47, 80	175	7
	Tone	34	UC502				80891B	13	CS121							
872 Series	Vol.	‡	SRP271				80894B	4	CM172					^{2}58, ^{3}57, 47, 80	175	7
	Tone	34	UC502				80891B	13	CS121							
C-CG (1st and 2nd types)	Vol.	60/15	DRP243		See Note A4		2-1-1-1	59	See Note	B1				^{5}26, 24A, ^{2}45, 80		9
	Vol.	2	E12		See Note A27											
V6Z2, Z6Z1	Vol.	17	N				P80956	25/19	RM262/TS102	B126	34	292	C12	^{2}78, 77, 75, 41, 84	262	10
							P80937	14/15	RN231	B127						
							.02		Buffer	B14						
WESTERN AUTO SUPPLY CO. (Truetone, Wells-Gardner)																
062, 062A	Vol.	45	N				4	13	CS121		1	206		^{3}39, 36, 37, 41	262	
	Tone	34	UC502				4	15	TS105							
06W	Vol.	56	N				16-8	1	CN155		2	210	C3	^{2}78, 77, 85, 41	262	26
	Tone	41	UC502				4	15	TS105							
06Z	Vol.	18	N				P80956	25/19	RM262/TS102	B126	34	292	C12	78, 77, 41, 84, 75	262	10
							P80937	14/15	RN231	B127						
							.02		Buffer	B14						
6S	Vol.	17	UC511	6			45X204	1	CN152		20	253	C3	^{2}6D6, 6C6, 75, 41, 84	175	10
	Tone	22	L				45X203	15	TN111							
							.01		Buffer	B14						

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
WESTERN AUTO SUPPLY CO.—Continued																
6U	Vol.	18	UC511	6			P81028	1	CN152		20	253	C3	^{2}78, 77, 75, 41, 84	262	10
	Tone	22	UC502				P81021	15	TN111							
							.01		Buffer	B14						
670	Vol.	17	N	6			P103-2	4	RM262		37	296	C3	6D6, 6C6, 78, 75, 42,		
							20	15	TS102					84	175	10
							.02		Buffer	B14						
685, 686 Series	Vol.	18	MR53	M26			P103-6	23	RS213					6L7, 6K7, 6C5, 6Q7,		
	Tone	22	K12				P103-7	23	RS213					6F6, 5Y3, 6G5	465	1
720, 732	Vol.	18	O	6			103-6	42	RS213					6L7, 6K7, 6C5, 6Q7,		
	Tone	22	K12				103-7	42	RS213					6G5, 6F6, 5Y3	465	1
786 Series A	Vol.	18	MR53	M26			P103-6	23	RS213					6L7, 6K7, 6C5, 6Q7,		
	Tone	22	K12				P103-7	23	RS213					6F6, 5Y3, 6G5	465	1
1312 (R131)	Vol.	17	N	6			84829	4	CM171		35	294	C3	^{2}78, 77, 75, 41, 84	177.5	10
							83803	15	TS101							
							.03-.03		Buffer	B14						
D692 (Truetone)	Vol.	124	TRP621				3111	72	HD683					^{2}6K7, 6A7, 6H6, 6G5,		
	Tone	147	UM181	M28			3112	72	RS216					6C5,^{2}76,^{2}42, 80	465	1
	Sen.	48	A2MP				3113	72	WE1647							
							3136	72	TS102							
D699	Vol.	18	MR53	M26			103-6	4	RS213					6A8, 6K7, 6Q7, 6C5,		
	Tone	22	MR44				103-14	4	RS216					^{2}6F6, 5Y3, 6G5	465	1
D706	Vol.	18	MR48	M27			119-32	1	RN231		15	246	C3	^{2}6S7G, 6D8G, ^{2}6L5G,		
	Tone	22	MR39				.005		Buffer	B14				6T7G, 19, 6N5	465	10
D717	Vol.	18	MR53	M26			119-38	23	RM261					6A7, 6K7, 75, 41, 80	465	1
	Tone	21	MR53													
D719	Vol.	18	MR48	M27			4459	24	RM259		13	245	C3	6D8G, 6S7G, 6T7G,		
							.04		Buffer	B14				1D5G	456	10
D734	Vol.	17	UM154-SS13	M26			119-33	4	RM261		35	294	C3	6A8, 6K7, 6Q7, 6F6,		
							.005		Buffer	B14				6X5	465	10
D743	Vol.	18	UM154-SS13	M26			119-37	4	RM261		35	294	C3	^{2}6K7, 6A8, 6Q7, 41,		
							.005		Buffer	B14				6X5	465	10
D744	Vol.	18	UM147-SS13	M26			119-34	4	RM261		35	294	C3	^{2}6K7, 6A8, 6Q7, 6F6,		
	Tone	22	MR53				.01		Buffer	B14				6X5	262.5	10
L7	Vol.	45	N	7			P391	1	RN232	B90	14	245C	C3	1C6, 19,^{3}30,^{2}34	456	10
	Tone	‡	L				.01-.01		Buffer	B14						
S690, S691	Vol.	45	N				4	13	CS121		1	206		^{3}39, 36, 38	262	
							4	15	TS105							
S716, S717	Vol.	8	A5MP				4-2-6	46	CM175					^{3}35,^{2}24, 27, 47, 80	175	3
	Tone	34	UC502													
S719	Vol.	6	Y	6	EX300		8-8	4	CM172					^{2}57, 35, 47, 80	262	1
S721	Vol.	‡	SRP271				P80196	4	RS213					^{2}58,^{2}57, 47, 80	175	7
	Tone	34	UC502				P80878-C	13	CS121							
S724	Vol.	97	TRP617	14			P45X28	12	CS121					32,^{2}34, 30, 19	175	
S727	Vol.	15	P	6			P81039	2	WE1647					^{4}6D6, ^{3}76, ^{2}45, 80	456	7
	Tone	41	UC504				P81018	2/13	CM173							
S725, S726	Vol.	56	N	6			P81043	23	WE1847					^{3}6D6, 6B7, 76, 42, 80	456	1
	Tone	34	UC502				P81032	23	RS213							
S732, S733	Vol.	17	N				P80956	25/19	RM262/TS102	B126	34	292	C12	^{2}78, 77, 75, 41, 84	262	10
							P80937	14/15	RN231	B127						
							.02		Buffer	B14						
S735	Vol.	17	P	6			P82002	1/15	CM173		32	286S	C3	^{2}6D6, 6C6, 75, 41	175	10
S740	Vol.	18	UC511	6			P81028	1	CN152		20	253	C3	^{2}78, 77, 75, 41, 84	262	10
	Tone	22	UC502				P81021	15	TN111							
							.01		Buffer	B14						
S743	Vol.	17	N	6			84829	4	CM171		35	294	C3	^{2}78, 77, 75, 41, 84	177.5	10
							83803	15	TS101							
							.03-.03		Buffer	B14						
V6Z2	Vol.	17	N	6			P80956	25/19	RM262/TS102	B126	34	292	C12	^{2}78, 77, 75, 41, 84	262	10
							P80937	14/15	RN231	B127						
							.02		Buffer	B14						
Z4	Vol.	45	SRP275	7			P391	1	RN232	B90	14	245C	C3	1C6, 19,^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z5	Vol.	45	SRP275	7			P958	1	RN232	B90	14	245C	C3	1C6, 19,^{2}30, 32, 34	456	10
	Tone	44	L				.01-.01		Buffer	B14						
Z6Z1	Vol.	17	N	6			P80956	25/19	RM262/TS102	B126	34	292	C12	^{2}78, 77, 75, 41, 84	262	10
							P80937	14/15	RN231	B127						
							.02		Buffer	B14						
WESTERN RADIO MFG. CO.																
SG80BM, SG80BMX	Vol.	12	Y50MP				8-8-8	3	See Note	B3				^{4}24A, 27,^{2}45, 80		3
WESTINGHOUSE																
WR4—See Radiola 48																
WR5—See Radiola 80																
WR6—See Radiola 82																
WR6R—See Radiola 82R																
WR7—See Radiola 86																
WR7R—See Radiola 86R																
WR8—See Radiola 82 (with clock)																
WR8R—See Radiola 82R (mod. for vertical operation.)																
WR9—See T5																
WR10—See R7 (Superette)																
WR10A—See R7A																
WR10 (DC)—See R7 (DC)																
WR12—See R9																
WR12 (DC)—See R9 (DC)																
WR13—See RE16																
WR13A—See RE16A																
WR14—See R5																
WR14 (DC)—See R5 (DC)																
WR14CR—See R5X																
WR15—See R11																
WR15A—See R10																
WR16—See RO23																
WR17—See R4																
WR18—See R8																
WR18 (DC)—See R8 (DC)																
WR19—See R71																
WR20	Vol.	6	Y	6			4-8	4	CM161					6D6, 6C6, 38, 1V		
WR21	Vol.	6	Y	6	EX300		4-16-8	11	UR193	B264				^{2}78, 77, 43, 25Z5	456	
WR22	Vol.	6	Y		EX500		8-8	4	CM172					^{2}58, 57, 47, 80	456	1
WR23, WR24	Vol.	18	N				SA106665	25	RM261/TS102	B213				^{3}58, 2A6, 2A5, 56	456	1
	Tone	26	M	6												
WR25	Vol.	17	UM154	M26		A96	ZC123	1	See Note	B3	35	294	C20	^{2}78, 6A7, 75, 41, 84	172.5	10
							IC43	15	TS101		37	296	C20			
							.02		Buffer	B14						
WR26	Vol.	18	N	6			WR06558	4	CM172		35	294	C20	^{2}77, 78, 75, 42, 84	175	10
	Tone	22	N				.02		Buffer	B14	37	296	C20			
WR27	Vol.	6	Z12	6	EX250		WRUC-93	4	CM172					6A7, 77, 42, 80	456	1
WR28, WR29	Vol.	18	N				WR06665	25/19	RM261/TS102	B213				6A7,^{2}6D6, 75, 42, 80	456	1
	Tone	121	M	6			WR07239	13	RS213							

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
WESTINGHOUSE—Continued																
WR30	Vol. Tone	18 121	N M				WR07510 WR07516	59 15	RN245 BN226	 B8				[3]78, 77, 6B7, [2]6A6, 42, 76, 83V	456	1
WR100	Vol.	18	N	6			2DC203	27	CM164					6A7, 6D6, 75, 43, 25Z5	456	
WR101	Vol. Tone	55 121	N M	6			ZZC192A YC98A	11/27 19	UR193 CS121	B99 B99				6A8, [2]6K7, 75, 43, 25Z5	456	
WR102	Vol.	7	MR18	M26	EX300		CE9533 CE9534 CE9515	6 6 15	RS205 RS232 TS101	 B8 				6A7, 6C6, 43, 25Z5, K55C	465	
WR102A	Vol.	7	MR18	M26	EX300		CE9553 CE9534	27 27	RS208 RN232	 B8				6A7, 6F7, 25B6G, 25Z5, K55C	465	
WR103, WR103A	Vol.	18	MR48	M26			CE9545 CE9546	27 27	RS207 RN232	 B8				6A7, 6D6, 75, 43, or 25B6, 25Z5, K49C	465	
WR116	Vol. Tone	45 22	TM230-SS1 MR24	M26			CE9539 CE9538 CE9540	27 27 13	RS207 RS207 RS201					6A8, 6K7, 6H6, 6F5, 25A6, 25Z6, K42E	465	
WR120	Vol.	18	MR48	M26			CE9559 CE9560	4 4	RS208 RS207					6A8G, 6K7G, 6Q7G, 25B6G, 25Z6G, K49CB	456	
WR140	Vol.	18	MR48	M26			CE9557 CE9574 CE9575	4 4 13	RS208 RS207 RS203					6A8, 6K7, 6Q7G, 25L6, 25Z6G, K49CB	455	
WR201	Vol.	6	E12		EX150		8-6 12	1 15	See Note TS102	B3				[2]6D6, 76, 42, 80	456	1
WR203	Vol. Tone	55 22	M M	 6			8-8	4	See Note	B3				6A8, [2]6K7, 75, 6F6, 80	456	1
WR204	Vol. Tone	18 121	N N	 6			CE954 CE9511 CE9515	25/19 14 15	RM261/TS102 RS213 TS101	B213				[2]6K7, 6A8, 6H6, 6F5, 6F6, 80	465	1
WR205	Vol. Tone	18 121	N N	 6			CE954 CE9518 CE9515	25/19 14 15	RM261/TS102 RS213 TS101	B213				[2]6K7, 6A8, 6C5, 6H6, 6F5, 6F6, 80	465	1
WR208	Vol.	56	M	6			2NC246 2NC247 IC43A	1 1 15	WE1647 WE1647 TS105					6A7, 6D6, 85, 42, 80	456	1
WR209	Vol.	18	MR48	M26			CE9512 CE9511 CE9558	1 1 19	RS215 RS213 TS101					6F7, 6D6, 75, 42, 80	465	1
WR210	Vol.	18	MR48	M26			CE9536 CE9535 CE9515	1 1 19	RS215 RS216 TS101					6A8, 6K7, 75, 6F6, 5Y3	465	1
WR211	Vol. Tone	45 22	TM230-SS1 MR24	M26			CE9536 CE9535 CE9537	25 25 13/15	RS215 RS216 RN241					6A8, 6K7, 6H6, 6F5, 5Y3	465	1
WR212	Vol. Tone	45 15	TM230-SS1 MR48	 M26			CE9536 CE9535 CE9528 CE9526	25 25 13 15	RS215 RS216 RS213 TN111					[2]6K7, 6A8, 6F5, 6H6, 6F6, 5Y3 or 5Z4	465	1
WR214	Vol. Tone	45 22	N O	 6			CE9536 CE9535 CE9528 CE9526	25 25 13 15	RS215 RS216 RS213 TN111					[2]6K7, 6A8, 6C5, 6H6, 6F5, [2]6F6, 5Y3 or 5Z4, 6G5	465	1
WR217	Vol.	18	N	6			3RC318	23	CM170	B3				6A7, 6D6, 75, 41, 80	456	1
WR222	Vol.	18	MR48	M26			CE9564 CE9565	4 4	RN232 RN232	B8 B8				6A8G, 6K7, 6Q7G, 6Y6G, 5Y3G	455	1
WR224	Vol.	18	MR48	M26			CE9554 CE9562 CE9568	1 1 13	RS216 RS216 RS213					6A8G, 6K7, 6Q7G, 6V6G, 5Y3G	455	1
WR226	Vol.	45	MR48	M26			CE9554 CE9562 CE9568	1 1 13	RS216 RS216 RS213					6A8, 6K7, 6H6, 6F5, 6V6G, 5Y3G	455	1
WR228	Vol.	18	TM251-SS1	M26			CE9554 CE9562 CE9568	1 1 13	RS216 RS216 RS213					[2]6K7, 6Q8, 6Q7G, [2]6F6G, 6U5, 5Y3G	455	1
WR303	Vol. Tone	55 22	M M	 6			8-8	4	See Note	B3				6A8, [2]6K7, 75, 6F6, 80	456	1
WR304	Vol. Tone	18 121	N N	 6			CE954 CE9511 CE9515	25/19 14 15	RM261/TS102 RS213 TS101	B213				[2]6K7, 6A8, 6H6, 6F5, 6F6, 80	465	1
WR305	Vol. Tone	18 121	N N	 6			CE954 CE9518 CE9515	25/19 14 15	RM261/TS102 RS213 TS101	B213				[2]6K7, 6A8, 6C5, 6H6, 6F5, 6F6, 80	465	1
WR306	Vol.	15	MR53				CE9516 CE9517 SA107913	59 59 15	RS213 RS216 TN111					[3]6K7, 6A8, 6C5, 6H6, 6F5, [2]6F6, 5Z3	465	1
WR310	Vol.	18	MR48	M26			CE9536 CE9535 CE9515	1 1 19	RS215 RS216 TS101					6A8, 6K7, 75, 6F6, 5Y3	465	1
WR311	Vol. Tone	45 22	MR48 MR24	M26			CE9536 CE9535 CE9537	23 23 13/15	RS215 RS216 RN241					6A8, 6K7, 6H6, 6F5, 6F6, 5Y3 or 5Z4	465	1
WR312	Vol. Tone	45 15	TM230-SS1 MR48	 M26			CE9536 CE9535 CE9528 CE9526	25 25 13 15	RS215 RS216 RS213 TN111					[2]6K7, 6A8, 6F5, 6H6, 6F6G, 5Y3 or 5Z4	465	1
WR314	Vol. Tone	45 22	N O	 6			CE9536 CE9535 CE9528 CE9526	25 25 13 15	RS215 RS216 RS213 TN111					[2]6K7, 6A8, 6C5, 6H6, 6F5, [2]6F6, 5Y3 or 5Z4	465	1
WR315	Vol.	18	TM230-SS1				CE9536 CE9528 CE9535 CE9515	3 3 3 15	RS215 RS213 RS216 TS101					[3]6K7, [2]6A8, 6J7, 6H6, 6Q7, [2]6L6, 5Z3, 6G5	465	1
WR316	Vol. Tone	45 22	TM230-SS1 MR24	M26			CE9539 CE9538 CE9540	27 27 13	RS207 RS207 RS201					6A8, 6K7, 6H6, 6F5, 25A6, 25Z6, K42E	465	
WR326	Vol.	45	MR48	M26			CE9554 CE9562 CE9568	1 1 13	RS216 RS216 RS213					6A8, 6K7, 6H6, 6F5, 6V6G, 5Y3G	455	1
WR328	Vol.	18	TM251-SS1	M26			CE9554 CE9562 CE9568	1 1 13	RS216 RS216 RS213					[2]6K7, 6A8, 6Q7G, [2]6F6G, 6U5, 5Y3G	455	1
WR330	Vol.	20	TM251-SS1				CE9554 CE9562 CE9528	1 1 14	RS216 RS216 RS213					[2]6K7, 6A8, 6H6, 6F5, 6C5, [2]6F6G, 6U5, 5Y3G	455	1
WR332	Vol.	20	TM251-SS1				CE9554 CE9562 CE9528	1 1 14	RS216 RS216 RS213					[2]6K7, 6A8, 6H6, 6F5, 6C5, [2]6F6G, 5Y3G, 6U5	455	39
WR334	Vol.	18	TM251-SS1				CE9554 CE9570 CE9562	3 3 3	RS216 RS216 RS216					[3]6K7, 6A8, 6Q7, 6J7, 6H6, 6C5, [2]6V6G, 6U5, 5X4G	465	39

‡ Data not substantiated.

*** IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
WESTINGHOUSE — Continued																
WR336	Vol.	18	TM251-SS1				CE9554	3	RS216					^{3}6K7, 6A8, 6Q7, 6C5,		
							CE9562	3	RS216					6J7, 6H6, ^{2}6V6G,		
							CE9570	3	RS216					6U5, 5X4G	465	39
WR338	Vol.	45	MR48	M26			CE9554	1	RS216					6A8, 6K7, 6H6, 6F5,		
							CE9562	1	RS216					6V6G, 5Y3G	455	1
							CE9568	13	RS213							
WR500	Vol.	18	N	6	RS246		CE951	4	CM172		22	253Y	C3	^{2}77, 78, 75, 42, 84	175	10
	Tone	121	N				.008		Buffer	R14						
WR501	Vol.	17	UM157		See Note	A96	8-8	1	See Note	B3	22	253Y	C3	78, 6A7, 85, 41, 84	172.5	10
							10-10	15	TN111							
							.008		Buffer	B14						
WR503	Vol.	45	UM150			A96	CE951	4	CM172		35	294	C3	^{2}6K7, 6A8, 6H6, 6F5,		
	Tone	121	UM150			A96	CE9524	14	TS101					6F6, 0Z4	175	10
							.005		Buffer	B14						
WR601	Vol.	17	N	7										33, 34, 25S, 1C6, 30,		
														LLL25—Ballast	456	
WR603	Vol.	18	MR48	M26			CE9541	1/15	RN232/TS101		13	245	C3	6D6, 6A7, 75, 41	• 465	10
							.008		Buffer	B14						
WR604	Vol.	18	MR48	M24			CE9542	12	RS203					1C6, 1A4, 1B5, 30, 19	465	
WR605	Vol.	18	MR48	M24			CE8543	12	RS208					1C6, ^{2}1A4, 1B5, 30, 19	465	
	Tone	22	MR18													
WR606	Vol.	18	MR48	M26			CE9541	1/15	RN232/TS101		13	245	C3	6D6, 6A7, 75, 41	465	10
							.008		Buffer	B14						
WR607	Vol.	18	MR48	M24			CE9542	12	RS203					1C6, 1A4, 1B5, 30, 19	465	
WR608	Vol.	18	MR48	M24			CE9543	12	RS208					1C6, ^{2}1A4, 1B5, 30, 19	465	
	Tone	22	MR18													
WR610	Vol.	18	MR48	M26			CE9573	1	RS203		13	245	C3	6D8G, 6S7G, 6T7G,		
	Tone	22	MR14				CE9550	15	TS104					6K6G	455	10
							.02-.02		Buffer	B14						
WESTONE RADIO CORP.																
20	Vol.	6	G12				4-4	4	See Note	B3				58, 56, 2A5, 80		1
34 (4 Tube)	Vol.	6	G12				4-4	23	See Note	B3				2A7, 57, 2A5, 80	456	1
34 (5 Tube)	Vol.	6	G12				4-4	23	See Note	B3				57, 58, 56, 2A5, 80	‡	1
40	Vol.	18	N				4-4	23	See Note	B3				2A7, 58, 2A6, 2A5, 80	456	1
WEXTARK RADIO CORP.	(See Allied Radio & Knight Radio)															
WHOLESALE RADIO SERVICE "Lafayette"—Also see Wells-Gardner																
L1 (AC)	Vol.	45	Z12				8	58	HD682					^{3}56, ^{2}57, ^{4}58, ^{2}46, 82	175	3
	Tone	41	UC502				8	58	RS213							
	Supp.	8	E				4	58	RS211							
							4	19	CS121							
10	Vol.	7	F		2		8, 8	23	RS213					^{2}35, ^{2}24A, 27, 47, 80	175	3
	Tone	103	O													
20	Vol.	78	N				8, 8, 8	30	RS213					^{4}35, ^{3}27, ^{2}47, 80	175	1
	Tone	41	P	6												
L20 (0[illegible] Series)	Vol.	6	G12	6	EX300		P80944	11	UR182	B31				^{2}77, 78, 43, 25Z5	262	
							P8087C	20	CS121							
							P80936C	15	TS105							
M31	Vol.	6	G12				271	4	CS131					^{2}57, 58, 47, 80	‡	1
M35, M37	Vol.	124	N				4-4	4	See Note	B3				^{3}58, 55, 56, 47, 80	175	1
	Tone	22	M													
40	Vol.	111	Y5MP				4-2-6	30	CM173					^{3}35, ^{2}24A, 27, 47, 80	175	3
	Tone	34	UC502				4	13	CS121							
40A	Vol.	14	N				4-2-6	30	CM173					^{3}35, ^{2}24A, 27, 47, 80	175	3
	Tone	34	UC502				4	13	CS121							
M53	Vol.	124	N				4-4	4	See Note	B3				^{3}58, 55, 56, 47, 80	175	1
	Tone	22	M													
Mighty Atom	Vol.	6	G12	6			2-2	1	See Note	B2				^{2}51, 24, 47, 80		3
V.A.	Vol.	6	H12				5-5	4	See Note	B3				^{2}24A, 51, 47, 80	‡	1
Great Duo-Symphonic	Vol.	24	GG				1-1-1.5-1.5	61	See Note	B1				^{3}24, ^{2}27, ^{2}45, 80		3
	Tone	41	O													
Duo-Symphonic Jr. 1931	Vol.	6	H12				1-1-5	‡	See Note	A1				^{3}24A, 27, ^{2}45, 80		1
	Tone	41	O													
Duo-Symphonic 1930	Vol.	1	E12				1-1-1-2	59	See Note	B1				^{5}26, 24, ^{2}45, 80		9
Auto Radio Superheterodyne	Vol.	64	N											^{3}39, 36, 37, 38	262	
WILCOX-GAY																
A21	Vol.	15	MR48	M26			18-721	4	RS213					^{3}6K7, 6A8, 6H6, ^{2}6F5,		
	Tone	21	MR45	M27			18-2004	14	CS131					^{2}6L6, ^{2}5Z4, 6G5	456	1
							18-928	15	TS103							
A27, A28	Vol.	18	MR48	M26			18-2005	1	RS215					6A7, 78, 75, 42, 80	175	1
	Tone	21	MR45				18-2006	1	RS216							
							18-928	15	TS103							
A29	Vol.	18	MR48	M26			18-2003	8	UR193					6A7, 78, 75, 25L6,		
	Tone	21	MR45				18-928	15	TS103					25Z5	175	
A30, A31	Vol.	18	MR48	M26			18-2008	1	RS213	B3				6A8, 6K7, 6Q7, 6F6,		
	Tone	21	MR45				18-928	15	TS103					5Z4	456	1
A33	Vol.	18	MR48	M26			18-2005	1	RS215					6A7, 78, 75, 42, 80	175	1
	Tone	21	MR45				18-2006	1	RS216							
							18-928	15	TS103							
A35, A36, A37	Vol.	17	MR48				18-721	1	RS213					^{3}78, 6A7, 75, 42, 80	456	1
	Tone	21	MR45				18-2005	1	WE1247							
							18-928	15	TS103							
A40	Vol.	18	MR48	M26			18-2005	1	RS215					6A7, 78, 75, 42, 80	175	1
	Tone	21	MR45				18-2006	1	RS216							
							18-928	15	TS103							
A43, A44	Vol.	18	MR48	M26			18-2008	1	RS213	B3				6A8, 6K7, 6Q7, 6F6,		
	Tone	21	MR45				18-928	15	TS103					5Z4	456	1
2S5	Vol.	6	G12				4-4	4	See Note	R3				^{2}57, 58, 47, 80	175	1
2T5	Vol.	6	G12				4-4	4	See Note	B3				^{2}57, 58, 47, 80	175	1
2U7	Vol.	18	N				4-12	4	See Note	B3				2A5, 2A6, 56, ^{3}58, 80	175	1
	Tone	21	M													
2VA7	Vol.	124	N				4-4	4	See Note	B3				^{3}58, 56, 55, 47, 80	175	1
	Tone	22	M													
2VB7	Vol.	18	N				4-12	4	See Note	B3				^{3}58, 2A6, 2A5, 56, 80	‡	1
	Tone	21	M													
3D5	Vol.	6	G12	6			4-4	4	See Note	B3				^{2}57, 58, 47, 80	175	1
	Tone	21	M													
3F7	Vol.	6	G12	6			4-12	4	See Note	B3				57, 58, ^{3}56, 47, 80	‡	1
	Tone	21	M													
3J5, 3K5	Vol.	6	G12				4-12-4	8	See Note	B3				^{2}78, 77, 43, 25Z5	175	
							928	15	TS103							
3JD5, 3JG5	Vol.	6	G12	6			1085	8	UR182					6A7, 78, 77, 43, 25Z5	115	
							267A	15	TS101							
							928	15	TS103							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
WILCOX-GAY—Continued																
3JF5	Vol.	6	G12				6-6	6	See Note	B3				6A7, 78, 77, 43, 25Z5	175	
3KD5	Vol.	6	G12	6			4-10-4	8	See Note	B3				^{2}77, 43, 78, 25Z5	115	
							25	15	TS103							
3KE5	Vol.	6	G12				1085	8	UR182					^{2}77, 78, 43, 25Z5	175	
							928	15	TS103							
3LB7	Vol.	18	N				8-8-4-4-4-4	62	See Note	B3				^{2}78, 6A7, 75, 42, ^{2}25Z5	175	
	Tone	76	M													
3PA6-66, 3P6	Vol.	6	G12	6			1085	8	UR182					^{3}77, 78, 43, 25Z5	115	
	Tone	22	M				928	15	TS103							
3PB8	Vol.	6	G12	6			4-10-4	8	See Note	B3				^{2}43, 76, ^{2}77, 78, 25Z5	115	
	Tone	21	M													
3R6	Vol.	7	J	6	See Note A1		8-4	1	CN151	B3	37	296	C3	77, ^{2}78, 75, 79, 84	175	10
	Tone	22	M				928	15	TS103							
							.02		Buffer	B14						
3SB5	Vol.	15	N				8-4	25	See Note	B3				6A7, 78, 75, 42, 80	175	1
	Tone	21	M				25	19	TS103							
3S5-66	Vol.	76	N	6			4-4	4	CM170	B3				6A7, 78, 75, 42, 80	175	1
	Tone	76	M				928	15	TS103							
3T6-66	Vol.	18	N	6			1085	8	UR182					6A7, ^{2}78, 75, 43, 25Z5	175	
	Tone	21	M				928	15	TS103							
3TB8	Vol.	18	N				4-19-4	8	UR182	B3				^{2}78, 6A7, 76, 75, ^{2}43,	175	
	Tone	22	M											25Z5		
3V6 (BC & SW)																
3VA6 (BC only)	Vol.	17	N				4-4	4	See Note	B3				^{2}78, 6A7, 75, 42, 80	175	1
	Tone	21	M				25	19	TS103							
3VB6	Vol.	17	N	6			4-4	4	See Note	B3				6A7, ^{2}78, 42, 75, 80	175	1
	Tone	21	M				25	19	TS103							
4B6 Road Mate	Vol.	18	N				1327	1	CN142		34	292	C23	^{2}78, 77, 75, 41, 84	175	10
							25	15	TS103							
							.015		Buffer	B14						
4C5, 4CA5 4CB5,	Vol.	17	N				8-4	25	See Note	B3				6A7, 78, 75, 42, 80	175	1
							25	19	TS103							
4CD5	Vol.	17	N				8-4	25	See Note	B3				6A7, 78, 75, 42, 80	175	1
							25	19	TS103							
4D10, 4DB10	Vol.	106	N				8-8	1	CN152	B3				2B7, ^{4}45, 2A7, ^{2}58, 56,		
	Tone	106	M				25	15	TS103					80	175	1
4E6	Vol.	17	N	6			4-4	4	CM170	B3				42, 75, 76, 77, 78, 80	115	1
	Tone	21	M				25	15	TN113							
4G7	Vol.	17	N	6			1129	4	RM261					42, 75, 76, ^{3}78, 80	456	1
	Tone	76	M				928	20	TS103							
4H11	Vol.	76	N	6			18-721	1	RS213					^{4}45, 6B7, ^{2}76, ^{3}78, 80	456	3
	Tone	76	M				75-267A	13	CS121							
							18-928	15	TS103							
4J6, 4JC6	Vol.	76	N	6			1295	8	CN145					6A7, ^{2}78, 43, 75, 25Z5	456	
	Tone	76	M				1379	13	CS121							
							928	15	TS103							
4JA6, 4JB6	Vol.	76	N	6			1295	8	CN145					6A7, ^{2}78, 43, 75, 25Z5	456	
	Tone	76	M				1379	8	CS121							
							928	15	TS103							
5E7	Vol.	17	N	6			18-1247	4	CM170	B3				76, ^{3}78, 42, 75, 80	456	1
	Tone	21	M				18-928	15	TS103							
5EA7	Vol.	76	N	6			18-1247	4	CM170	B3				76, ^{3}78, 75, 42, 80	456	1
	Tone	76	M				18-928	20	TS103							
6S12	Vol.	15	MR48	M26			18-721	4	RS213					^{3}6K7, 6A8, 6H6, ^{2}6F5,		
	Tone	21	MR45	M27			18-2004	14	CS131					^{2}6L6, ^{2}5Z4, 6G5	456	1
							18-928	15	TS103							
7A5	Vol.	18	MR48	M26			18-2005	1	RS215					6A7, 78, 75, 42, 80	175	1
	Tone	21	MR45				18-2006	1	RS216							
							18-928	15	TS103							
7AB5	Vol.	18	MR48	M26			18-2005	1	RS215					6A7, 78, 75, 42, 80	115	1
	Tone	21	MR45				18-2006	1	RS216							
							18-928	15	TS103							
7AC5	Vol.	18	MR48	M26			18-2005	1	RS215					6A7, 78, 75, 42, 80	175	1
	Tone	21	MR45				18-2006	1	RS216							
							18-928	15	TS103							
7D6	Vol.	18	MR48	M26			18-2003	8	UR193					6A7, 78, 75, 25L6,		
	Tone	21	MR45				18-928	15	TS103					25Z5	175	
7E5, 7EA5	Vol.	18	MR48	M26			18-2008	1	RS213	B3				6A8, 6K7, 6Q7, 6F6,		
	Tone	21	MR45				18-928	15	TS103					5Z4	456	1
7G5, 7GB5	Vol.	18	MR48	M26			18-2005	1	RS215					6A7, 78, 75, 42, 80	175	1
	Tone	21	MR45				18-2006	1	RS216							
							18-928	15	TS103							
7J7, 7K7	Vol.	17	MR48				18-721	1	RS213					^{3}78, 6A7, 75, 42, 80	456	1
	Tone	21	MR45				18-2005	1	WE1247							
							18-928	15	TS103							
WINDHAM—See Airking																
WINGS—See Goodyear Service.																
WORKRITE MFG. CO.—See U. S. Electric Corp.																
RUDOLPH WURLITZER—Also see All American Mohawk "Lyric"																
Model "B" 1930-31	Vol.	25	DRP169											^{2}32, 30, ^{2}31		
C4, M4	Vol.	‡	O	6			16	10	CS126					6A7, 6B7, 43, 25Z5	456	
							8-4-10	10/15	CN141/TS101							
P5	Vol.	17	N	6			Y3764RA	6/15	UR189	B98				6A7, 78, 75, 43, 12Z3	456	
SA5	Vol.	18	N				Y3715RA	1/15	RN245					2A7, 58, 2A6, 2A5, 80	175	1
	Tone	22	G12	6			10	15	TS101							
SU5	Vol.	17	N	6			16-12-10	6/15	UR182	B110				6A7, 78, 75, 43, 12Z3	456	
	Tone	22	H12													
SA6	Vol.	18	N				8-8	1	RN242					2A7, ^{2}58, 2A6, 2A5, 80	175	1
	Tone	22	G12	6			10	15	TS101							
B6	Vol.	25	DRP244											1A6, ^{2}34, 32, 33, 10AB	175	
	Tone	22	H12	6												
D.C. 7 110 volts	Vol.	24	‡		See Note A5		1.5-2	1	See Note	B7				^{2}33, ^{3}36, ^{2}37	175	
	Tone	34	K12													
S40	Vol.	2	Y				8-8	1	See Note	B3				47, ^{2}57, 80	175	1
							10	19	TS101							
S50	Vol.	6	F12	6			8, 8	1	RS213					47, ^{2}57, 58, 80	175	1
	Tone	22	G12				10	19	TS101							
U50	Vol.	6	Y	6			16-12-10	6/15	UR182	B110				^{3}44, 43, 25Z5	485	
A60	Vol.	‡	UC502				Y3773RA	1/15	CN141/TS101		34	292	C3	6B7, ^{2}78, 6A7, 41, 84	485	10
	Tone	22	H12				.02		Buffer	B14						
S63	Vol.	42	H				6900	1	RS213					24, 27, ^{2}35, 47, 80	175	1
	Tone	22	G12				10	15	TS101							
DC65 110 volts	Vol.	8	G				3.5	‡	See Note	B11				^{2}33, 36, 37, ^{2}39	175	
	Tone	34	K12													
SA65	Vol.	15	N	6			8, 8	1	RS213					47, 55, ^{2}57, 58, 80	175	1
	Tone	22	G12				10	16	TS101							
B80	Vol.	43	DRP169				8	12	RS203					^{5}30, ^{2}34, 32	175	
	Tone	21	M													

‡ Data not substantiated.

* **IMPORTANT: Read Notes in Note Section if specified in Note Column.**

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
RUDOLPH WURLITZER—Continued																
SW80	Vol.	15	N				8, 8	1	RS213					47, ^{2}56, ^{2}57, ^{2}58, 80	485	1
	Tone	22	G12													
SW88	Vol.	15	N				8, 8	1	RS213					^{2}57, ^{2}58, ^{2}56, 2A5, 80	485	1
	Tone	22	G12	6			10	15	TS101							
SA90, SA91	Vol.	45	N	6			8, 8	1	RS213					^{2}24, 27, ^{2}35, ^{2}47, 55, 80	175	1
	Tone	21	N				10	15	TS101							
	Sen.	‡	F		See Note A4											
SA91A	Vol.	45	N				8, 8	1	RS213					^{2}57, ^{2}58, 56, 55, ^{2}2A5, 80	175	1
	Tone	21	N	6			10	15	TS101							
	Sen.	‡	F													
SA120	Vol.	45	N				8, 8	1	RS213					^{2}58, ^{3}56, ^{2}57, ^{2}46, 80	175	1
	Tone	21	N				5	15	TS105							
	Supp.	‡	F				5	17	TS105							
SA130	Vol.	15	N				8, 8, 8	7	RS213					^{2}47, ^{3}56, ^{4}57, ^{3}58, 82	175	7
	Tone	39	N	6			5	15	TS105							
	Sen.	8	H12		See Note A4											
SA133	Vol.	15	O				8, 8, 8	7	RS213					^{3}56, ^{4}57, ^{3}58, ^{2}2A5, 82	175	7
	Tone	21	N	6												
450	Vol.	6	F7	6	1		Y3715RA	1/15	RN245					^{2}58, 57, 2A5, 80	456	1
454	Vol.	18	N	6			Y3715RA	1/15	RN245					6A7, 6D6, 75, 41, 80	456	1
							10	15	TS101							
460	Vol.	17	UC512				8-6-10	4/15	CM162/TS101	B3	34	292	C3	41, 6B7, ^{3}6D6, 84	175	10
	Tone	22	H12													
470, 471	Vol.	18	N				8-8	1	CN152	B3				^{2}6D6, 76, 6A7, 6B7,		
	Tone	22	G12				10	15	TS101					80 or 6D6, 6A7, 75,		
														41, 80	370	1
480	Vol.	18	N				8	1	CS133	B3				^{3}6D6, 6A7, 75, 41, 80	456	1
	Tone	21	L				12	1	CS135	B3						
							10	15	TS101							
U500	Vol.	17	N	6			Y3764RA	6/15	UR182	B110				6A7, 78, 6B7, 43,		
														25Z5	456	
ZANEY GILL																
Vitatone Model 54	Vol.	4/7	DRP119	6	Dual		2-2	1	See Note	B1				^{3}24, 27, 45, 80		3
	Vol.	6	G12	6	Single											
	Tone	22	G12													
ZENITH																
A, B, C, D (2004)	Vol.	‡	Order from	Mfr.			22-87	1	RS213					^{3}24, ^{2}45, 80		3
	Tone	34	Order from	Mfr.			22-84	1	CS130	B3						
AH	Vol.	8	SRP262	6			22-118	4	RS213					^{2}27, ^{3}51, 24, 47, 80	175	7
	Tone	22	O				22-119	4	RS213							
BH (2021)	Vol.	7	G	6			22-132	26	CS131					^{2}51, 24, ^{2}27, 47, 80	175	3
	Tone	22	K12				22-133	26	CS131							
							22-131	26	CS133							
GH	Vol.	8	SRP262	6			22-118	4	RS213					^{2}27, ^{3}51, 24, 47, 80	175	7
	Tone	21	O				22-119	4	RS213							
L (2009-C)	Vol.	6	G12				22-87	1	RS213					^{3}24, 45, 80		1
							22-102	1	RS213							
LH, MH (2022)	Vol.	8	A10MP	6			22-131	4	CS133					^{2}51, 24, ^{2}27, 47, 80	175	1
	Tone	34	N				22-140	4	CS133							
LP (2009CP)	Vol.	6	G12				22-119	1	RS213					^{2}51, 24, 47, 80		1
							22-118	1	RS213							
R.H.	Vol.	8	SRP262	6			22-118	4	RS213					^{2}27, ^{3}51, 24, 47, 80	175	7
	Tone	21	O				22-119	4	RS213							
WH (2022)	Vol.	8	A10MP	6			22-131	4	CS133					^{2}51, 24, ^{2}27, 47, 80	175	1
	Tone	34	N				22-140	4	CS133							
							8-8	4	CM172	B10						
4B106, 4B131,																
4B132 (5406)	Vol.	18	N	6			22-419	1	RN241		15	246	C3	^{2}15, 75, 38	456	10
	Tone	34	L				22-225	15	TS101							
							.01-.01		Buffer	B14						
4B231 (Chassis																
5409)	Vol.	18	N	6			22-582	1/15	RN231/TS101	B252	15	246	C3	6D8G, 6S7G, 6R7G,		
							.01-.01		Buffer	B14				38	456	10
4F133 (Chassis																
5407)	Vol.	17	O	7			22-522	1	RN231		15	W246	C3	1C7, 1D5, 1F7, 1F5	456	10
							.01-.01		Buffer	B14						
4F227 (Chassis																
5408)	Vol.	17	O	7										1C7G, 1D5G, 1F7G,		
														1F5G	456	
4P26, 4T26 (Chassis																
5403)	Vol.	6	D7	6			22-407	4/13	RM265	B58				6A7, 6F7, 42, 80, or		
														6A8, 6P7, 6F6, 5Y3	456	1
4P51, 4T51 (Chassis																
5401)	Vol.	6	D7	6			22-407	4/13	RM265	B58				6A7, 6F7, 42, 80, or		
														6A8, 6P7, 6F6, 5Y3	456	1
4V31, 4V59 (5405)	Vol.	18	M	6			22-419	1	RN241		15	246	C3	^{2}15, 75, 38	456	10
	Tone	34	L				22-225	15	TS101							
							.006		Buffer	B14						
5F134 (Chassis																
5518)	Vol.	17	O	7			22-522	1	RN231		15	W246	C3	1C7, 1D5, 1F7, 1H4,		
	Tone	44	K12				.01-.01		Buffer	B14				1J6	456	10
5F166 (Chassis																
5518)	Vol.	17	O	7			22-522	1	RN231		15	W246	C3	1C7, 1D5, 1F7, 1H4,		
	Tone	44	K12				.01-.01		Buffer	B14				1J6	456	10
5F233, 5F251																
(Chassis 5522)	Vol.	15	O	7										1C7G, 1D5G, 1F7G,		
														1H5G, 1J6G	456	
5J217, 5J247,																
5J255 (Chassis																
5524)	Vol.	18	N	7			22-577	1/15	RN232/TS101		35	294	C3	6D8G, 6S7G, 6T7G,		
							.02-.02		Buffer	B14				38, 6ZY5G	456	‡
5M90 (Chassis 5510)	Vol.	18	UM154-SS11	M26			22-388	4	CM171		35	294	C3	6A7, 6D6, 75, 41, 6Z4	456	10
							.01		Buffer	B14						
5M191 (Chassis																
5520)	Vol.	17	O	7		A31	22-528	23	RM261		35	294	C3	6A8G, 6K7G, 6Q7G,		
							.008		Buffer	B14				6F6G, 6X5 or 0Z4	465	10
5R123, 5R135,																
5R165 (Chassis																
5519)	Vol.	18	N	6			22-505	4	WE1247					6A8, 6K7, 6Q7, 6F6,		
							22-506	4	RS216					5W4, or glass		
														equivalents	456	1
5R216, 5R226,																
5R236 (Chassis																
5526)	Vol.	18	N	6			22-596	4	CM175	B250				6A8G, 6K7G, 6Q7G,		
							8	4	RS213	B10				6F6G, 5Y4G	456	1
							14	4	RS216	B10						
5S29, 5S56 (Chassis																
5513, 5513A)	Vol.	18	M	6			22-125	23	RM262	B216				6A8, 6K7, 6B6, 6F6,		
	Tone	34	K12											5Y3, or glass		
														equivalents	252.5	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ZENITH—Continued																
5S119, 5S126, 5S127, 5S150, 5S151, 5S161 (5516)	Vol. Tone	18 34	N K12	6			22-505 22-506	4 4	WE1247 WE1647					6A8, 6K7, 6Q7, 6F6, 5Y3, or glass equivalents	456	1
5S201, 5S218, 5S220, 5S228, 5S237, 5S250, 5S252 (Chassis 5521)	Vol.	18	N	6			22-596 8 16	25 25 25	CM175 RS213 RS216	B250 B10 B10				6A8G, 6K7G, 6Q7G, 6F6G, 5Y4G	456	1
6B107, 6B129, 6B164 (5635)	Vol.	124	TRP613	6			22-459 .01-.01	1	RN241 Buffer	B3 B14	15	246	C3	[2]15, 6A7, 75, 76, 19	456	10
6D116, 6D117, 6D118 (5633)	Vol.	18	N	6			22-517	11	UR182	B31				6A8, 6K7, 6Q7, 25A6, 25Z6, or glass equivalents	456	
6D202, 6D219, 6D221, 6D238 (Chassis 5639)	Vol.	18	N	6			22-560	1/15	Order from	Mfr.				6A8G, 6K7G, 6Q7G, 25L6G, 25Z6G	456	
6J230, 6J257 (Chassis 5642)	Vol. Tone	17 44	O K12	7			22-577 .02-.02	1/15	RN232/TS101 Buffer	 B14	35	294	C3	6D8G, 6S7G, 6R7G, 6L5G, 1J6G, 6ZY5G	456	‡
6M90S, 6M90D (Chassis 5630)	Vol. Tone	18 22	UM154-SS17 L	M26			22-464 .008	4	CM172 Buffer	 B14	35	294	C3	[2]6K7, 6A8, 6Q7, 6F6, 6X5	252.5	10
6M91S, 6M91D (Chassis 5631)	Vol. Tone	18 22	UM154-SS17 L	M26			22-464 .008	4	CM172 Buffer	 B14	35	294	C3	[2]6K7, 6A8, 6X5, 6Q7, 6F6	252.5	10
6M92 (Chassis 5632)	Vol.	18	UM147-SS17	M26			22-474 .008	4	CM172 Buffer	 B14	35	294	C3	[2]6K7, 6A8, 6Q7, 6F6, 6X5	252.5	10
6M192	Vol.	17	MR53	M27		A31	22-526 .008	23	RM262 Buffer	 B14	35	294	C3	[2]6K7, 6A8G, 6Q7G, 6F6G, 6X5 or 0Z4	262.5	10
6M193, 6M194 (5637)	Vol./ Tone	145	SMD500				22-526 .008	4	RM262 Buffer	 B14	35	294	C3	6K7G, 6A8G, 6Q7G, 6F6G, 6X5 or 0Z4	252.5	10
6S27, 6S52 (Chassis 5619)	Vol. Tone	18 34	M Y	6			22-414 22-420	25 15	RM262 TS101					6A8, [2]6K7, 6F6, 6H6, 5Y3	252.5	1
6S128, 6S137, 6S147, 6S152, 6S157 (5634)	Vol.	124	TRP613	6			22-294 22-491	1 1/13	WE1647 RN241					6A8, 6K7, 6F6, 6H6, 6F5, 5W4, or glass equivalents	456	1
6S203, 6S222, 6S223, 6S229, 6S239, 6S241 (Chassis 5638)	Vol. Tone	18 34	N K12	6			22-596 8 14	25 25 25	CM175 RS213 RS216					6A8G, 6K7G, 6H6G, 6F5G, 6F6G, 5Y4G	456	1
6S254, 6S256 (Chassis 5644)	Vol.	124	TRP613	6			22-551 22-552	25 25	WE1647 WE1847					6A8G, 6K7G, 6H6G, 6F5G, 6F6G, 5Y4G	456	1
6V27, 6V62 (Chassis 5621)	Vol. Tone	18 34	M K12	6			22-432 .01	1	RN231 Buffer	 B14	15	246	C3	[2]15, 6A7, 75, 76, 19	456	10
7	Vol.	17	UC512	6			7119-4 .015	4	SR605 Buffer	 B14	37	296	C3	6D6, 75, 42, 6C6, 84	175	10
7D119, 7D126, 7D127, 7D138, 7D148, 7D151, 7D162, 7D168 (5707)	Vol. Tone	45 34	N K12	6			22-514 22-515	1/11 11/13	RN235 RN231	B218 B218				6A8, 6K7, 6H6, 6F5, 25A6, 25Z6, or glass equivalents	456	
7D203, 7D222, 7D223, 7D229, 7D239, 7D241, 7D243, 7D253 (Chassis 5710)	Vol. Tone	18 34	N K12	6			22-559	6/13/15	Order from	Mfr.				6A8G, 6K7G, 6H6G, 6F5G, 25L6G, 25Z6G	456	
7J232, 7J259 (Chassis 5711)	Vol.	124	TRP613				22-577 .02-.02	1/15	RN232/TS101 Buffer	 B14	35	294	C3	[2]6S7G, 6D8G, 6T7G, 6L5G, 1J6G, 6ZY5G	456	‡
7M91S, 7M91D (Chassis 5706)	Vol. Tone	18 22	TRP606 L	6	RS246		22-469	1/15	SR611	B219	35	294	C3	[2]6K7, 6A8, 6Q7, 6X5, 6C5, 6N7	252.5	10
7S28, 7S53 (Chassis 5704)	Vol. Tone	45 34	N Y	6			22-416	25/13	RM265					[2]6K7, 6A8, 6H6, 6F6, 5Y3	456	1
7S204, 7S232, 7S240, 7S242, 7S258, 7S260, 7S261 (Chassis 5709)	Vol.	124	TRP613	6			22-569 22-562	25 13/25	RS215 RM265					6A8G, 6K7G, 6H6G, 6T5, 6F5G, 6F6G, 5Y4G	456	1
8M195 (Chassis 5803)	Vol./ Tone	145	SMD500				22-527 .008	1/15	SR610 Buffer	 B14				[2]6K7, 6A8G, 6H6G, [2]6C5G, 6N7G, 6X5G	252.5	10
8S129, 8S154 (Chassis 5801)	Vol.	124	TRP613	6			22-294 22-491	25 25/13	WE1647 RN241					[2]6K7, 6A8, 6H6, 6C5, 6F5, 6F6, 5W4, or glass equivalents	456	1
9S30, 9S54, 9S55 (5903)	Vol. Tone	45 ‡	TRP613 O	6			22-412	46	Order from	Mfr.				[2]6K7, 6A8, 6H6, 6C5, [2]6F6, 5Y3	456	1
9S204, 9S232, 9S242, 9S244, 9S262, 9S263, 9S264 (Chassis 5905)	Vol.	124	TRP613				22-569 22-571	1 1/13/15	RS215 RN245					[2]6K7G, 6L7G, 6J5G, 6H6G, 6T5, 6F5G, 6F6G, 5Y4G	456	1
10, 11, 12	Vol. Tone	12 41	SRP261 N				22-72	3	RS213					[4]24, 27, [2]45, 80		3

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS Use	Circuit	Correct Replacement	Switch	Bias	*Note	CONDENSERS Original Part	Circuit	Correct Replacement	*Note	VIBRATORS Vibr. Conn.	Replacement	*Note	Complete Tube Complement	I. F. Peak	Trans. Circuit
ZENITH—Continued																
10S130, 10S147, 10S153, 10S155, 10S156, 10S157, 10S160 (1004)	Vol.	45	TRP613	6			22-504	3	RS213					^{2}6K7, 6A8, 6H6, ^{3}6C5, ^{2}6L6, 5W4, or glass equivalents	456	1
							22-506	14	RS216							
							22-403	3	RN242							
							22-405	19	TS106							
							22-507	15	TS101							
11, 12	Vol.	11	L											^{5}01A, 71A, 00A, 12A		
12 (2nd Type)	Vol.	11	L											12A, ^{4}01A, 71A		
12A57, 12A58, 12L57, 12L58 (Chassis 1202)	Vol.	45	TRP613	6			22-294	3	RS216					^{2}6K7, 6A8, ^{4}6C5, 6H6, ^{2}6F6, ^{2}5Y3, or glass equivalents	456	1
	Tone	‡	O				22-445	3	CN151							
							22-405	19	TS106							
							22-420	15	TS101							
12U158, 12U159 (Chassis 1203)	Vol.	45	TRP613	6			22-504	3	RS213					^{2}6K7, 6H6, 6F5, 6F6, ^{2}6L6, ^{2}5Y3, 6L7, ^{2}6C5, or glass equivalents	456	1
							22-294	3	RS216							
							22-125	3	RM262	B216						
							22-506	14	RN232	B8						
							22-405	15	TS106							
							22-509	19	TS106							
14	Vol.	11	L											^{5}01A, 12A, 71A, 00A		
15U246, 15U269, 15U270, 15U271, 15U272 (Chassis 1501)	Vol.	124	TRP621				22-569	3	RS215					^{2}6K7G, 6L7G, 6T5, ^{4}6J5G, 6H6G, ^{4}6V6G, ^{2}5Y4G	456	1
							22-568	3	RN242							
							22-578	13/14	RN241							
							22-580	15	3-TS101							
16A61, 16A63 (1601C, 1601P)	Vol.	17	TRP613	6			22-361	1/3/14	RS216					^{3}6K7, 6A8, 6C5, 6H6, 6F5, ^{3}6F6, ^{4}5Z4	456	1/25
	Tone	‡	O				22-438	15	TS108							
	Fid.	‡	‡		See Note	A5	22-420	15	TS101							
							22-321	13	CS133							
17	Vol.	11	L											^{5}01A, 71A		
31, 32 Battery	Vol.	11	SRP261		See Note	A82								^{5}01A, 12A, 71A, 00A		
34P	Vol.	11	SRP261		See Note	A82								^{5}27, 10, ^{2}81		
33, 33X, 34, 35, 35A	Vol.	11	SRP261		See Note	A82								^{5}27, 71A		
35P, 35AP	Vol.	11	SRP261		See Note	A82								^{5}27, 10, ^{2}81		
35APX, 35PX	Vol.	11	SRP261		See Note	A82								^{5}27, 26, 50		
37A, 39, 39A	Vol.	11	SRP261		See Note	A82								^{5}27, 10		
40A	Vol.	11	SRP261		See Note	A82								^{6}27, 26, 10		
41, 42	Vol.	11	SRP261		See Note	A82								24, ^{4}27, 71A		
	Sen.	1	K12													
52, 53, 54, 55 (50 Series)	Vol.	12	SRP261		Single	A82	22-61	3	MN277					^{3}24, ^{3}27, 45, 80		‡
	Vol.	123	DRP221		Dual	A83										
60, 61, 62, 64, 67 (60 Series)	Vol.	12	SRP261		Single	A82	22-61	3	MN277					^{3}24, ^{3}27, ^{2}45, 80		‡
	Vol.	123	DRP221		Dual	A83										
71, 72, 73, 77 (70 Series)	Vol.	12	SRP261		Single	A82	22-72	3	RS213					^{3}24, ^{3}27, ^{2}45, 80		3
	Vol.	123	DRP221		Dual	A83	22-73	3	RS216							
	Tone	41	M		See Note	A4										
80 (Hypermetron)	Vol.	12	SRP261				22-72	3	RS213					^{4}24, ^{3}27, ^{2}45, 80		3
	Tone	41	N				22-73	3	RS216							
91, 92	Vol.	111	A5MP		See Note	A27	22-119	26	RS213					^{5}51, ^{3}27, ^{2}45, 24, 80	175	17
	Vol.	15	N		See Note	A4	22-125	26	RS213							
	Tone	41	M													
102	Vol.	12	SRP261		See Note	A82	22-72	3	RS213					^{4}24, 27, ^{2}45, 80		3
103 (2017) Serials 450,001 to 450,450	Vol.	111	Y5MP				22-119	26	RS213					^{4}51, ^{2}24, ^{4}27, ^{2}45, 80	175	17
	Tone	41	N				22-125	26	RS213							
103 (2017) Serials above 450,451	Vol.	23	NN				22-119	26	RS213					^{4}51, ^{2}24, ^{4}27, ^{2}45, 80	175	17
	Tone	41	N				22-125	26	RS213							
112, 122	Vol.	12	SRP261		See Note	A82	22-72	3	RS213					^{4}24, 27, ^{2}45, 80		3
	Tone	41	N													
210, 210-5, 211-5 (2022 A & B)	Vol.	8	A10MP	6			22-156	4	CS133					^{2}58, 24, ^{3}27, 47, 80	175	1
	Tone	34	M				22-157	4	CS133							
215-216 (Chassis 2044)	Vol.	15	M				22-73	25	RS213					^{3}58, 56, 55, 59, 80	175	1
	Tone	34	N													
	Sen.	7	SRP262													
220 (2022 A & B)	Vol.	8	A10MP				22-157	4	CS133					^{2}58, 24, ^{3}27, 47, 80	175	1
	Tone	34	M				22-156	4	CS133							
225 (Chassis 2044)	Vol.	15	N				22-73	25	RS213					^{3}58, 56, 55, 59, 80	175	1
	Tone	34	N													
	Sen.	7	SRP262													
230, 240, 244, 245 (Chassis 2036)	Vol.	15	M	6			22-172	23	CS130					^{3}58, 56, ^{2}57, 59, 80	175	3
	Tone	34	N				22-173	23	CS133							
250, 260 (Chassis 2031)	Vol.	8	A10MP	6			22-156	4	CS133					^{2}58, 24, ^{3}27, 47, 57, 80	175	1
	Tone	34	N				22-157	4	CS133							
258 (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 55, 56, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													
259, 260, 261, 262 (Chassis 2031)	Vol.	8	A10MP	6			22-156	4	CS133					^{2}58, 24, ^{3}27, 57, 47, 80	175	1
	Tone	34	N				22-157	4	CS133							
263 (Chassis 2044)	Vol.	15	M	6			22-173	1	CS133					^{3}58, 56, 55, 59, 80	175	1
	Tone	34	N													
	Sen.	7	SRP262													
268 (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 56, 55, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													
269 (Chassis 2031)	Vol.	8	A10MP	6			22-157	4	CS133					^{2}58, 57, 24, ^{3}27, 47, 80	175	1
	Tone	34	M				22-156	4	CS133							
270-5	Vol.	8	A10MP	6			22-156	4	CS133					^{2}58, 24, ^{3}27, 47, 80	175	1
	Tone	34	N				22-157	4	CS133							
271 (Chassis 2036)	Vol.	15	M	6			22-173	42/12	RS213					^{3}58, 56, ^{2}57, 59, 80	175	3
	Tone	34	N				22-172	42	CS130							
	Sen.	7	‡		See Note	A5										
272 (Chassis 2031)	Vol.	8	A10MP	6			22-156	4	CS133					^{2}58, 24, ^{3}27, 47, 57, 80	175	1
	Tone	34	N				22-157	4	CS133							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ZENITH—Continued																
273 (Chassis 2030)	Vol.	20	TRP606				22-167	28	RS213					^{3}58, ^{2}56, 57, ^{3}59, 80	175	3
	Tone	41	N				22-169	15	TS106							
	Sen.	7	‡		See Note A5											
277 (Chassis 2056)	Vol.	17	N	6			22-204	1	RN242					^{4}58, 56, 2A6, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	E													
278, 280, 281 (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 56, 55, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													
281 (2nd) (Chassis 2056)	Vol.	17	N	6			22-204	1	RN242					^{4}58, 56, 2A6, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	E													
288, 289 (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 56, 55, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													
288 (2nd) (Chassis 2056)	Vol.	17	N	6			22-204	1	RN242					^{4}58, 56, 2A6, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	E													
291, 292 (Chassis 2022)	Vol.	8	A10MP	6			22-157	4	CS133					^{2}58, 24, ^{2}27, 47, 80	175	1
	Tone	34	M				22-157	4	CS133							
293 (Chassis 2056)	Vol.	17	N	6			22-204	1	RN242					^{4}58, 56, 2A6, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	E													
299 (Chassis 2031)	Vol.	8	A10MP	6			22-157	4	CS133					^{2}58, 57, 24, ^{3}27, 47, 80	175	1
	Tone	34	M				22-156	4	CS133							
333	Vol.	11	SRP261		See Note A82									^{5}01A, 71A		
342	Vol.	11	SRP261		See Note A82									^{5}27, 71A		
342P	Vol.	11	SRP261		See Note A82									^{5}27, 10, ^{2}81		
352, 352A	Vol.	11	SRP261		See Note A82									^{5}27, 71A		
352P, 352AP	Vol.	11	SRP261		See Note A82									^{5}27, 10		
352PX, 352APX	Vol.	11	SRP261		See Note A82									^{5}27, 26, 50		
353A	Vol.	11	SRP261		See Note A82									^{5}01A, 71A		
362, 362X	Vol.	11	SRP261		See Note A82									^{5}27, 71A		
392, 392A	Vol.	11	SRP261		See Note A82									^{6}27, 10		
410, 411	Vol.	20	TRP606				22-167	28	CS133					^{3}58, ^{2}56, ^{2}59, 57, 80	175	3
	Tone	41	N				22-169	15	TS106							
412 (414)	Vol.	11	SRP261		See Note A82									24, ^{4}27, 71A		
420	Vol.	20	TRP606				22-167	28	CS133					^{2}56, 57, ^{3}58, ^{3}59, 80	175	3
	Tone	41	N				22-169	15	TS106							
422	Vol.	11	SRP261		See Note A82									24, ^{4}27, 10		
	Sen.	1	K12													
430, 440, 441, 442	Vol.	20	TRP606				22-167	28	CS133					^{3}56, ^{2}57, ^{3}58, ^{3}59, 80	175	7
	Tone	41	N				22-169	15	TS106							
	Sen.	‡	A400P													
443 (Chassis 2030)	Vol.	20	TRP606				22-167	28	RS213					^{3}58, ^{2}56, 57, ^{3}59, 80	175	3
	Tone	41	N				22-169	15	TS106							
	Sen.	7	‡		See Note A5											
444 (Chassis 2033)	Vol.	124	TRP606	6			22-167	28	RS213					^{3}58, ^{3}56, ^{2}57, ^{3}59, 80	175	7
	Tone	41	N				22-169	15	TS106							
	Sen.	8	A400P													
460 (2047) (Auto)	Vol.	‡	N				22-183	1	CN151		4	221	C3	^{2}6D6, 85, ^{2}89, 6Z4	485	10
	Tone	44	K12				22-195	15	TS101							
	Sen.	7	J				.02		Buffer	B14						
462 (Chassis 2057)	Vol.	17	UM154	M26	See Note A96		22-236	4/15	SR628		4	221	C3	6C6, 6F7, 6D6, 75,		
	Tone	34	K12				.02		Buffer	B14				42, 84	252.5	10
470 (Chassis 2044)	Vol.	15	M	6			22-173	1	CS133					^{3}58, 56, 55, 59, 80	175	1
	Tone	34	N													
	Sen.	7	SRP262													
472 (Chassis 2031)	Vol.	8	A10MP	6			22-157	4	CS133					^{2}58, 57, 24, ^{3}27, 47, 80	175	1
	Tone	34	M				22-156	4	CS133							
473 (Chassis 2030)	Vol.	20	TRP606				22-167	28	RS213					^{3}58, ^{2}56, 57, ^{3}59, 80	175	3
	Tone	41	N				22-169	15	TS106							
	Sen.	7	‡		See Note A5											
474 (Chassis 2053)	Vol.	17	N	6			22-168	1	CN152	B42				^{3}58, 55, ^{2}59, 56, 80	175	1
	Tone	41	N													
	Sen.	7	SRP262													
475 (Chassis 2054)	Vol.	17	N	6			22-168	1	CN152					^{3}56, ^{3}58, ^{2}59, 80	175	1
	Tone	41	N				22-169	15	TS105							
	Sen.	7	UC500													
476, 476A (Chassis 2032)	Vol.	20	TRP606	6			22-241	28	RN241					^{3}56, ^{2}57, ^{3}58, ^{3}59, 80	175	7
	Tone	41	N				22-240	28	RS213							
	Supp.	7	A400P													
476B (Chassis 2059)	Vol.	15	N	6			22-230	3	RN242					^{6}56, ^{3}58, ^{2}59, 80	175	1
	Tone	57	K12				22-247	3	RS213							
	Sen.	7	K				22-225	15	TS101							
478 (Chassis 2056)	Vol.	17	N	6			22-204	1	RN242					^{4}58, 56, 2A6, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	E													
478 (2nd) (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 56, 55, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													
479 (Chassis 2059)	Vol.	15	N	6			22-247	3	RS213					^{3}58, ^{6}56, ^{2}59, 80	175	1
	Tone	57	K12				22-230	3	RN242							
	Sen.	58	K				22-225	15	TS101							
500, 501, 503, 514, 515, 516 (Chassis 2037)	Vol.	15	N				22-173	23	CS133					56, ^{2}57, ^{3}58, 59, 80	175	3
	Tone	34	N				22-172	23	CS130							
517, 518 (Chassis 2031)	Vol.	8	A10MP	6			22-157	4	CS133					^{2}58, 57, 24, ^{3}27, 47, 80	175	1
	Tone	34	M				22-156	4	CS133							
520, 521, 530, 531, 533, 535 (Chassis 2035)	Vol.	20	TRP606	6			22-167	28	CS133					^{3}58, ^{3}56, ^{3}59, ^{2}57, 80	175	7
	Tone	41	M				22-169	15	TS106							
	Sen.	7	UC500													
558 (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 56, 55, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													
563	Vol.	11	SRP261		See Note A82		22-61	3	MN277	B83				‡		
568 (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 56, 55, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Cir-cuit
	Use	Cir-cuit	Correct Replacement	Switch	Bias	*Note	Original Part	Cir-cuit	Correct Replacement	*Note	Vibr. Conn.	Replace-ment	*Note			
ZENITH—Continued																
577 (Chassis 2056)	Vol.	17	N	6			22-204	1	RN242					^{4}58, 56, 2A6, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	E													
578 (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 56, 55, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													
588 (Chassis 2056)	Vol.	17	N	6			22-204	1	RN242					^{4}58, 56, 2A6, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	E													
581, 590 (Chassis 2051)	Vol.	15	N	6			22-204	1	RN242					^{4}58, 56, 55, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	J													
593 (Chassis 2056)	Vol.	17	N	6			22-204	1	RN242					^{4}58, 56, 2A6, 59, 80	485	1
	Tone	34	K12				22-203	15	TS101							
	Sen.	7	E													
600 (Chassis 2037)	Vol.	15	M	6			22-173	23	CS133					56, ^{2}57, ^{3}58, 59, 80	175	3
	Tone	34	N				22-172	23	CS130							
M601 (P51)	Vol.	6	G12				22-119	1	RS213					^{2}35, 24, 47, 80		1
							22-118	1	RS213							
602	Vol.	12	SRP261		See Note	A82	22-61	3	MN277	B83				^{3}24, ^{3}27, ^{3}45, 80		
603 (Chassis 2038)	Vol.	124	TRP606	6			22-167	28	RS213					^{3}58, ^{3}56, ^{2}57, ^{3}59, 80	175	7
	Tone	41	N				22-169	50	TS106							
	Sen.	8	‡		See Note	A5										
604, 606 (Chassis 2037)	Vol.	15	M	6			22-173	23	CS133					56, ^{2}57, ^{3}58, 59, 80	175	3
	Tone	34	N				22-172	23	CS130							
608 (Chassis 2035)	Vol.	20	TRP606	6			22-167	28	RS213					^{3}58, ^{2}56, 57, ^{3}59, 80	175	3
	Tone	41	N				22-169	15	TS106							
	Sen.	7	‡		See Note	A5										
610 (Chassis 2031)	Vol.	15	M	6			22-173	23	CS133					^{3}58, 56, ^{2}57, 59, 80	175	3
	Tone	34	N				22-172	23	CS130							
611 (Chassis 2035)	Vol.	20	TRP606	6			22-167	28	RS213					^{3}58, ^{2}56, 57, ^{3}59, 80	175	3
	Tone	41	N				22-169	15	TS106							
	Sen.	7	‡		See Note	A5										
612 (Chassis 2038)	Vol.	124	TRP606	6			22-167	28	RS213					^{3}58, ^{3}56, ^{2}57, ^{3}59, 80	175	7
	Tone	41	N				22-169	15	TS106							
	Sen.	8	‡		See Note	A5										
613	Vol.	12	SRP261		See Note	A82	22-61	3	MN277	B83				^{3}24, ^{3}27, ^{2}45		
615 (Chassis 2035)	Vol.	20	TRP606	6			22-167	28	RS213					^{3}58, ^{2}56, 57, ^{3}59, 80	175	3
	Tone	41	N				22-169	15	TS106							
	Sen.	7	‡		See Note	A5										
616 (Chassis 2037)	Vol.	15	M	6			22-173	23	CS133					56, ^{2}57, ^{3}58, 59, 80	175	3
	Tone	34	N				22-172	23	CS130							
617 (Chassis 2038)	Vol.	124	TRP606	6			22-167	28	RS213					^{3}58, ^{3}56, ^{2}57, ^{3}59, 80	175	7
	Tone	41	N				22-169	15	TS106							
	Sen.	8	‡		See Note	A5										
618 (Chassis 2037)	Vol.	15	M	6			22-173	23	CS133					^{3}58, 56, ^{2}57, 59, 80	175	3
	Tone	34	N				22-172	23	CS130							
619 (Chassis 2033)	Vol.	124	TRP606	6			22-167	28	RS213					^{3}58, ^{3}56, ^{2}57, ^{3}59, 80	175	7
	Tone	41	N				22-169	15	TS106							
	Sen.	8	A400P													
620 (Chassis 2038)	Vol.	124	TRP606	6			22-167	28	RS213					^{3}58, ^{3}56, ^{2}57, ^{3}59, 80	175	7
	Tone	41	N				22-169	15	TS106							
	Sen.	8	‡		See Note	A5										
622	Vol.	12	SRP261		See Note	A82	22-61	3	MN277	B83				^{3}24, ^{3}27, ^{2}45, 80		
623 (Chassis 2038)	Vol.	124	TRP606	6			22-167	28	RS213					^{3}58, ^{3}56, ^{2}57, ^{3}59, 80	175	7
	Tone	41	N				22-169	15	TS106							
	Sen.	8	‡		See Note	A5										
642	Vol.	12	SRP261			A82	22-61	3	MN277	B83				^{3}24, ^{3}27, ^{2}45, 80		
650HD, 651HE, 660TD, 661TE	Vol.	17	N				22-236	4/15	SR628		34	292	C3	^{2}6D6, 6F7, 75, 42, 84	252.5	10
	Tone	34	K12													
663-4 (Chassis 5510)	Vol.	18	UM154-SS11	M26			22-388	4	CM171	B253	36	294SW	C3	6A7, 6D6, 75, 41, 6Z4	456	10
							.01		Buffer	B14						
666, 668 (Chassis 5616)	Vol.	18	UM154	M26		A96	22-347	4	CM171	B253	35	294	C3	^{2}6D6, 6C6, 75, 42, 84	252.5	10
							.01		Buffer	B14						
672	Vol.	12	SRP261		See Note	A82	22-61	3	MN277	B83				^{3}24, ^{2}45, 27, 80		
680 (Chassis 5617)	Vol.	18	UM154	M26	RS245	A96	22-347	4	CM171	B253	35	294	C3	^{2}6D6, 6C6, 75, 42, 84	252.5	10
							.01		Buffer	B14						
701	Vol.	15	N	6			C525	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	456	
702	Vol.	17	N	6			C525	11	UR182	B31				6A7, 6D6, 75, 43, 25Z5	465	
705, 706, 707 (Chassis 2052)	Vol.	17	N	6			22-217	1	RN242					57, 58, 56, 2A6, 59, 80	485	1
							22-225	15	TS101							
710	Vol.	17	N	6			C525	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	465	
711, 712 (Chassis 2052)	Vol.	17	N	6			22-217	1	RN242					56, 57, 58, 2A6, 59, 80	485	1
							22-225	15	TS101							
712 (Early)	Vol.	12	SRP261		Single	A82	22-72	3	RS213					^{3}24, ^{3}27, ^{2}45, 80		3
	Vol.	123	DRP221		Dual	A83	22-73	3	RS216							
	Tone	41	M		See Note	A4										
715 (Chassis 2053)	Vol.	17	N	6			22-168	1	CN152					^{3}58, 55, ^{2}59, 56, 80	175	1
	Tone	41	N													
	Sen.	7	SRP262													
722	Vol.	12	SRP261		Single	A82	22-72	3	RS213					^{3}24, ^{3}27, ^{2}45, 80		3
	Vol.	123	DRP221		Dual	A83	22-73	3	RS216							
	Tone	41	M		See Note	A4										
730	Vol.	97	TRP602				P80968	12	CS121					19, 30, 32, ^{2}34	175	
732	Vol.	12	SRP261		Single	A82	22-72	3	RS213					^{3}24, ^{3}27, ^{2}45, 80		3
	Vol.	123	DRP221		Dual	A83	22-73	3	RS216							
	Tone	41	M		See Note	A4										
735	Vol.	97	TRP602				P80968	12	CS121					19, 30, 32, ^{2}34	175	
740	Vol.	15	O				P80968	12	CS121					^{3}34, ^{6}30, 10AB	175	
	Tone	44	UC502													
750 (Chassis 2052)	Vol.	17	N	6			22-217	1	RN242					56, 57, 58, 2A6, 59, 80	485	1
							22-225	15	TS101							
755, 756 (Chassis 2053)	Vol.	17	N				22-168	1	CN152					^{3}58, 55, ^{2}59, 56, 80	175	1
	Tone	41	N													
	Sen.	7	SRP262													
757 (Chassis 2054)	Vol.	15	N	6			22-168	1	CN152					^{3}58, ^{3}56, ^{2}59, 80	175	1
	Tone	41	N				22-169	15	TS106							
	Sen.	58	UC500													
760, 765, 767 (Chassis 2054)	Vol.	17	N	6			22-168	1	CN152					^{3}56, ^{3}58, ^{2}59, 80	175	1
	Tone	41	N				22-169	15	TS105							
	Sen.	7	UC500													

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ZENITH—Continued																
770 (Chassis 2032)	Vol.	20	TRP606	6			22-241	28	RN241					^{3}58,^{3}56,^{2}57,^{3}59, 80	175	7
	Tone	41	N				22-240	28	RS213							
	Supp.	7	A400P													
770B (Chassis 2059)	Vol.	15	N	6			22-230	3	RN242					^{3}58,^{6}56,^{2}59, 80	175	1
	Tone	57	K12				22-247	3	RS213							
	Sen.	7	K				22-225	15	TS101							
772	Vol.	123	DRP221	6			22-72	3	RS213					^{3}24,^{3}27,^{2}45, 80		3
							22-73	3	RS216							
775 (Chassis 2032)	Vol.	20	TRP606				22-241	28	RN241					^{3}56,^{2}57,^{3}58,^{2}59, 80	175	7
	Tone	41	N				22-240	28	RS213							
	Supp.	7	A400P													
775B (Chassis 2059)	Vol.	15	N	6			22-230	3	RN242					^{6}56,^{3}58,^{2}59, 80	175	1
	Tone	57	K12				22-247	3	RS213							
	Sen.	7	K				22-225	15	TS101							
777	Vol.	12	SRP261		Single	A82	22-72	3	RS213					^{3}24,^{3}27,^{2}45		3
	Vol.	123	DRP221		Dual	A83	22-73	3	RS216							
	Tone	41	M		See Note	A4										
780 (Chassis 2032)	Vol.	20	TRP606	6			22-241	28	RN241					^{3}56,^{2}57,^{3}58,^{3}59, 80	175	7
	Tone	41	N				22-240	28	RS213							
	Supp.	7	A400P													
788 (Chassis 2059)	Vol.	15	N	6			22-247	3	RS213					^{3}58,^{6}56,^{2}59, 80	175	1
	Tone	57	K12				22-230	3	RN242							
	Sen.	58	K				22-225	15	TS101							
801	Vol.	17	N	6			C525	11	UR182	B31				^{2}6D6, 75, 43, 25Z5	456	
805 (Chassis 5502)	Vol.	18	N	6			22-125	23	RM262	B50				6F7, 6D6, 75, 42, 80	252.5	1
806, 807 (Chassis 5504, 5505)	Vol.	18	M	6			22-125	23	RM262	B50				6A7, 6D6, 75, 42, 80	252.5	1
808, 809 (Chassis 5605, 5607)	Vol.	18	M	6			22-125	25	RM262	B216				^{2}6D6, 6A7, 75, 42, 80	252.5	1
							22-318	25/14	RN241							
							22-306	13	CS130							
810, 811 AC-DC (Chassis 5609)	Vol.	18	M	6			22-307	11	RM257	B215				6D6, 6A7, 75, 43, 25Z5	252.5	
							22-308	11	RN232	B8						
							22-195	15	TS101							
812 (Chassis 5608) AC-DC	Vol.	18	M	6			22-307	11	RM257	B215				^{2}6D6, 6A7, 75, 43, 25Z5	125	
							22-308	11	RN232	B8						
814, 815 (Chassis 5611, 5612)	Vol.	18	M	6			22-125	25	RM262	B216				^{2}6D6, 6A7, 75, 42, 80	125	1
							22-318	25/13	RN241							
816 (Chassis 5608)	Vol.	18	M	6			22-307	11	RM257					^{2}6D6, 6A7, 75, 43, 25Z5	125	
							22-308	11	RN232	B8						
819 (Chassis 5608)	Vol.	18	M	6			22-307	11	RM257	B215				^{2}6D6, 6A7, 75, 43, 25Z5	125	
							22-308	11	RN232	B8						
825, 827 (Chassis 5701-2-3)	Vol.	18	M	6			22-283	23	CM172					^{3}6D6, 75, 42, 37, 80	485	1
							22-266	23	CM175	B10						
S827 (Chassis 5701R)	Vol.	18	M	6			22-321	25	CS133					^{3}6D6, 76, 75, 42, 80	252.5	1
							22-322	25/13	RN242							
829 (Chassis 5701-2-3)	Vol.	18	M	6			22-283	23	CM172					^{3}6D6, 75, 42, 37, 80	485	1
							22-266	23	CM175							
S829 (Chassis 5701R, 5702R, 5703R)	Vol.	18	M	6			22-321	25	CS133					^{3}6D6, 75, 42, 76, 80	252.5	1
							22-322	25/13	RN242							
835 (Chassis 1001, 1001A)	Vol.	18	TRP606	6			22-331	3	RS213					^{3}6D6, 75,^{3}42, 76, 5Z3, 6A7	485	1
							22-125	3	RM262	B216						
							22-225	15	TS101							
845 (Chassis 5502)	Vol.	18	N	6			22-125	23	RM262	B50				6F7, 6D6, 75, 42, 80	252.5	1
S847, 850 (Chassis 5504, 5505)	Vol.	18	M	6			22-125	23	RM262	B50				6A7, 6D6, 75, 42, 80	252.5	1
860, 861 (Chassis 5605, 5607)	Vol.	18	M	6			22-125	25	RM262	B216				^{2}6D6, 6A7, 75, 42, 80	252.5	1
							22-318	25/14	RN241							
							22-306	13	CS130							
862 AC-DC (Chassis 5609)	Vol.	18	M	6			22-307	11	RM257	B215				^{2}6D6, 6A7, 75, 43, 25Z5	252.5	
							22-308	11	RN232	B8						
							22-195	15	TS101							
864 (Chassis 5611, 5612)	Vol.	18	M	6			22-125	25	RM262	B216				^{2}6D6, 6A7, 75, 42, 80	125	1
							22-318	25/13	RN241							
865, 866 AC-DC (Chassis 5609)	Vol.	18	M	6			22-307	11	RM257	B215				^{2}6D6, 6A7, 75, 43, 25Z5	252.5	
							22-308	11	RN232	B8						
							22-195	15	TS101							
870 (Chassis 5701-2-3)	Vol.	18	M	6			22-283	23	CM172					^{3}6D6, 75, 42, 37, 80	485	1
							22-266	23	CM175	B10						
S870, S871 (Chassis 5701R, 5702R, 5703R)	Vol.	18	M	6			22-321	25	CS133					^{3}6D6, 75, 42, 76, 80	252.5	1
							22-322	25/13	RN242							
880, 881 (Chassis 1001, 1001A)	Vol.	18	TRP606	6			22-331	3	RS213					^{3}6D6, 75,^{3}42, 76, 5Z3, 6A7	485	1
							22-125	3	RM262	B216						
							22-225	15	TS101							
908, 909 (Chassis 5614)	Vol.	18	M	6			22-385	25/13	RM265					^{2}6D6, 6A7, 75, 42, 80	252.5	1
	Tone	22	Y50MP													
S908, S909 (Chassis 5618)	Vol.	18	M	6			22-385	25/13	RM265					^{2}6D6, 6A7, 75, 42, 80	252.5	1
	Tone	34	Y50MP													
935 (Chassis 1001)	Vol.	124	TRP606	6			22-331	3	WE847					^{3}6D6, 6A7, 76, 75,^{3}42, 5Z3	485	1
							22-125	3	WE847							
945, 950 (Chassis 5508, 5509)	Vol.	18	M	6			22-125	25	RM262	B216				6A7, 6D6, 75, 42, 80	252.5	1
	Tone	22	Y50MP													
960, 961 (Chassis 5614)	Vol.	18	M	6			22-385	25/13	RM265					^{2}6D6, 6A7, 75. 42, 80	252.5	1
	Tone	22	Y50MP													
S961 (Chassis 5618)	Vol.	18	M	6			22-385	25/13	RM265					^{2}6D6, 6A7, 75, 42, 80	252.5	1
	Tone	34	Y50MP													
970, 975 (Chassis 5902)	Vol.	114	N	6			22-125	3	RM262	B216				^{2}58, 2A7, ^{2}2A5, ^{3}56, 80	175	1
	Tone	114	N				22-230	3	RN242							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ZENITH—Continued																
978 (Chassis 1001)	Vol.	124	TRP606	6			22-331 22-125	3 3	WE847 WE847					^{3}6D6, 6A7, 76, 75, ^{3}42, 5Z3	485	1
980 (Chassis 1201, 1201A)	Vol.	20	TRP606				22-331 22-125	3 3	RS213 RM262	 B216				^{3}6D6, ^{5}76, 6A7, ^{2}42, 5Z3	485	1
983 (Chassis 1001)	Vol.	124	TRP606	6			22-331 22-125	3 3	WE847 WE847					^{3}6D6, 6A7, 76, 75, ^{3}42, 5Z3	485	1
985, 990 (Chassis 1201, 1201A)	Vol.	20	TRP606				22-331 22-125	3 3	RS213 RM262					^{3}6D6, 6A7, ^{5}76, ^{2}42, 5Z3	485	1
Stratosphere 1000Z (Chassis 2501C, 2501P)	Vol. Tone Supp.	‡ ‡ ‡	Order from Mfr. Order from Mfr. 500M No. 1		 See Note A19		22-361 22-360 22-362 22-189 22-225	3 3 14 15 15	RS216 HS691 CS133 TS102 TS101					^{6}6D6, 6A7, ^{3}76, ^{2}42, 85, 79, ^{8}45, ^{3}5Z3	485	‡
1101 (Chassis 1001)	Vol.	124	TRP606	6			22-331 22-125	3 3	WE847 WE847					^{3}6D6, 6A7, 76, 75, ^{3}42, 5Z3	485	1
1105 (Chassis 1001)	Vol.	124	TRP606	6			22-331 22-125	3 3	WE847 WE847					^{3}6D6, 6A7, 76, 75, ^{3}42, 5Z3	485	1
1117 (Chassis 5614)	Vol. Tone	18 22	M Y50MP	6			22-385	25/13	RM265					^{2}6D6, 6A7, 75, 42, 80	252.5	1
1161 (Chassis 5611, 5612)	Vol.	18	M	6			22-125 22-318	25 25/13	RM262 RN241	B216				^{2}6D6, 6A7, 75, 42, 80	125	1
1162 (Chassis 5609) AC-DC	Vol.	18	M	6			22-307 22-308 22-195	11 11 15	RM257 RN232 TS101	B215 B8				^{2}6D6, 6A7, 75, 43, 25Z5	252.5	
1167 (Chassis 5618)	Vol. Tone	18 34	M Y50MP	6			22-385	25/13	RM265					^{2}6D6, 6A7, 75, 42, 80	252.5	1
1170 (Chassis 5701R, 5702R, 5703R)	Vol.	18	M	6			22-321 22-322	25 25/13	CS133 CN152					^{3}6D6, 75, 42, 76, 80	252.5	1
2009C	Vol.	6	G12				22-87 22-102	1 1	RS213 RS213					^{3}24, 45, 80		1
2051 (Chassis)	Vol. Tone Sen.	15 34 7	N K12 J	6			22-204 22-203	1 15	RN242 TS101					^{4}58, 55, 59, 56, 80	485	1
2056, 2056I (Chassis)	Vol. Tone Sen.	18 34 7	N K12 E				22-204 22-203	1 15	RN242 TS101					^{4}58, 2A6, 59, 56, 80	485	1
2062 (Chassis)	Vol. Tone Sen.	17 34 7	N K12 K	6			22-230	1	RN242					^{2}58, 57, 56, 2A6, 2A5, 80	125	1
ZEPHYR																
AA (650,001 & up)	Vol.	‡	N				5	19	TS101					1A6, ^{2}1B4, 1F4	456	
C (AC-DC 750,001 & up)	Vol.	6	G12		EX600		8-4 5	6 15	See Note TS101	B3				78, 77, 43, 25Z5		
DA	Vol. Tone	17 22	N L				5	19	TS101					1C6, 1A4, 1B5, 30, 19	456	
DB, DF	Vol.	17	N				10-20 .01	1	RN245 Buffer	B190 B14	14	245C	C3	1C6, 34, 1B5, 38	456	10
G	Vol. Tone	15 34	N L				8-8 5	4 15	See Note TS101	B3				6A7, 6K7, 76, 6F5, 42, 6G5, 80	456	1
GB, GBE	Vol. Tone	17 34	N N				8-8 .01	1	See Note Buffer	B3 B14	14	245C	C3	1C6, 1A4, 1B5, 30, 19	456	10
GE	Vol. Tone	15 34	N L				8-8	4	See Note	B3				6A7, 6K7, 76, 6F5, 42, 6G5, 80	456	1
NT, NTE	Vol. Tone	15 22	N N				4-8-8 5	3 15	CN155 TS101	B3				6K7, 6A8, 6D6, ^{2}76, ^{2}6B5, 75, 80, 6G5	456	1
P (645,001 & up)	Vol. Tone	17 22	N L				8-8 5	4 15	CN152 TS101	B3				6A7, 6D6, 75, 42, 80	456	1
RKD, RKE, RKSD	Vol.	6	UC510		EX300		15-8 5-5	6 15	See Note TN110	B3				6D6, 6C6, 43, 25Z5		
V (AC-DC, 285,001 & up)	Vol.	6	UC510	6	EX500		8-4 5-5	6 15	See Note TN110	B3				77, 78, 43, 25Z5		
Y (AC-DC, 405,001 & up)	Vol. Tone	6 22	G12 L		EX500		20-4 5-5	6 15	See Note TN110	B3				6D6, 6C6, 43, 25Z5		
2M7	Vol.	18	SRP281	6			8-8	1	SR605		34	292	C3	^{2}6K7, 6A8, 6Q7, 6F6, 0Z4	177.5	10
3M7	Vol.	18	UC514	6			8-6	1	SR605		35	294	C3	^{2}6D6, 6A7, 6Q7, 41, 0Z4	262	10
3M8	Vol.	18	UC514	6			8-6	1	SR605		35	294	C3	^{2}6K7, 6L7, 6C5, 6Q7, 6F6, 0Z4	262	10
4Z (290,001 & up)	Vol.	6	UC510		EX300		15-8 5-5	24 15	See Note TN110	B3				78, 6C6, 38, 76		
5DA	Vol.	17	N				5	19	TS101					1C6, 34, 1B5, 30, 19	456	
5DK (780,001 & up)	Vol. Tone	17 22	N L				4-20 5-5	6 15	See Note TN110	B3				6A7, 6D6, 75, 43, 25Z5	456	
6G (700,001 & up)	Vol. Tone	17 22	N L	 6			8-8 5	4 15	See Note TS101	B3				6A7, 6D6, 75, 76, 42, 80	456	1
6GM (650,001 & up)	Vol. Tone	17 22	N L	 6			8-8 5	4 15	See Note TS101	B3				6A8, 6K7, 6H6, 6F5, 6F6, 5Z4	456	1
8J (765,001 & up)	Vol. Tone	17 22	N L	 6			4-8 4-8-8 5 5	30 30/13 19 15	RN241 CM175 TS105 TS101	B3				^{2}6D6, 6A7, 75, ^{3}42, 80	456	1
8J (765,361 & up)	Vol. Tone	17 22	N L	 6			4-8 4-8-8 5	30 30/13 15	RN241 CM175 TS101	B3				^{2}6D6, 6A7, 75, 76, ^{2}6B5, 80	456	1
8JM (720,001 & up)	Vol. Tone	118 22	L L	 6			4-8 4-8-8 5	30 30/13 15	RN241 CM175 TS101	B3				^{2}6K7, ^{2}6A8, ^{3}6F6, 5Z4	456	1
20A6	Vol.	15	N	6										1C6, 1A4, 1B5, 30, 19	456	
20B6	Vol. Tone	15 34	N L	 6			4-8 5-5	1 15	RN231 TN110		48	See Note	C8	6D8, 6S7, 6Q6, 38, 6G5	456	10
20X7	Vol. Tone	15 34	N L	 6			20-20 5-5	1 15	UR192 TN112					6A7, 6K7, 75, 43, 25Z5, 6G5, K38B2	456	
23A5	Vol.	15	N	7										1C6, 1A5, 1B5, 30, 19	456	
25B5	Vol.	15	N	6			8, 8 10	1 15	RS213 TS101					6A7, 6S7, 6T7, 41, 6G5	456	10
25X7	Vol.	15	N	6			20 10	4 4	RS207 RS205					6A7, 6D6, 75, 43, 25Z5, 6G5, L42C	456	
25Y11	Vol. Tone	15 34	N L	 6			8-8 5-5	2 15	CN152 TN110					6K7, 6L7, 6D6, ^{3}76, 75, ^{2}6B5, 80, 6G5	456	1

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

MANUFACTURER AND MODEL	CONTROLS						CONDENSERS				VIBRATORS			Complete Tube Complement	I. F. Peak	Trans. Circuit
	Use	Circuit	Correct Replacement	Switch	Bias	*Note	Original Part	Circuit	Correct Replacement	*Note	Vibr. Conn.	Replacement	*Note			
ZEPHYR—Continued																
30B7	Vol.	15	N				8-8	1	CM165		48	See Note	C8	6D8, 6S7, 6L5, 6Q6, 38, 6G5	456	10
	Tone	34	L	6			5-5	15	TN110							
30P7	Vol.	15	N				8-8	1	CM165		48	See Note	C8	6D8, 6S7, 6L5, 6Q6, 38, 6G5	456	10
	Tone	34	L	6			5-5	15	TN110							
30X5	Vol.	6	G12	6	EX300		14-8	1	UR189					6D6, 6C6, 43, 25Z5, K55C		
							5-5	15	TN112							
30Y9	Vol.	15	N				16-16-8-4	9	Order from	Mfr.				6L7, 6D6, 76, 6H6, 75, 25B5, 25Z5	456	
	Tone	34	L	6												
31X5	Vol.	6	G12	6	EX300		20-10	1	UR192					6D6, 6C6, 25A7, L49C		
31YP6	Vol.	15	N	6			40-12-10	‡	UR182/TS101					6A7, 6D6, 6Q7, 25B5, 25Z5, 165L8	456	
	Tone	34	L													
32B7	Vol.	15	N	6			8-8	1	CN142		48	See Note	C8	6D8, 6S7, [2]6L5, 19	456	10
	Tone	34	L													
32P6	Vol.	15	M	6										6A7, 6D6, 75, 76, [2]48	456	
	Tone	34	L													
32X5, 33X5, 34X5	Vol.	6	G12	6	EX300		16-12	4	CM164					6D6, 6C6, 43, 25Z5, L49C		
32Y5	Vol.	15	N	6			8-4	4	CM171					6A7, 6D6, 75, 42, 80	456	1
	Tone	34	L													
32Y6	Vol.	15	N	6			8-4	4	CM171					[2]6K7, 6A8, 6Q7, 6F6, 6G5, 80	456	1
	Tone	34	L													
33B6	Vol.	15	N	6			8-8	1	CN142		48	See Note	C8	6D8, 1E5, [2]1A4, 1J6, 6T7	456	10
	Tone	34	L													
35X5, 36X5	Vol.	6	G12	6	EX300		20-8-6-5	1	UR182					6D6, 6C6, 43, 25Z5, 185R8		
35Y12	Vol.	15	N	6			12	4	RS215					[2]6K7, 6A8, [2]6H6, 6G5, [2]6C5, [2]6F6, [2]5Y3	456	1
	Tone	34	L				18	4	WE1847							
40Y6	Vol.	15	N	6			16-16-8-4	9	Order from	Mfr.				6A7, 6K7, 6Q7, 6F6, 6G5, 80	456	1
41X5	Vol.	6	G12	6	EX500		16-12	4	CM164					6D6, 6C6, 43, 25Z5, L55C		
41X6	Vol.	15	N	6			16-20	4	CM164					6A7, 6D6, 6Q7, 43, 25Z5, BM49B	456	
42X5	Vol.	6	G12	6	EX500		16-12	4	CM164					6D6, 6C6, 43, 25Z5, L49C		
42X6	Vol.	15	N	6			12-30	4	CM164					6A7, 6D6, 6Q7, 25L6, 25Z5, BM49B	456	
43X5	Vol.	6	G12	6	EX500		14-8-4-5	1	UR182					6D6, 6C6, 43, 25Z5, L55C		
61X6	Vol.	15	N	6			16-12	4	CM164					6A7, 6D6, 75, 43, 25Z5, L49C	456	
61X8	Vol.	15	N	6			16-12	4	CM164					6A7, 6D6, 75, 6G5, 76, 25L6, 25Z5, L49C	456	
	Tone	34	L													
62X8	Vol.	15	N	6			40-10-8	1	UR182/CS126					6A7, 6D6, 75, 6G5, 76, 25L6, 25Z5, L49C	456	
	Tone	34	L													
63X8	Vol.	15	N	6			16-12	4	CM164					6A7, 6D6, 76, 6G5, 6F5, 43, 25Z5, L40S	456	
	Tone	34	L													
67Y8	Vol.	15	N				8, 8	‡	WE847					6A7, 6D6, [2]76, 6F5, 6G5, 42, 80, WL22	456	1
	Tone	34	L	6			10	15	TS101							

‡ Data not substantiated.

* IMPORTANT: Read Notes in Note Section if specified in Note Column.

Explanation of Abbreviations

(Used in Control Listings, Pages 13 to 157)

Att. . . . Attenuator Control.

AVC . . . Automatic Volume Control.

Band . . . Band Adjustment Control.

Bass . . . Bass Tone Adjustment Control.

Batt. . . . Battery Voltage Control.

BFO . . . Beat Frequency Osc. Control.

Bias . . . Bias Adjustment Control.

B. Tone . . . Bass Tone Control.

Clr'ty . . . Clarity Control.

Equal . . . Equalizer Control.

Exp. . . . Expander Control.

Exp. Bias . . . Expander Bias Adjustment Control.

Fid. . . . Fidelity Control.

Fidlty. . . . Fidelity Control.

Fil. . . . Filament Control.

F.O.G. . . . Flashograph Adjustment Control.

Gain . . . Gain Control.

H.F. Tone . . . High Frequency Tone Control.

Hum . . . Hum Control.

L.F. Tone . . . Low Frequency Tone Control.

Loc'lzr. . . . Localizer Control.

Meter . . . Meter Adjustment Control.

Mic. . . . Microphone Adjustment Control.

Mike . . . Microphone Adjustment Control.

Mod. . . . Modulator Control.

Mon. . . . Monitor Control.

M. Vol. . . . Manual Volume Control.

NSC . . . Noise Suppression Control.

Osc. Adj. . . . Oscillator Adjustment Control.

P.E. Adj. . . . Photo-Electric Cell Adjustment Control.

Phantom . . . Phantom Tuning Control.

Phono. . . . Phonograph Pick-up Control.

Power . . . Line Voltage Control.

Primary . . . Primary Voltage Control.

P.U. Adj. . . . Pick-up Adjustment Control.

P.U. Volt . . . Pick-up Voltage Control.

QAVC . . . Q.A.V.C. Adjustment Control.

Reg. . . . Regeneration Control.

Regen. . . . Regeneration Control.

Relay . . . Relay Adjustment Control.

Screen . . . Screen Voltage Control.

Sel. . . . Selectivity Control.

Sen. . . . Sensitivity Control.

Sil. . . . Silencing Control.

Supp. . . . Suppressor Control.

Tone . . . Tone Control.

Tone B'm. . . . Tone Beam Adjustment Control.

T. Tone . . . Treble Tone Control.

Tunlgt. . . . Tuning Light Adjustment Control.

Vol. . . . Volume Control.

Voltage . . . Plate Voltage Adjustment Control.

V. R. . . . Voltage Regulator Control.

EX 100 . . . EX followed by a numeral indicates that an external resistor of the stated value must be connected between the right hand terminal of the control and the cathode circuit of the receiver.

SECTION "A" CONTROLS

RESISTANCE VALUE

One of the first points to be considered in the replacement of a defective control is the proper resistance value. Although actually of secondary importance as compared to the primary need of correct taper, the resistance value was usually the dominant factor in choosing a replacement control. This situation was entirely natural inasmuch as the listing of replacement controls with really complete taper information has been a comparatively recent innovation. Secondly, many servicemen were not familiar enough with the tremendous influence which taper has on the operation of any volume control. Finally, they were not aware of the permissible tolerance in the matter of control resistance value.

In many cases the tolerance range has been very wide. The tolerance specification in one particular instance was plus 40%, and minus 25%. This means that if the nominal value is 10,000 ohms, the control will be acceptable and will give good performance if its resistance is anywhere between 7500 ohms and 14,000 ohms inclusive. Nominal tolerance of carbon controls is plus or minus 20% from stated value. Yet many servicemen fear to use a 10,000 ohm control (of proper taper), to replace one of 11,000 ohms.

Always Remember—**"RESISTANCE VALUE IS NOT CRITICAL BUT TAPER MUST NOT BE CHANGED." This rule will save time and worry because the resistance value need only be sufficient to give full control. Thus, it should be great enough that weak stations may be heard at their full strength, and yet it should not be so great that difficulty is encountered on local stations.**

Consider an actual case, wherein the specified value is 12,500 ohms. This is readily replaceable with a 15,000 ohm control. **Warning! Of the same taper.**

In many instances this control is replaceable with a 10,000 ohm control (of the same taper). To a certain extent, this is controlled by circuit action. (See "Circuit Action."—page 161.)

DEFINITION OF TAPER

The word taper, as applied to controls, means that the resistance of the control does not change in a direct ratio with the rotation of the control. The term direct ratio or linear action means that the resistance value varies directly with the degree of rotation. That is, at ¼ rotation there is ¼ of the total resistance, similarly at ½ rotation there is ½ of the total resistance.

IMPORTANCE OF TAPER

Since it is generally agreed that taper is the most important factor in control replacement work, an understanding of the fundamentals of this subject is indispensable to the individual interested in service work. Many stubborn cases of volume control trouble may be quickly diagnosed, correct treatment or remedy prescribed, and a permanent cure effected by simple application of this knowledge. The subject of taper is not difficult to understand, on the contrary it is quite simple, yet there is more misinformation and lack of information on this subject than on any other subject of equal importance in the radio service field.

The following discussion is presented with a view of clarifying any confusion created by the wide circulation of complicated taper charts with little or no attendant explanation. For purposes of clarity and emphasis this discussion is presented in an informal and non-technical style.

TYPES OF TAPER

There are only two basic types of taper, Left Hand (Yaxley No. 1) and Right Hand (Yaxley No. 2).

Popular usage has defined "Linear" as a "Taper," therefore it will be listed as such.

In addition to the two basic tapers, Yaxley lists the III (3), a combination of tapers I (1) and II (2), for "special" (SRP) controls. Also, the VII (7) taper (in wire wound controls only) for special use as a replacement for Ant.-Bias circuits, or to replace shunt controls for circuits designed before it was possible to make logarithmic types of taper. The three remaining Yaxley tapers (4A, 5, and 6) are modifications of the basic tapers. The Yaxley No. 5 taper is a general type of taper having a characteristic of approximately 20% of total resistance at 50% rotation. The curve of this taper varies according to the location of the tap. This design is necessary because in circuits using tapped controls, the loss of the higher frequencies must be offset by shifting the taper curve to obtain an apparently even control in volume. It is not desirable to have a large and confusing array of slightly different tapers, hence the generalization of the No. 5 taper.

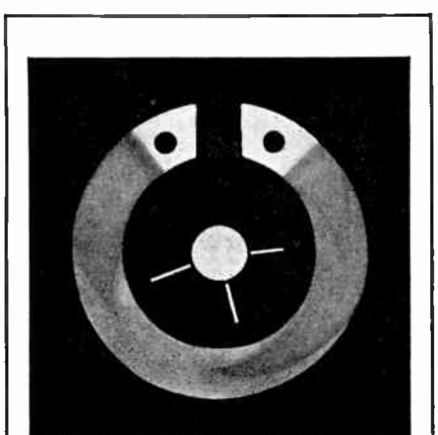


FIGURE 37

Yaxley tapers are controlled by a new and exclusive design as shown in Figure 37.

This views a tapered element (Yaxley No. 2 right hand taper, with switch) and shows the method of tapering a control by **"Geometric Design," mathematically calculated and field checked. This is the only real solution to the problem of taper.** Notice that the tails of each section fade into the next section (marked by the ball and arrows) and that **the "Roller" which does not roll, contacts a gradually increasing or decreasing area of each section. This prevents any "step" or "jump" in resistance value and assures a smoothness unknown to any other method of tapering a control.**

WHY TAPER?

It is necessary to taper the resistance of a control in order to give an apparent linear control of the signal, thus when the control is turned to the "half-way on" position, one expects to hear a volume of signal which will be one-half that obtained at the full "on" position of the control.

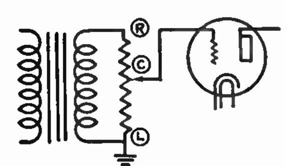


FIGURE 38

Let us suppose that the control in Circuit 16 (Figure 38) is in an amplifier and that we supply a certain measured value of signal, with the control at full "on" position, next we turn the control until the signal sounds only half as loud, and then measure the signal at the grid of the tube.

Our measurement shows that we have reduced the signal to approximately 1/10 its former value.

The reason for this unusual action is that **the human ear has a peculiar characteristic in that to double a given volume of sound requires an increase of approximately ten times the original intensity.**

Or, more simply—if it requires a pressure of one pound per square inch to produce a certain volume of sound, it will require a pressure of ten pounds per square inch to double this volume. Sound pressures are not measured in the large quantities given. However, the explanation is plain.

LEFT-HAND TAPER
(Yaxley No. 1)

The taper action shown in Circuit 16 (Figure 38) is that of the common or "Left-Hand" taper (Yaxley No. 1). **Let us see why this is called a "Left-Hand" taper.**

It is common practice to have volume controls wired so that when the knob is rotated all the way in a clockwise direction, or as we often say, "to the right," we will have our full volume position. Minimum volume or "off" position will be at the full counter-clockwise, or "left hand" position of the knob.

In the explanation of taper action, we pointed out that at half volume or half rotation position of the control knob, we need only 1/10 of the full volume voltage. Therefore, we need only 1/10 of our total resistance between full "left" position and the "half-way" position of our knob. This is made clear in Figure 39.

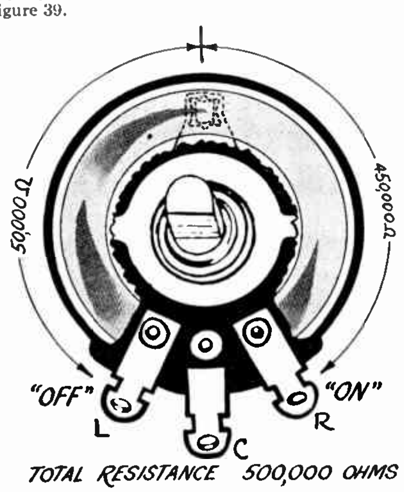


FIGURE 39

Note the position of the arm of the control and the resistance values of the two halves of the control.

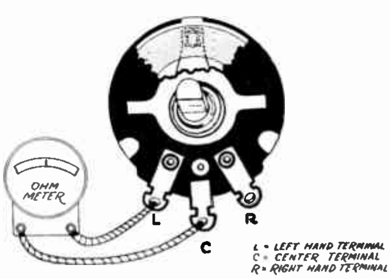


FIGURE 40

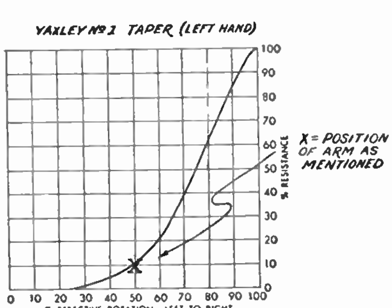


FIGURE 41

Figure 40 shows the connections of the ohmmeter, and Figure 41 illustrates the plotting of the complete taper curve. See page 160 "How to find the taper of a control."

Note that the left hand half of the control has its resistance tapered out. This is the reason for calling this a "Left Hand" taper.

Always use a left hand taper (Yaxley No. 1) **for all "Shunt" or "Short Out" circuits.** (See the exceptions given in the chapter on "Circuit Action," page 161.) Refer to pages 178 to 183 and **look** at circuits numbered 1 to 6, 10 to 16 to 20, (21), (22), 23, 33 to (36), 39 to 41, 44 to 46, 50, 55 to 57, 60 to (67), (69), 72, 73, 76, 77, 79, 80, 81, 83, 85, 87, 93, 94, 96, (100). All these circuits require a left hand taper **fundamentally.** Those marked with parenthesis and a few others use a modified or combination taper. The reasons for this departure are given in the chapter on "Circuit Action." **Note! Tone Controls are generally left hand taper.** They usually have the "Bass" position at the left of the knob. When "Bass" position is at the right of the knob, a right hand taper is required. See the chapter on "Tone Controls," page 169.

A good general rule is, **"When only the center and left hand terminals are used, use a left hand taper** (Yaxley No. 1).

When replacing a control, always examine the circuit and check the taper of the original control. It is wise to question your customer in regard to the action of the control to learn if it was smooth or jerky in its action. Study the circuit and refer to the chapter on "Circuit Action" before replacing it. Often a slight change will give better volume control and a satisfied customer.

QUICK REFERENCE
(Yaxley No. 1)
LEFT HAND
TAPERED CONTROLS

Ohms Resist-ance	Catalog Number	Type	General Use
500	A	W. W.	Ant. Shunt
1000	B	W. W.	Ant. or Pri. Shunt
2000	C12	W. W.	Ant. or Pri. Shunt
3000	D12	W. W.	Ant. or Pri. Shunt
5000	E12	Carbon	Ant. or Pri. Shunt
7500	F12	Carbon	Ant. or Pri. Shunt
10,000	G12	Carbon	Ant. Shunt or Ant.-Bias Tone
15,000	H12	Carbon	Ant. Shunt or Ant.-Bias Tone
20,000	Y	Carbon	Ant. Shunt or Ant.-Bias Tone
50,000	K12	Carbon	Screen Voltage, Tone
75,000	Z12	Carbon	Screen Voltage, Tone
100,000	L	Carbon	AF or RF Shunt, Audio, Tone
150,000	UC502	Carbon	AF or RF Shunt, Audio, Tone
250,000	M	Carbon	AF or RF Shunt, Audio, Tone
250,000	UC511*	Carbon	Audio Control (Auto)
500,000	N	Carbon	Audio Control
500,000	UC512*	Carbon	Audio Control (Auto)
500,000	UC515	Carbon	Audio Control (Auto)
750,000	UC503	Carbon	AF Shunt, Audio, Tone
1 Meg.	O	Carbon	Audio, Tone
1 Meg.	UC514*	Carbon	Audio, Auto
2 Meg.	P	Carbon	Audio, Tone
3 Meg.	UC501	Carbon	Audio, Tone
4 Meg.	UC505	Carbon	Audio, Tone
5 Meg.	UC506	Carbon	Audio, Tone
9 Meg.	UC508	Carbon	Audio, Tone

*Slotted shaft for auto receivers.

In the "General Use" column are abbreviations of the use of the control; circuits follow:

Ant. Shunt—Circuits 1 to 5, 40, 60.

Pri. Shunt—Circuits 10, 81 (Plate control).

Ant.-Bias**—Circuits 6, 69.

Screen Voltage—Circuit 12.

Tone—Circuits 21, 22, 34, 39, 41, 44, 57, 65, 67, 72, 85, 101, 103.

AF Shunt—Circuits 15 to 18, 33, 76, 96.

RF Shunt—Circuits 13, 14, 81 (Grid).

Audio—Circuits 15 to 18, 33, 45, 46, 55, 56, 61, 73, 76, 77, 78, 83, 93, 96.

**Ant.-Bias circuits 6 and 69 often use a left hand tapered control where tubes of sharp cut off characteristics (such as type 24) are used: Yaxley No. 7 taper is excellent for this use.

WARNING! Be careful that the control for circuits 6 and 69 is not too large a resistance value that plate current "cut-off" occurs at or near minimum volume position. If **cut-off** is approached too closely distortion will occur. Read "Circuit Action" page 161.

RIGHT HAND TAPER
(Yaxley No. 2)

Right Hand Taper (Yaxley No. 2) **is the designation applied to a control wherein the Right Hand half of the resistance is tapered out. Right Hand taper is used in series circuits.**

We have explained the necessity of taper, because of the characteristics of the human ear. **Right Hand taper is necessary because of the peculiar combination of circuit action and the action of the ear.** Figures 42, 43, 44 and 45 give a clear picture of the arrangement and measurement of Right Hand Taper.

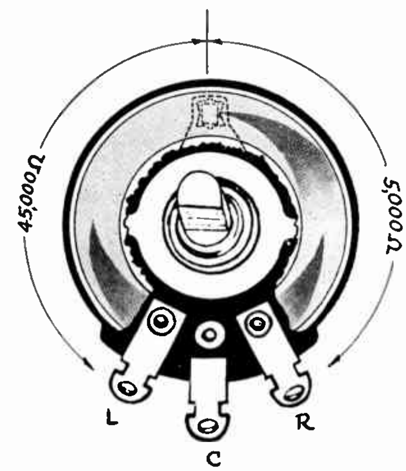


FIGURE 42

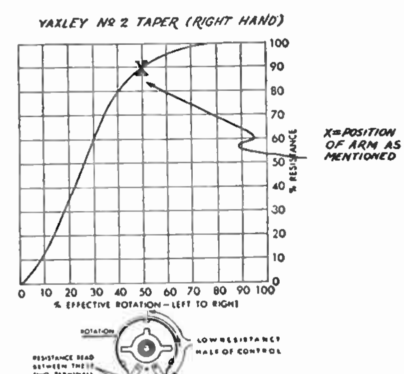


FIGURE 43

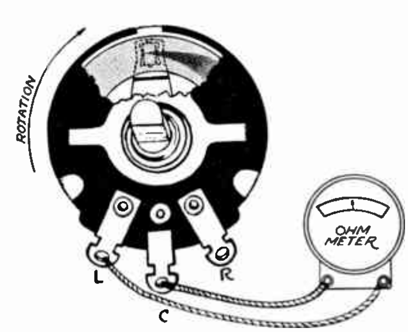


FIGURE 44

Study these illustrations. They will help you understand taper. Let's take a common application of Right-Hand Taper (Yaxley No. 2) to see **why** it is necessary and how it works. The "graph" (Figure 46) plots the "resistance against rotation" versus the Mutual Conductance (Gm) of a tube of the remote "cut-off" type such as a 6D6. The control—Yaxley UC510—100,000 ohms No. 2 right-hand taper.

Reducing the Mutual Conductance (Gm) of a tube lowers the amplification, however, there is a limit to this reduction because **if the plate current of the tube is reduced to the "cut-off" point, distortion will occur.** Be sure to read the full particulars of this in "Circuit Action" page 161. Study the curve in Figure 46. Note that the "gain" is reduced to approximately 10% when this control is at the "middle" point of its rotation. This is necessary if we wish to have an apparent linear reduction of volume with rotation of the control. Right hand taper (Yaxley No. 2) is used in most "Series" circuits, such as plate voltage, screen voltage, cathode or "Bias" control and "series losser" types of circuits. Note the list of Right Hand tapered controls (Yaxley No. 2) and look at the circuits that are specified for each one.

WHERE ONLY THE CENTER AND RIGHT HAND TERMINALS ARE SUPPLIED ON A CONTROL

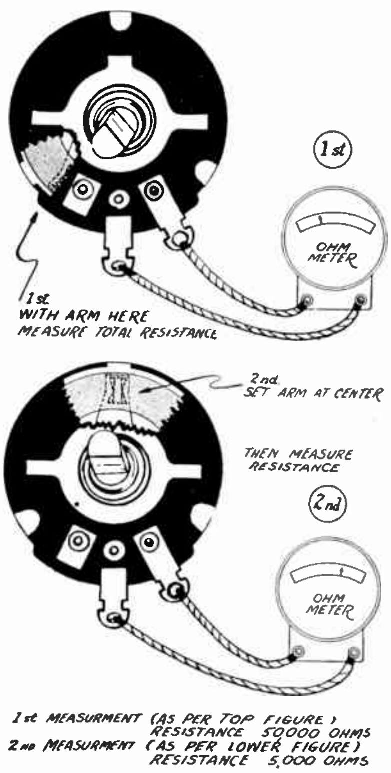


FIGURE 45

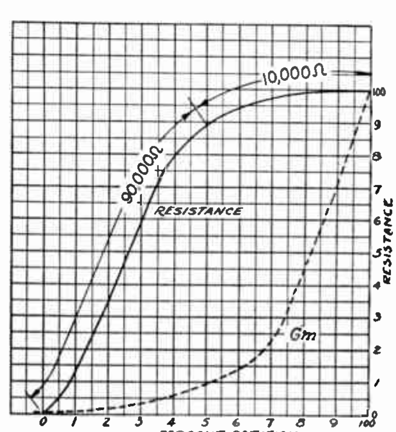


FIGURE 46

QUICK REFERENCE (Yaxley No. 2) RIGHT HAND TAPERED CONTROLS

Ohms Resistance	Catalog Number	Type	General Use
1,000	UC500	W. W.	Bias
2,000	C*	W. W.	Bias
3,000	D*	W. W.	Bias
5,000	E*	W. W.	Bias
7,500	F*	W. W.	Bias
10,000	UC501*	Carbon	Bias, Losser
10,000	G*	W. W.	Bias, Losser
15,000	H*	W. W.	Bias, Losser
25,000	J*	Carbon	Bias
50,000	K*	Carbon	Bias, Plate, Screen
75,000	Z*	Carbon	Bias, Plate, Screen
100,000	UC510*	Carbon	Bias, Ant.-Bias, Plate
250,000	UC509*	Carbon	Bias, Ant.-Bias, Bias-Audio
500,000	UC513	Carbon	Bias, Ant.-Bias, Bias-Audio
5 Meg.	UC507	Carbon	Screen

*Have exclusive Yaxley "adjustable fixed bias" feature.

Note: Nearly all low resistance "Bias" controls carry heavy current and are therefore wire wound type. Don't take a chance. Use Yaxley.

In the "general use" column are abbreviations of the use of the control; Circuits follow:

Bias—Circuits 7, 8, 42, 47, 49, 58, 98.
Losser—Circuit 84.
Plate—Circuit 26.
Screen—Circuit 27.
*Ant.-Bias—Circuits 6, 69, 70 (See note).
Bias-Audio—Circuit 88.

WARNING! **Right Hand taper** (Yaxley No. 2) **is to be used for Ant.-Bias only with Variable Mu or Remote Cut-Off tubes.** It is usually found in popular AC-DC receivers. Be sure to read "Circuit Action" page 161. Look at the taper curves for Yaxley No. 2 Right Hand taper and see the small curve at the left hand end. This curve gives smooth action in Ant.-Bias and Bias-Audio Circuits.

COMBINATION TAPER (Yaxley No. 3)

Yaxley No. 3 taper is a combination of left and right-hand tapers. It is necessary in only a few designs. Supplied in SRP (special) controls only.

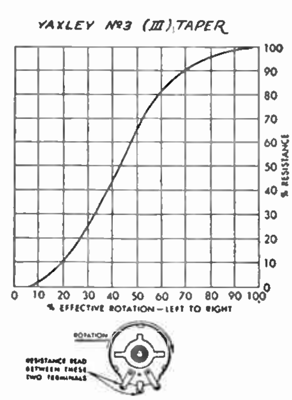


FIGURE 47

LINEAR TAPER (Yaxley No. 4)

A Linear control is not tapered, that is the resistance is equal in percentage to the percentage of rotation. At the center of rotation the resistance is equal in both halves of the control.

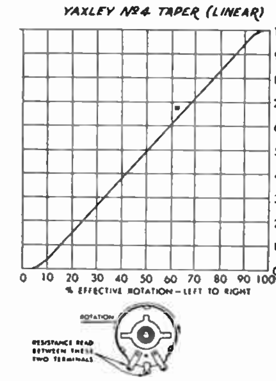


FIGURE 48

Note the ends of the "curve" are tapered off so that there will be no "hop off" on a weak signal.

"LINEAR" CONTROLS

Ohms Res't.	Catalog No.	Type
400	A400P	WW
550	A550P	WW
1,000	A1MP	WW
2,000	A2MP*	WW
3,000	A3MP*	WW
5,000	A5MP*	WW
5,000	Y5MP	Carbon
10,000	A10MP*	WW
10,000	Y10MP	Carbon
20,000	A20MP*	WW
25,000	Y25MP	Carbon
50,000	Y50MP	Carbon
100,000	Y100MP	Carbon
200,000	Y200MP	Carbon
250,000	Y250MP	Carbon
500,000	Y500MP	Carbon
1 Meg	Y1000MP	Carbon

*Has exclusive Yaxley adjustable bias feature.
WW—Wire Wound.

YAXLEY No. 7 TAPER

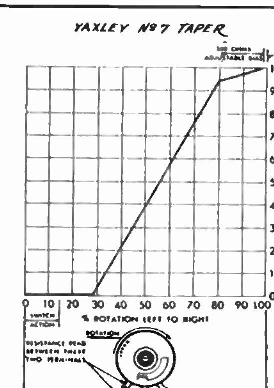


FIGURE 49

Yaxley No. 7 taper is almost a linear. Note that at the left hand terminal there is a small amount of resistance in the first few degrees of rotation. Yaxley No. 7 taper is for use in replacing older types of Wire Wound controls in Ant.-Bias circuits. **The "spread-out" portion of resistance, at the left hand end of the control, gives a smooth control of the most powerful signals.** Controls with this taper have the **Adjustable Bias feature,** explained on page 185.

HOW TO FIND THE TAPER OF A CONTROL

To find the taper of a control, set the moving arm at the middle point or center of its arc of travel and then (with the terminals "down" or toward you) (Figure 50) measure the resistance between the center terminal and the left hand terminal and compare this resistance value with the resistance between the center and right hand terminals.

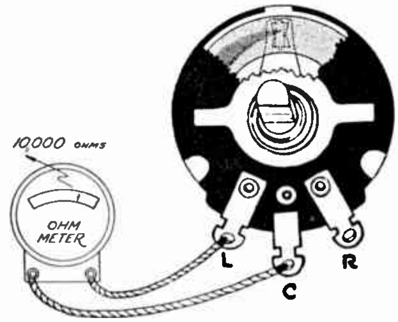


FIGURE 50

If the left-hand half of the control (Figure 50) has a lower resistance than that of the right-hand half of the control (Figure 51), the taper is "Left-Hand" (Yaxley No. 1). If the resistance of the two halves are the same (or very nearly so), the control is a "linear" taper. If the right-hand half has the lowest resistance value, the control has a "right-hand" taper. (Figures 50 and 51 show a 100,000 ohm left-hand (Yaxley No. 1) tapered control Type "L").

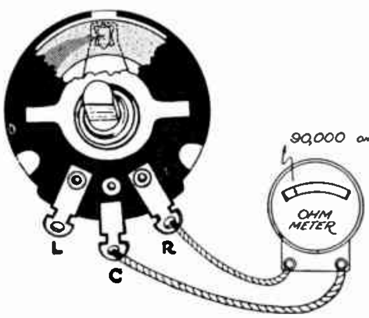


FIGURE 51

To determine the taper of a control wherein there is an "open" in the resistance element proceed as follows:

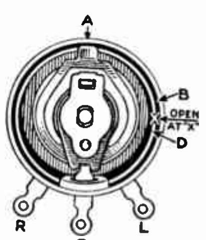


FIGURE 52-53

Refer to Figure 52-53 wherein there is a rear view of a wirewound control with an "open" at the point marked "X."

Although a wire wound control is shown, these instructions also apply to carbon type controls.

In Figure 52-53, **note that the terminals bear the designations R, C and L. By turning the control around and facing the shaft end, these would read properly; i. e., L, left hand; C, center, and R, right hand.**

To determine the taper first place the moving arm in the center of its rotation as shown in Figure 52-53.

Second, measure the resistance between terminal "R" and terminal "C" and make a note of this value.

Third, measure the resistance between "C" and the edge of the "open" marked "B" and make a note of this value.

Fourth, measure the resistance between terminal "L" and the edge of the "open" marked "D."

Fifth, add the values obtained in steps three and four to obtain the resistance of right hand half of the control.

With the values of the two halves of the control known a comparison will quickly show the taper as explained earlier in this article.

If there is more than one "open" proceed as above with the exception that the value of resistance between the different "open" places will have to be obtained and added together so that it is possible to compare the resistance of the two halves of the control.

The foregoing method of determining taper by comparing the right and left halves of the resistance element is a "rough and ready" method applicable in most cases. However, for those who wish to obtain the exact shape of taper curve employed in any control they may do so very readily by employing the 360 deg. scale.

This scale should be made on paper, cut out and pasted on a thin Bakelite or Wood panel with a 7/16" or 1/2" hole at the center for the volume control bushing.

To use this device mount the control on the rear of the panel and fasten with the usual mounting nut or one of the Yaxley shoulder nuts No. 11260-12 or 11260-2. Adjust the control so that when the knob is turned all the way to the left the dial reading is zero. Then turn the knob all the way to the right and read the total rotation in degrees and divide by ten to get the number of degrees for each 10% rotation. Attach an ohmmeter to the left hand terminal and to the center terminal of the control and with the control rotated all the way to the left take the first reading which in most instances will be zero.

Take a reading of the resistance every 10 percent of the rotation from left to right and plot the readings on graph paper.

CIRCUIT ACTION

Many servicemen are somewhat afraid to make minor changes in a receiver, even though they know that the receiver is of earlier design and not suitable for satisfactory operation under present conditions. This statement does not intend any reflection on the older receivers. At the time of their production these receivers were capable of excellent reception, and a similar quality of reception can reasonably be expected now if minor changes are made to allow for the greatly increased power of broadcasting stations. In a number of the older receivers, this increased power has resulted in unsatisfactory control of volume on local stations. The most common complaints are:

a. A "jumpy" control action on local stations (one in which the increase or reduction in volume is not gradual).
b. An inability of the control to reduce the volume of local stations to an acceptable value.

A thorough study of this section devoted to an analysis of each type of control circuit, will be of real assistance to the serviceman. In many cases it will enable him to make a highly satisfactory replacement in the matter of the older receivers. The creation of such customer good will contributes in a large measure to the success of any business.

ANTENNA CONTROL CIRCUITS

The most simple type of control circuit is that generally called the **"Antenna Control."** This type of control came into popular use with the introduction of the AC Tube, the filament rheostat having been widely used as a volume control previous to that time.

The reason for using this type of circuit was not so much to gain "volume control" but was to allow **single dial tuning** because at this early date, antenna coil design had not been developed sufficiently to allow a tuned antenna circuit to "track" with the other tuned circuits. In addition the "AC" tube filament current could not be successfully varied so as to give control of volume.

This type of **"Antenna" control functions as a regulator, controlling the amount of signal fed to the grid of the first RF amplifier.** Circuits 1 to 5, 40 and 60 on pages 178 to 183, are variations of this type of control circuit. Circuit 1 (Figure 54), illustrates the simplest circuit of this type.

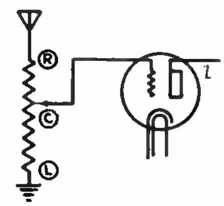


FIGURE 54

The antenna is directly connected to the right hand terminal of the control, the left hand terminal being connected to the ground, and the moving arm (center terminal) is connected directly to the grid of the first RF amplifier tube. This connection gives maximum volume when the control is turned to the right (clockwise).

Thus, we see that the full antenna voltage of all signals, affecting the antenna, is applied directly across the control and that any portion of this voltage may be applied to the grid of the first tube, depending upon the setting of the moving arm of the control. The resistance value of this type control varies from a minimum of 450 ohms (see the older Atwater Kent receivers) to a value of about 10,000 ohms maximum, inasmuch as a resistance value greater than this tends to isolate the grid of the tube, and causes hum.

TAPER—Refer now to the previous article on "Left Hand" taper and note that, here, we have the same conditions; i. e., a control shunted across the source of signal, therefore the same rules will apply to this or to any other circuit so connected, as apply to the circuit given as an illustration in that article.

The taper for the Antenna type control is, in general, of the left-hand, or Yaxley No. 1 type. Many of the earlier receivers used wire wound controls, which are difficult to make with logarithmic taper, and inasmuch as the antenna voltages developed by the earlier low-power transmitters were not of any great magnitude, it was not necessary to pay much attention to taper, although a slight amount of taper in the form of a low resistance winding, generally 10 to 25 ohms and spread over about 20% (1/5) of the rotation, at the left hand side of the control, was often used.

It is found **that this type circuit,** using the earlier type wire control, **does not give good attenuation, because of the high antenna signal voltages developed by modern transmitters.** This condition may be overcome by **using a left-hand taper carbon control** (Yaxley No. 1). This will allow smooth attenuation of powerful local signals. TROUBLES usually encountered with this type of circuit are: **Poor attenuation** or "hop off," that is, a sharp "cutting off" of the signal (usually on local stations), and generally poor control of all signals, as previously mentioned, a simple change from the original wire type control to the Yaxley No. 1 left-hand tapered carbon control will often cure the trouble. It has been reliably reported that a sure cure of this trouble will be had if a Yaxley DRP241 or DRP243 control is installed with the low resistance section connected as the original antenna control and the high resistance section connected as per Circuit 16 (Figure 38), so as to give a dual control of both the input signal and of the output. This overcomes chassis pick-up due to lack of, or poor shielding.

Circuit 2 (Figure 55), illustrates the second type of "Antenna" control circuit.

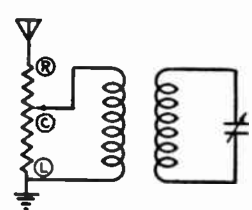


FIGURE 55

The connections of the Antenna to the control are the same as those in Circuit 1 (Figure 54) but that the primary of an RF transformer is connected to "ground" and to the moving contact (center terminal), of the control. **When the control is at maximum volume position** (R-right-hand terminal) **the total resistance of the control is in shunt with both the Antenna** (Source) and **the primary coil** (Load). Varying the position of the control arm causes the resistance value of the shunt across the **primary** to vary over the full range of the resistance value of the control.

In view of this, **the total resistance of the control must be of such a value so that, at "full volume" position, there will be but little loss of signal through the control.** In other words, **the total resistance of the control must be much greater than the impedance of the primary.** In practice the resistance value of the control is usually not more than 4 or 5 times the value of the primary impedance, as higher ratios are not practical because of the shunting action of the antenna impedance, which varies greatly because of the wide variety of Antennas.

Resistance value of the control for this type circuit may range from 2,000 to 20,000 ohms, depending upon the receiver design which is, of course, dependent to a large degree upon the impedance value of the primary coil of the RF transformer.

TAPER for this circuit is Left Hand, or Yaxley No. 1. Some receivers were built with very little taper in the control. The replacement control for the latter, may well be a Yaxley control of No. 4 (Linear) taper although a Yaxley No. 1 tapered (carbon type) control will sometimes be better, than the original linear control, depending on local conditions.

Troubles with this type circuit are best overcome by the methods outlined for Circuit 1 (Figure 54), however, due to increased transmitter power, a lower resistance control will often work wonders without loss of signal strength even on the weaker stations. It is best to "cut and try" to ascertain the correct value

Circuit 3 (Figure 56) illustrates the third type of "Antenna" control.

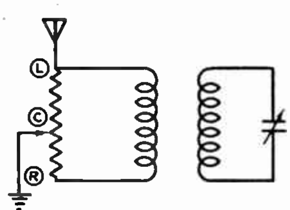


FIGURE 56

In this circuit the Antenna is connected to the left-hand terminal of the control. The primary coil floats across the total resistance of the control.

This change of connections causes the effective resistance in shunt with the antenna to vary with the setting of the moving contact of the control. The shunt resistance across the primary coil does not vary, to any great extent, with the position of the contact arm of the control. If anything, the shunt impedance rises slightly, with reduction of volume. This type of circuit does not give as good results as that of Circuit 2 (Figure 55) or Circuit 4 (Figure 57).

TAPER and Resistance values for this circuit are the same as for the previously mentioned types except that the range of resistance is limited to a certain extent by the impedance of the primary coil.

Trouble—In case of attenuation trouble it might be advisable to change the connections to either that of Circuit 2 (Figure 55) or Circuit 4 (Figure 57) in addition to the information given previously.

Circuit 4 (Figure 57) is an illustration of a fourth type of "Antenna" control.

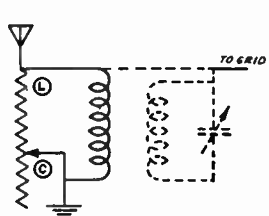


FIGURE 57

The antenna is connected to the left-hand terminal and ground to the moving arm terminal. The right-hand terminal is not used.

This type of circuit is often called a "Shunt" circuit, however, it is better to refer to it as a Short Out type of circuit, inasmuch as the control "Shorts Out" the primary and simultaneously grounds the antenna.

Taper and Resistance Value of the controls for this type circuit is the same as for the circuits previously given.

Trouble is usually encountered with this type of circuit unless the chassis is thoroughly grounded. This is not so when the ground wire is connected to the antenna post, because this leaves the chassis at RF potential to ground.

If a good Antenna cannot be erected and it is necessary to use such an improvision for an Antenna, it may be advisable to change this circuit to that of Circuit 2 (Figure 55) or if possible use Circuit 6 (Figure 68).

Circuit 5 (Figure 58) is the fifth type of "Antenna" circuit.

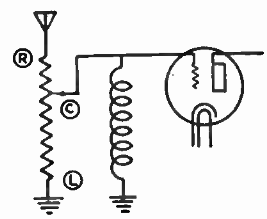


FIGURE 58

This circuit is similar to that of Circuit 1 (Figure 54) except that an RF choke is connected from Grid to Ground.

The purpose of this choke may be to either give a "rising response" at the lower frequency end of the broadcast band or to allow the use of a higher resistance value of control without hum trouble. In addition these chokes are often broadly peaked in the center of the broadcast band so as to get a slightly increased signal voltage from the Antenna. For all practical purposes there is little to gain from such design.

Taper and Resistance values for this circuit are much the same as for previous circuits except that the resistance of the control may be as high as 50,000 ohms.

This ends the discussion of "Antenna" type circuits and we will now consider the next most popular type of the older circuits, **one that is widely used today** for "Sensitivity," "Quiet" or "Silent Tuning" control.

"BIAS" CONTROL CIRCUITS

This type of volume control circuit makes use of a variation of the bias voltage, applied to the tubes as a means of controlling the volume of a receiver. Increasing the bias of a tube lowers the Mutual Conductance (GM) of a tube and reduces the "Gain" of the stage.

Remember, there are two general types of tubes, those with "Sharp" cut-off and the Variable Mu or Remote cut-off types. This introduces a disturbing factor in that complete control cannot be had with Sharp cut-off types of tubes.

"Cut-off" means the cutting off of plate current by means of a high bias voltage. The Sharp Cut-Off type requires a rather **small** increase in bias voltage to completely cut off the plate current whereas the Remote Cut-Off type requires an enormous increase in bias voltage to bring the plate current down to "cut-off" and in some types of tubes the plate current cannot be completely cut off by the bias voltage.

As an illustration, the type 24A tube has a (GM) of 1050 at 3 volts bias, yet it requires only 9 volts to bring the plate current down to cut-off. This is an example of the sharp cut-off type of tube. The type 35 tube also has a (GM) of 1050 at the same plate, screen and bias voltages. It requires 40 volts to bring the plate current down to approximate cut-off. This is an example of the Remote Cut-Off type of tube. Incidentally, **the useful range of control is 5 to 1 for the 24 and 70 to 1 for the 35 tubes respectively.**

Circuit 31 (Figure 59) is an illustration of the earliest Bias Type control.

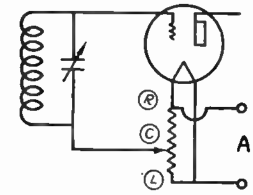


FIGURE 59

This control was used on the early battery sets. It consists of a fairly high resistance potentiometer generally of 200 or 400 ohms total resistance shunted across the filament supply which was, of course, 6 volts. This control served to vary the bias on the R.F. amplifier tubes, and thereby gave control of the volume. On the whole, this circuit was not very satisfactory, as the range of control was not great and it was used mostly as a control to prevent oscillation.

Figure 60 (Circuit 7) illustrates the common Bias control circuit.

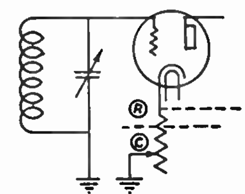


FIGURE 60

In this illustration **dotted lines indicate that a portion of the control resistance may be retained to supply the minimum bias which is required by the tube at full volume.** Also, the dotted lines show that one or more cathodes may be connected to the control and that there may, or may not be a bleed current through the control. For the present, we will consider that the circuit controls only one tube and does not have a bleed current. Although a triode tube is shown, this circuit is also used with tetrodes and pentodes. For the purpose of explanation, we give Figure 61, which shows the use of a 100,000 ohm Yaxley No. 2 right-hand taper control, Yaxley type UC509, with the resistance plotted against the (GM) Mutual Conductance of the tube and both curves against the rotation of the control.

Note that **at 50% rotation, we have introduced approximately 10% of the total resistance of the control** (considering for the present the rotation from right to left) and that **with this amount of resistance the Mutual Conductance has dropped to approximately 10% of its "full volume" value.** Thus—by this curve we see that the Yaxley No. 2 right-hand taper is adhering to the laws laid down in the explanation of "taper." A study of this graph with its two curves will reveal that at the full resistance of the control, i. e., at full counter-clockwise position, the "Mutual Conductance" has not been reduced to absolute zero. However, it is down to such a value that no signals other than from powerful stations will be heard.

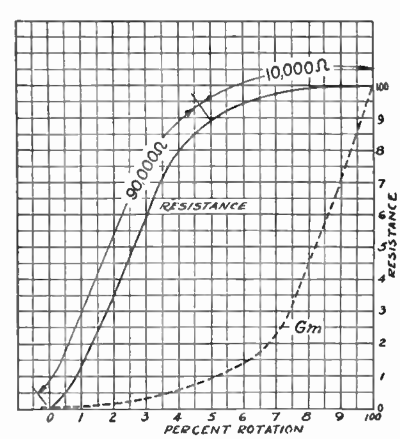


FIGURE 61

The graph in Figure 61 (page 162) illustrates the use of a bias type control on a remote cut-off type of tube. In fact, a 6D6 was used in this calculation. In practice, a straight Bias type control would hardly ever be used with this tube, but rather the combination Ant.-Bias circuit in order that locals may be fully attenuated.

The cathode bias type control was widely used with the type 27 tube which has a fairly remote cut-off. However, the increased power of modern broadcasting stations has resulted in poor control from this type of circuit. Therefore, **it is sometimes necessary to change this circuit to the "Ant.-Bias" type circuit by connecting the right-hand terminal, of the control, to the Antenna.** Additional types of circuits similar to circuit 7 are circuits numbers 47, 58 and 98, see pages 178 to 183. The difference in these circuits is merely in the connections to the control and associate circuit, the control action remaining entirely the same.

A study of these circuits will reveal that **the main difference is in the connection of the bias resistor** which supplies the minimum bias necessary for correct operation of the tube or tubes at full volume position.

The Second Class of "Bias" control circuits, represented by Circuit 8 (Figure 62) and Circuit 42 (Figure 63) differs but little from the class just mentioned, the difference being that the resistance value is lower and that a current is bled, from either the screen or plate supply, into the control so as to give a rapidly rising bias voltage, with rotation of the control.

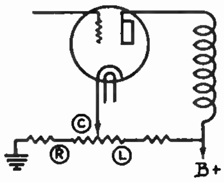


FIGURE 62

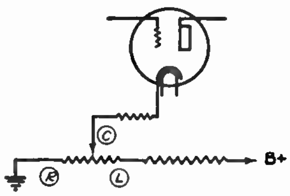


FIGURE 63

In receivers using the lower values of control resistance, such as from 15,000 ohms down, the control used for these types of circuits will usually be found to be of linear taper.

Taper used for bias control is nearly always of the right-hand type (Yaxley No. 2), except in the instances mentioned, or in the third class of bias control circuit which we will now discuss.

The Third Class of "bias" control circuit is that in which the grid return connects to the arm of a variable resistance, which is connected across the source of bias voltage. This type of circuit is generally used in battery receivers and therefore the bias source is usually a "C" battery or "voltage dropping" network of resistors in the "B" circuit. In this type of control circuit, **the range of bias voltage applied to the tube, is dependent** almost exclusively **upon the voltage applied to the control,** inasmuch as the grid does not draw any current from the control circuit. The resistance value of the control **may be quite high** in order **to prevent unnecessary "drain"** on the batteries.

Circuit 9 (Figure 64) is an illustration of one of the most common circuits of this type.

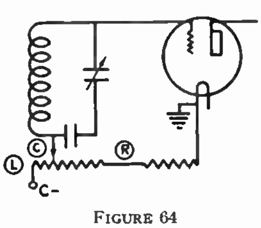


FIGURE 64

Note, that **the left hand terminal** of the control **connects to the highest negative polarity of the "C" battery,** as shown by the notation C—. The Right-Hand terminal of the control connects to a fixed resistor which is of such a value that **the current flowing through the control will cause a voltage drop across it, equal to the required "minimum" bias of the tube.** The rotating arm or "Center Terminal" of the control connects directly to the grid return. Thus, it will be seen that the bias may be varied over quite a range, depending upon the voltage of the "C" battery.

Circuit 54 (Figure 65), although a resistance coupled amplifier, is basically, identical to Circuit 9 (Figure 64) and clearly shows the full connections for this type of circuit.

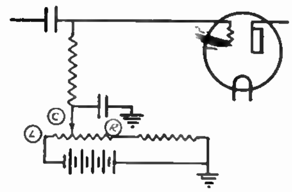


FIGURE 65

Circuit 59 (Figure 66), is of the same type as that of Circuit 9 (Figure 64) and Circuit 54 (Figure 65). However, it is applied in this case to an "A.C." receiver.

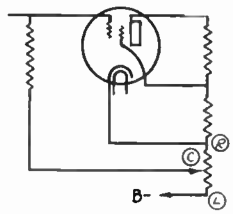


FIGURE 66

This type of circuit is often used on the AVC tube for control of its action.

There is one remaining type of bias control in which **the grid of the tube is biased by signal voltage developed across a diode rectifier Load,** which in this case is the resistance of the control. Circuit 62 (Figure 67) illustrates a circuit of this type.

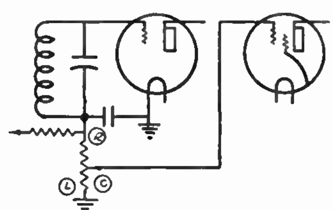


FIGURE 67

Usually, there is provision made for minimum bias of the controlled tube, which is not shown in this schematic. Study of this circuit will reveal that the bias on the controlled tube **varies with the strength of the signal input,** in addition to the position of the "arm" of the control, this type of circuit being used in "Quiet" AVC circuits.

Resistance for use in the third class of Bias type control circuits is usually of a range from about 20,000 to 100,000 ohms, with the following exceptions:

The control for use in Circuit 59 (Figure 66) is usually of a fairly low value ranging from 150 ohms to 10,000 ohms, whereas the resistance range for Circuit 62 (Figure 67) will be from 100,000 to 500,000 ohms inclusive. **The main consideration of resistance for this type of circuit is that the current flowing through the control should not be of such a large value that it will quickly exhaust the battery.** In addition, where the voltage of the battery is much higher than that required to bring the tube or tubes down to cut-off, it is usually necessary to insert resistors in series with the control so as to limit the voltage drop across the control to the required value.

Taper of controls for the third class of Bias type of control circuit varies considerably. It depends upon the class of tube, that is, Sharp or Remote cut-off. In general, the taper is linear, although in some cases a slight left-hand taper is required, particularly where sharp cut-off types of tubes are employed.

Trouble encountered in "bias" type control circuits is usually "noisy" controls, best overcome by replacing with a new control. In case the "range" of control is too great (i. e., cut-off is obtained, even on the most powerful stations, at less than full rotation), it may be advisable to insert a resistor in series with the control to reduce the voltage drop across the control, and give a smoother action.

In laying out a battery receiver using this type of control, or in rebuilding an old receiver to a modern circuit, involving the use of this type circuit, **it is advisable to carefully calculate the voltage drop which will be obtained across the control. It is imperative that the control circuit include means for obtaining the minimum bias.**

"ANT.-BIAS" CONTROL CIRCUITS

The "Ant.-Bias" type of control circuit is probably the most widely used to date. However, it is indeed surprising that so many servicemen fail to have any knowledge concerning the action of this type circuit.

In this circuit, **there are two distinct actions combined. The first is the control of volume by means of increasing the bias on the controlled tubes. The second action is the shorting out of the input signal at the Antenna.**

Important—There are two basic types or classes of this circuit; i. e., that type employed with sharp cut-off tubes and that employed with remote cut-off tubes. **In the first class, the control serves to increase the bias to reduce the (Gm) Mutual Conductance of the tube or tubes, to a slight extent, and simultaneously short out the input signal.**

Note: **The main function of the control** in this case **is really to short out the signal input and at the same time reduce the (Gm) Mutual Conductance** of the tubes to a point where chassis pick-up will not be bothersome. Chassis pick-up means the absorption of signal voltage from powerful stations by poorly shielded conductors within the receiver. **This type of circuit is used where the straight antenna shunt or short-out type of circuit would fail to give full attenuation of powerful signals** such as from local broadcasting stations, and was widely used in the days when the type 24 and sharp cut-off tubes were used as radio frequency amplifiers.

The second class of Ant.-Bias circuit operates in exactly the reverse manner, in that the main attenuation of signal is accomplished by increasing the bias to a high value, which reduces the (Gm) Mutual Conductance. This action will attenuate all but the most powerful local signals. These powerful signals are taken care of by the antenna short-out action. The resistance value of controls for the second type circuit is much greater than that for use in the first class.

Circuit 6 (Figure 68) is an illustration of the "Antenna-Bias" type of circuit.

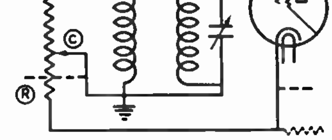


FIGURE 68

Your attention is called to the dotted lines on this schematic. **The dotted line across the control indicates that a portion of the resistance may be retained for use as the minimum bias resistor** to supply correct bias to the tube or tubes at full volume position.

The straight dotted line immediately below the tube indicates that other cathodes may be connected at this point. The dotted line resistor immediately below the last mentioned dotted line indicates that there may be a bleed current flowing through the control.

The exclusive design of Yaxley controls **provides an adjustable resistor** for use **when replacing controls** wherein a portion of the resistance was set aside for use **as the minimum bias resistor.** In **wire type** controls, this is a built-in variable resistor. **In carbon type** controls, **it is a variable resistor** supplied with the control for exterior application.

The bleed current mentioned is merely a current which is bled from either the screen or plate supply circuits. The purpose of this current is to stabilize the circuit and to provide a greater increase of bias per degree of rotation of the control, where it is necessary or desirable to use a fairly low resistance control.

Remember: That this is a very convenient way of controlling or **improving the action of a volume control when used in this type circuit.** There are many cases, especially in old receivers, where **the control will not "cut out" the local signals, in which case the addition of a slight amount of bleed current through the control will provide for sufficient increase in bias, and thereby give complete cut-off.**

WARNING—Be very careful that the bleed current is not high enough to give complete cut-off, as this will introduce distortion. The correct value of bleed current is best ascertained by the old reliable cut and try method.

Circuit 69 (Figure 69) is the same as Circuit 6 (Figure 68) except for the untuned antenna circuit.

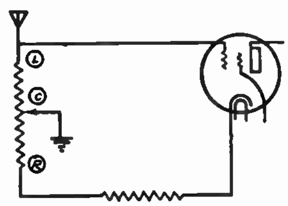


FIGURE 69

Another type of "Antenna-Bias" circuit is generally used in battery receivers. Circuit 70 (Figure 70) given below, is an example of this type circuit.

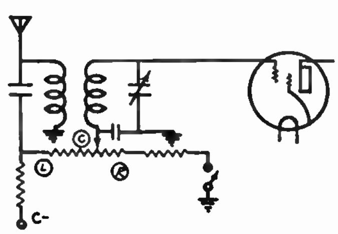


FIGURE 70

Study this circuit. Note that **the control varies the bias** applied to the tube, **and** in the left-hand position **shorts out the antenna.** This latter action is accomplished by reason of the condenser connected from the antenna to the control. Signal current leakage, or by-pass in the full volume of the control, is prevented by the resistance of the control, and by the resistor connected between "C" and the junction of the condenser and left-hand terminal of the control.

Attention is called to the resistor connected between the right-hand terminal of the control and the switch. This is the minimum bias resistor.

Taper for use in this circuit is generally left-hand (Yaxley No. 1), although Yaxley No. 4 may be used, depending upon the type of tubes, as previously explained under "Bias Control Circuits."

Trouble encountered in this type of circuit may be due to leakage of the antenna condenser, or in the by-pass condenser which is connected between moving arm of the control and ground. This condenser serves as an R.F. by-pass for the grid circuit. In addition, we wish to point out that a shorted tube would quickly exhaust the "C" battery, if the volume control should be in minimum volume position.

Oscillation and poor tuning may often be traceable to a poor by-pass condenser, inasmuch as the R.F. impedance of these condensers usually increases with age. It might be well to check this whenever servicing a receiver using this type of circuit.

General design of this type circuit calls for selecting the proper value of resistance for the control, for the minimum bias resistor, and in addition for the R.F. blocking resistor. The latter also serves to limit the value of bias voltage which may be applied to the tube, which, as has been previously mentioned, if too high, particularly with sharp cut-off tubes, will cause distortion.

The capacity value for the Antenna condenser should be rather large, inasmuch as it should offer but very little Capacitive Reactance to the lowest frequency signal voltage to be handled, and it will thus act so as to allow a complete short-out of the signal. The capacity value of the by-pass condenser from the moving arm of the control to ground, is generally of a value of .05 mfd., or .1 mfd.

Circuit 97 (Figure 70A) is an illustration of another type Ant.-Bias circuit.

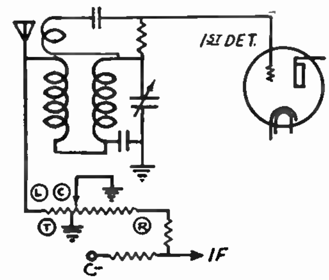


FIGURE 70A

Observe that in this circuit the control is tapped. The purpose of this tap is to divide the action of the control into two separate and distinct parts. Thus—when the moving arm is to the right of the tap, the control is acting purely as a bias type control. When it is to the leftof the tap, the control acts onlyas an Antenna short-out type of control. This circuit is ingenious in this respect, as the two actions of the control are entirely separate. They do not conflict.

Resistance Value for this control is usually about 6,000 ohms with the tap located at approximately 2,500 ohms from the left-hand terminal.

Taper for this control is special. This need not be explained as Yaxley TRP600 replacement control is especially designed for this circuit.

Trouble in this circuit is rare. A shorted antenna or tube will have little effect upon batteries.

SUMMARY "ANT.-BIAS" CONTROL CIRCUITS

The Resistance Value of controls for the first type Ant.-Bias control circuit ranges from 1,500 to approximately 15,000 ohms, as the resistance value for use with sharp cut-off type tubes (type 24), can not very well be higher than these values, without introducing distortion due to cut-off. For the Remote cut-off type of tubes, the resistance will range from a minimum of 10,000 ohms to 250,000 ohms.

AC-DC receivers quite often use the Ant.-Bias type of circuit. Because they usually contain but one RF amplifier tube, the resistance value for the control must be very high. The types of tubes suitable for use in these receivers are usually of the Variable Mu or Remote cut-off type, such as 6D6.

For use in this type of circuit, and especially in these receivers, Yaxley controls—UC509 of 250,000 ohms resistance, and UC510 of 100,000 ohms resistance will be found to be ideal.

Receivers using the lower resistance values of control, such as 1,500 ohms, usually employ a rather heavy "bleed" current, in order to obtain sufficient bias, and in addition to stabilize the current distribution of the receiver.

For the intermediate values of resistance approximating 25,000 ohms, we advise the use of the Yaxley special control SRP263 (which is equipped with universal shaft), because this control is of the Yaxley No. 3 taper, which, incidentally, is the reason for it being listed as an SRP or special control.

Taper for use in Ant.-Bias type circuits has been explained to a certain extent. However, we would like to call your attention to the use of the Yaxley controls having No. 7 taper, wire wound and of special design for use in Ant.-Bias circuits wherein the original control was wire wound, especially where a heavy bleed current is used. Yaxley No. 1 left-hand taper will be found to be excellent in most all cases where the resistance value is 20,000 ohms or less. As explained, intermediate resistance values above 20,000 ohms, can be serviced by Yaxley SRP263. In replacing controls having a resistance value above 50,000 ohms, we advise the use of Yaxley No. 2 right-hand taper, unless recommended otherwise.

Troubles in this type of circuit, are usually limited to failure to cut-off the signal. The most frequent cause of this trouble is that the receiver was originally designed for much lower signal strengths than are found today (because of the terrific increase in power of broadcasting stations). **Increasing the bias voltage developed across the control will often effect a cure. However, we would again like to give you warning that this voltage should not be increased so far as to drive the Tube to plate current cut-off, due to the possibility of distortion.**

SCREEN VOLTAGE CONTROL CIRCUITS

Circuit 12 (Figure 71) is an illustration of the usual screen voltage control.

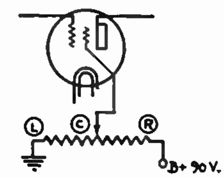


FIGURE 71

The action of this control is similar, in most respects, to the action obtained by controlling the bias of the tube. The (Gm) "Mutual Conductance" of the tube varies with the screen voltage.

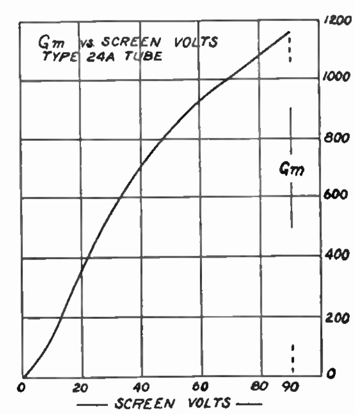


FIGURE 72

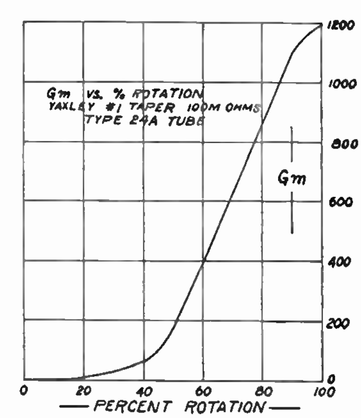


FIGURE 73

The first graph (Figure 72) (page 164) shows the relation of Mutual Conductance to screen voltage. The second graph (Figure 73) shows the curve of "Mutual Conductance" versus the rotation of the Yaxley control and illustrates the use of left-hand taper in this circuit.

At this time, we would like to point out that circuit 27, as given on page 179, is a rare type of screen voltage control, in which the control is in series with the screen. Taper for this control is Yaxley No. 2 right-hand, and the resistance is 5 megohms total. Circuit 79 (Figure 74), is an illustration of a combined screen voltage and antenna short-out control circuit.

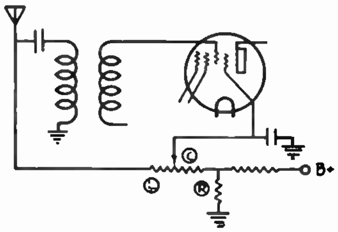


FIGURE 74

This control is used to a limited extent in battery receivers. **A study of this circuit will reveal that the control simultaneously controls the screen voltage, and by that the (Gm) of the tube, and at the same time acts as an Antenna short-out.**

This type control circuit is not recommended. Yaxley Silent Controls **will give faultless service** in this, or any other critical circuit.

General Design considerations for the screen-voltage type control circuit are that the voltage range should be such that the plate current of the tube is not reduced to too low a value, inasmuch as this will introduce serious distortion. On the whole, the screen-voltage type of control circuit is not to be recommended wherever another type circuit could be used.

The screen-voltage type of control circuit is not recommended for Variable Mu tubes, as it is much better to employ the Bias type of control circuit for these tubes.

TAPER AND RESISTANCE

For very low resistance values, 10,000 ohms or less, the taper of the volume control, for use in this circuit is generally linear. For values above 10,000 ohms, it is the general rule to use Yaxley No. 1 left-hand taper.

The most common value of resistance for this type control, with the exceptions noted above, is 100,000 ohms. This value is replaceable with Yaxley type L control.

PLATE VOLTAGE CONTROL CIRCUITS

Circuit 11 (Figure 75), is an illustration of the most common "Shunt Plate Voltage" volume control circuit.

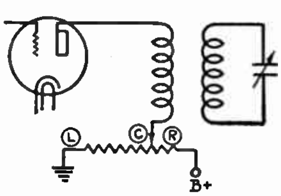


FIGURE 75

The action in this circuit is similar to that of the "Screen Voltage" control circuit except that here the plate voltage is varied.

The Taper for use in this type circuit is nearly always left-hand. The resistance value is usually of the order of 50,000 to as much as 500,000 ohms.

The trouble usually encountered in this type circuit is noise, due to the rather heavy current and the possibility of the control developing minute "burned" spots, which cause a rapid variation in resistance with rotation. Of course, this would cause terrific noise in the receiver.

This type of control circuit is no longer used. If encountered in service work, we advise that the control circuits be rewired to a more modern type.

Before closing this chapter on "Plate Voltage Control Circuits," we would like to call your attention to Circuit 26 (Figure 76).

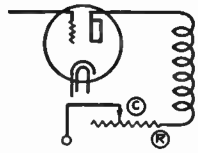


FIGURE 76

This circuit uses a series control which should be of right-hand taper Yaxley No. 2. **We strongly advise that wherever this circuit is encountered, the receiver should be rewired to use a different type control circuit.**

RF (PRIMARY SHUNT) CONTROL CIRCUITS

Circuit 10 (Figure 77), illustrates the connections of this type control circuit.

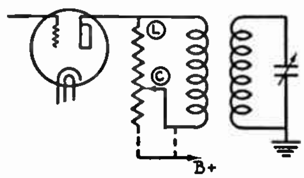


FIGURE 77

The dotted lines show connections that differ but little from each other, and may be encountered in the wiring of a control in a circuit of this type.

The action of this circuit is similar to that of the Ant.-Shunt type of circuit, in that the control is so arranged as to Short Out the primary of the RF transformer, and thereby prevent the transfer of RF current to the succeeding tubes in the receiver. This circuit was popular with the later battery and early AC receivers. **It is totally unsuited for modern conditions.**

An additional type of this circuit is shown in Circuit 81, on page 181, in which the plate connects to the moving arm of the control. The action in this circuit is similar to that of the ant.-shunt Circuit 3 (Figure 56), on page 162, or Circuit 40 on page 179.

Resistance range of controls used in the RF Primary-Shunt type of control circuits is usually only a few thousand ohms, ranging from 1,000 to perhaps an upper limit of 10,000 ohms.

Many of the original controls in this type of circuit are wire wound. When encountered in your service work, we advise replacing the wire type controls with Yaxley wire wound controls, or in some cases, with the Yaxley carbon controls.

Taper used in this type of circuit where the original control was wire wound, is usually of the Yaxley No. 7 type. Where the original control was of the carbon type, it may be either Linear Yaxley No. 4, or Left-Hand Yaxley No. 1.

RF SECONDARY (SHUNT) CONTROL CIRCUITS

Circuit 13 (Figure 78), illustrates the usual connections for this type circuit.

Although the connections shown in circuit 14 on page 178 may sometimes be encountered, the latter circuit does not give quite as good control as that of Circuit 13 (Figure 78). The action of Circuit 13 (Figure 78) is similar to the action of Circuit 16 (Figure 38), page 158, illustrated and thoroughly explained in the chapter entitled Taper.

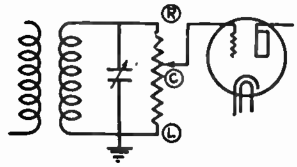


FIGURE 78

In Figure 78, we see the control shunted across a tuned RF transformer, with the left-hand terminal connected to the ground, and the right-hand terminal to what would ordinarily be the grid side of the tuned circuit. The grid of the tube is connected to the moving arm of the control. Hence—Variation in the position of the moving arm of the control varies the amount of RF voltage impressed on the grid of the tube.

In common with all shunt type circuits, the resistance of the control should be of such a value that it will not present too great a load or by-pass of the RF voltage developed in the secondary circuit. Inasmuch as one might broadly state that **the average impedance of a tuned circuit of this type is rarely more than 100,000 ohms,** the lowest value possible to use would be 100,000 ohms, with usual values of 250,000 ohms and in some cases 500,000 ohms. An outstanding example of this circuit is that of the Bosch model 28, which, incidentally, uses Yaxley Control SRP179 of 125,000 ohms resistance.

Taper of the control for use in this type circuit is of the left-hand Yaxley No. 1 type, thoroughly explained in the chapter entitled Taper. This also applies to controls for use in Circuit 14, page 178.

This type control circuit was not very widely used, and has long since passed out of favor. The introduction of the control into an RF circuit causes broad tuning and other troubles which make it impractical.

AF "SHUNT" CONTROL CIRCUITS

Circuit 15 (Figure 79), is one of the two basic types of this circuit.

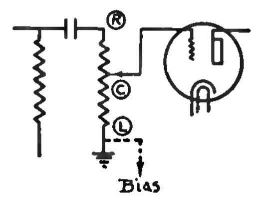


FIGURE 79

The AF "Shunt" control circuit is one in which the control is shunted across the Source of Audio frequency voltage, either as indicated in Circuit 15 (Figure 79), or as in the Short Out type of circuit as is shown in Circuit 33 (Figure 80).

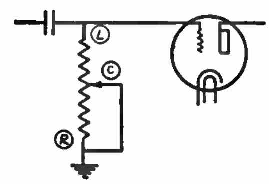


FIGURE 80

Circuit 33 (Figure 80), is not recommended because of distortion caused by the variation of the "plate load" of the preceding tube. Returning to Circuit 15 (Figure 79), note that the left-hand terminal of the control is the low volume or ground connection of the control and that the signal is applied to the right-hand terminal through the coupling condenser, which also serves to block out the DC plate voltage of the preceding tube.

In this type of circuit the control is actually part of the plate load of the preceding tube. This load is made up of the coupling condenser (capacitive reactance), **the resistance of the control and the resistance of the plate coupling resistor.** The input admittance of the tube must be considered. This is best determined by consulting tube manufacturers' data wherein you will often find a note: **"When using resistance coupling, the grid resistor for this tube should not exceed 'blank' ohms."** This is one way of saying that the admittance of the tube is rather low and that a high value of resistance (of the control) cannot be used.

Volumes have been published on the subject of "Impedance Matching" i. e., the relation of the load impedance to the impedance of the source or generator. We regret that space limitations do not allow more than a mention of this subject as applied to the above control circuits. The important point is that **the resistance of the control is determined by the required plate load of the preceding tube, and by the admittance of the grid circuit of the tube. It is also influenced by the coupling condenser and the plate resistor of the preceding tube. Thus we have a series parallel circuit made up of these three elements and also the consideration of admittance of the tube.** Truly a complicated subject. Entirely too broad to be presented here as gain, distortion and other factors must be considered. Finally it is necessary to make a compromise of all these factors.

Circuit 16 (Figure 81) is an illustration of the second type of Audio Shunt control circuit.

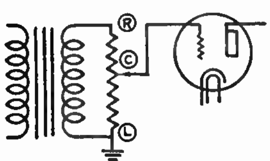


FIGURE 81

In this circuit we have approximately the same connections as for Circuit 15 (Figure 79). Note that the control is connected across the secondary of an Audio transformer. This gives a different picture, in that the control resistance is determined to a certain extent by the Impedance Ratio of the transformer in addition to the other factors, such as plate load and admittance, previously mentioned.

Circuit 96, page 181, is a peculiar reversed type of the Audio Shunt circuits. The same considerations, such as taper and resistance, also apply to this circuit.

Resistance Value of controls for this type of circuit usually range from 100,000 ohms to 2 megohms. In replacing controls the original resistance value should be approximated, thus for 200,000 ohms use 250,000; 350,000 ohms may be replaced with either 250,000 or 500,000 ohm values.

Taper of controls for use in these circuits **is always Yaxley No. 1 Left-Hand. These circuits give but little trouble.**

AUDIO CONTROL CIRCUITS

This designation is applied to any control which varies the Audio frequency voltage or current as a means of controlling the volume of a receiver. With one exception, they are mostly variations of the Shunt type of Audio circuits. The exception is Circuit 18 (Figure 82).

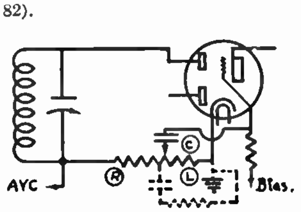


FIGURE 82

In this type of circuit the control acts as a Load Resistor, commonly referred to as the Load of a diode rectifier.

Study of this circuit will reveal the following actions. The signal current generated in the transformer secondary is applied to the diode plate or plates and to the resistance of the control.

The signal current is an alternating current, the same as our usual power and light supply. The frequency is determined by the resonant point of the transformer, usually several hundred kilocycles, i. e., 465, 175, or other frequencies. When the plate of the diode goes positive, in relation to the control, a current, the value of which depends on the voltage and load resistance, flows from the cathode to the plate, through the coil and resistance of the control and arrives back at the cathode, thus completing the circuit. The end of the control which is connected to the secondary is at a potential above the cathode, because: **"There is a voltage drop across a resistor when a current is flowing through it." Incidentally the polarity of the voltage drop is negative at the secondary end of the control, in respect to the cathode of the tube.**

The voltage developed across the diode load (the control) is usually thought of as having two components, first the DC voltage developed by the rectifying action of the diode and second, the Audio Frequency voltage. This is fully explained in the graph shown in Figure 83.

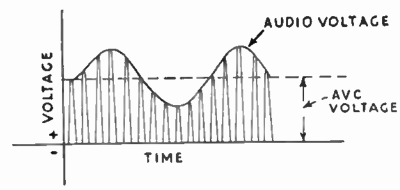


FIGURE 83

This graph shows the voltage appearing across the diode load; i. e., the control.

This is the Audio Frequency voltage applied to the grid of the tube (through the control) **and in addition, it is also applied to a "filter" from which it emerges as DC, the value of which** (in voltage) **is directly proportional to the signal voltage induced in the secondary coil. As the signal voltage rises in value, so does the DC. The DC can be used as a "bias" voltage.** (Remember it is negative to the chassis) **to give Automatic Volume Control.**

The Audio frequency component is taken off the control resistance and applied to the grid of the tube through the blocking condenser. In this circuit, **the DC component of the signal does not affect the grid circuit of the tube.**

In a certain type of this circuit, similar to Circuit 62 (Figure 67), there is no blocking condenser. **The DC potential across the control is applied to the grid so that the bias on the grid varies with the signal intensity, therefore the tube is said to be "signal biased."** This type of circuit is used in certain "Quiet" AVC circuits wherein the first audio stage is biased to "cut off" (with no signal). **When a signal is applied to the diode, the DC component, appearing across the control, counteracts the bias applied to the tube. When the signal is strong enough to overcome the "over-bias" on the tube, the signal will be amplified and appear at the speaker.**

Resistance value of controls for use in these types of circuits is from 250,000 to 500,000 ohms inclusive.

Tapers for controls for these circuits are Yaxley No. 1 Left-Hand for the first type and in most cases Yaxley No. 4 Linear for the second type, because of the common use of "Sharp Cut-Off" type tubes in this position.

TAPPED CONTROL CIRCUITS

With rare exceptions, **there are only three principal types of control circuits using a tapped control.** By "tapped" control we mean a control having a tap brought out from some point on the resistance element. This type of control construction is so common that it is hardly necessary to go into any detailed description.

The three basic types of circuits using the tapped control are: first—where the control is tapped **in order to provide different values of voltage,** such as in an AVC circuit; and second—where the tap is brought out **so that automatic tone compensation may be accomplished; third**—where it is desired **to use one control to act upon two circuits;** for example, to give either radio or phonograph control.

We will consider the explanation of the action in these three types of circuits in the order in which they have been given—

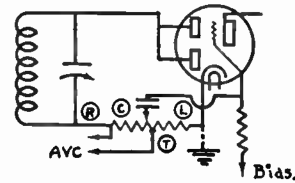


FIGURE 84

Circuit 19 (Figure 84), is a circuit **(of the first type)** employing what might be termed **the voltage type of tapped control,** in that the tap is brought out so that **two different values of Automatic Volume Control Voltage** may be had.

Note that this control is used as a "diode load" type of control, the functions of which were explained in the chapter "Audio Controls."

A study of the connections of the control reveals that the maximum DC voltage, as developed across the control, is used for Automatic Volume Control in a portion of the preceding circuit. The design of the receiver is such that **only a fraction of this voltage is required in certain parts of the circuit.** The easiest and the best method of obtaining this fractional voltage, is to tap it off the control. This assures the correct relation between the two values of AVC voltage which might not be obtained by the use of a separate resistor net-work in parallel with the control, when one considers that the control resistance changes, with wear and age and in addition, the resistor net-work would add to the cost. Note that circuits using the net-work actually use a control circuit as shown in Circuit 15 (Figure 79).

This type of circuit and/or connections is perfectly satisfactory, except in a circuit such as Circuit 62, (Figure 67), wherein the control is used as the diode load resistor, and furnishes signal bias to the succeeding tube.

The second type of tapped volume control circuit is that wherein the tap is used to obtain automatic tone compensation with rotation of the control; i. e., an increase in apparent Bass response at the lower volume levels to compensate for a deficiency of the ear.

Circuit 20 (Figure 85) illustrates most clearly the usual connections for the tone compensated type of tapped control circuit.

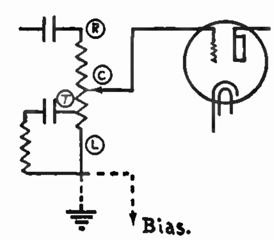


FIGURE 85

The action which takes place in this circuit follows: With the control arm at the Right-Hand (R) terminal, the signal is fed directly to the grid of the tube without being affected by the circuit. **As the control arm is rotated toward the "Left-Hand" (L) terminal, the effect of the tap,** with its associated circuit, consisting of the condenser and resistor connected from the tap to ground, **becomes pronounced. The condenser,** with or without a series resistor, as shown in the illustration, **acts as a by-pass for the higher frequencies of the signal. When the arm is at the tapped position, or is at any position between the tap and the "Left-Hand" terminal, the higher frequencies of the signal are by-passed to ground. It appears to the ear as though the bass portion of the signal had been increased.**

The position of the tap, that is, **the relation of the amount of resistance between the left-hand terminal and the tap, and the resistance between the tap and the right-hand terminal determines the signal level at which the tone compensation becomes effective.**

Previous to the designing of the Yaxley tapped replacement control (TRP) the method of locating and attaching the tap to the resistor ele-

ment of the control **was inaccurate**, in that usually a rivet was driven through the resistor element at some pre-determined point **based on the rotation of the control**, or else an ear was made on the element to which the tap was attached. **Both of these methods of tapping a control are**, in our opinion, **inaccurate, because the tap is mechanically fixed**, and cannot be shifted from its position. **This would not be quite so bad, were it not for the fact that the total resistance of a carbon type control element varies considerably in manufacturing, it being usual to allow a "tolerance" of plus or minus 20% of the value of the control. This means that there can be a variation in the resistance of the control of plus or minus 20% of the stated value.**

When Yaxley engineers started the development of the Yaxley "TRP" type controls, **they determined to overcome these difficulties**, and to so design the Yaxley TRP control **that the tap could always be located in the correct ratio of resistance, regardless of the variation in total resistance.**

Figure 86 shows the method used in "tapping" the Yaxley control.

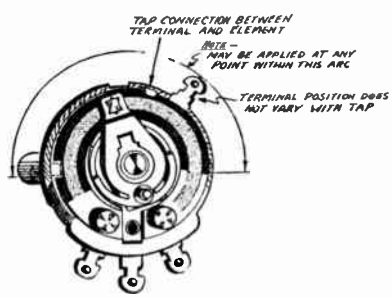


FIGURE 86

Note that underneath the resistor element is a silver-plated "ring," and that the actual tap connection is NOT at the terminal, but that the tap connection to the resistor element is made by means of the little clip which is indicated by the arrow. Observe that this clip may be attached at any point over the greater arc of the control element.

In building Yaxley TRP and TM controls the elements are first made and then the tap location is determined on the basis of the resistance ratio. This method of tapping a control is exclusively Yaxley. It **assures** you that **the action of the tap will be correct** at all times. This assurance cannot be had with any other method of tapping a control.

To return to the action of the tapped control circuit, **the percentage of attenuation**, of the higher frequencies of the signal, **is determined by the capacity of the condenser, and where used, the value of the resistor.** The resistor is employed to broaden the action of the condenser and to prevent a rather sharp attenuation of the higher frequencies.

We have covered the basic action, and although a great many varieties of circuits are used, the basic law rules all of them.

One of the latest developments in the use of (tone compensated) control circuits, is illustrated in Circuit **100 (Figure 87).**

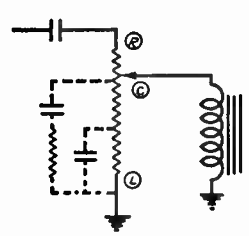


FIGURE 87

This shows a control circuit wherein **there are two taps on the control, both used for tone compensation. The action in this circuit is basically the same as the action in any tone compensated control circuit using a single tap, except that here we have the compensating action in two phases.** The first is not nearly so noticeable as the second. In simple words, **when the control arm is in the full volume position, there is practically no compensation in the circuit, but as the signal value is reduced, there is a slight amount of compensation at the first tap, and a much greater amount at the second tap.** The reason for this arrangement is to give a very gradual and smooth tone compensation, which is much more gradual than that to be obtained by the use of a single tap, particularly where it is desirable to have a rather large attenuation of the higher frequencies or where two different bands are to be successfully attenuated.

The third type of tapped control circuit is illustrated in Circuit 82 (Figure 88).

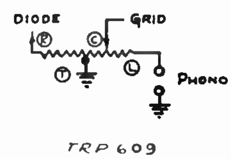


FIGURE 88

In this circuit the control is center tapped and is made with two separate tapers which meet at the tap, so that **in effect** there are two separate controls. When the arm of the control is to the left of the tap the control acts as the radio control. When the arm is to the right of the tap it controls the phonograph signal. Circuit 28, page 179, illustrates a slightly different circuit often used in amplifiers. The action is the same as described with the exception that, here, the sources of signal may be microphone and phonograph. Yaxley control number TRP609 is especially designed for these types of circuits.

Resistance Value of controls for use in tapped control circuits is roughly the same as for the audio control circuits.

Note: When replacing a tapped control, select a Yaxley TRP or TM control having the same overall resistance as that of the original AND BE SURE that the resistance between the left-hand terminal and the tap (with terminals down and facing the shaft side of the control) **is duplicated within reasonable limits by the Yaxley control which you select.**

NOTICE—Do not be confused by the fact that the Yaxley tap terminal may be in a different position from the other terminals than that of the original control. As we pointed out, the tap value of Yaxley controls is determined upon a scientific basis and not by the mechanical replacement of the tap.

Taper of controls for use in tapped volume control circuits is roughly the same as for audio control circuits. It is sometimes necessary to distort what would otherwise be a logarithmic taper, in order that the tone compensation will not occur at such a fast rate as to cause an apparent hop-off in the signal attenuation. **Yaxley TRP and TM controls are properly designed with this feature in mind.**

For the convenience of those who desire to know the methods for calculating the values of component parts in a bass compensation network, the following section includes a bass compensation design chart (Fig. 90) and an accompanying text which gives complete explanation as to its use.

BASS COMPENSATION DESIGN CHART

A direct method of choosing the proper condenser and series resistance values in tapped-volume-control bass compensators to obtain the maximum degree of compensation between 100 and 400 cycles.

To achieve the necessary bass response in radio receivers, resort is frequently made to bass-boost circuits. The most popular by far of these circuits is shown in Fig. 89. Resistors R_3 and R_1 constitute the usual tapped volume control. The resistor R_2 is inserted in the circuit in order that there will not be too great a loss in the higher audio-frequencies, and also to fix the output level of the receiver, when the volume control arm is set at the tap, at which point maximum compensation occurs. The problem arises of finding the proper value for C which will give the greatest attenuation ratio between two arbitrarily chosen frequencies. In most development laboratories these frequencies are usually chosen as 400 and 100 cycles.

In Fig. 89 looking into the network between points A and B (considering R_3 open), the impedance between these two points will, at two different frequencies, reach a maximum ratio for a certain combination of R_1, R_2, and C. Now if terminals A and B are fed from a high impedance source, say through R_3, the ratio of voltages across A and B, for two different impressed frequencies, will have the same ratio as the impedances at these two same frequencies. Of course, if the impedance across A and B were a pure capacitive reactance the ratio of reactances at 400 and 100 cycles would be 4 and there would be no point to our analysis. However, R_2 is always required to prevent the higher audio frequencies from being entirely lost, hence there will be a certain value of C which will yield the maximum impedance or voltage ratio across the terminals.

Developing the Basic Equation

If we then write the equation for the impedance at any arbitrary frequency f_a across terminals A and B,

$$Z_a = \frac{R_1\left(R_2 - j\dfrac{1}{\omega_a C}\right)}{R_1 + R_2 - j\dfrac{1}{\omega_a C}}$$

and the equation for a certain reference frequency, f_r

$$Z_r = \frac{R_1\left(R_2 - j\dfrac{1}{\omega_r C}\right)}{R_1 + R_2 - j\dfrac{1}{\omega_r C}}$$

where $\omega_a = 2\pi f_a$ and $\omega_r = 2\pi f_r$.

If we now write Z_a/Z_r and maximize with respect to C, set the resulting equation to zero and solve for C, we obtain,

$$C = \sqrt{\frac{1}{\omega_a\,\omega_r\,R_2\,(R_1 + R_2)}} \quad \ldots\ldots\ldots\ldots (1)$$

This value of C gives, therefore, a maximum ratio of the impedances at f_a and f_r.

Writing Eq. 1 for C in equations for Z_a and Z_r, we obtain,

$$Z_a = \sqrt{\frac{A^2 + R_1 A B N}{B^2 + N B R_2}} \quad \ldots\ldots\ldots\ldots (2)$$

and

$$Z_r = \sqrt{\frac{N A^2 + R_1 B A}{B^2 N + R_2 B}} \quad \ldots\ldots\ldots\ldots (3)$$

then,

$$K = \frac{E_a}{E_r} = \frac{Z_a}{Z_r}$$

$$= \sqrt{\frac{(A + N B R_1)(NB + R_2)}{(A N + BR_1)(B + NR_2)}} \quad \ldots\ldots (4)$$

where A is R_1R_2, B is $(R_1 + R_2)$ and N is f_r/f_a. These equations are perfectly general. However because they are somewhat cumbersome the chart shown

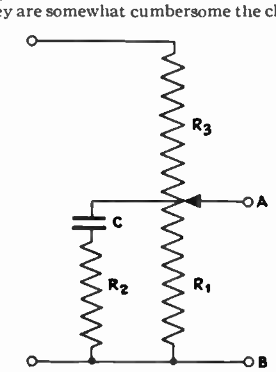
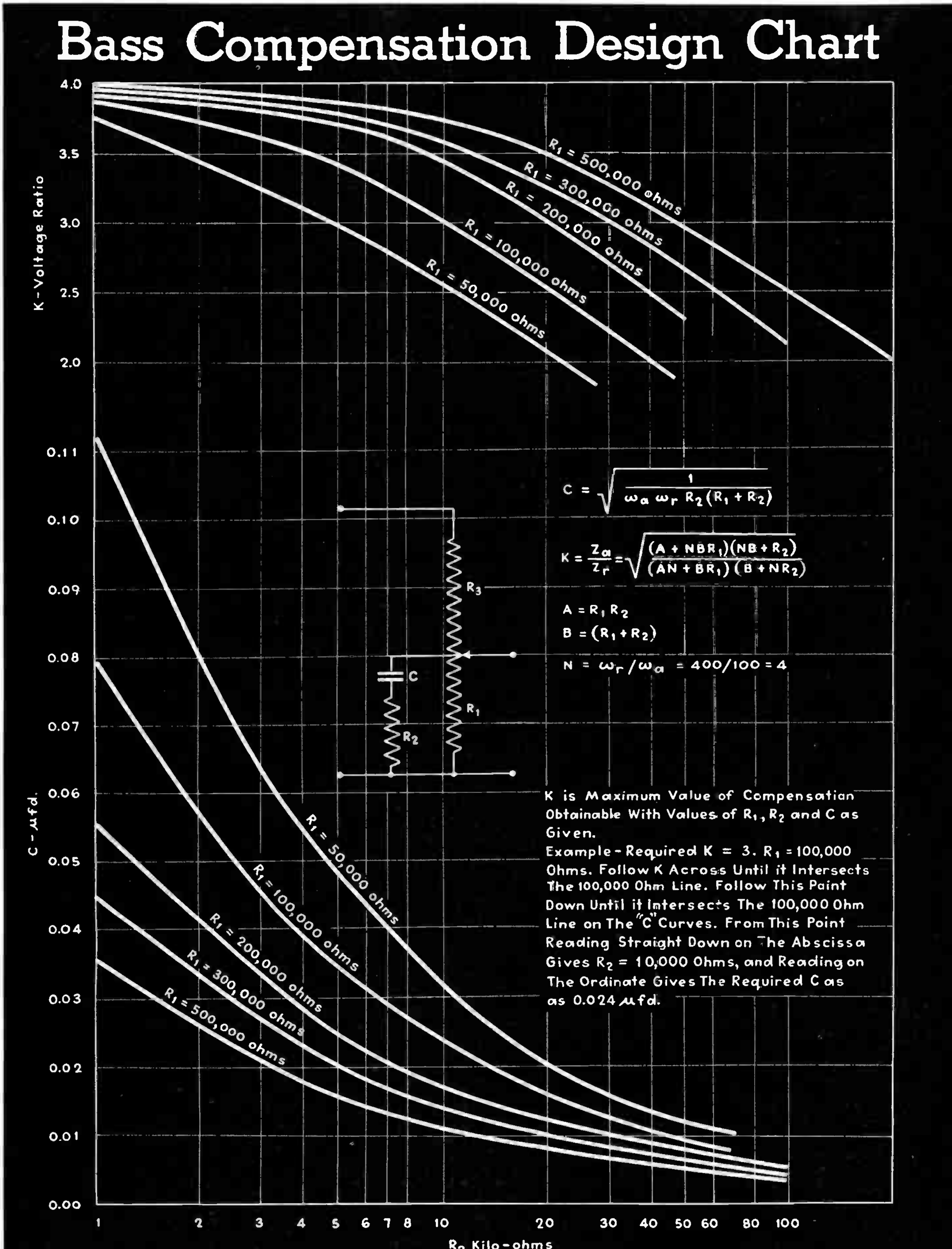


FIGURE 89
Tapped-control bass-boost circuit



Bass Compensation Design Chart
K - Voltage Ratio
4.0
3.5
3.0
2.5
2.0
R1 = 500,000 ohms
R1 = 300,000 ohms
R1 = 200,000 ohms
R1 = 100,000 ohms
R1 = 50,000 ohms
C - μfd.
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
$C = \sqrt{\frac{1}{\omega_a \omega_r R_2 (R_1 + R_2)}}$
$K = \frac{Z_a}{Z_r} = \sqrt{\frac{(A + NBR_1)(NB + R_2)}{(AN + BR_1)(B + NR_2)}}$
$A = R_1 R_2$
$B = (R_1 + R_2)$
$N = \omega_r / \omega_a = 400/100 = 4$
R3
C
R1
R2
K is Maximum Value of Compensation Obtainable With Values of R1, R2 and C as Given.
Example - Required K = 3. R1 = 100,000 Ohms. Follow K Across Until it Intersects The 100,000 Ohm Line. Follow This Point Down Until it Intersects The 100,000 Ohm Line on The "C" Curves. From This Point Reading Straight Down on The Abscissa Gives R2 = 10,000 Ohms, and Reading on The Ordinate Gives The Required C as as 0.024 μfd.
1
2
3
4
5
6
7
8
10
20
30
40
50
60
80
100
R2 Kilo-ohms

FIGURE 90

on page 168 has been constructed, for a range of values which covers most practical cases. The frequency ratio, N was taken as 400 cycles/100 cycles. K is the ratio of the voltages at these two frequencies. Say that K is chosen at 3, and that R_1 (one of the resistors must be known or assumed) is 100,000 ohms. Then on Fig. 90 follow K over parallel to the abscissa, until it intersects R_1 at 100,000 ohms, then follow this point down, until it again intersects the R_1 line at 100,000 ohms, on the "C" curves, then reading straight down from this point, R_2 is given as 10,000 ohms and reading straight across toward C, gives C as .024 μfd. The values of C and R_2 thus derived will give maximum value for compensation with the chosen value of R_1. Increasing or decreasing either R_1 or R_2 will require a new value of C for maximum compensation to be attained. Experimental checks of values derived from the chart show a high order of accuracy. It will be found that the use of the chart will save considerable effort and at the same time yield circuit constants of which one can be sure gives the maximum compensation. The addition of high frequency compensation networks across the volume control will not affect the values of R_1, R_2 and C for maximum compensation.

TONE CONTROL CIRCUITS

Tone controls are supplied with radio receivers so that the user may adjust the tone characteristics to suit a personal preference. **Some people like a deep bass response while others prefer a high-pitched, or brilliant response.**

The usual tone control consists of a condenser in series with a variable resistance so connected that when the resistance of the control is zero, the **higher frequencies of the signal will be attenuated; i. e., by-passed, and will not appear at the loud speaker.**

There are many types of tone control circuits. **Fundamentally, all of them act upon this principle. There are a few tone control circuits arranged to really boost the bass response of a receiver.** There are certain circuits so arranged that when the control is turned in one direction, the higher frequencies are attenuated. When turned in the other direction, the lower frequencies are attenuated. This type circuit can only be successfully employed in a receiver having a flat response over the whole audio frequency spectrum.

Circuit 21 (Figure 91) illustrates what is popularly known as a **"Grid circuit" tone control.**

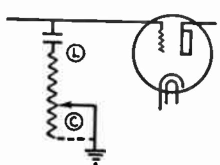


FIGURE 91

This circuit is seen to consist of the condenser and the variable resistor. The action of the circuit follows: When the control arm is at the "Left-Hand" (L) terminal, the condenser is seen to be shorted directly from grid to ground. Inasmuch as the Capacitive Reactance of a Condenser decreases with an increase in frequency, it is easy to see that the resistance; i. e., "Capacative Reactance" of the condenser is much lower at the higher frequencies and that they are effectually short circuited and cannot influence the grid of the tube to any great extent. As the arm of the control is rotated toward the right hand terminal, resistance is gradually introduced into the circuit, in series with the condenser. This increasing resistance gradually adds to the resistance; i. e., Capacitive Reactance of the condenser. It will be seen that the variable resistance is a convenient means of reducing the Capacative Reactance of the condenser. Of course, the same action could be obtained by using a variable condenser. However, the space required by a variable condenser of a size suitable to obtain the desired action would be entirely prohibitive. Therefore, a fixed condenser and a variable resistance is used to obtain the same action. In the design of a tone control circuit of this type, a control having a resistance value many times that of the "resistance"; i. e., "Capacitive Reactance" of the condenser (at the lowest frequency to be considered) is chosen, in order that when the moving arm of the control is at the right-hand terminal there will be very little, if any, attenuation of the higher frequencies of the signal.

Circuit 22 (Figure 92), illustrates the so-called **"plate circuit" type of tone control circuit.**

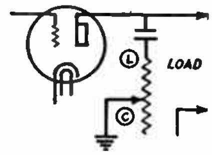


FIGURE 92

The connections and action of this control circuit are practically the same as that of the previously discussed grid circuit type, with of course the exception that the condenser is connected to the plate of the tube.

There is one outstanding difference between the grid circuit and plate circuit types of tone control. That is the difference in impedance of these two circuits.

The impedance of the ordinary grid circuit is in the order of 100,000 ohms or more, whereas the impedance of the plate circuit, particularly of the output or power tubes, ranges from approximately 2,000 to 20,000 ohms. As tone controls are in "shunt" with the respective grid or plate circuits, it is easy to see that in a grid circuit, a small condenser and a large value of resistance must be used. In the plate circuit, a larger condenser and a lower value of resistance is required to give the same amount of tone control.

Another consideration in the action of these two types of tone control circuits is the fact that **there is little voltage,** other than that of the signal, **impressed upon the grid circuit type of control. In the plate circuit type of tone control the condenser is subject to the full plate voltage of the tube. When used in the plate circuit of a high-powered amplifier, the control must be able to dissipate considerable power.**

Failure to take this factor into consideration has caused a good bit of grief to service men who have installed tone controls in power amplifiers, in that they forgot that the control might have to handle 4 or 5 watts of power when used in this position, with the result that they "Burned Out" the control, and were "mystified" because the condenser failed to show leakage of the DC plate current. The "Grid Circuit" type of tone control may use an ordinary carbon control with safety.

Resistance Value of controls for use in tone control circuits ranges for the "Grid" type from 50,000 to 500,000 ohms inclusive. The resistance value of controls for the plate type ranges from 5,000 to 50,000 ohms, in some cases, to a maximum of 150,000 ohms. **The exact value of the control is dependent upon the amount of high frequency attenuation desired. This is determined by the "Capacitive Reactance" of the condenser. We would again like to point out that the value of control resistance and capacity of the condenser is regulated by the impedance of the circuit in which it is used; i. e., high impedance for grid circuits, and a low impedance for plate circuit use.**

Taper used in tone controls is generally of the Yaxley No. 1 Left-Hand type.

A simple rule, regarding taper, to be observed when replacing tone controls is: "WHEN THE BASS POSITION IS TO THE LEFT OF THE KNOB, USE A YAXLEY NO. 1 LEFT-HAND TAPER, or, WHEN THE BASS POSITION IS AT THE RIGHT-HAND SIDE OF THE KNOB, USE A YAXLEY NO. 2 RIGHT-HAND TAPER."

Another convenient rule to be applied when replacing tone controls is: "WHEN ONLY THE CENTER AND LEFT-HAND TERMINALS OF THE CONTROL ARE USED, USE YAXLEY NO. 1 LEFT-HAND TAPER, or, WHEN ONLY THE CENTER AND RIGHT-HAND TERMINALS OF THE CONTROL ARE USED, USE YAXLEY NO. 2 RIGHT-HAND TAPER."

For the combination Bass and Treble control circuit where the control gives Bass attenuation when turned in one direction, and Treble in the other direction, use Yaxley No. 4 Linear taper.

Trouble encountered in tone control circuits is usually in burning out of the control because of the break-down of the condenser. This occurs only in the plate circuit type of control. The cure for this, of course, is to install a new condenser of the same value of the original before replacing or attempting to replace the control.

Additional tone control circuits of the grid type are illustrated by Circuits 39, 41, 57, 65, and 72, appearing on pages 178 to 183. Additional tone controls of the plate type are illustrated in Circuits 34, 44, 80, 85, 95, and 103, on pages 178 to 183.

"LOSSER" TYPE CONTROL CIRCUITS

Losser type volume controls were at one time in fairly common use. The general development and improvement of circuits obsoleted this type of control circuit.

Circuit 84 (Figure 93), illustrates one common type of "Losser" control.

This control was employed in a receiver designed only a few years ago; in fact, one of the early receivers using AVC.

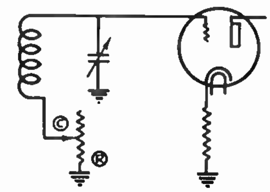


FIGURE 93

This circuit is an outstanding example of all "losser" type control circuits. **The reason for the peculiar name applied to this type of circuit is that the control introduces a "loss" into a circuit. The word "losser" indicates that the control destroys the efficiency of the circuit.**

To explain the action of this circuit it is necessary to briefly review the action of a tuned circuit.

The voltage developed across the tuned circuit; i. e., from grid to ground, is maximum when the impedance of the circuit is maximum; i. e., at resonance; as is shown by the formula L/RC. Where L is the inductance, R is the resistance and C is the capacity.

This formula shows that an increase of R will decrease the impedance of the circuit and lower the voltage applied to the grid of the tube.

When the control arm is at the Right-Hand terminal, the lower end of the coil is grounded. In this position the control has no effect on the tuned circuit. When the arm is rotated, resistance is introduced into the circuit. This is, of course, an increase of "R" in the formula.

It will be seen from this formula and explanation, that as resistance is introduced into the circuit, the voltage applied to the grid of the tube is reduced, and from the explanation, it is clearly seen that **any control which destroys the efficiency of a circuit, can very aptly be termed a "losser" type control.**

A characteristic of this type of control is that it tends to broaden the resonant peak, resulting in reduced selectivity.

Resistance Value of controls for "losser" type circuits is dependent upon the circuit with which they are used. In the example given, the resistance, for a circuit tuned to 175 kilocycles, is 10,000 ohms. This might be taken as an average value for this type of circuit.

Taper for controls used in a circuit as shown in Figure 93, is of the Yaxley No. 2 Right-Hand type, because the control is a Series Control, and as we have previously explained in the chapter on Taper, a series circuit requires the use of a Right-Hand taper.

Trouble in Circuit 84 (Figure 93), outside the general objections listed is noisy operation. This can best be cured by replacing the original control with a Yaxley No. 2 Right Hand taper control of approximately the same value as the original. It might be wise when servicing a receiver equipped with a control circuit of this type, to change the wiring of the receiver to use a more efficient and more modern control circuit.

"DUAL" CONTROL CIRCUITS

The expression "Dual Control Circuits" is applied to all circuits using two controls driven by the same shaft.

The reason for using a dual control circuit is that it is often necessary to do this in order to obtain smooth, even and complete attenuation of all signals.

In the following paragraphs, we will discuss a few of the outstanding, or more common types of dual control circuits.

The first of these types to be discussed is one of the most common, illustrated by Circuit 23 (Figure 94). This shows the use of a dual "Audio" control. This control is applied, in the circuit, to the grids of a push-pull amplifier. This is necessary as it would be quite impossible to control the volume on only one side of the circuit.

Study of the control connections in the illustration reveals that as the control is rotated, the arm moves from the center of the diagram, where the letter "L" indicates the Left-Hand terminals of both sections of the control, outward toward the Right-Hand terminals of the control, which are indicated by the letter "R."

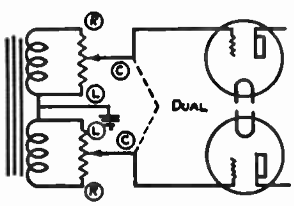


FIGURE 94

A control for use in this circuit would consist of two sections, each of the same resistance and taper.

In our previous study of the action in volume control circuits, we learn that an "Audio" control requires a Yaxley No. 1 Left-Hand taper, and that, in general, the resistance for such a circuit may range from 100,000 ohms to an approximate upper limit of 500,000 ohms.

Yaxley furnishes "Universal Dual" replacement controls, suitable for use in this circuit. These are "LL," "MM," and "NN." A dual megohm is not supplied because there is little or no demand for such a high resistance value, particularly in a circuit such as is given.

Before taking up other types of "dual" control circuits, we wish to point out that Circuit 36, on page 179 is, for all practical purposes, identical to the one explained above.

The second most common type of dual control circuit is Circuit 24 (Figure 95).

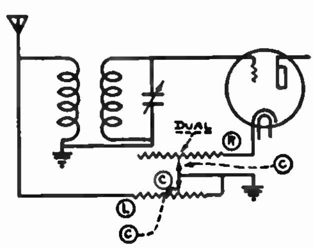


FIGURE 95

In this circuit we meet a combination of two **entirely different circuits, which are controlled by means of a dual control.**

A study of this circuit reveals that **it is a combination of two rather common circuits.** One section of the control acts as an antenna control of the Short-Out type, similar to that previously shown and discussed. (See Circuit 4, Figure 57). The other section of the control is of the Bias type. This section of this control circuit is identical to that described and illustrated in Circuit 7, Figure 60.

The action in the dual control circuit No. 24 (Figure 95) is a combination of the action of the two circuits controlled, in that as the control is rotated from right to left, the bias on the tube is increased and the signal is shorted out at the antenna.

The reason for using a dual control in this circuit, which is, as far as its action is concerned, the same as that of Circuit 6 (Figure 68), is that the conditions in this particular design are such that neither one of the two sections of the circuit could be used for satisfactory control of the volume. Also Circuit 6 (Figure 68) was not applicable at the time of design, because the sensitivity of the receiver was probably rather low, and every possible means had to be taken to get the most out of the receiver. The use of the single control Ant.-Bias circuit would probably reduce the input from the Antenna, whereas a special taper on the Antenna section of the dual control, assures the full possible input.

Circuit 24 (Figure 95), has not been used for several years, because the terrific increase in power by the broadcasting stations has made it possible for designers to use Circuit 6 (Figure 68) even in the lowest gain receivers. It is often practical to replace the original dual control with a Yaxley single control with, in many instances, an improvement in the control action.

Resistance Values for controls for use in Circuit 24 (Figure 95) usually range from a minimum value of 2,000 and 5,000 ohms to 10,000 and 50,000 ohms. Yaxley DRP119, of 3,000 and 10,000 ohm value, is widely used in this type of circuit, as is the DRP169, 7,500 and 10,000 ohms. "Universal Dual" controls "CE," "GE," "GG" and "GK" are also widely used for this type dual control circuit.

Circuit 43 (Figure 96) illustrates another type of "Dual Control Circuit." This is one of the combination antenna Short-Out and Bias Control circuits.

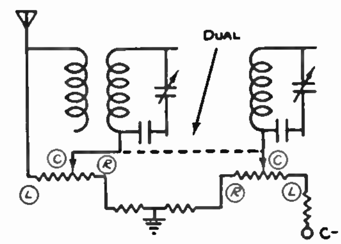


FIGURE 96

Circuit 43 (Figure 96), is used in battery type receivers. A study of the circuit reveals that the action is identical to that of Circuit 24 (Figure 93).

In some cases it might be possible to replace this dual control with a single tapped control, by using Circuit 97, see page 181.

"ANTENNA-LOSSER" TYPE CONTROL CIRCUITS

This type is illustrated in Circuit 38 (Figure 97), and is seen to consist of two sections, one of which is an antenna "Short-Out" type control. The other section serves to short out the RF signal at the plate of the first RF tube.

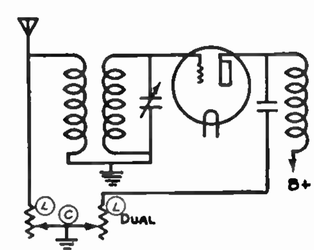


FIGURE 97

This circuit is rather unique in its action, in that when the control is rotated to its full counter-clockwise position, the two arms of the control, as shown in Figure 97, would be at the top of the resistance. In this position the antenna would be connected to ground. Inasmuch as the "Capacitive Reactance" of the condenser (usually of rather large capacity value) is practically zero at the frequencies involved, the plate is effectively shorted to ground, thereby preventing the flow of RF current through the primary coil and transferring to the succeeding tubes.

This circuit was used to a limited extent in some of the earlier battery receivers, and it is rarely encountered in service work.

Resistance Values for the control for this circuit, for replacement purposes, should approximate the values of the original control.

A second type of "Antenna-Losser" circuit is illustrated in Circuit 102 (Figure 98).

The action in this circuit is standard for the antenna section. However, the losser section is unusual, in that **the control forms a series circuit with a tertiary, or third coil, which is inductively coupled to the RF transformer between the second and third RF tubes.**

The action of this losser control circuit is rather unique in that **when the control is at maximum volume position, the full resistance value of the control is in series with the tertiary coil, and thus prevents this coil from absorbing energy from the RF transformer.**

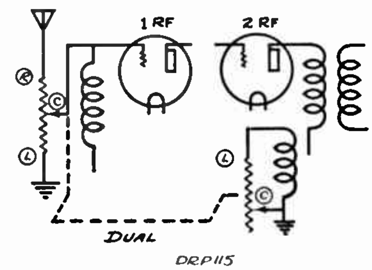


FIGURE 98

The antenna control arm, at full volume position, is at the right-hand terminal of the control. In this position it contacts the antenna. The signal is applied directly to the grid of the first RF tube.

When the control is turned so as to reduce the volume, the arm of the antenna section moves down the control, away from the antenna, reducing the RF input. At the same time the arm of the losser section of the control moves up on the resistance, reducing the amount of resistance in series with the tertiary coil. This reduction of resistance causes the tertiary coil to absorb energy from the transformer and reduces the amount of signal which reaches the grid of the third RF tube.

When the control is at the minimum volume position, the grid of the first RF tube is grounded. The resistance in series with the tertiary coil is at zero. Under this condition this coil will absorb practically all the RF energy present in the RF transformer. Thus—it is seen that there will be no voltage at the grid of the third RF tube.

The reason for using this circuit was that the straight single antenna control would be impractical in the high gain receiver in which the circuit was used. Due to the fact that filament heater Type 26 tubes, were used as the RF amplifier, it was impossible to use a bias type or combination "Ant.-Bias" circuit, because increasing the bias on a "filament type" tube introduces a serious amount of hum.

"ANT.-RF RHEO" DUAL CONTROL CIRCUITS

In some respects, an unusual type of dual control circuit to be discussed. One of the most unique ever designed. The schematic, Circuit 123, is shown in Figure 99.

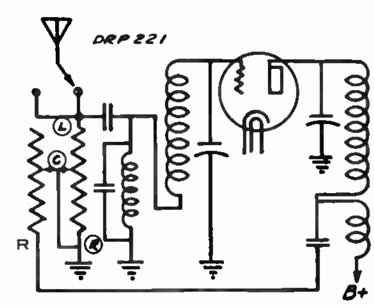


FIGURE 99

Circuit 123 consists of two sections, each controlled by its own section of the dual control. One section is a more or less standard antenna control, discussed in the chapter headed Ant.-Controls. The other section acts as an RF Rheostat which controls the amount of RF current flowing into the primary circuit of the RF transformer. This couples the plate of the first RF tube to the grid of the second RF tube.

A study of the connections of the above circuit will reveal that the primary of the RF transformer is tuned to resonance with the signal. The primary is coupled to the secondary by means of a small coupling coil, immediately below. Immediately below this coil is an RF choke which prevents the RF current from getting into the plate voltage supply of the receiver.

In order to complete the RF circuit, that is, in order that there may be a connection between the tuning condenser and the primary, there is a large condenser connected on one side to the junction of the coupling coil and the choke, and on the other to the right-hand terminal of the control.

Now, when the control is at the full volume position, the path of the RF current is from the plate through the primary and coupling coil; then through the large condenser, inasmuch as the right-hand terminal of the control is grounded at full volume position to the chassis. The tuning condenser being connected from the plate of the tube to chassis is (at full volume position of the control) effectively connected across the primary.

As the control is turned to reduce the volume, resistance is introduced in series with the tuned primary circuit. The Antenna-Section acts exactly as outlined in a previous chapter and illustrated by Circuit 4 (Figure 57).

In addition, due to the decreased current flowing in the primary circuit (because of the resistance introduced into its path) **there will be a reduction in signal transfer at the coupling coil. This signal transfer depends upon the amount of current flowing in the circuit.**

While this action is taking place, the antenna section of the control has reduced the signal input to the grid of the tube.

The reason for using this peculiar and rather complicated circuit was because an "Antenna Type Control Circuit" (using a single control) would not have given satisfactory control of the volume. Also, the then popular screen voltage control (which was used on the same chassis in place of this control circuit) **failed to give smooth** and complete attenuation of signals, especially when the receiver was used in areas of high signal strength.

This dual control circuit may be replaced with the "Antenna-Bias Circuit," described in the chapter under that heading and illustrated by Circuit 6 (Figure 68).

Resistance and Taper of the dual control for use in Circuit 123 (Figure 99), are both special. A correct dual replacement control for the receivers using this circuit, is listed in the forepart of the encyclopedia.

"HUM" CONTROL CIRCUITS

As the title suggests, the type of circuit now explained is used to control hum in receivers.

Whenever "filament type" tubes are used, it is necessary that the grid return be connected (in effect) to the center tap of the filament. In other words the grid return must be connected to a neutral point in respect to the filament voltage. If the grid return is connected to either side of the filament, there will be an alternating voltage impressed upon the grid, which will cause an objectionable hum. An adjustable resistor is used to select the "neutral voltage" point in the filament circuit.

Although this effect may be had by center tapping the filament winding on the transformer, in practice it has been found that there are disturbing factors which in most cases make it preferable to use the adjustable resistor.

The adjustable resistor used for hum control is a potentiometer, usually connected directly across the filament supply. **In some designs hum control is effected by selecting a voltage equivalent to the disturbing or hum voltage, but "out of phase" with the hum voltage, and applying this "out of phase" voltage to the grid of the tube in such a manner as to counteract the effect of the voltage causing the hum.**

The most common circuit for hum control is illustrated by Circuit 37 (Figure 100), which shows the control connected across the filament supply.

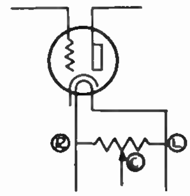


FIGURE 100

The action in this circuit is simple, but rather difficult to explain. The simplest explanation is to consider that the filament supply of voltage reverses the polarity twice for each cycle of the supply voltage. The frequency at which this reversal occurs, is of course determined by the frequency of the filament supply current, ordinarily 60 cycles per second, meaning 120 reversals of polarity per second.

In receivers using a direct current for filament supply, as in old battery receivers, **it is customary to connect the grid return to one side or the other of the filament, depending upon the polarity of bias desired, it being the usual practice to make the connection to the negative side of the filament. If this were attempted with an AC filament supply, the polarity applied to the grid would shift with the reversal of polarity in the filament circuit. This, of course, would give rise to a terrific hum.**

Suppose that we theoretically "stop" or arrest the AC filament supply at such a point in its cycle so that we would have full voltage across the filament. If this were possible, we could take a voltmeter and find a point on the resistance element of the control at which the polarity of the voltage would be neutral. That is, it would be neither positive or negative. This neutral point does not shift with the frequency or the alternations of the filament supply voltage. If we connect our grid return to this point, there will be no alternating voltage impressed upon the grid, and no hum.

In practice the control is wired with the resistor element across the filament. The moving arm of the control is connected to the grid return circuit. This is usually accomplished through the chassis. The control arm may be connected directly to the chassis. It is necessary to apply a bias voltage to the tube. As this control not only provides the return or completion of the grid circuit, but also for the plate circuit, **there is often a resistor connected between the moving arm of the control and the chassis. This resistor, because of the plate current, causes a "voltage drop" between the filament and the chassis** (which is the grid return). **This voltage developed across the resistor, is the bias voltage,** because, due to the polarity of the plate current, the chassis end of the resistor will be negative in polarity, in respect to the filament.

Resistance Values of controls for use in this circuit are usually of a very low value, because of the low voltage impressed across the control. In practice, the resistance usually ranges from 6 ohms for a 2 1/2-volt circuit, to a value of probably several hundred ohms where high filament volts are used.

Yaxley "HU" controls are especially designed for use in this type circuit.

Taper is not required in controls for these circuits, because of their use as a simple voltage divider.

Another type of hum control is illustrated in Circuit 30 (Figure 101).

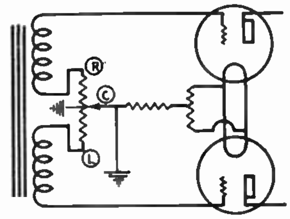


FIGURE 101

In this circuit we see a center tapped control which is connected between the two halves of the secondary of an audio transformer which supplies signal to the grids of a push-pull amplifier.

The action taking place in the above circuit is that when the two tubes are exactly alike, **the neutral point,** obtained by the fixed center tapped resistor across the filament circuit, **provides the correct adjustment for minimum hum.** In this case the arm of the hum control would be at the center position of the control, which point is grounded.

Because tubes for use in this circuit **are rarely exactly alike** in their characteristics, and because of a slight difference in plate current, hum might develop, were it not for the fact that **the control can be shifted to either side** of the center tap **to adjust the bias** supplied to the tubes, **and equalize the plate current** and other factors causing the hum.

Another circuit, having the same action as Circuit 30, is shown in Circuit 66 on page 180. These circuits are practically identical, with the exception that Circuit 66 is applied to a resistance coupled type of amplifier.

Resistance of the control for use in Circuit 30 is usually one of three values i. e., 200, 400 or 600 ohms. Yaxley supplies SRP controls Nos. 265, 253 and 266 for use in these circuits.

These hum-controlling circuits are usable to a certain extent **to overcome distortion which might arise due to a lack of balance in the plate currents** drawn by the tubes. These circuits perform a dual function, both controlled by one adjustment of the control. This could not be accomplished by the use of the first described type of hum control shown in Circuit 37 (Figure 100).

Circuit 51 (Figure 102), illustrates an unusual circuit which accomplishes the same results as that of the two circuits which have just been discussed.

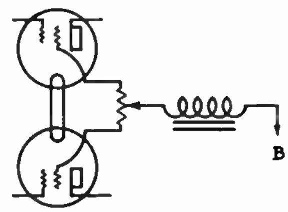


FIGURE 102

A study of this circuit reveals that **the control is connected from one screen to the other** of the two tubes in a push-pull amplifier, usually the output or power tubes.

The arm of the control is connected, in case of Circuit 51 to a choke. This has little bearing on the action of the control.

As explained, **the action of this circuit** is similar to that of Circuit 30 (Figure 101), and Circuit 66 (see page 180). In this case **the control of the hum is accomplished by balancing the plate current of the two tubes by means of varying the screen voltage. As explained, balancing the plate current tends to minimize hum and to prevent distortion.**

Resistance for this control should be rather low, determined to a certain extent by the range of control desired, which in most cases need only be a few volts. The resistance value can be calculated by means of the screen current.

MISCELLANEOUS CONTROL CIRCUITS

In addition to the control circuits discussed, there are others of relative unimportance. Gain, Sensitivity, Silent Tuning and Suppressor, are subsidiary controls in that they are used to control the sensitivity of a receiver, and not the volume. Although many of these controls affect the volume of the receiver, they are provided so that the sensitivity may be reduced to the required level and thereby reduce the amount of noise or interference which would otherwise be objectionable.

All these controls will be found to use one of the control circuits previously discussed. For example, the most usual circuit for use as Gain or Sensitivity control, is the "Bias" control circuit.

When you encounter a circuit not mentioned, we advise that you carefully study the connections. In practically all cases you will find that it will fall into one or another of the different types of control circuits which are illustrated on pages 178 to 183.

Occasionally a receiver will use a control, the circuit of which is peculiar and to be found only in that receiver.

A good example is the "Flash-O-Graph" control listed in the Encyclopedia with the abbreviation "F.O.G." This is a "trade name" for a tuning indicator used to indicate resonance of the receiver to incoming signals.

As signal intensity varies with each installation, it is necessary to provide a control so that the indication will be the same for all locations.

The proper control for use in this circuit is specified in the "Replacement Part" of the Encyclopedia. It is a simple voltage divider and should be replaced with a control of the same resistance value. Taper is not required.

Another control circuit of the same description is a simple voltage divider used to control the height of gas glow in a Neon tube used as a tuning indicator. This circuit is listed in the "Replacement Part" of the Encyclopedia as "Tone Beam" with its proper replacement.

CARBON OR WIRE CONTROLS

Many servicemen are of the opinion that only carbon type controls should be used. This is a mistake. Carbon and wire wound controls have their distinct individual advantages—advantages which are not alike. The wire wound control is the oldest type. Let us analyze its advantages and disadvantages first.

ADVANTAGES OF WIRE WOUND CONTROLS

1. **Absolute accuracy of resistance value** maintained throughout the life of the control. Wire controls can be commercially made to within a tolerance of 2% plus or minus.

2. **High current carrying ability.** In the case of Yaxley wire wound replacement controls, dissipation of a full 5 watts is assured.

3. **Low resistance values** are obtainable with the wire wound type control. Yaxley wire wound controls start as low as one-half ohm.

DISADVANTAGES OF WIRE WOUND CONTROLS

1. **Difficulty of obtaining taper.** Tapers in wire wound controls are rather abrupt.

2. **A slight amount of noise is generated** when the arm moves from one turn of wire to another. The cause of this noise is the "voltage drop" per turn of the resistance wire.

3. **Limited resistance value.** Because it is difficult to handle wire of less than .001" diameter, controls of more than 150,000 ohms would be not only extremely difficult to wind, but would require a large amount of space.

ADVANTAGES OF CARBON TYPE CONTROLS

1. **Ease of tapering**—A distinct advantage in that any taper "curve" may be easily obtained.

2. **Silent operation,** because the resistance change is progressive and not by means of minute steps as in the wire control.

3. **Resistance values** of carbon type controls **may range into many megohms** without bulkiness or undue difficulty of manufacture.

DISADVANTAGES OF CARBON TYPE CONTROLS

1. **Variation of resistance.** The resistance value of a carbon control is influenced by humidity, heat, age and wear, in addition to the tolerance which must be allowed in order to obtain commercial production. (See page 184 for further data).

2. **Low current handling capacity.** The usual limit of dissipation for carbon type controls of approximately 1 1/2 inch diameter is 1 watt. Yaxley carbon controls below 75,000 ohms will readily handle 2 watts, or even more for the lowest resistance values. For midget control ratings see "Midget Controls."

3. **Limited resistance value.** It is almost impossible, at this time, to successfully make carbon controls of less than approximately 500 ohms.

From this compilation, we see that **each type of control has advantages which offset the disadvantages of the other type. Each type of control is limited in its application to the circuits or conditions requiring the particular advantages of its type.**

In your service work, you are confronted with the **replacing of controls of either type.** It is our advice that you **replace a wire control with a wire control,** and an original **carbon type control with a carbon type control. By adhering to this rule, you will avoid customer dissatisfaction,** loss of time and labor, which are distinct possibilities if one type control is substituted for the other.

For your convenience "Yaxley" provides both type controls in all necessary resistance values; and tapers in the range of resistance wherein either type may be used.

There are certain conditions where it might be desirable to change the type of control; i. e., use a carbon control to replace an original wire wound control. This is a matter of discretion for the serviceman. The exchange should not be made unless the advantages to be gained are NOT offset by the disadvantages of the particular type control. Quite often this can only be correctly ascertained by trial and error.

For your advantage, we list below a table showing the Yaxley wire wound and carbon types which are interchangeable as to resistance value and taper.

Wire	Carbon
E7	E12
F7	F12
G7	G12
H7	H12
G	UC501

MIDGET CONTROLS
(See Pages 174-175)

The introduction of the midget volume control brought a new problem to the servicing fraternity. The ramifications of shaft length and shape in the large size control has been duplicated in the midget. This has resulted in a difficult service condition which in the past has had no effective solution. Before considering any methods for solution, let us review the midget situation.

The midget control has been developed in response to a demand for smaller component parts for auto receivers, and the small AC-DC receiver types.

Due to its small size the midget control is not, as a general rule, suitable for use in circuits where the control is called upon to dissipate much more than one-half watt. Therefore, it finds its widest field of use in those circuits generally classed as the "Audio Control Circuits" (such as circuits 15 to 20 inclusive on page 178).

However, some designers have used midget controls in current-carrying circuits of the Antenna-Bias type, where they may be overloaded. Although this is not likely to occur in the receivers made by nationally known concerns, it is a possible source of trouble, particularly in "off brand" or a few "trade name" receivers, where midget controls are often used even though there is sufficient space for the larger type control. **If the original midget control is burned out and a check reveals that the failure is due to excessive current in the control, replace it with a large control if there is space available!**

On the other hand, the midget may be used to replace the large control in the "audio" type of control circuits whenever this procedure tends to simplify a crowded installation.

LEFT HAND TAPER CONTROLS (TAPER I)
Yaxley Midget Controls
(See pages 159-160 for large size controls)

Ohms Resist.	Catalog Numbers	Type	General Use
10M...	MR18, UM118	Carbon	Antenna Shunt,
15M...	MR21, UM121	Carbon	Ant.-Bias,
20M...	MR24, UM124	Carbon	Tone
50M...	MR33, UM133	Carbon	Tone
75M...	MR36, UM137	Carbon	
100M..	MR39, UM140	Carbon	RF or AF
100M..	UM143 Clutch Type.	Carbon	Shunt, Tone
150M..	MR42, UM144	Carbon	
250M..	MR45, UM147	Carbon	Tone
350M..	UM151	Carbon	RF or AF
500M..	MR48, UM154	Carbon	Shunt,
500M..	UM157 Clutch Type.	Carbon	Tone
750M..	MR51, UM158	Carbon	
1 Meg.	MR53, UM161	Carbon	
1 Meg..	UM162 Clutch Type.	Carbon	AF Shunt, Tone
2 Meg..	MR55, UM163	Carbon	
3 Meg..	MR57, UM165	Carbon	

RIGHT HAND TAPER CONTROLS (TAPER II)
Yaxley Midget Controls

10M...	MR19, UM119	Carbon	
15M...	MR22, UM122	Carbon	
25M...	MR28, UM128	Carbon	Bias
50M...	MR34, UM134	Carbon	
75M...	MR37, UM138	Carbon	
100M..	MR40, UM141	Carbon	Bias, Antenna Bias (AC-DC)

LINEAR CONTROLS (TAPER IV)
Yaxley Midget Controls

5M....	MR14, UM114	Carbon	Antenna, Antenna Bias
10M...	MR20, UM120	Carbon	Ant.-Bias, Voltage Divider (Low Current)
25M...	MR29, UM129	Carbon	
50M...	MR35, UM135	Carbon	Voltage
100M..	MR41, UM142	Carbon	Divider
250M..	UM149	Carbon	(Low Current)
500M..	MR50, UM156	Carbon	

MIDGET REPLACEMENT CONTROLS
(See Pages 174-175)

Midget type controls have been in use for approximately three years. Although the greater majority fall in the taper and resistance values for audio circuits (usually 250,000 or 500,000 ohms and No. 1 left hand taper), there are some eight (8) or more basically different types of shafts for this group. This does not include the various lengths of each type, which if counted, would make the number of different shafts required extremely large. It is natural to expect a distributor to be able to supply any replacement part, but if he attempted to stock an exact replacement for every type of midget control, it would require an exceedingly large investment and inventory.

THE NEW YAXLEY UNIVERSAL MIDGET DESIGN
(See Pages 174-175)

After careful consideration of all the requirements involved, Mallory-Yaxley presents a complete and outstanding new solution to the problems previously outlined. Yaxley midget controls embody the following salient features:

1. The revolutionary Plug-In Shaft—
   This development results in a tremendous increase in the flexibility of control application. Only a few types of controls are required to service a large majority of receivers.
2. A ruggedly constructed, smoothly tapered element, built on the principle of the famous Yaxley Silent element. Again taper controlled by geometric design.
3. Pure silver to silver contact. Pure metallic silver on the element in contact with silver plating on the terminal.
4. Terminal anchorage; sprung into place and anchored by a permanent clamp. The terminal is flexible, yet it maintains lasting contact.
5. The Yaxley resistance ratio tap, again pure silver to silver contact, and correctly tapped by resistance ratio.
6. Floating silver plated moving contact arm.

7. Element perfectly centered and anchored in place with rivets.
8. A patented locking method, which rigidly clamps the shaft. When the shaft is inserted this part is sprung outward to give a perfect fit between the shaft and the receptacle, and the receptacle and the bushing. This eliminates any play or looseness in the shaft parts.

AUTOMOBILE CONTROLS

(See Pages 174-175)

Here in a few words with clear distinct pictures is something new which will lighten your work tremendously. See the many ways provided for the replacement of Auto Radio Controls. The rapid development and wide spread use of auto radio receivers has brought about an annoying situation, in that it seems as though every designer strives to out-do all others in the mechanical design of the control shafts to be used in his receiver.

The serviceman is faced with shafts of every conceivable shape and size. There are round shafts; square shafts; shafts with holes, with slots, grooves and pins. This extremely wide variety of shapes of control shafts would be almost unbearable to the serviceman, were he without the universal features of the Yaxley line.

For your benefit, Yaxley pioneered the "Universal" plan and it is in the field of auto radio control replacements that this plan of Universality finds its full expression and assures you of being able to replace practically any control, regardless of its shaft.

A study of auto radio controls reveals that a 1/4" diameter shaft, with a longitudinal slot, the width of which is usually 3/32", is by far the most popular type. Therefore, we will first demonstrate the universal replacement features of the Yaxley line with this type shaft.

Figure 103 shows a type of slotted shaft which is often used with auto receivers. This type of shaft is usually required where the control is operated by means of a removable key, as this allows the locking of the receiver by removal of the key.

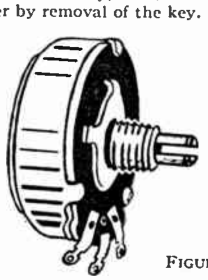


FIGURE 103

Yaxley supplies two controls equipped with this type shaft. These are:

SRP251—250,000 ohms—No. 1 Left-Hand taper.
SRP252—500,000 ohms—No. 1 Left-Hand taper.

These controls have the Yaxley attachable switch feature. In addition **THE SHAFT MAY BE CUT OFF FLUSH WITH THE BUSHING** wherever the application requires a control having a slotted shaft which is flush with the bushing. Such controls are used by certain models of Arvin, Ford and RCA Auto Receivers.

For the replacement of the slotted type shaft where the length of the shaft lies between 1/4" and 2" (as measured from the bushing), Yaxley presents in Figure 104 the type of shaft used in Yaxley controls—types:

UC511—250,000 ohms—No. 1 Left-Hand taper.
UC512—500,000 ohms—No. 1 Left-Hand taper.
UC514—1 Meg.—No. 1 Left-Hand taper.
TRP620—2 Meg.—Tapped at 1 meg. Special Tapped Taper.

These controls will supply a replacement for any automobile receiver requiring a slotted shaft less than 2" long.

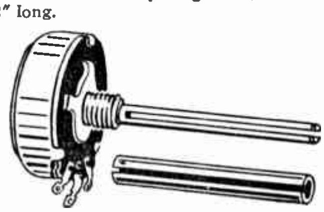


FIGURE 104

Figure 104 shows that this shaft is equipped with a sleeve. **When cutting the shaft it is advisable to cut through the sleeve, except in rare cases where it is necessary to have the sleeve project beyond the end of the shaft.**

For replacing controls having a slotted shaft over 2" in length, Yaxley presents the UC515 which is truly a Universal Control.

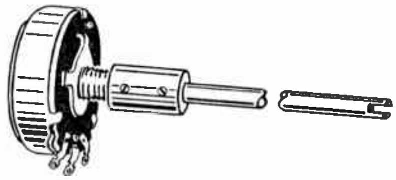


FIGURE 105

Figure 105 clearly reveals that Yaxley Control Type UC515 of 500,000 ohms No. 1 Left-Hand taper will readily replace any control wherein the shaft length is not more than 5 1/2".

By cutting off the shaft and using the coupler to connect it to the control, you may easily and quickly make a replacement.

Because controls of values other than 500,000 ohms rarely are equipped with a slotted shaft greater than 2" in length, Yaxley has not found it necessary to furnish the above described type of control in values other than 500,000 ohms.

For your convenience, and to assure that you may replace most any control which may have a slotted shaft, Yaxley supplies a Slotted Extension Shaft—RS245 as shown in Figure 106.

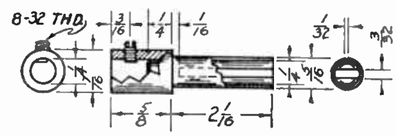


FIGURE 106

A tongue-shaped shaft, with a guiding sleeve, and equipped with a set screw attachment is catalogued as the RS246 and illustrated in Fig. 107.

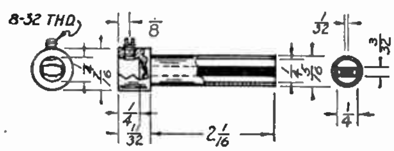


FIGURE 107

CLUTCH TYPE CONTROLS

(See Pages 174-175)

A large number of auto receivers are constructed so that the "On-Off" switch is located in or upon the control head in place of being attached to the volume control. This is shown in Fig. 108.

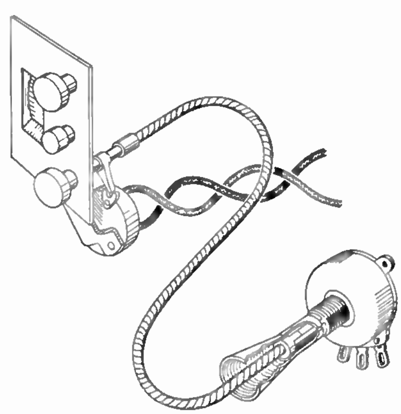


FIGURE 108

This arrangement requires a special type of control known as the "Clutch Type" because it contains a clutch which permits the shaft to "slip," to allow the alignment of the rotation of the control with the knob indicator on the tuning head. Install the control and insert the driving shaft, then turn the control knob through its full rotation in both directions. The result is the proper alignment of the moving arm of the control with the driving knob so that the switch operates at the correct position.

Controls having this clutch feature are provided with a plain cover but with a proper portion of the resistance shorted out for the switch action. Midget controls having this feature are marked in the catalogue in the following manner: "UM143, 50M (ohms) Taper 1, Clutch." In addition the SRP282 (with short-tongue shaft) is a Clutch-Type control.

QUICK AND EASY REPLACEMENT OF CONTROLS

Replacement of controls in receivers will always be an easy and simple matter if the instructions outlined in this chapter are followed.

1. Before removing the control, or even unsoldering the leads **TRACE OUT THE CIRCUIT** and **be sure to note the connections** of the leads to the control. It is advisable to **make a sketch** so as to **prevent confusion** when attaching the leads to the new control.

2. Remove the control from the chassis.

3. Measure the overall resistance. If the control is burned out, it will be necessary to open it and measure the various remaining sections of the resistance, and from this total, calculate the amount of resistance which has been destroyed, so as to obtain the overall resistance value.

4. Ascertain the taper. To measure the taper, it is only necessary to **set the moving arm** of the control **at the center of its arc of movement.** It is not necessary to remove the cover to do this, inasmuch as the shaft of the control may be marked, its total travel ascertained from this mark by rotating the shaft, then set the mark at the center of the indicated travel. **With the arm of the control at the center of its rotation, measure the resistance of the two halves of the control.** When **facing the shaft** end of the control and **with the terminals down or toward the operator, if the resistance between the center terminal and left-hand terminal is lower than the resistance between the center and right hand terminal, replace with a Yaxley No. 1 Left-Hand tapered control. If the resistance between the center and left hand terminal is greater than that between the center and right hand terminal, the control should be replaced with a Yaxley No. 2 Right-Hand tapered control.**

In case the resistance of the two halves of the control is equal, a Yaxley control of No. 4 taper should be used.

5. If the control is tapped, measure and note the resistance between the left hand terminal and the tap.

6. At this point, you have the following information which is to be used in selecting the correct Yaxley replacement control:

(a) Circuit.
(b) The overall resistance.
(c) The taper.
(d) Tap value (if control is tapped).
(e) Shape of shaft.

Procedure:

If shaft is of standard 1/4" diameter (regardless of milling [flat] on the shaft), proceed as follows: For purposes of explanation we will assume that we have the following information: **50,000 ohms resistance, left hand taper** and no tap. Therefore, it is necessary to consult only a listing of Yaxley controls and select a control of 50,000 ohms No. 1 Left-Hand taper, which will be the Yaxley type K12, MR33, or UM133.

However, if we are dealing with a tapped control, it is necessary to consult the table of Yaxley TRP or TM controls, first looking for the TRP or TM control having an overall resistance value nearest that of the original. Then choose the TRP or TM control having the same overall resistance which is tapped at a value nearest that of the original.

ADVANTAGES OF THE MALLORY-YAXLEY PLUG-IN SHAFT

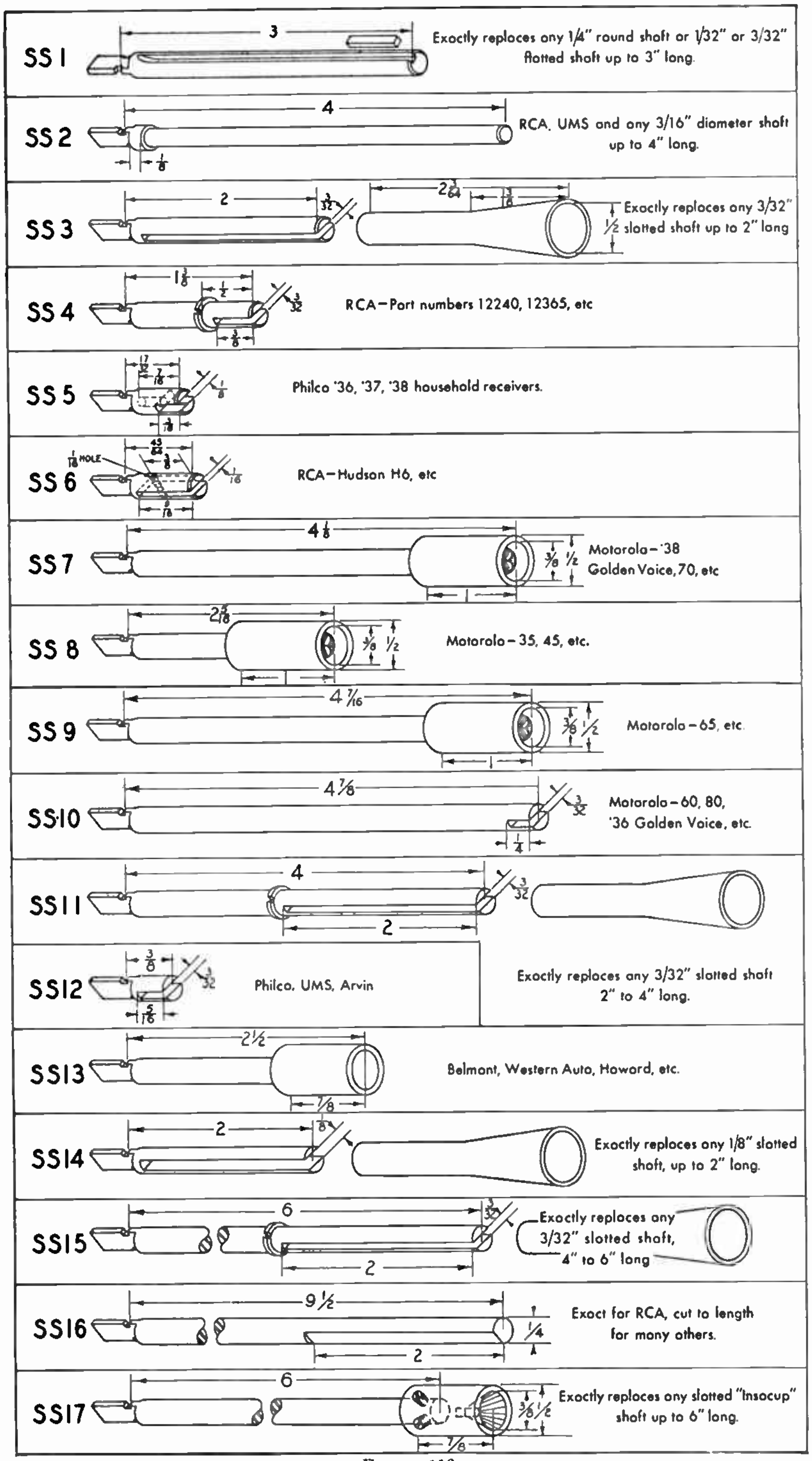


FIGURE 116

Figure 109 illustrates the new Yaxley Plug-In type controls, and a few of the replacement shafts available.

The connection between the shaft and receptacle is rigid and unfailing. It is accomplished by a novel design (patents pending) that does not require the use of tools to install. It is only necessary to line up the long axis of the ovular shaped lock ring with the slot in the receptacle and push in the shaft, after which, for safety, the lock ring is easily clinched with pliers. Should this clinching be overlooked the possibility of the lock ring aligning itself with the slot is remote.

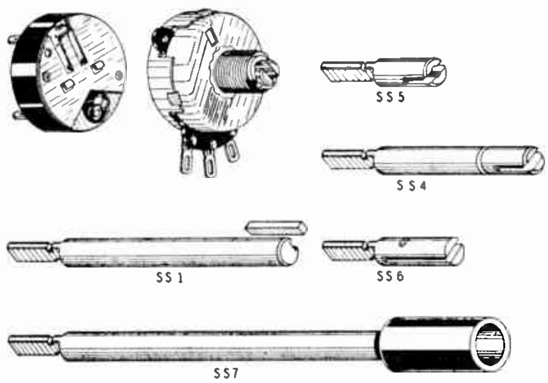


FIGURE 109

With the use of the Yaxley Plug-In shaft controls, it is possible to carry a small stock of five or six controls which are capable of replacing, both mechanically and electrically, over 90% of the midget requirements.

For complete coverage of midget control requirements, the Yaxley line includes 56 known basic controls. At the present time a total of 17 Plug-In Shafts provide all necessary types. Since the possible use of any one control is increased 17 times by the plug-in feature, it naturally follows that the complete line has a potential range equal to 952 (17 x 56) fixed shaft controls. This provides two results beneficial to servicemen. First, since the stock required is small, a distributor is able to carry a complete line, thereby assuring the serviceman of a reliable source of supply. Secondly, as pointed out before, a serviceman can carry a few popular or representative controls and shafts, and in this manner be able to service a large percentage of sets without immediate reference to his supplier.

The most common type of shaft is the ordinary 1/4" shaft with a milled flat. This has been standardized as either 1/32" or 3/32" in depth. The 1/32" flat is used either for a "set screw" knob or one type of the push-on knob, whereas the 3/32" flat is for the other type of push-on knob only.

The relation of the flat to the moving arm varies with different receivers and for convenience it is best to check this before plugging in the SS1 shaft, because this shaft may be inserted either with the flat on the same side as the moving arm or on the opposite side. Figures 110 and 111 illustrate this point.

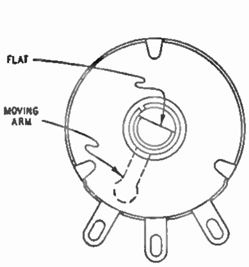


FIGURE 110

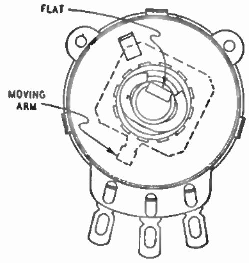


FIGURE 111

The use of the plug-in shafts is very simple as shown by Figures 112, 113, and 114.

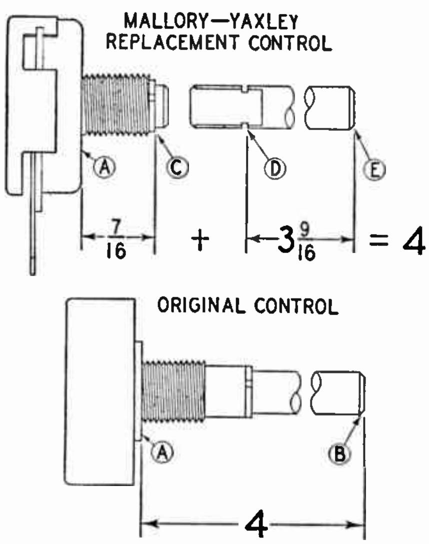


FIGURE 115

The Plug-In (SS) Shafts

Ten (10) of the shafts are of such shape or design that their length is necessarily fixed but the other seven (7) are so designed that they will exactly fit many receivers by sawing them off at the required length. This is easy to do. The cutting may be done either before or after plugging in the shaft, though preferably before, as it is easier to handle. Figure 115 illustrates the method of ascertaining the correct length of shaft.

The chart (Fig. 116) illustrates the complete line of Yaxley Plug-In Shafts.

Yaxley Standard (MR) Midget Controls

These controls have the same constructional details as the Universal Midget types with the exception of the Plug-In Shaft feature. The same high quality is incorporated in the MR types, but their use is of course limited to fixed shaft application.

Attachable Switches

Similar to the large control, the Yaxley Midget Control is designed for a snap-on switch.

The line switches for the Yaxley Midget Controls are necessarily smaller than the switches for the large Yaxley controls. They are of rugged construction. For your convenience the connections of the various switches are shown in Figures M26, M27, M28, M23, M24. The M27 may be used in place of the M23 as shown in Fig. M27 (3-pole closing).

How to Insert "Plug-In" Shaft

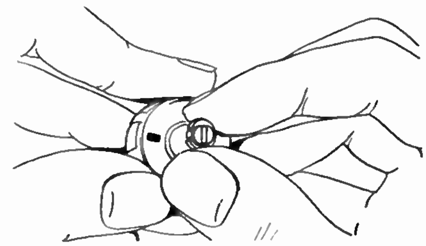


FIGURE 112

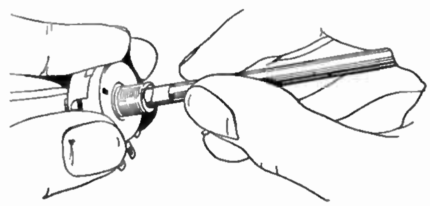


FIGURE 113

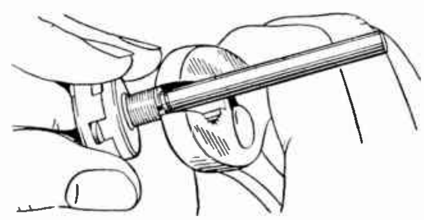


FIGURE 114

How to Cut "Plug-In" Shaft

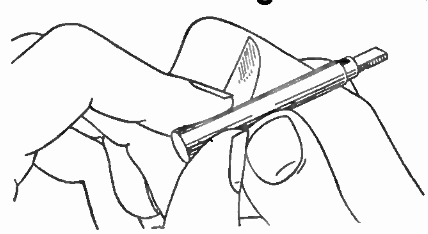
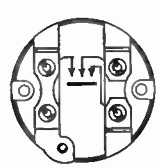


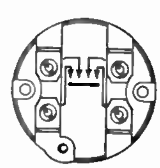
FIGURE 117

The aluminum funnel shaft guide for use with slotted shafts is easily cut to the proper length with a file or knife as illustrated.

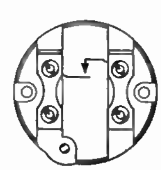
Yaxley Midget Attachable Switches



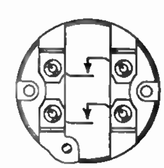
M-23



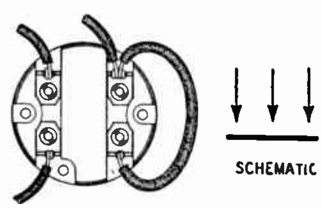
M-24



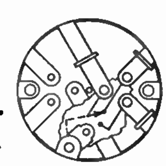
M-26



M-27



M-27 (3 Pole, Closing)



M-28

"A" NOTES

Explanation of "A" Control Notes

The following section of the MALLORY-YAXLEY ENCYCLOPEDIA is without doubt the finest and most helpful compilation ever presented to servicemen.

This section of the encyclopedia enables you to have detailed instruction on replacement of controls. It also allows us to be perfectly frank with you. It permits the listing of receivers and information which will enable you to make a quick replacement.

WE STRONGLY ADVISE FOR YOUR OWN BENEFIT THAT YOU READ "A" NOTES. IT WILL SAVE YOU TIME, WORRY, AND MONEY.

A1—Shape of shaft unknown; if slotted or tongue shaped see Yaxley UC511, UC512, SRP251 or adapter shafts RS245, RS246, etc. (See article "Auto Controls").

A2—This control used on some types of this chassis in place of the first mentioned control.

A3—Mechanics of control unknown; select proper Yaxley control having resistance and taper given, or if value is not given, see Note 5. If control is of two sections use a Yaxley dual. See Note 1.

A4—This control used on later type of this chassis.

A5—Resistance value unknown; measure the overall resistance; if control is burned out use the method given under heading "Determination of Taper," then select Yaxley control having an equivalent resistance of the taper suggested. If not suggested see the article, "Determination of Taper."

A6—Use Yaxley GG if there is sufficient space; if not change circuit to use G12. See Circuit No. 6.

A7—Circuit was changed during production so as to use a 500M control.

A8—This receiver was originally equipped with either a Yaxley wire control of 6M ohms, or a carbon control of 30M ohms. Yaxley Type Y control will replace either of the originals. However, if you wish a wire control use the Yaxley F7.

A9—Space available unknown; if not sufficient for the Yaxley DRP119, change the circuit to the ordinary "Ant.-Bias" circuit as shown in Circuit No. 6 and use the Yaxley G12 control; this will be both easy and satisfactory.

A10—Improved signal attenuation may be obtained by connecting the left-hand terminal of the control to the antenna. This gives the ordinary Bias and Antenna type of control circuit.

A11—Original control is in filament circuit. Change to Circuit No. 2 and use Yaxley type G12.

A12—AK receivers for which Yaxley SRP-239 is specified may be serviced with the Yaxley silent carbon control type E12 by installing it in the original bakelite control housing. This is easily accomplished and gives a smooth, silent control. See note 30.

A13—See instructions on page 123 for use of Yaxley No. 7 Switch.

A14—Check original control or circuit to ascertain if the minimum bias resistor is included in the original control. If so use the Yaxley minimum bias plate on the wire controls, or if a carbon is recommended, use the adjustable resistor.

A15—Requires use of Yaxley shoulder nut A11260-12 and also the regular nut. Arrange so that control is set back from the panel so as to clear the dial. Yaxley extension bushing EB247 might be used.

A16—May require use of Yaxley bracket RB248.

A17—Be sure to check the coupling condenser before replacing the control.

A18—Note: Some of these chassis use the Yaxley Type GG Dual Control.

A19—Note: Measure resistance between left-hand terminal and tap (when facing shaft, terminals at bottom), and select Yaxley TRP having same overall resistance and tapped at a value nearest that of the original.

A20—Originally a dual control, this circuit is easily adaptable to the Yaxley Type G12 Control by using Circuit No. 6 as given in the schematics. Refer to Note 14 when installing the control. If desired, Yaxley DRP119 is suitable for this circuit.

A21—This receiver may require a control with a portion of the shaft of smaller diameter to clear the dial; if so, use Yaxley SRP275.

A22—Note: Use Yaxley extension shafts RS242 and RS244. These shafts are attached to the Type T Control and cut to the proper length, preferably by cutting the shaft of the Type T Control and the RS242 Shaft.

A23—Note: When using the Yaxley SRP185 with metal shaft, be sure to ground the shaft near the front of the set by means of a pigtail, if there is any tendency toward oscillation.

A24—Extension shaft required; use RS244 for 3/16" diameter. For 1/4" diameter use RS242 or RS243.

A25—Note: If shaft of UC512 Control is not of sufficient length use the Yaxley Type N Control and extension shaft RS245.

A26—Note: Some of these chassis use a dual control; Yaxley GG is correct replacement.

A27—Used on first type of this chassis.

A28—Volume control for radio tuner section.

A29—Volume control for radio amplifier section.

A30—Note: This is a replacement strip to be installed in the original housing.

A31—Parallel the two sections of the Yaxley No. 7 Switch to prevent overload; see page 123 for instructions on the use and connections of the Yaxley No. 7 Switch.

A32—It is suggested that this receiver be changed to use type '36 tubes in place of the 24 and 26 types, and the 37 in place of the 01A.

A33—Requires Nos. 203 and 212 washers.

A34—"Kennedy" made by Detrola; see Detrola Model 1000.

A35—Note: Controls SRP276 and SRP277 are to be used together and neither is to be used with any other make of control.

A36—Note: Mechanical features unknown; we suggest Control SRP276.

A38—Note: The Antenna section of this control is wired as per schematic No. 4. The other section is wired as follows: the center terminal to type '30 plate, the right-hand terminal to "P" of the audio transformer, and the left-hand terminal to "B" positive. Yaxley GK should make a satisfactory replacement. However, the Yaxley DRP243 wired with the rear section in the grid circuit of the 1st A.F. ('30) as per schematic No. 15, and the front section wired as per schematic No. 2, will give better attenuation in areas of high signal intensity.

A39—Note: Switch used on later types and model KDC only.

A40—Note: Switch used on volume control only on the chassis having a tone control.

A41—Connect left-hand terminal to chassis, center terminal to screen circuit, and right-hand terminal to positive 67.5 volts. (View control from shaft end, terminals down or toward operator).

A42—Note: Cut off the shaft of the SRP251 Control flush with bushing.

A43—Note: Original control was of the inductive type. Replacement with a variable resistance control is highly satisfactory. Connect the left-hand terminal to the antenna and grid, and the center terminal to ground. (Control viewed from shaft end, terminals at bottom).

A44—Original control is a dual; however, only one section is to be used at any one time. The Yaxley G7 is a perfect replacement for the Antenna Shunt section which is most commonly used.

A45—Note: When replacing the tone control, use Yaxley Bracket RB249, or file out the hole in the original mounting bracket. Be sure to use only the left-hand and center terminals of the control.

A46—Original dual control is replaced with single Yaxley Y100MP, which is connected as follows: Center terminal to first audio plate, left terminal to tone condenser, and right terminal through 5,000 ohm resistor to B positive.

A47—If original control is wire and carbon, use Yaxley DRP307. If original is carbon in both sections, use DRP244, with the front section (nearest the shaft) for the screen circuit and the rear section for the Antenna circuit.

A48—Refer to schematic 14. The original control was in the filament circuit. We recommend a change as per Circuit No. 14 using a Yaxley Type "M" Control as a shunt across the detector grid coil.

A49—The DRP222 Control was originally made with a short shaft for use in the chassis 180 (model 181), and requires the use of two RS242 extension shafts when used in the chassis 100 (model 101).

The DRP222 is now being made with a 7 5/32" shaft to fit the chassis 100. When used in the chassis 180 this shaft should be cut off at a point 1 3/8" from the body of the control.

Note: The chassis 100 requires the use of three terminals on the rear (phono.) section and only the center and right-hand terminals of the front section.

In some cases better ratio of signal attenuation is obtained by connecting the left-hand terminal of the front section to the Antenna so as to obtain a signal attenuation in addition to the bias increase.

A50—The DRP117 Control is an exact replacement for the Yaxley original. The DRP242 Control is an exact replacement for the control in the bakelite housing.

A51—Requires Yaxley FS251 flexible shaft.

A52—Requires Yaxley FS252 flexible shaft.

A53—This control does not require the fixed resistor shunt.

A54—When installing the "CE" control, connect thefront section to the An tenna circuit and the rear section to the bias circuit. This is the reverse of the original but has been filed checked and found to give satisfactory results.

A55—The Yaxley No. 14 Switch has four terminals which must be connected as follows: one terminal to chassis, one terminal to white lead and one to black lead with white tracer. Disconnect the 1,500 ohm resistor from the chassis and connect it between the remaining switch terminal and the remaining lead, which goes to C-9 volts and to the grid returns of the 1H4G and 1E7G.

A56—The Yaxley DRP114 has a 250 ohm front section for the bias control (Circuit 8) and a 5000 ohm rear section for the antenna control (Circuit 2). Original control may have had sections in reverse order.

A57—The original control is two megohms.

A58—Left-hand terminal (control viewed from shaft end, terminals down) must be grounded to chassis.

A59—Note: The original switch has three terminals, only two are actually used, the other is a "tie" point. When using the Yaxley switch, solder together and tape—the wires formerly connected to this "tie" terminal.

A60—May require use of Yaxley EB247 extension bushing.

A61—Can be replaced with Standard Yaxley Control. May require use of RB248.

A65—For emergency replacement use SRP-265 Control.

A66—Wire the switch so that it is shorted when control is turned to extreme counter-clockwise position. (See chapter on "Attachable Switches.")

A67—Disregard the tap in this replacement.

A68—File shaft to duplicate original.

A69—This control requires two Yaxley RS-242 Extension Shafts or the EC240 Coupler and a suitable length of 1/4" shaft.

A70—This replacement (L) requires a slot to be filed or sawed in the shaft of the "L" control, or change of the knob to the standard Philco push-on type.

A71—Note: Requires a 100M No. 1 Taper or "L" Control (subject to the instructions in Note 70) for replacement. In some cases a UC511 Control is satisfactory.

A72—The EC240 is a 1/4" shaft coupler having an internal sleeve to reduce the diameter to 3/16".

A73—For this replacement we advise a change in the volume control circuit, to correspond to Circuit No. 8. Use an A3MP Control and a 4,500 ohm Fixed Resistor in series, in place of the original tapped control.

A74—Due to the many variations in both circuit and control, we advise measuring the original control carefully and duplicating with similar Yaxley Control, or returning original to Yaxley for duplication.

A75—If tone control on the broadcast band is not desired, an L control with No. 7 switch may be used. If tone control is desired, use the SRP284 with No. 7 switch. The short wave band will then be switched on at the extreme right end of rotation. If present circuit leaves dead end of coil open, rewire to short unused portion of coil.

A76—Improved operation may often be obtained by removing the shunt (6M ohms) resistor across the control and using the Yaxley E Control. In extreme cases, use a Yaxley E7 Control and connect as per Circuit No. 6.

A77—If original control has 3/16" diameter shaft end, use Yaxley RS244 Extension Shaft.

A78—Replace with an A2MP Control and an EC240 and a portion of 1/4" shaft taken from the old control.

A79—If trouble with oscillation is encountered in this set, the addition of a 5M ohm resistor, connected from antenna to ground will usually effect a cure.

A80—Be Sure to check the series resistor between the screen circuit and B positive! It it is not a full 20,000 ohms or if it is of the carbon type REPLACE it with a Wire Wound 20,000 ohm resistor. This will prevent the control being burned out and the possibility of a dissatisfied customer.

A81—Select a Yaxley TRP Control of 500,000 ohms total resistance having a tap at the same resistance value (as measured from left-hand terminal) and slot the shaft.

A82—The voltage applied across the SRP-261 Control should not exceed a maximum of 170 volts. If the voltage exceeds this value, the control will burn out. **Important:** Be sure that the bias on the tubes is at the rated value when using the SRP261 Control as a plate voltage control.

A83—The Yaxley DRP221 Control is an exact replacement for the dual control used on the 50, 60, and 70 Series receivers, although it was used interchangeably with the SRP261 Control in the earlier 50 and 60 series. In many cases a change of circuit to the antenna-bias type, and the use of the Yaxley H7 Control will give much better control action.

A84—Question as to available space. If sufficient for 1 1/2" diameter control use a Yaxley "Y" Control.

A85—Because of a tendency toward noisy operation with the present volume control circuit, we recommend a change to circuit 15 using a Yaxley "O" control. Connect a 500M ohm fixed resistor between the leads that were soldered to the outside terminals of the original control. Take out the one megohm resistor connected between the grid of the first audio tube (type 27) and the chassis. Install the "O" control as follows: The right hand terminal to the coupling condenser, the center terminal to the first audio grid, and the left hand terminal to the chassis. (Control viewed from shaft end, terminals at bottom.)

A86—The tone control as connected in circuit 130 has its maximum treble response in the extreme counter-clockwise or normal "off" position.

A87—If control is single section type, use Yaxley UC504.

A88—Ground the cover of the control for this installation.

A89—This control when wired as in the specified circuit has its maximum bass response and switch action (if switch is included) at the extreme counter-clockwise or left position.

A90—Refer to specified circuit and reverse "L" and "R" terminals.

A91—The recommended control requires shunting of its outside terminals with a 1500 ohm resistor such as the Yaxley 71500 to duplicate the resistance value of the original control.

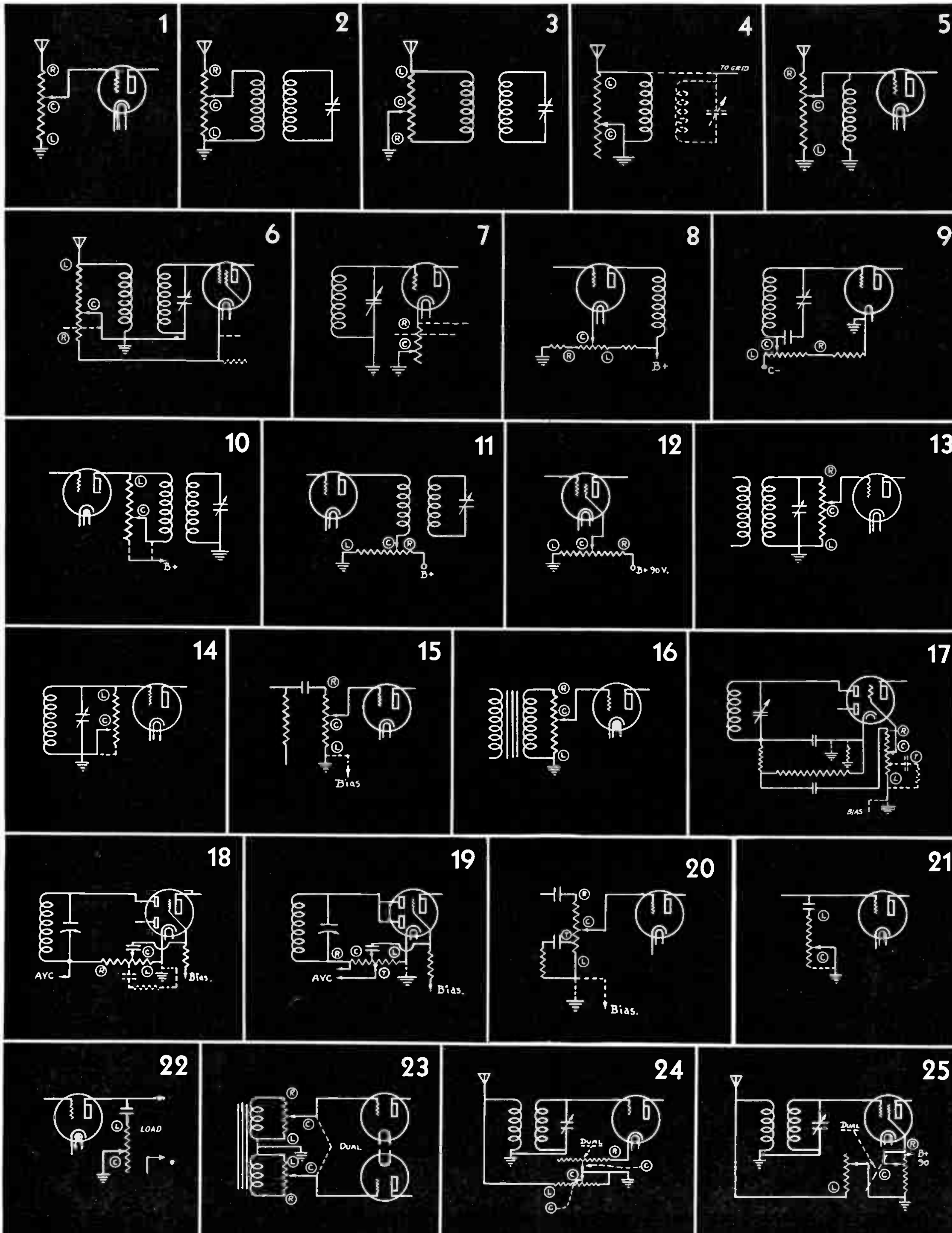
A92—May require use of shoulder nut for mounting.

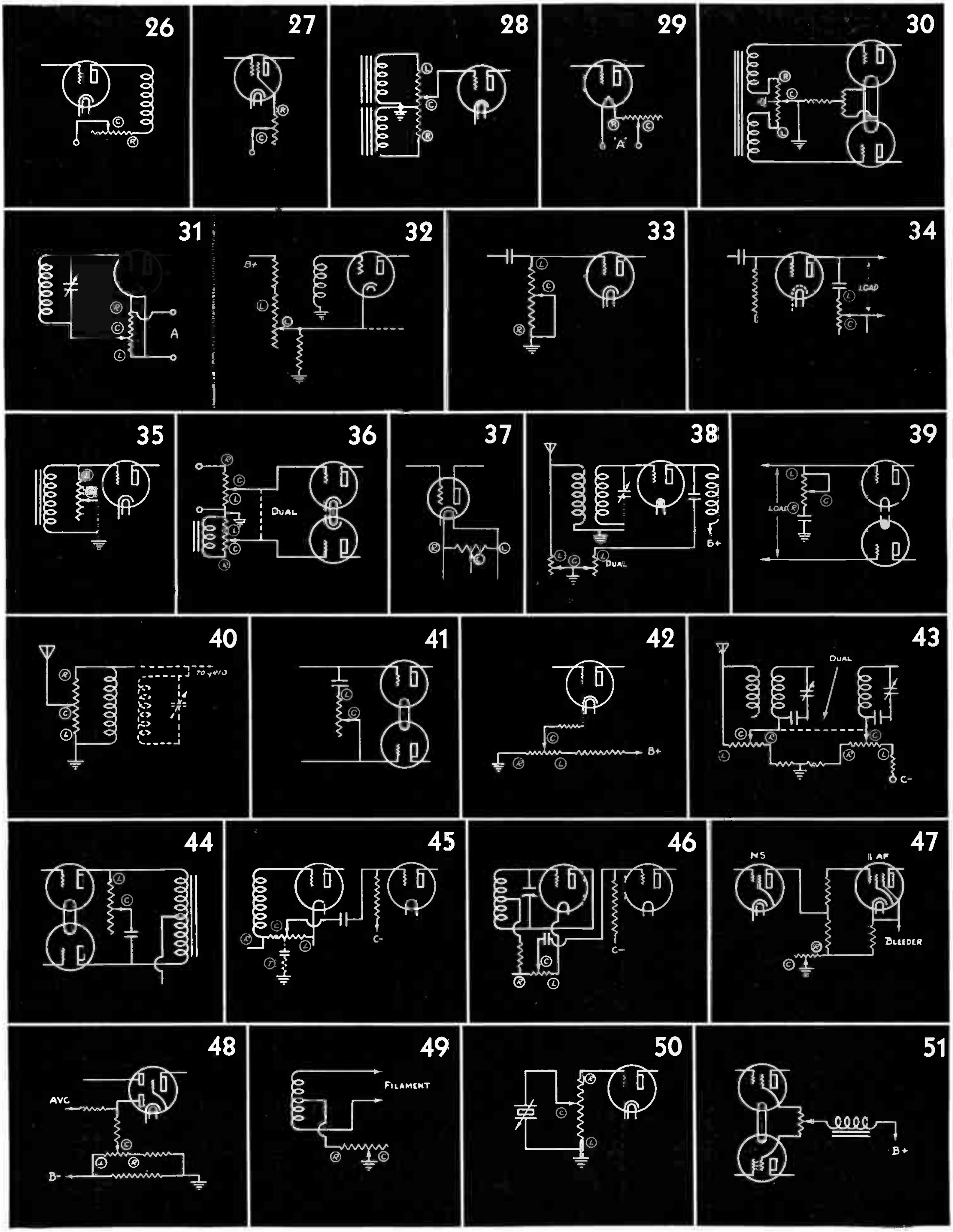
A93—The Yaxley MN control may be used for this replacement. Use the 500M ohm section in place of the one megohm section of the original. The lower resistance value will not affect the performance of the receiver.

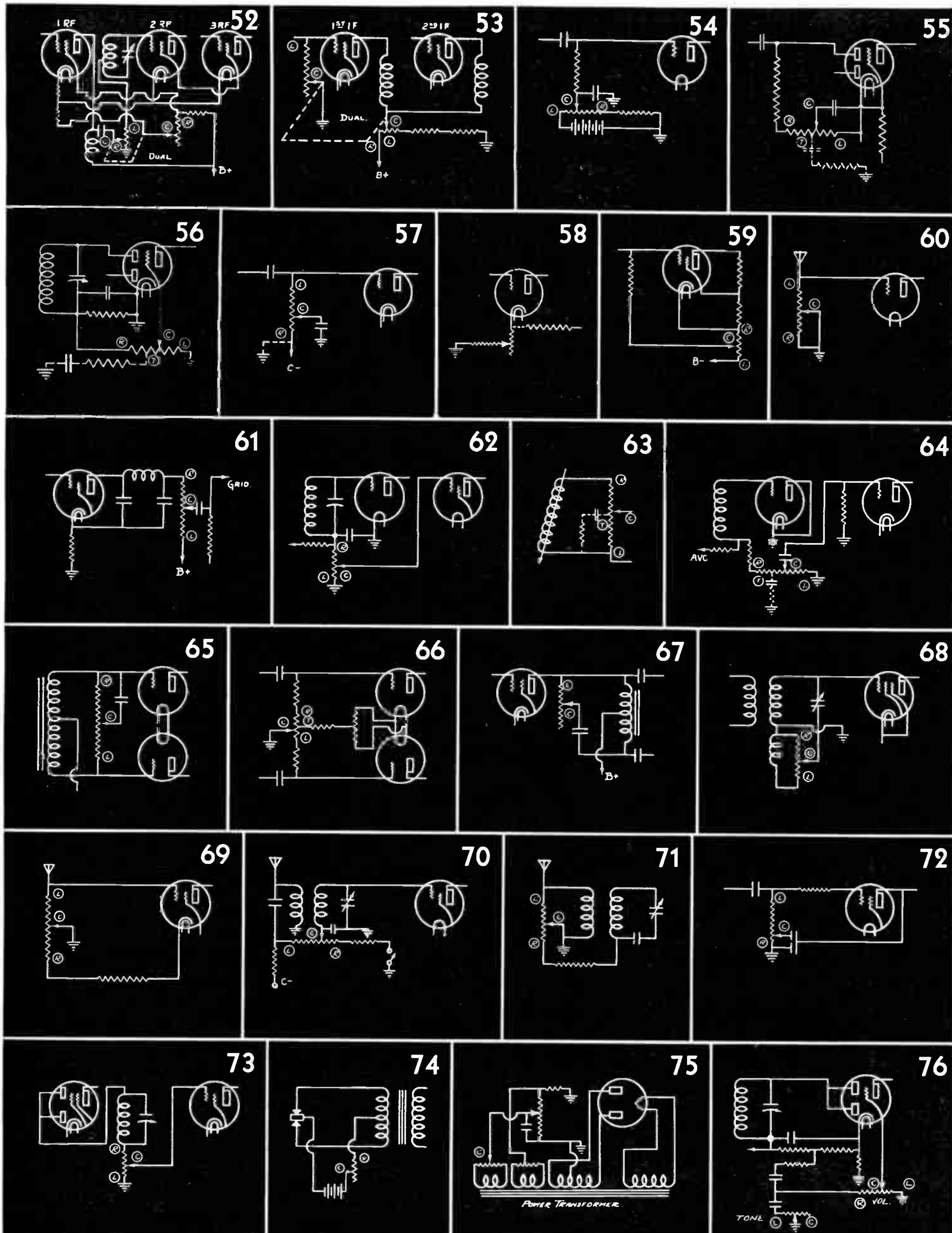
A94—To save yourself time and trouble we advise the use of the Yaxley RS244 conversion shaft which allows the use of the old 3/16" knob with an easily obtainable Yaxley Universal Control. Where the original has a short 3/16" shaft, either drill out the knob or use the later 1/4" type which may be obtained from the set manufacturer.

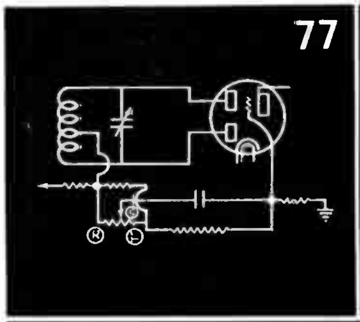
A95—The original volume control had a 5000 ohm resistor connected between the two actuating arms of the switch. This or similar resistor must be connected in the same manner on the Yaxley No. 7 replacement switch.

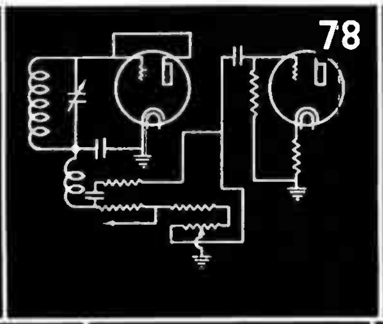
A96—Select proper replacement shaft. See replacement shaft (SS types) description, page 174.

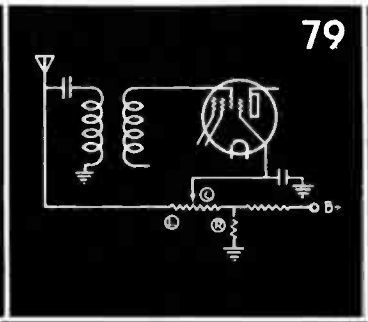

1
2
3
4
TO GRID
5
6
7
8
B+
9
C-
10
B+
11
B+
12
B+ 90 V.
13
14
15
Bias
16
17
BIAS
18
AVC
Bias.
19
AVC
Bias.
20
Bias.
21
22
LOAD
23
DUAL
24
DUAL
25
DUAL
B+ 90

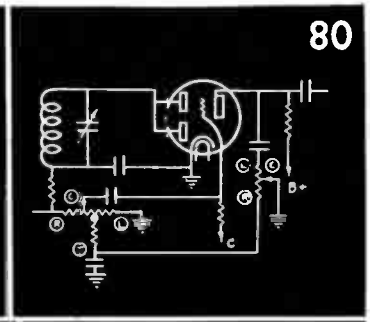

26
27
28
29
30
31
A
32
B+
33
34
LOAD
35
36
DUAL
37
38
B+
DUAL
39
LOAD
40
TO GRID
41
42
B+
43
DUAL
C-
44
45
C-
46
C-
47
NS
1 AF
BLEEDER
48
AVC
B-
49
FILAMENT
50
51
B+

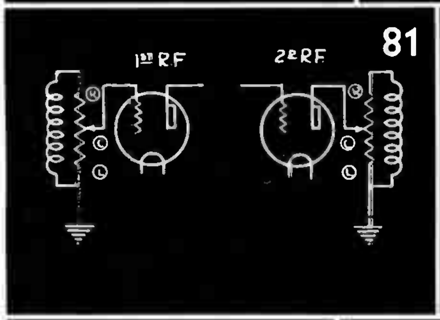

52
1 RF
2 RF
3 RF
DUAL
B+
53
1ST IF
2ND IF
DUAL
B+
54
55
56
57
C-
58
59
B-
60
61
GRID
B+
62
63
64
AVC
65
66
67
B+
68
69
70
C-
71
72
73
74
75
POWER TRANSFORMER
76
VOL.
TONE

77


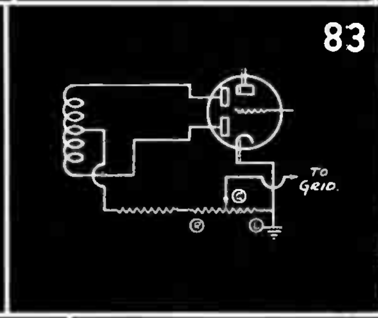
78


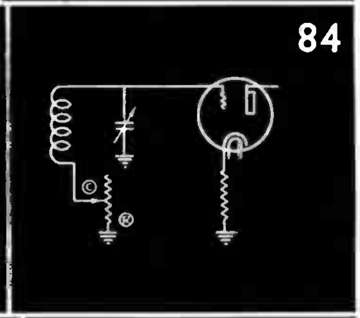
79


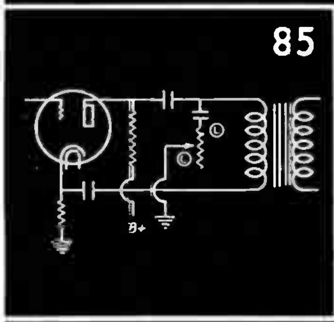
80


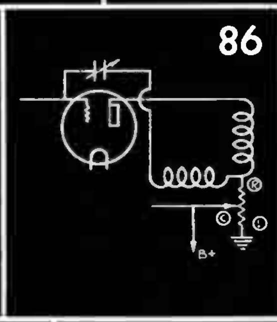
81


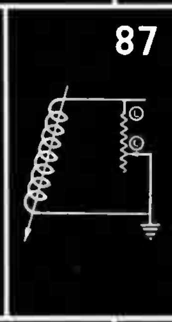
82

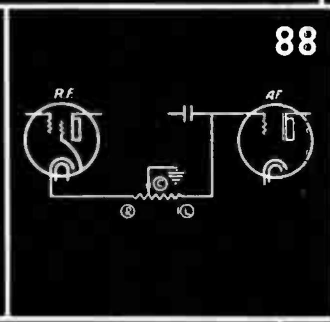

83


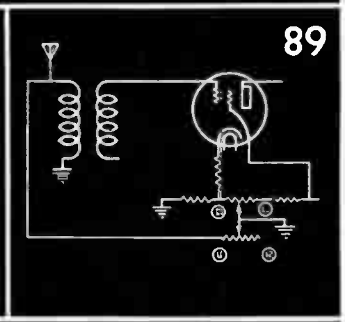
84


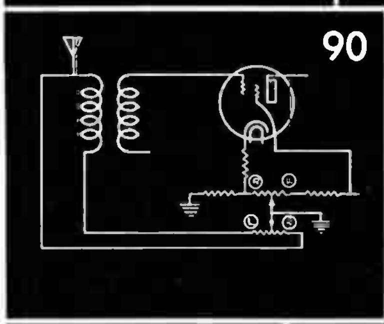
85


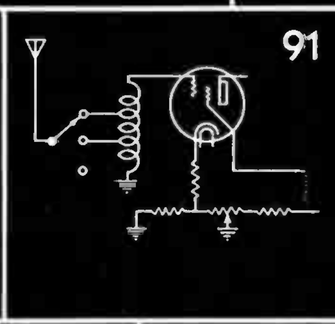
86


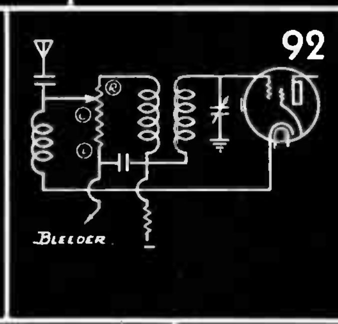
87


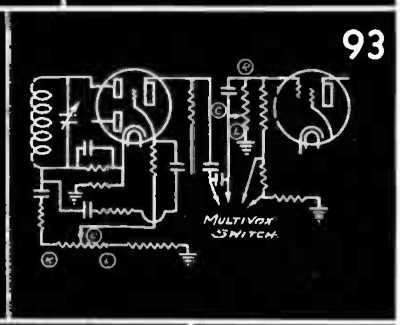
88


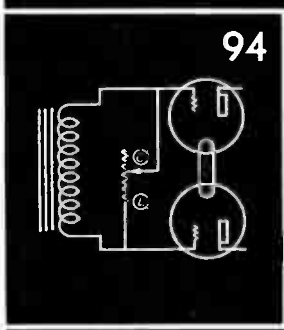
89


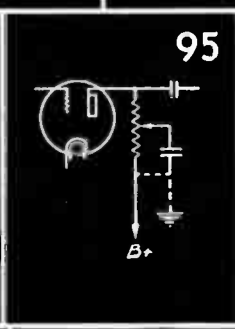
90


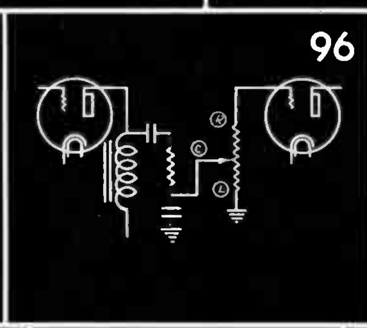
91


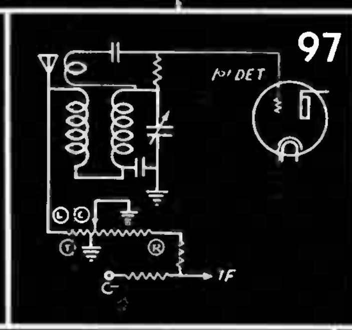
92


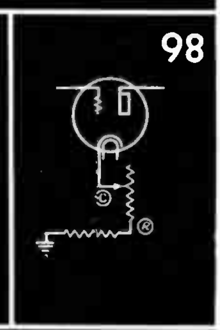
93


94


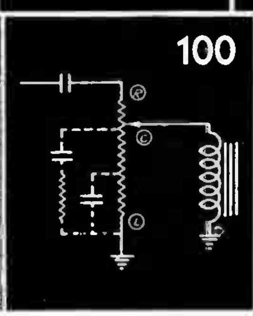
95


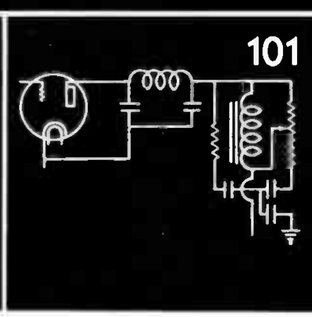
96


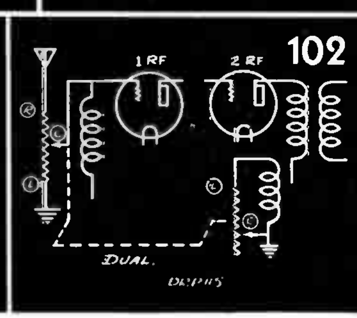
97


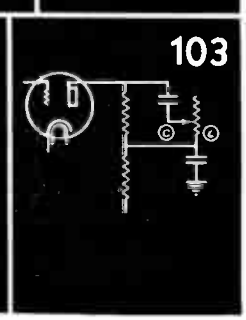
98


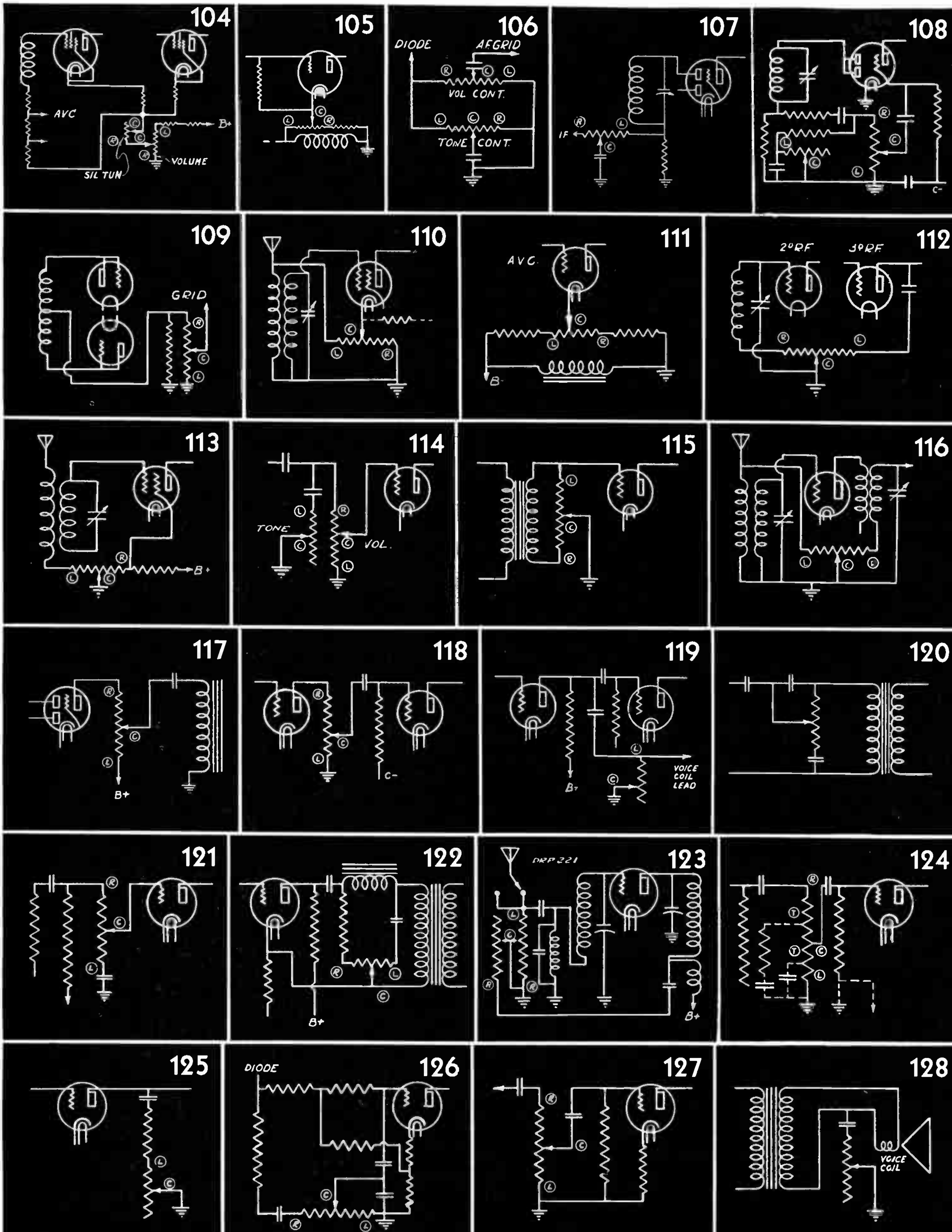
99

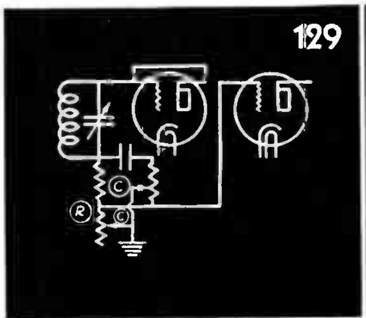

100


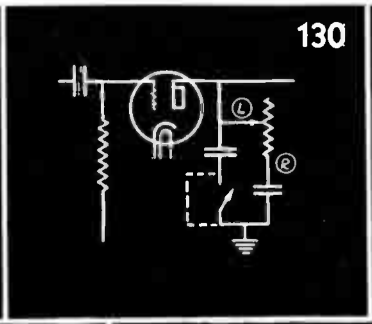
101


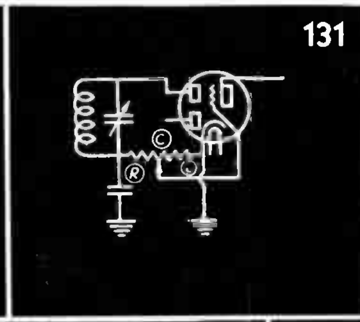
102


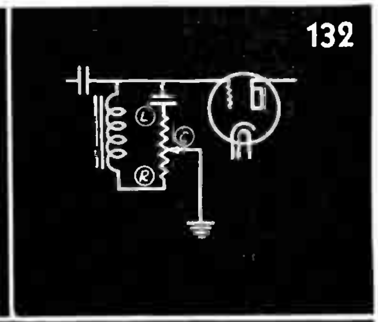
103


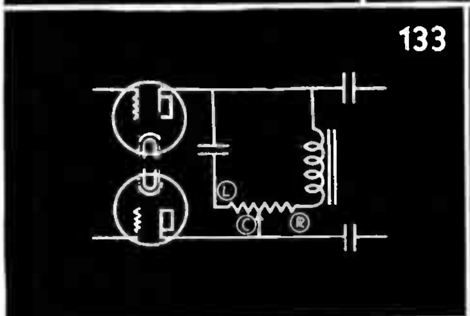

104
AVC
B+
VOLUME
SIL TUN
105
106
DIODE
AF GRID
VOL. CONT.
TONE CONT.
107
IF
108
C-
109
GRID
110
111
A.V.C.
B-
112
2ND RF
3RD RF
113
B+
114
TONE
VOL.
115
116
117
B+
118
C-
119
VOICE COIL LEAD
B+
120
121
122
B+
123
B+
124
125
126
DIODE
127
128
VOICE COIL

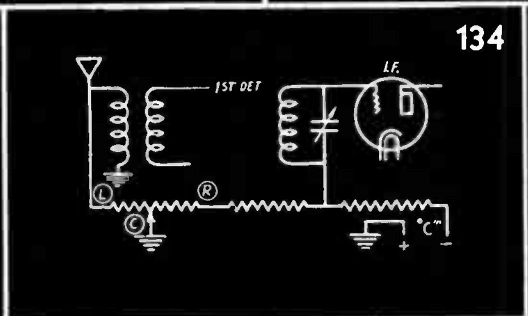

129


130

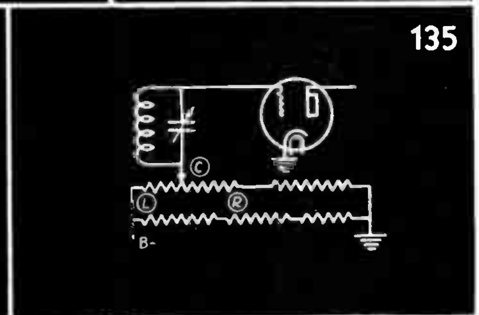

131


132

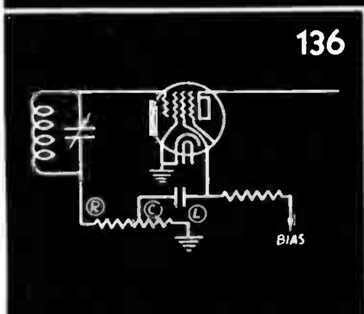

133



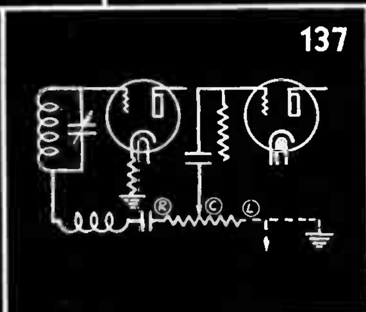
134

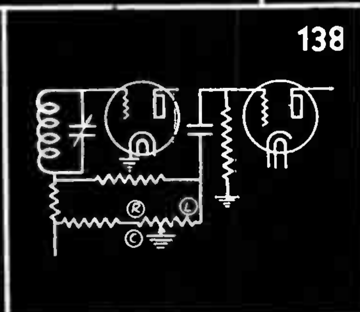


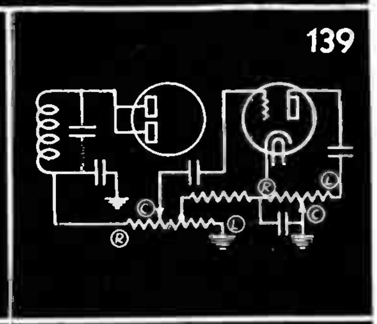
135

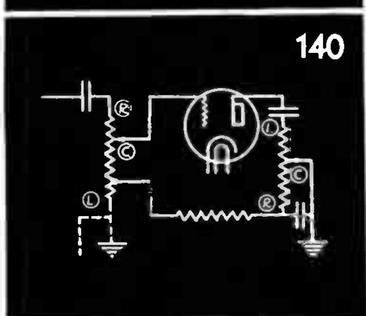


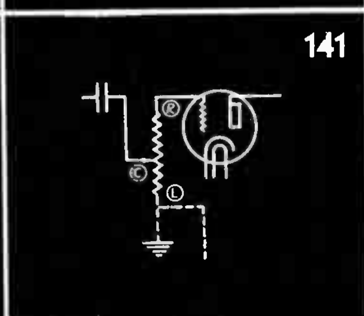
136

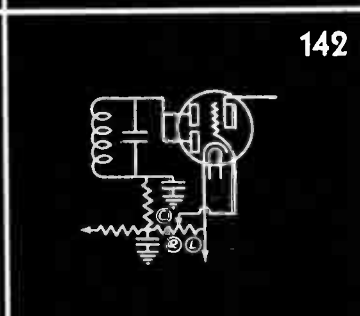

137

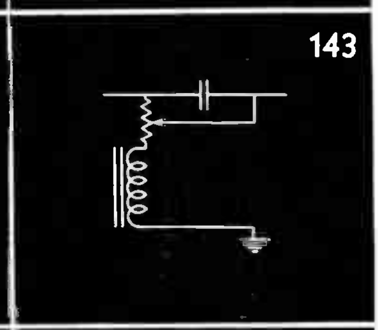

138

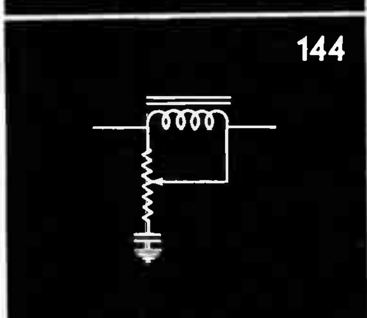

139

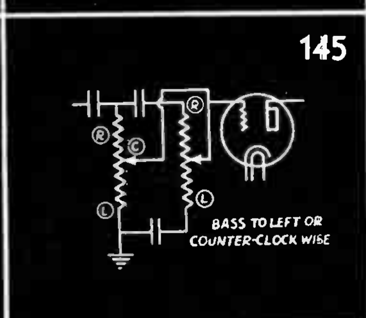

140


141

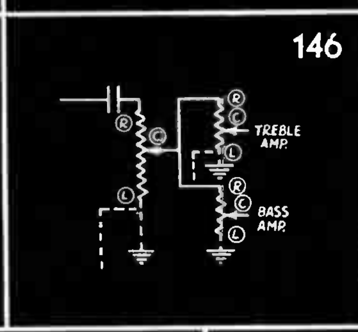

142


143

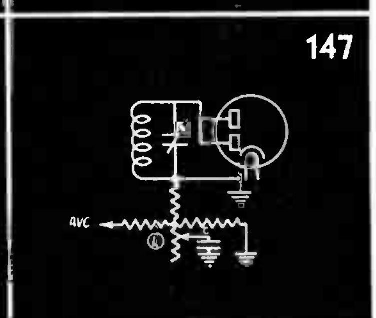

144



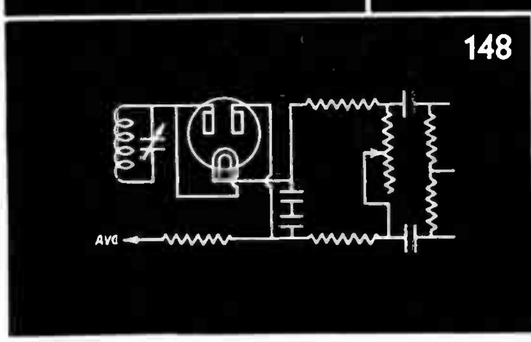
145



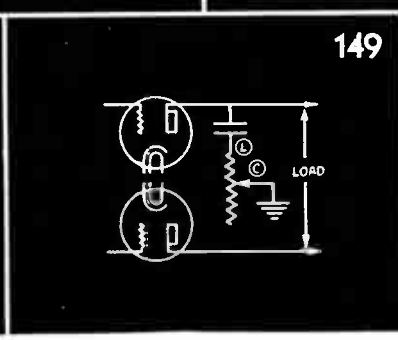
146



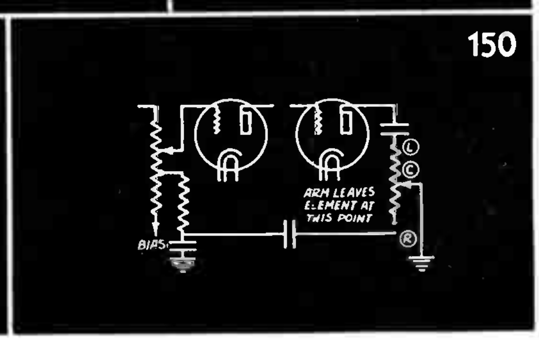
147



148



149



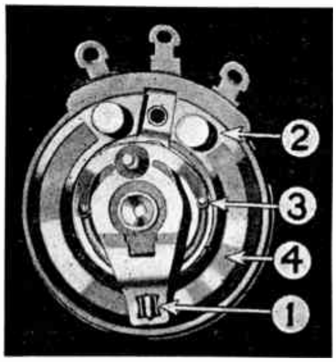
150

YAXLEY REPLACEMENT CONTROLS ACCESSORIES

Yaxley volume controls are designed for the purpose of furnishing the utmost convenience to the serviceman. A completely Universal line. Universal Controls apply in 90% of the service cases. A minimum number of special controls for application where the particular requirement, because of unorthodox mechanical or electrical features, renders Universal types unsatisfactory.

EXCLUSIVE FEATURES OF YAXLEY CONTROLS

Yaxley volume controls represent a culmination of years of intensive research and engineering development. The Yaxley "Silent Element" is one of the major improvements this research has contributed. Attention should be called to several other noteworthy features of these controls.



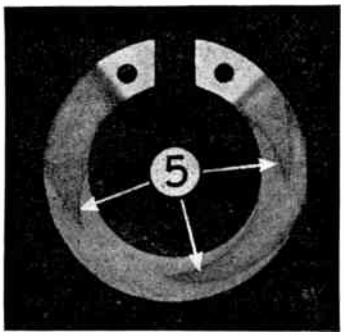
1. "The Roller That Does Not Roll." This exclusive Yaxley contact design maintains a constantly dust-free surface element and is further protected by Yaxley's dust-proof shield. The best type of contactor as recognized by leading contact engineers.

Yaxley engineers recognize the basic law of physics that there is friction between moving objects. Yaxley provides a firm pressure on the roller, but this is opposed by a carbon element that can "take it." It does not require mollycoddling as on ordinary elements where the pressure must be kept low to prevent destruction of the element.

2. Pure Silver Shortouts! Used for clean-cut, quick, positive switch action. Assure zero signal before switch action and a never failing contact between terminals and carbon on the element.

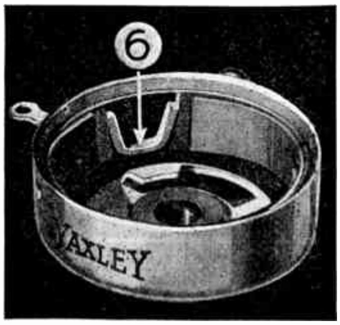
3. Silver to Silver Contacts! Used between all moving current carrying parts. Another Yaxley superiority. Silver oxide is a conductor. No trouble will ever be experienced due to oxide insulating films as would be the case with brass or copper.

4. Perfect Contact! Yaxley controls have perfect contact between moving arm and carbon element. A true and uniform area of contact is effected on the



element at all points. **Notice the track.** It does a real job of contacting! Other methods are likely to hit only the high spots.

5. Perfect Smooth Taper! Controlled by geometric design; no sudden changes in resistance value. Yaxley elements are sprayed by mathematically designed methods. Tapers are feather-edged to insure electrical smoothness and are applied in rapid succession to permit flow between joints. That provides perfect mechanical smoothness. **Only Yaxley has such perfect control of taper.**



6. New Spring Wedge. Yaxley Wire Wound Controls are also new. They embody a **new spring wedge design**, which definitely eliminates any possibility of loose terminals. Expansion and contraction due to temperature changes are taken up by this patented spring which holds the element and terminals firmly in place.

Low Humidity Coefficient! Less than 15% resistance change when subjected to 110°F. 90% relative humidity for 100 hours. No need to fear "damp spots." **Yaxley controls will work in all climates.**

Negligible Voltage Coefficient! Yaxley controls are the same in all circuits, truly universal regardless of voltage. It is almost impossible to separate this coefficient from the temperature coefficient, but it will not exceed 4% or 5% per 100 volts.

Extremely Low Temperature Coefficient! Yaxley controls are not limited by climate. They give perfect performance everywhere. Temperature does not affect a Yaxley control. This coefficient does not exceed 5% for 80° C. change and the combined temperature and voltage coefficients will not ordinarily exceed 5% for 100 volts and 80° C. rise.

Highest Current Carrying Capacity of Any Carbon Control. Careful engineering has raised the dissipation factor of Yaxley carbon-type controls above the common one-watt rating.

Uniform Characteristics. All Yaxley controls are held to rigid, detailed specifications, and are manufactured for you to the same exacting specifications that are required by original equipment users. Inspection limits are rigidly enforced.

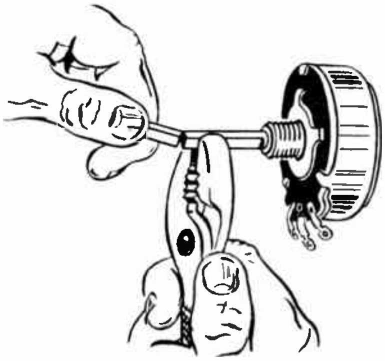
Long Life. 25,000 to 50,000 and over complete cycles, borne out in over 3 years testing. Yaxley controls have a longer operating life. Resistance changes 10% or less in 50,000 complete cycles, or 100,000 passes of the contactor.

Long Shelf Life. Yaxley controls will never go "stale." Age will not affect them nor in any way change their excellent characteristics.

Permanently Identified. A non-removable ink assures permanent identification.

"UNIVERSAL SHAFT"

This long, specially designed, aluminum alloy shaft will save you time and labor, because it is so easy to cut (no saw required). Either type of **push-on** or any **set-screw** type of knob may be used **without filing**. The long 3″ length is ample for ordinary work, and, where necessary, a greater length is easily secured by using Yaxley Extension Shafts. The illustration shows the easy breaking feature.



"Just notch it, then break." Always cut the notch rather deeply, with either a file or a pocket knife, then hold the shaft near the cut with pliers, and bend back and forth once or twice, as shown. Simple, easy, and no burrs.

PUSH-ON KNOBS requiring a 1/32″ flat on the shaft (Philco) are easily attached. Place the insert in the groove at the end of the shaft, and press on the knob. The 3/32″ type of push-on knob (Crosley and RCA) is readily attachable. The edges of the groove should be scraped or cut away until level with the bottom of the groove. This is easily accomplished with a file, a knife, or with the edge of a screw driver.

THE ADJUSTABLE BIAS RESISTOR

This time, labor and money saver is excl. sively Yaxley. All Yaxley carbon and wire controls for cathode or Antenna Bias circuits, are provided with a simple minimum bias resistor (an adjustable stop plate), easily and quickly adjusted to the proper value.

(Some manufacturers use a portion of the volume control element, as a resistor, to supply the correct minimum bias to the tubes at full volume position of the control.)

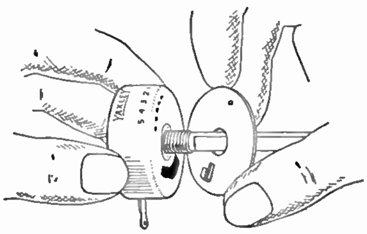


FIGURE 1

Figure 1 shows the Yaxley Stop Plate and the numerals 1 to 5 on the shell of the control.

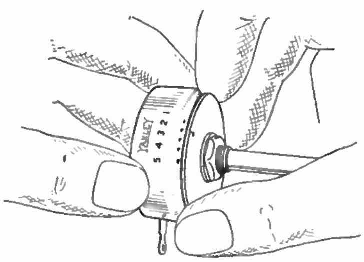


FIGURE 2

Figure 2 illustrates the setting of the plate. Position 1—100 ohms, position 2—200 ohms, position 3—300 ohms, position 4—400 ohms, position 5—500 ohms, all with the usual commercial tolerance of approximately plus or minus 10%.

For resistance values other than the values given, the indicating bump may be filed off the plate and an adjustment made with an ohmmeter.

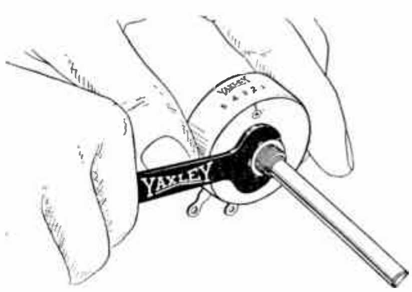


FIGURE 3

Figure 3 illustrates a method of locking the plate in its proper position while mounting the control. Some servicemen prefer to merely hold the plate in its proper position and let the mounting nut perform the dual function of mounting the control and holding the plate.

Yaxley carbon controls are equipped with a small easily adjusted external resistor, which has a total resistance of 500 ohms, for use as the bias resistor.

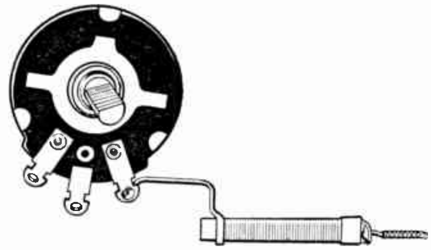


FIGURE 4

This unit is to be attached to the right-hand terminal of the control, as per figure 4, and the clip attached at the correct point and firmly clamped with ordinary slip-joint pliers, after which the unused portion may be clipped off with "diagonal" or "side" cutters. The lead from the cathode circuit connects to the end of the resistor.

YAXLEY ATTACHABLE SWITCHES

SWITCH PROBLEMS CLARIFIED

Yaxley attachable switches are equipped with a bayonet and slot arrangement which assures a definite location and placement on the back of the control. This unique feature of Yaxley controls is furnished for all Universal replacement controls, both wire and carbon.

Controls are covered with a protective dust plate (Figure 5) which is easily removed.

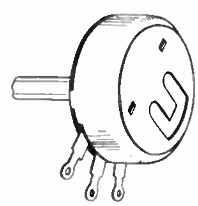
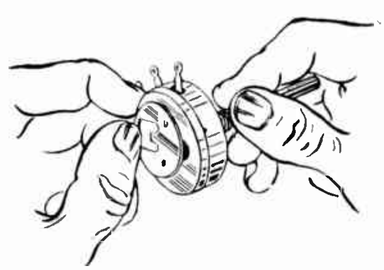
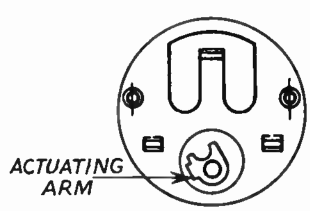


FIGURE 5

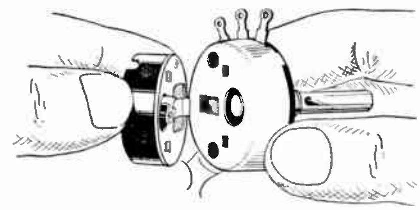
To attach the switch, first remove the cover from the back of the control.



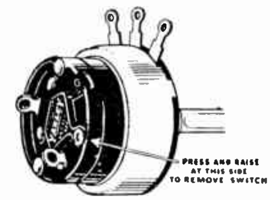
Second, holding the shaft in your hand, turn the shaft as far as it will go in a clockwise direction. Third, make certain actuating arm in switch is in proper position as shown.



Fourth, insert the tongue of the switch into the slot from which the cover was removed.



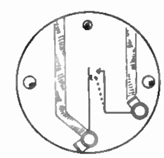
Fifth, push up slightly on the switch and it will snap into position, when it is again pushed down.



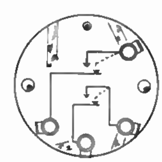
NOTE: If a switch does not fit properly, it is due to mishandling, and is easily restored to perfection by bending the tongue down into the switch by means of "small nosed" pliers.

Yaxley Attachable Switches:

- **No. 6—Single pole, single throw.**
- **No. 7—Double pole, single throw.**
- **No. 8—Single pole, double throw.**
- **No. 13—Three pole, single throw, shorting.**
- **No. 14—Four pole, single throw, shorting.**



No. 6 is a **heavy duty** switch for general use on both battery and power type receivers.



No. 7 is for use on battery receivers where it is necessary to break both the "A" and "B," or the "A" and "C" battery circuits.

In addition No. 7 may be paralleled to give a greater current handling ability than that of the No. 6; however, this is rarely necessary.

No. 7 may also be used as a Three pole, single throw shorting type of switch as illustrated in Figure 6.

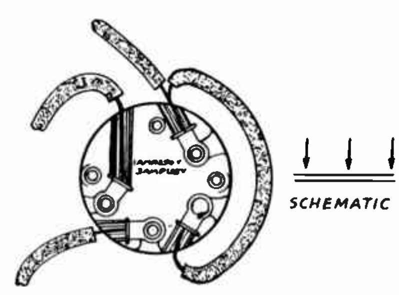


FIGURE 6

No. 8 is for use where it is desired to close one circuit during operation of a control, yet open this circuit and close another when the control is turned to the off position. This is usually found on radio-phonograph combinations. Figure 7 shows the proper connections of the No. 8 switch.

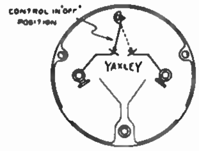


FIGURE 7

No. 13 is for use on battery receivers because it is often necessary to open the "A," "B," and "C" battery lines to prevent useless discharge of the batteries. Figure 8 shows connections.

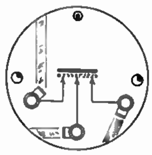


FIGURE 8

No. 14. Like the No. 13, this switch is for use on battery receivers. It allows one additional circuit to be opened and although there are only three battery circuits, the wiring of many late battery receivers is such that it is necessary to open four circuits. Figure 9 clearly shows the connections for this switch.

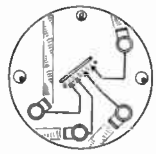
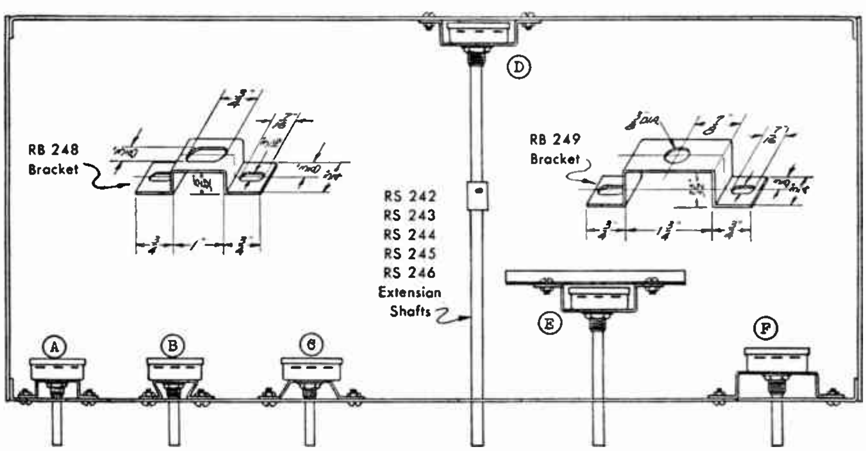


FIGURE 9

ACCESSORIES THAT SIMPLIFY SERVICE WORK

A knowledge of the proper use of these accessories will be of genuine assistance to the serviceman. A real advantage of these accessories lies in their ability to speed up or clarify an apparently difficult installation.

MOUNTING BRACKETS

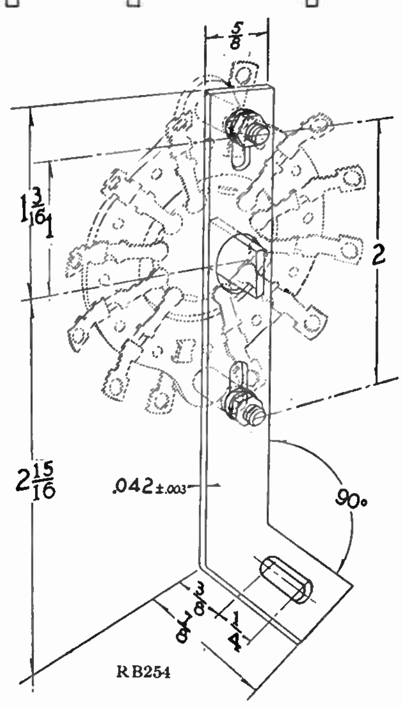


The illustration shows the many uses to which the RB248 and RB249 mounting brackets may be adapted. These brackets may also be used to relocate old controls, allowing shorter lead lengths and curing tendencies toward oscillation. The RB248 and RB249 brackets are helpful in experimental work, when it is desirable to mount controls or similar parts on a breadboard layout.

Note, also, the use of Yaxley extension shafts. See how easy it is to bend the brackets to meet the different requirements. "A," "B," and "C" show the use of the RB248. "D," "E," and "F" show the use of the RB249.

Note the new Universal Mounting Bracket RB254. It is ideal for baseboard or rear support mounting for all Yaxley circuit selector switches, Yaxley Volume controls, jacks, or in fact any device having a standard 3/8" bushing requiring a supporting bracket for mounting at right angles to a baseboard.

The height is especially convenient for mounting circuit selector switches in building short wave receivers, because of easy accessibility to the underneath terminals, or actual mounting of coils beneath the switch. The drawing fully describes this useful product.

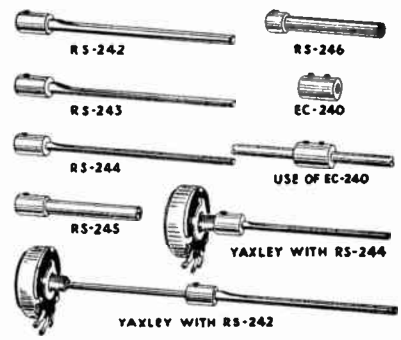


RB254

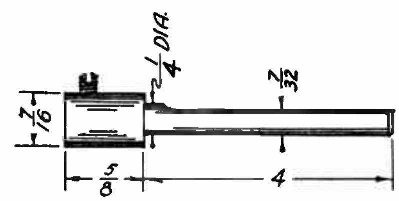
EXTENSION SHAFTS

Helpful, widely used and in great demand.

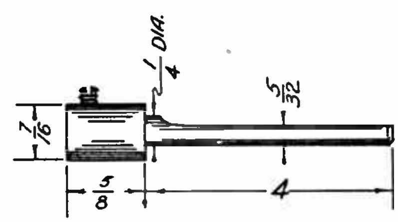
This picture shows clearly how every necessary type of shaft is made available for your use.



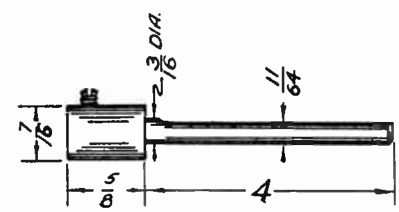
In their order are: RS242, RS243, RS244, RS245, RS246, each of which is explained. Notice Shaft Coupler EC240.



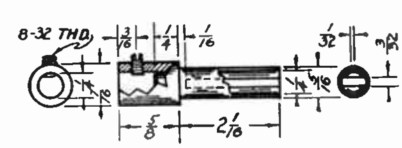
RS242 with its 1/32" flat is used wherever a push-on knob of this type or a set-screw type of knob is to be used.



RS243 with its 3/32" flat is for the 3/32" type of push-on knob.

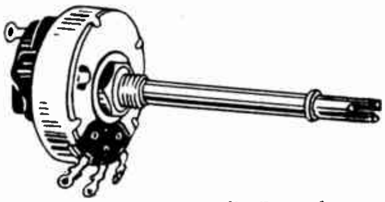


RS244. The solution to any 3/16" diameter shaft problem. Use the RS244 and a Universal Yaxley control whenever you need a 3/16" shaft control.

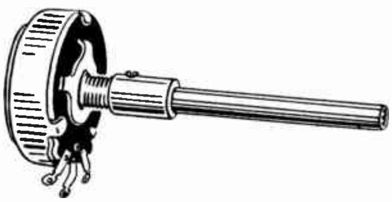


RS245 for Auto Radio Control. Use RS245 with Universal Controls for automotive type replacements. If the length of the original control shaft is two (2) inches or less, cut off the Yaxley control shaft at 1/4" from the bushing. Then cut the RS245 to the proper

length, attach it to the control and the job is done. If the original control shaft is over three inches long, either cut off (if necessary) the Yaxley control shaft or cut the RS245, so as to obtain the correct length. (See Figure 10.)



Original Auto Radio Control

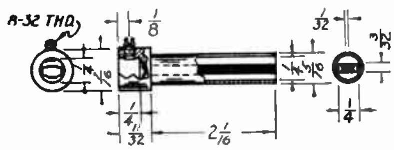


Yaxley Replacement with RS245

FIGURE 10

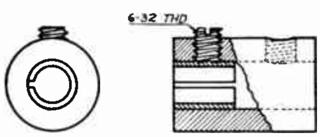
RS246 is also for **Auto Radio Controls** and should be used where a tongue-shaped shaft is required.

The tongue is roughly finished because it is often necessary to file this shaft to the desired dimensions. This is easy because of the soft brass material.



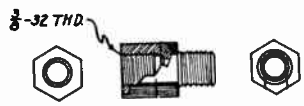
EXPERIMENTERS will find that by inserting the RS246 within an RS245, they can obtain a positive drive in a rotary direction, yet be able to vary the length of the shaft at will. This gives a "push-pull" and rotary motion with one shaft.

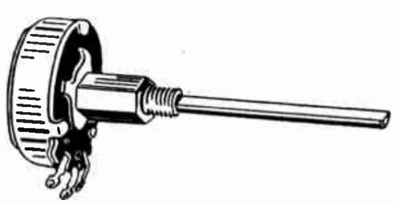
For complete descriptions of the Plug-In Shaft (SS type) accessories for use with UM and TM controls, see page 174.



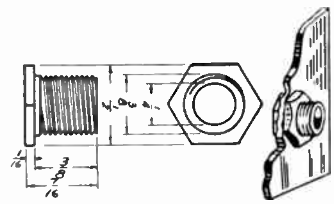
EC240. This shaft coupler is very useful to couple two 1/4" diameter shafts, or a 1/4" shaft to a 3/16" diameter shaft. Remember the Yaxley EC240 the next time you have such a problem. See the illustration on page 186.

EB247. A necessary accessory where the control must "set back" from the chassis so as to clear a dial or switch. Easy to use. Just screw it on the bushing of a Yaxley control and then install the control. The effective length is 5/8". If necessary, use two. Extremely useful when servicing Philco receivers.





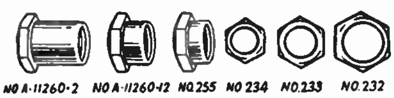
Yaxley Control with EB247



UB241. A universal panel bushing for experimental and repair work.

MOUNTING NUTS

These accessories facilitate panel mounting of controls, switches, and jacks or any other parts of similar nature.



There is the common flat hexagon nut No. 232 as supplied on Yaxley controls. No. 255 nut is for 1/8" panels.

SHORT SHOULDER nut No. A11260-12 for use on medium thick panels and for jacks and other similar parts.

LONG SHOULDER nut No. A11260-2 for thick panels. Will mount a control on a **3/4" panel.** In addition it may be used as a "safety" to prevent tampering with the setting of a control or switch; just screw it on the bushing with the hexagon end next to the panel.

FLEXIBLE SHAFTS

The FS Flexible Shafts may be used to replace wire shaft controls or for experimental work. Fig. 30 illustrates their use.

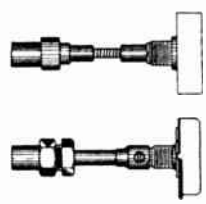


FIGURE 30

Properly used, these shafts will equal or better the life of a "wire shaft" because they are not subject to steel "fatigue."

Made of special rubber compound surrounding a flexible copper wire core and covered with a varnish protected braid, they offer a very low "capacity" coupling between units.

Note: All types of flexible shafts are limited both as to the angle of the center lines of the driving and driven shafts and to the amount of "twist" or torque which may be applied. The illustration (Figure 31) shows the practical limits of these shafts as to angle of operation. The "load" should not exceed 50 "inch ounces" torque, for the least "whip" (which is useless rotation). These shafts will readily operate a dual volume control with a line switch attached, or a light multiposition switch.

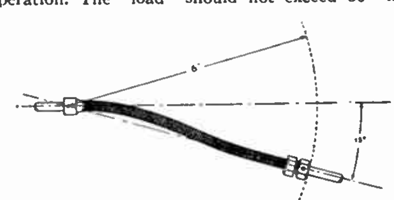
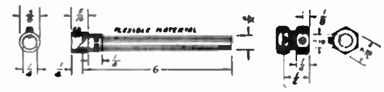
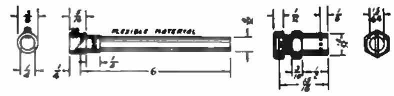


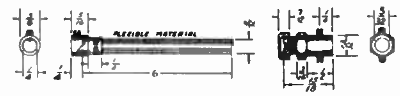
FIGURE 31



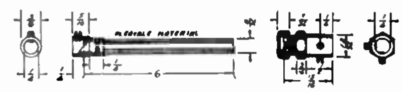
FS250 is for general use, where a flexible coupling is required between two 1/4" shafts.



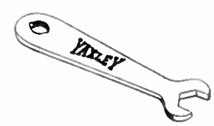
FS251 has a 15/64" diameter hole, 1/2" deep with a transverse pin to be used with a Universal Yaxley control to replace **Auto Radio Controls** having a slotted end on the driving shaft, such as used by Philco on their models 805, 806 and others.



FS252 has a 5/32" diameter hole approximately 1/2" deep and is equipped with two set screws opposite each other. It is for use with the proper Yaxley Control as a replacement for wire shaft controls which are used with a driving shaft having a small diameter round end, such as is used on Philco models D and AC989 (122).



FS253 has a 1/4" diameter hole, 1/2" deep and is equipped with two set screws located at 90 degrees to each other. It is for use with a Yaxley Control, to replace the original wire shaft such as is used on Chevrolet model 364441.



No. 178 Yaxley Volume Control Wrench is for all standard control hexagon nuts.

HARDWARE

Your attention is directed to Yaxley hardware items:

Bakelite head tip jacks and tip plugs.

Bar knobs, Round knobs.

Cable—Plugs, Jacks, Jack Switches—Push Button Switches—Circuit opening switches.

Jewels.

Dial lights—Panel lights.

Many other useful items are all beautifully illustrated and described in the new Yaxley catalogue. Look them over. You will find many uses for them.

Yaxley Universal Single Controls

Ohms Resistance	Taper	General Use	Type Element	Catalog Number
2	IV	Filament	W.W.	Q
6	IV	Filament	W.W.	R
10	IV	Filament	W.W.	S
20	IV	Filament	W.W.	T
30	IV	Filament	W.W.	U
60	IV	Filament	W.W.	V
100	IV	Misc.	W.W.	W
200	IV	Misc.	W.W.	X
400	IV	Misc.	W.W.	A400P
500	I	Ant.-Shunt	W.W.	A
550	IV	Bias	W.W.	A550P
1M	IV	Voltage Divider (Bias)	W.W.	A1MP
1M	I	Ant. or Pri. Shunt	W.W.	B
1M	II	Bias	W.W.	UC500
2M	IV	Voltage Divider (Bias)	W.W.	*A2MP
2M	I	Ant. or Pri. Shunt	W.W.	*C12
2M	II	Bias	W.W.	*C
3M	IV	Voltage Divider	W.W.	*A3MP
3M	I	Ant. or Pri. Shunt	W.W.	*D12
3M	II	Bias	W.W.	*D
3M	VII	Ant.-Bias	W.W.	*D7
5M	IV	Voltage Divider	W.W.	*A5MP
5M	IV	Voltage Divider (Bias, Screen)	Carbon	Y5MP
5M	I	Ant.-Shunt or Ant.-Bias	Carbon	*E12
5M	II	Bias	W.W.	*E
5M	VII	Ant.-Bias	W.W.	*E7
7500	I	Ant.-Shunt or Ant.-Bias	Carbon	*F12
7500	II	Bias	W.W.	*F
7500	VII	Ant.-Bias	W.W.	*F7
10M	IV	Voltage Divider (Bias, Screen)	W.W.	*A10MP
10M	IV	Voltage Divider (Bias, Screen)	Carbon	*Y10MP
10M	I	Ant.-Shunt or Ant.-Bias, Tone	Carbon	*G12
10M	II	Bias	W.W.	*G
10M	II	Bias	Carbon	*UC501
10M	VII	Ant.-Bias	W.W.	*G7
15M	I	Ant.-Shunt or Ant.-Bias, Tone	Carbon	*H12
15M	II	Bias	W.W.	*H
15M	VII	Ant.-Bias	W.W.	*H7
20M	IV	Voltage Divider (Bias)	W.W.	*A20MP
20M	I	Ant.-Shunt, Ant.-Bias, Screen	Carbon	*Y
25M	IV	Voltage Divider (Screen)	Carbon	Y25MP
25M	II	Bias	Carbon	*J
50M	IV	Batt. Bias, Screen	Carbon	Y50MP
50M	I	Screen Voltage, Tone	Carbon	K12
50M	II	Bias	Carbon	*K
75M	I	Screen Voltage, Tone	Carbon	Z12
75M	II	Bias	Carbon	*Z
100M	IV	Voltage Divider (Bias, Screen)	Carbon	Y100MP
100M	I	RF or AF Shunt, Screen, Tone	Carbon	L
100M	II	Bias or Ant.-Bias (AC-DC)	Carbon	*UC510
150M	I	Tone, RF or AF Shunt	Carbon	UC502
200M	IV	Voltage Divider, Misc.	Carbon	Y200MP
250M	IV	Voltage Divider, Misc.	Carbon	Y250MP
250M	I	Audio Tone, RF or AF Shunt	Carbon	M
250M	I	Audio (Automobile)	Carbon	†UC511
250M	II	Bias, Ant.-Bias (AC-DC)	Carbon	*UC509
500M	IV	Voltage Divider, Misc.	Carbon	Y500MP
500M	I	Audio, RF or AF Shunt	Carbon	N
500M	I	Audio (Automobile)	Carbon	†UC512
500M	I	Audio (Automobile)	Carbon	††UC515
500M	II	Bias, Ant.-Bias, Bias-Audio	Carbon	UC513
750M	I	Tone, Audio, Audio Shunt	Carbon	UC503
1 Meg.	IV	Misc.	Carbon	Y1000MP
1 Meg.	I	Audio, Audio Shunt, Tone	Carbon	O
1 Meg.	I	Audio (Automobile)	Carbon	†UC514
2 Meg.	I	Audio, Audio Shunt, Tone	Carbon	P
3 Meg.	I	Audio Shunt, Tone	Carbon	UC504
4 Meg.	I	Tone	Carbon	UC505
5 Meg.	I	Audio Shunt	Carbon	UC506
5 Meg.	II	Series Screen Control	Carbon	UC507
9 Meg.	I	Audio Shunt	Carbon	UC508

*Wire Wound Controls have exclusive Yaxley Adjustable Bias Feature. Carbon Controls have external adjustable resistor. W.W.—Wire Wound Element.
†Has Slotted Shaft for Automobile Receivers.
††Has long, adjustable Slotted Shaft for Automobile Receivers and Special Shaft Coupling

Yaxley Universal Dual Controls

Ohms Resistance		Taper		Type Element		General Use	Cat. No.
Front	Rear	Front	Rear	Front	Rear		
2M	5M	I	I	W.W.	W.W.	Ant. Shunt and Bias	CE
10M	5M	VII	IV	W.W.	W.W.	Ant.-Shunt Bias or Screen	*GE
10M	10M	VII	IV	W.W.	W.W.	Ant.-Shunt Bias or Screen	GG
10M	50M	I	IV	Carbon	Carbon	Ant.-Shunt Bias or Screen	GK
50M	50M	IV	IV	Carbon	Carbon	Grid Shunt and Cathode Control	†KK
100M	100M	I	I	Carbon	Carbon	Audio Shunt in Push-Pull	LL
100M	250M	I	I	Carbon	Carbon	Audio Shunt, Tone, Screen or RF Shunt	LM
250M	250M	I	I	Carbon	Carbon	Audio Shunt in Push-Pull	MM
250M	500M	I	I	Carbon	Carbon	Audio Shunt and Tone Compensation	MN
500M	500M	I	I	Carbon	Carbon	Audio Shunt in Push-Pull	NN

*Formerly DRP192 †See DRP 308.

Yaxley Universal Tapped (TRP) Controls

Catalog Number	Total Ohms Resistance	Tapped at Ohms	Used As
TRP600	6M	2500	Vol.
TRP601	30M	6000	Vol.
TRP602	63M	3000	Vol.
TRP603	250M	125000	Vol., Phono.
TRP604	350M	25000	Vol.
TRP605	350M	75000	Vol., Phono.
TRP606	500M	100000	Vol.
TRP607	500M	250000	Vol.
TRP608	1 Meg.	200000	Vol.
TRP609	1 Meg.	500000	Vol., Phono.
TRP610	1 Meg.	20000	Vol.
TRP611	1 Meg.	170000	Vol.
TRP612	2 Meg.	25000	Vol.
TRP613	2 Meg.	400000	Vol.
TRP614	350M	75000	Vol.
TRP615	3 Meg.	1 Meg.	Vol.
TRP616	500M	50000	Vol.
TRP617	60M	10000	Vol.
TRP618	2 Meg.	200M	Vol.
TRP619	500M	100M 300M	Vol.
TRP620	2 Meg.	1 Meg.	Vol.
*TRP621	2½ Meg.	250M 500M	Vol., Phono.
TRP622	44M	7000 14000	Vol.
TRP623	250M	50M	Vol.
TRP624	2½ Meg.	250M 500M	Vol., Phono.

*No provision for attachable switch. If desired use TRP624.

Yaxley Universal Hum Controls

Ohms Resistance	General Use	Type Element	Cat. Number
6	Hum	W.W.	HU6
10	Hum	W.W.	HU10
20	Hum	W.W.	HU20
30	Hum	W.W.	HU30
50	Hum	W.W.	HU50
75	Hum	W.W.	HU75
100	Hum	W.W.	HU100
200	Hum	W.W.	HU200

Yaxley Special Single (SRP) Controls

Catalog Number	Ohms Resist.	Type Element	Used As
SRP133	2M	W.W.	Vol.
SRP134	4500	W.W.	Vol. Sen.
SRP138	450	W.W.	Vol.
SRP139	550	W.W.	Vol.
SRP141	1200	W.W.	Vol.
SRP142	2400	W.W.	Vol.
SRP144	2M	W.W.	Vol.
SRP145	2M	W.W.	Vol.
SRP150	50M	Carbon	Vol.
SRP152	60	W.W.	Phono. Vol.
SRP153	13M	W.W.	Vol.
SRP154	50M	Carbon	Vol.
SRP160	2500	W.W.	Equal
SRP170	75M	Carbon	Vol.
SRP179	125M	Carbon	Vol.
SRP185	1500	Carbon	Vol.
SRP188	32M	Carbon	Vol.
SRP213	250M	Carbon	Vol.
SRP216	500M	Carbon	Vol.
SRP223	1M	W.W.	Vol.
SRP239	450	W.W. Strip	Vol.
SRP241	6M	W.W. Strip	Vol.
SRP245	32M	Carbon	Vol.
SRP249	20M	W.W.	
SRP251	250M	Carbon	Vol.
SRP252	500M	Carbon	Vol.
SRP253	400	W.W.	Hum
SRP254	3500	W.W.	Vol.
SRP255	15M	W.W.	Vol.
SRP256	10M	Carbon	Vol.
SRP257	3M	WW..	Vol.
SRP258	15M	Carbon	Vol.
SRP259	50M	Carbon	Phono.
SRP260	1M	W.W.	Vol.
SRP261	100M	Carbon	Vol.
SRP262	1500	W.W.	Vol.
SRP263	32M	Carbon	Vol., Tone
SRP264	650	W.W.	Vol.
SRP265	200	W.W.	Hum
SRP266	600	W.W.	Hum
SRP267	8M	W.W.	Tone Beam
SRP268	15	W.W.	Vol.
SRP269	10M	Carbon	Vol.
SRP271	150	W.W.	Vol.
SRP272	300	W.W.	Vol.
SRP273	500M	Carbon	Vol.
SRP274	10M	W.W.	Vol.
SRP275	500M	Carbon	Vol.
SRP276	3M	Carbon	Regen.
SRP277	2M	Carbon	Vol.
SRP278	500M	Carbon	Vol.
SRP279	50M	Carbon	Vol.
SRP280	500M	Carbon	Vol.
SRP281	350M	Carbon	Vol.
SRP282	350M	Carbon	Vol.
SRP283	2500	W.W.	Vol.
*SRP284	100M	Carbon	Tone, Vol.
*SRP285	500M	Carbon	Tone, Vol.
*SRP286	250M	Carbon	Tone, Vol.
*SRP287	5M	Carbon	Tone, Vol.
SRP288	100M	Carbon	Tone, Vol.
SRP900	20M	Carbon	Vol.
SRP901	10M	Carbon	Vol.
SRP960	800	W.W.	Vol.
SRP961	10M	Carbon	Vol.
SRP962	250M	Carbon	Vol.

*Right-Hand Switch Action.

Yaxley Special Dual (DRP) Controls

Catalog Number	Ohms Resistance		Type Element		Used As
	Front	Rear	Front	Rear	
DRP114	250	5M	W.W.	W.W.	Vol.
DRP115	3800	3800	Carbon	Carbon	Vol.
DRP116	Spcl.	Spcl.	W.W.	W.W.	Vol.
DRP117	500	2500	W.W.	W.W.	Vol.
DRP119	3M	10M	W.W.	W.W.	Vol.
DRP122	645	10M	W.W.	W.W.	Vol.
DRP169	7500	10M	W.W.	W.W.	Vol.
DRP221	10M	100M	Carbon	Carbon	Vol.
DRP222	75M	32M	Carbon	Carbon	Vol.
DRP232	3 Meg.	3 Meg.	Carbon	Carbon	Vol.
DRP239	25M	25M	Carbon	Carbon	Vol.
DRP240	250M	10M	Carbon	Carbon	Vol.
DRP241	5M	150M	Carbon	Carbon	Vol.
DRP242	10M	500M	Carbon	Carbon	Vol.
DRP243	3M	750M	Carbon	Carbon	Vol.
DRP244	25M	6M	Carbon	Carbon	Vol.
DRP245	1 Meg.	3 Meg.	Carbon	Carbon	Vol.
DRP246	32M	50M	Carbon	Carbon	Vol.
DRP250	50M	1M	Carbon	Carbon	Vol.
DRP301	5M	2500	Carbon	W.W.	Vol.
DRP302	100M	250M	Carbon	Carbon	Vol.
DRP303	2500	100M	Carbon	Carbon	Vol.
DRP304	1 Meg.	3 Meg.	Carbon	Carbon	Vol.
DRP305	15M	25M	Carbon	Carbon	Vol.
DRP306	5M	10M	W.W.	Carbon	Vol.
DRP307	3M	12M	W.W.	Carbon	Vol.
DRP308	50M	50M	Carbon	Carbon	Vol.
DRP309	12M	65M	Carbon	Carbon	Vol.
DRP310	25M	27M	Carbon	Carbon	Vol.
DRP311	150M	250M tapped 90M	Carbon	Carbon	Vol.
DRP312	75M	500M	Carbon	Carbon	Vol.
DRP313	1000	500M	Carbon	Carbon	Vol.
DRP314	500M	2500	Carbon	Carbon	Vol.
DRP315	2 Meg.	2500	Carbon	Carbon	Vol.
DRP316	200M	1M	Carbon	Carbon	Supp.
DRP317	500M	1M	Carbon	Carbon	Vol.

Yaxley Universal Midget Controls

UM TYPES (PLUG-IN SHAFT)

For correct Plug-In Shaft (Types "SS") to use with "UM" Controls, refer to recommendation in listings on pages 13 to 157 inclusive, for any given application.

Ohms Resistance	Taper	General Use	Type Element	Catalog Number
5M	IV-A	Antenna, Antenna-Bias	Carbon	UM114
10M	I	Antenna Shunt, Ant.-Bias, Tone	Carbon	UM118
10M	II	Bias	Carbon	UM119
10M	IV	Ant.-Bias, Voltage Divider (Low Current)	Carbon	UM120
15M	I	Antenna Shunt, Ant.-Bias, Tone	Carbon	UM121
15M	II	Bias	Carbon	UM122
20M	I	Antenna Shunt, Ant.-Bias	Carbon	UM124
25M	II	Bias	Carbon	UM128
25M	IV	Voltage Divider (Low Current)	Carbon	UM129
50M	I	Tone	Carbon	UM133
50M	II	Bias	Carbon	UM134
50M	IV	Voltage Divider (Low Current)	Carbon	UM135
75M	I	Tone	Carbon	UM137
75M	II	Bias	Carbon	UM138
100M	I	RF or AF Shunt, Tone	Carbon	UM140
100M	II	Bias, Ant.-Bias (AC-DC)	Carbon	UM141
100M	IV	Voltage Divider (Low Current)	Carbon	UM142
*100M	I	RF or AF Shunt, Tone (Clutch Type)	Carbon	UM143
150M	I	Tone	Carbon	UM144
250M	I	RF or AF Shunt, Tone	Carbon	UM147
250M	IV	Voltage Divider (Low Current)	Carbon	UM149
*250M	I	RF or AF Shunt, Tone (Clutch Type)	Carbon	UM150
350M	I	RF or AF Shunt, Tone	Carbon	UM151
500M	I	RF or AF Shunt, Tone	Carbon	UM154
500M	IV	Voltage Divider (Low Current)	Carbon	UM156
*500M	I	RF or AF Shunt, Tone (Clutch Type)	Carbon	UM157
750M	I	AF Shunt, Tone	Carbon	UM158
1 Meg.	I	AF Shunt, Tone	Carbon	UM161
*1 Meg.	I	AF Shunt, Tone (Clutch Type)	Carbon	UM162
2 Meg.	I	AF Shunt, Tone	Carbon	UM163
3 Meg.	I	AF Shunt, Tone	Carbon	UM165
†100M	Spec.	Tone, AF Shunt	Carbon	UM180
†2 Meg.	Spec.	Tone. AF Shunt	Carbon	UM181

*These controls are for automobile radio use where the switch is in the control head, and is actuated by the control shaft to the receiver chassis.
†These controls are constructed so that switch action occurs at the full "on," or extreme clockwise position of the moving arm.

Yaxley Tapped Midget Controls

TM TYPES (PLUG-IN SHAFT)

For correct Plug-In Shaft (Types "SS") to use with "TM" Controls, refer to recommendations in listings on pages 13 to 157 inclusive, for any given application.

Catalog Number	Total Ohms Resistance	Tapped at Ohms	Taper	Used As
*TM219	250M	50M	V	Vol.
TM220	250M	50M	V	Vol.
TM221	250M	125M	V	Vol.
*TM222	250M	125M	V	Vol.
TM225	350M	75M	V	Vol.
TM228	500M	5M	VI	Vol.
*TM229	500M	125M	V	Vol.
TM230	500M	125M	V	Vol.
TM231	500M	250M	V	Vol.
*TM232	500M	250M	V	Vol.
TM240	1 Meg.	200M	V	Vol.
*TM241	1 Meg.	200M	V	Vol.
*TM242	1 Meg.	450M	V	Vol.
TM243	1 Meg.	500M	V	Vol.
TM245	2 Meg.	5M	V	Vol.
TM246	2 Meg.	25M	V	Vol.
TM247	2 Meg.	50M	V	Vol.
TM248	2 Meg.	300M	V	Vol.
TM249	2 Meg.	500M	V	Vol.
TM251	2 Meg.	1 Meg.	V	Vol.
*TM252	2 Meg.	1 Meg.	V	Vol.
TM253	2 Meg.	5M 500M	Spec.	Vol.
TM257	3 Meg.	1 Meg.	IV	Vol.

*These controls are for automobile radio use where the switch is in the control head, and is actuated by the control shaft to the receiver chassis.

"SS" TYPE PLUG-IN SHAFTS

Nos. SS1 to SS17 inclusive. For details see page 174.

Yaxley Standard Midget Controls

MR TYPES (FIXED SHAFT)

Ohms Resistance	Taper	General Use	Type Element	Catalog Number
5M	IV-A	Antenna, Antenna-Bias	Carbon	MR14
10M	I	Antenna Shunt, Antenna Bias, Tone	Carbon	MR18
10M	II	Bias	Carbon	MR19
10M	IV	Ant.-Bias Voltage Divider (Low Current)	Carbon	MR20
15M	I	Antenna Shunt, Ant.-Bias, Tone	Carbon	MR21
15M	II	Bias	Carbon	MR22
20M	I	Antenna Shunt, Antenna-Bias	Carbon	MR24
25M	II	Bias	Carbon	MR28
25M	IV	Voltage Divider (Low Current)	Carbon	MR29
50M	I	Tone	Carbon	MR33
50M	II	Bias	Carbon	MR34
50M	IV	Voltage Divider (Low Current)	Carbon	MR35
75M	I	Tone	Carbon	MR36
75M	II	Bias	Carbon	MR37
100M	I	RF or AF Shunt, Tone	Carbon	MR39
100M	II	Bias, Antenna-Bias (AC-DC)	Carbon	MR40
100M	IV	Voltage Divider (Low Current)	Carbon	MR41
150M	I	Tone	Carbon	MR42
250M	I	RF or AF Shunt, Tone	Carbon	MR45
500M	I	RF or AF Shunt, Tone	Carbon	MR48
500M	IV	Voltage Divider (Low Current)	Carbon	MR50
750M	I	AF Shunt, Tone	Carbon	MR51
1 Meg.	I	AF Shunt, Tone	Carbon	MR53
2 Meg.	I	AF Shunt, Tone	Carbon	MR55
3 Meg.	I	AF Shunt, Tone	Carbon	MR57

Yaxley Special Dual Midgets

SMD Types (Fixed Shafts)

Catalog Number	Ohms Resistance		Type Element		Used As
	Front	Rear	Front	Rear	
*SMD500	2 Meg.	2 Meg.	Carbon	Carbon	Vol. and Tone
*SMD501	2 Meg. Tap at 500M	1 Meg.	Carbon	Carbon	Vol. and Tone
*SMD502	250M	1 Meg. Tap at 250M	Carbon	Carbon	Vol. and Tone

*These special dual controls are supplied complete with switch attached and have special concentric shafts.

YAXLEY STANDARD POTENTIOMETERS AND RHEOSTATS

"C" Type Variable Resistor

Dissipates 2 Watts—Grounded Contact Arm

The Yaxley "C" Type Variable Resistor is the smallest wire wound control manufactured, finding its greatest application where space is at a premium. The contact arm is grounded to the shaft.

"C" TYPE POTENTIOMETERS			"C" TYPE RHEOSTATS		
Ohms Resistance	Carrying Capacity in Amperes	Catalog Number	Ohms Resistance	Carrying Capacity in Amperes	Catalog Number
6	.58	C6P	6	.58	C6R
10	.45	C10P	10	.45	C10R
15	.36	C15P	15	.36	C15R
20	.3	C20P	20	.3	C20R
30	.25	C30P	30	.25	C30R
40	.22	C40P	40	.22	C40R
50	.2	C50P	50	.2	C50R
100	.14	C100P	100	.14	C100R
200	.1	C200P			
400	.07	C400P			
1M	.045	C1MP			
3M	.025	C3MP			
5M	.02	C5MP			
6M	.018	C6MP			
10M	.014	C10MP			
15M	.011	C15MP			

"M" Type Variable Resistor

Dissipates 4 Watts—Insulated Contact Arm

"M" TYPE POTENTIOMETERS			"M" TYPE RHEOSTATS		
Ohms Resistance	Carrying Capacity in Amperes	Catalog Number	Ohms Resistance	Carrying Capacity in Amperes	Catalog Number
15	.57	M15P	½	2.75	M05R
20	.50	M20P	1	2.2	M1R
25	.45	M25P	2	1.5	M2R
30	.4	M30P	3	1.3	M3R
40	.35	M40P	4	1.1	M4R
50	.32	M50P	6	.9	M6R
60	.29	M60P	10	.7	M10R
75	.25	M75P	15	.6	M15R
100	.22	M100P	20	.5	M20R
200	.15	M200P	25	.45	M25R
400	.11	M400P	30	.40	M30R
600	.09	M600P	40	.35	M40R
1M	.07	M1MP	50	.32	M50R
2M	.05	M2MP	60	.29	M60R
3M	.04	M3MP	75	.25	M75R
4M	.035	M4MP			
5M	.03	M5MP			
10M	.02	M10MP			
15M	.017	M15MP			
20M	.015	M20MP			
25M	.014	M25MP			
50M	.01	M50MP			
70M	.0085	M70MP			

"E" Type Potentiometers

Dissipates 9 Watts—Contact Arm Grounded

Ohms Resistance	Carrying Capacity in Amperes	Catalog Number	Ohms Resistance	Carrying Capacity in Amperes	Catalog Number
5M	.042	E5MP	75M	.011	E75MP
10M	.03	E10MP	100M	.0095	E100MP
20M	.021	E20MP	125M	.0085	E125MP
25M	.019	E25MP	150M	.008	E150MP
50M	.0135	E50MP			

Yaxley Attenuators—Type "T" and "L" Pads

YAXLEY "T" PADS		YAXLEY "L" PADS	
Resistance Value	Catalog Number	Resistance Value	Catalog Number
6 Ohms	T-6	6 Ohms	L-6
8 Ohms	T-8	15 Ohms	L-15
15 Ohms	T-15	50 Ohms	L-50
50 Ohms	T-50	200 Ohms	L-200
200 Ohms	T-200	500 Ohms	L-500
500 Ohms	T-500	2000 Ohms	L-2000
2000 Ohms	T-2000		

Matched Yaxley Dial Plates

Specially designed to match rotation of Yaxley controls, rheostats, and potentiometers.

Type of Control	Correct Yaxley Dial Plate
For all Yaxley Silent Carbon controls with switch type cover	No. 398
For all Yaxley Silent Carbon controls with plain cover	No. 397
For all Yaxley Wire Wound controls with switch type cover	No. 396
For all Yaxley Wire Wound controls with plain cover, also "M" type rheostats and potentiometers	No. 395
For all Yaxley "C" type rheostats and potentiometers	No. 393
For all Yaxley "E" type (9 Watt) potentiometers	No. 399
General Purpose type, marking "0 to 100"	No. 369
General Purpose type, marking "Increase Volume"	No. 391

SECTION "B" CONDENSERS

THE "HOW AND WHY" OF CONDENSERS

A condenser, or as it is more rightly termed, a capacitor, **consists of two conducting plates separated by a nonconducting medium called the dielectric.**

The popular explanation of **a condenser is**, that it **is an electrical device capable of storing a charge of current** when voltage is applied to its terminals. **Applying direct current to the condenser establishes a static charge** in the dielectric, the voltage of which is of opposite polarity to that of the charging or applied voltage. **The value of the static charge rises until the voltage is equal to the charging voltage. When this point is reached the charging voltage is opposed by the voltage of the electrostatic charge in the condenser, and there can be no further "flow" of current unless THE CHARGING VOLTAGE EITHER RISES OR FALLS.**

Let us see what happens when the applied voltage rises or lowers in value in respect to the voltage of the established electrostatic charge:

First—**If the charging voltage rises above the electrostatic voltage, additional current will "flow" through the condenser** until the electrostatic voltage again equals and opposes the applied voltage.

Second—**If the applied voltage falls below the voltage of the established electrostatic charge, CURRENT WILL FLOW FROM THE CONDENSER INTO THE CIRCUIT** until the electrostatic voltage again equals the applied voltage.

SUMMARY OF THE ACTION TAKING PLACE IN A CONDENSER

1. An electrostatic charge is established equal to, but of opposite polarity of the applied voltage.
2. Any rise of applied voltage causes the current to flow from the circuit into the condenser; i. e., "through" the condenser, and any fall in the applied voltage causes current to flow from the condenser into the circuit.

This is a clear explanation of the action of a condenser, especially so where it is used for filter circuits.

ELECTROLYTIC CONDENSERS

Condensers are classified according to the nature of the dielectric medium employed in their construction. Thus—**an oil condenser** is one in which oil is used as the dielectric; **an air condenser** is one in which air is used as the dielectric; **a paper condenser** is one in which paper is used as the dielectric.

From the description of the terminology applied to condensers, one might suppose that the **electrolytic condenser** uses an electrolyte—as the dielectric. This supposition, however, is inaccurate in that the electrolyte used in the electrolytic condenser is not the actual dielectric material but is one of the conducting "plates."

The dielectric material, or medium, in the electrolytic condenser consists of an extremely thin oxide "film" which is formed on the surface of the condenser anode or positive plate.

The nature and composition of the film which forms the dielectric in an electrolytic condenser is not definitely known. The formation and action of this film is understood and can be explained in rather simple terms.

It is a peculiar characteristic of aluminum and a few other metals that when they are immersed in certain electrolytic solutions, or electrolytes, and a current passed through the metal and electrolyte to another electrode, **a non-conducting film will be formed on the metal which will oppose the flow of current.**

Thus, if we take two pieces of aluminum and immerse them in a suitable electrolyte and pass a current from one plate to the other, the current will be very high when first applied, but it will taper off until there is little, if any, current flowing in the circuit. This is termed "forming," which means the establishment of a film upon the surface of one of the plates. In the case of aluminum, **the film is formed on that plate to which the positive wire is connected.**

The formation of the film on the plate retards the flow of current. If the polarity is reversed; i.e., the polarity of the charging voltage, current will flow. **Thus we see that the "film" acts as an insulator only as long as we maintain the same polarity as was used in forming.**

CAPACITY OF A CONDENSER

Capacity is the term applied to a condenser which **indicates the ratio of the quantity of the electrostatic charge, to the voltage.** The quantity of the charge in a condenser is expressed in coulombs, or, as it is usually expressed: $Q = C \times V$. Where Q is coulombs, C is capacity in farads, and V is voltage, which gives us the fundamentals for stating that the capacity is equal to the quantity divided by the voltage, or $C = \frac{Q}{V}$

The capacity of a condenser is dependent upon:

First—The area of the plates.

Second—The thickness of the dielectric.

Third—The "Dielectric Constant."

The "Dielectric Constant" of a material is the ratio of the capacity of a condenser using this material, to the capacity of a condenser of equal plate area, but using air as the dielectric. The usual formula for "Dielectric Constant" is $K = \frac{Cs}{Ca}$

Where Cs is the capacity with the dielectric in question, Ca is the capacity when using air as the dielectric, and K is the "Constant."

The "Dielectric Constant" of a material is not constant in value, but varies with the frequency of the applied current, moisture content, temperature, voltage applied, and other factors.

The dielectric constant of the "film" in an electrolytic condenser varies with the "formation voltage." Thus—for equal plate area, **a condenser "formed" at low voltage will have a higher capacity than one of the same area formed at high voltage.**

Another characteristic of **the electrolytic condenser film is** that it **is dependent upon the composition of the electrolyte,** inasmuch as the composition of **the electrolyte determines the maximum voltage at which the film can be formed or maintained.** Thus, if an electrolyte is said to be a "400 volt electrolyte," the meaning is, that if more than 400 volts is applied to a condenser using this electrolyte, the film will be punctured though not necessarily damaged. **This is the reason why, when electrolytic condensers are rated at "525 volts surge," it means that 525 volts is the maximum momentary voltage which can be applied to the plates without puncturing the dielectric film.**

A characteristic of electrolytic condensers is that **a constant DC voltage when applied aids in maintaining the dielectric film, and because the film is not perfect, there will be a small amount of current continuously flowing through the condenser. This current is called the "leakage current," and for a good electrolytic condenser, it is very small.** The value of the **leakage current is determined by the condition of the film on the plate and the length of time it has been without a polarizing voltage; i. e., "on the shelf."**

DRY ELECTROLYTIC CONDENSERS

In general, there are **two types of electrolytic condensers:** the **"WET TYPE,"** which uses a liquid electrolyte, and the **"DRY TYPE"** which uses a "PASTE" electrolyte.

The **"DRY"** electrolytic condenser possesses many **advantages. They will not spill or leak, may be mounted in any position, and in any type container.** For instance, a cardboard carton. In addition, **it is not necessary to provide for the escape of gas,** a costly and inconvenient factor.

NECESSITY OF ELECTROLYTIC CONDENSERS

Previous to the development of high voltage "DRY" electrolytic condensers, the general design of radio receivers and amplifiers was considerably below present standards, due to the fact that completely filtered plate voltage supplies were practically unknown. This is obvious because:

(a) The terriffic expense of the necessary high capacity for filtering, if paper condensers were used, or—

(b) The restricted mounting and unsightly appearance of the early wet electrolytic condensers.

The lack of pure direct current for plate voltage supply caused serious difficulties with hum. In order to obviate this condition, it was necessary to deliberately design the receiver or amplifier, so that frequencies below 130 cycles would be "cut-off" and would not appear at the loud speaker. Note that the principal "hum frequency" is twice the frequency of the supply voltage; i. e., 120 cycles for a 60 cycle supply current (except on a half-wave rectifier where the hum frequency is 60 cycles). This "cut-off" of the all-important "Bass" notes meant that music would sound "shrill and tinny."

The introduction of **the "Dry Electrolytic Condenser,"** with its numerous advantages, meant that here was a low cost, compact condenser of high capacity which would **allow perfect filtering of the "B" supply current.** Thus, with pure "DC" plate supply, the way was open for the design of **receivers having high fidelity of response,** as it was no longer necessary to "cut-off" the bass notes in order to prevent hum.

CONDENSER CIRCUIT ACTION

There are **two main uses for Electrolytic condensers; the first and most important is in "Filter Circuits,"** which are used to convert pulsating direct current into a smooth "DC" plate supply.

The second is as "By-Pass" units. In audio frequency circuits, this generally calls for a much higher capacity in relation to the voltage than is encountered in filter circuit work. However, **the low voltage, high capacity electrolytic condenser is very small in physical size.** In addition it is often used to "by-pass" very low values of resistance, which requires a very high capacity value. **The high ratio of capacity to physical size** of the low voltage electrolytic condenser, is of great advantage, in that it **allows the use of the proper capacity value without requiring too much space.**

It is imperative that servicemen, as a group, should know more about condenser circuit action, because this **knowledge will enable** them not only to make **a quick and easy repair,** but also to diagnose those troublesome cases involving condensers and their actions upon associated circuits.

Because of the universal use of electrolytic condensers in filter circuits, and also because the filter circuit is of much more importance than the by-pass type of circuit, we will first discuss **the action of filter circuits.** Before entering upon this discussion, it will be best to have an **understanding of the different types of current which require "filtering."**

RECTIFIERS

The usual current to be "filtered," is obtained by rectifying a high voltage alternating current. There are a number of different types of rectifiers. For high voltage "B" supply, the thermionic rectifier tube is universally used.

There are two types of rectifier circuits—"half-wave" and "full-wave."

HALF-WAVE RECTIFIER

We will first discuss the "half-wave" rectifier.

Figure 1 illustrates the connections of a "half-wave" rectifier. This circuit is seen to consist of a transformer and half-wave rectifier tube. The transformer serves to supply the necessary high voltage alternating current. One side of the high voltage winding connects to the plate of the tube and the other side to ground. The filament of the tube is lighted by the current obtained from the low voltage winding on the transformer. The high voltage winding of the transformer, as previously mentioned, supplies an alternating current. **By alternating, we mean that the polarity, or direction of current flow, reverses itself periodically.** First one side of the transformer is positive, then the other. The voltage will rise to a peak and then fall to zero, at which point the polarity reverses; i. e., the side which was positive will now be negative, and the voltage will again rise to a peak value and fall **to zero. This completes one cycle of the current.**

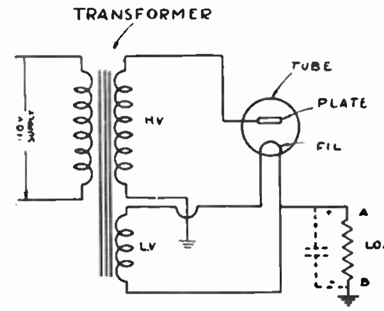


FIGURE 1

The general frequency of supply current is 60 cycles per second.

Figure 2 shows the voltage applied to the plate during the half-cycle wherein the plate is positive in respect to ground.

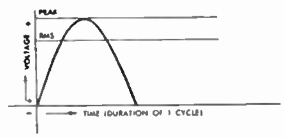


FIGURE 2

Notice that the voltage gradually rises to a peak value and then falls to zero. If we should connect a voltmeter across the transformer it would not indicate the peak value, but rather the **"RMS" value, which means—the root mean square voltage applied to the plate of the tube.**

The action taking place in the tube follows: When the plate is positive, electrons are attracted from the filament. The electrons flowing from the filament to the plate constitutes a current, the value of which depends on the voltage applied to the plate. Therefore the current is seen to rise and fall with the voltage applied to the plate. **When the plate of the tube is negative in respect to the filament, there can be no current flow** because the plate must be positive in order to attract electrons from the filament.

Figure 3 shows that during two cycles the plate will be positive for certain periods of time and negative for equal periods.

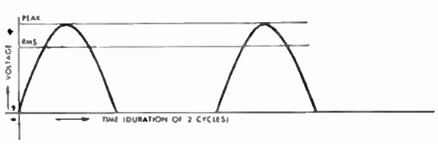


FIGURE 3

From our previous explanation of the action in the tube, and from Figure 3, we see that during two cycles of the supply voltage, the tube will deliver current for two periods of time, which is equal to the length of time during which the plate is positive, and that there will be a lack of current during two periods of time in which the plate is negative. Thus—we see that **for a half-wave rectifier we will have regular periods of current flow, each of which is followed by a period of time during which no current flows.** This, of course, is far different from the steady "Direct Current" plate supply, which is required to give successful operation of a radio receiver. A voltmeter connected across points "A" and "B" of Figure 1 would show the **average voltage** existing across the load connected to points "A" and "B." **This average voltage would be far below the RMS voltage supplied by the transformer, because of the periods of time during which there is no current flowing in the circuit.**

Now, if by some means we could provide a reservoir, which would absorb current during the periods of current flow, and then "feed" this stored current into the circuit during the periods when current is not flowing from the tube into the circuit, we would be able to raise our average voltage across the load. We would, in effect have a more continuous flow of current and therefore a higher "average" voltage across the load. **A condenser provides just such a reservoir,** and when connected across the load as in Figure 1, it will act exactly as the imaginary reservoir action described.

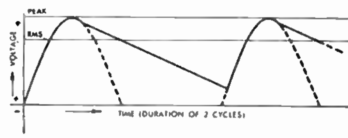


FIGURE 4

Figure 4 is a graph of the voltage across the load resistor shown in Figure 1, as plotted on the basis of time. **The two heavy and dotted curves** show the voltage supplied by the tube, and **the slanting line** shows the voltage which would be supplied to the circuit by a condenser connected from points "A" to "B." Notice that this condenser will act exactly as was described in the chapter headed "The How and Why" of Condensers. It will discharge current into the circuit during the period of time, **wherein the charging voltage is falling,** and that this discharge continues, until the condenser is either entirely discharged or until a charging voltage is again applied to the circuit by the rectifier tube.

Inasmuch as the quantity of current is determined by the amount of load, it is easy to see that **a very large condenser would be required to totally "fill in," or supply voltage to the circuit** during the entire period of time in which the rectifier tube plate is negative.

In order to further smooth out the current, it will be necessary to provide some means whereby we can "hold down" the peaks, so that we may take full advantage of the action; i. e., **the "holding up" or maintenance of current** supplied by the condenser. Before going into this matter, we will first discuss the **"Full-Wave" rectifier.**

FULL-WAVE RECTIFIER

The full wave rectifier operates in exactly the same manner as the half-wave rectifier, with the exception **that the full-wave rectifier enables us to use both halves of each cycle of current.**

It was pointed out and carefully explained **in the description of the half-wave rectifier, that current flowed for a certain length of time and then was absent for an equal length of time,** due to the second half of the cycle being of reversed polarity. However, **the full-wave rectifier enables us to use the other "half" of the cycle, or, it enables us to "fill in holes"** which exist in the output of the half-wave rectifier.

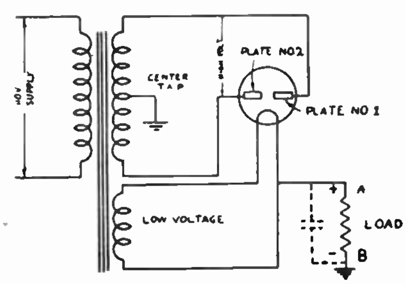


FIGURE 5

Figure 5 shows the circuit of a full-wave rectifier. This circuit consists of a transformer which supplies the high voltage, to be rectified, and the low voltage for lighting the filament of the rectifier tube. **Note that the high voltage winding is tapped at its center.** This center tap of the transformer provides a return path common to both sections of the high voltage winding.

The high voltage winding is arranged to supply a voltage between the two ends of the winding, which is twice the value of the voltage required across the load. **The reason for this is that only half of the winding is used at a time**; therefore, each half of the winding has to supply the desired output voltage.

Notice that the tube shown in Figure 5 has one more plate than the tube shown in Figure 1. However, the tube action is identical. Thus—**current will flow from the filament to that plate which is positive, but not to the plate which is negative.**

For explanation, **let us assume that plate No. 1 is positive.** Therefore, **plate No. 2**, since it is connected to the other end of the high voltage winding, **is negative. Current will** flow from the filament to plate No. 1 (but not to plate No. 2), and complete the circuit by leaving the center tap and going through the chassis and load, back to the filament. We will call this the "First Action."

In our previous study of the half-wave rectifier, it was pointed out that **the current and voltage rises, to a peak, and falls to zero and reverses polarity,** rises to a peak and again falls to zero, to complete one cycle. Therefore, in the "First Action," the voltage across the load (because of the current flowing through the plate No. 1), will gradually rise to a peak and then fall to zero. This is shown in Figure 6.

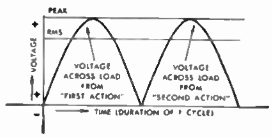


FIGURE 6

Remember that when the current supplied by the transformer reaches zero, the polarity reverses. Therefore, for the "Second Action," plate No. 2 of the rectifier tube, in Figure No. 5, will be positive and plate No. 1 will be negative.

Now, as the voltage rises and falls on plate No. 2, there will be a current flow from the filament of the rectifier tube to plate No. 2, and from the center tap of the high voltage winding through the chassis and load, back to the filament, thus completing the circuit.

The voltage across the load will gradually rise and fall. **It flows in the same direction as the current obtained in the "First Action." Therefore, the voltage across the load will rise and fall in the same manner and with the same polarity as that obtained by the "First Action."** This is shown in Figure 6.

By the use of a full-wave rectifier, we have a MORE CONTINUOUS CURRENT FLOW, or in other words, we have "filled in the holes" which we found to exist in the current supplied by the half-wave rectifier. **This means that we will not have to depend upon an extremely large condenser to maintain the flow of current in the load.** In the discussion of the "Half-Wave" rectifier, it was pointed out that the condenser would supply current to the load during the period of time when the voltage, from the rectifier, was "falling."

Refer to Figure 6 and note that we have a period of time, between each half cycle of the supply current, during which the voltage falls to zero. If a condenser is connected across the load, it will discharge current through the load as soon as the applied voltage starts to "Fall," and it will continue this discharge of current until its voltage falls to zero, or until the condenser voltage is opposed by the rising voltage of the second half of the cycle.

Figure 7 shows the meeting point between the discharge of the condenser and the increasing "charging voltage" of the second half of the cycle of current supplied by the rectifier.

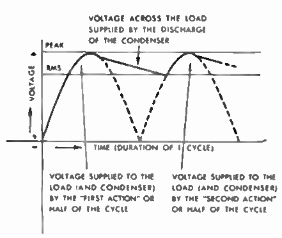


FIGURE 7

Compare the shape of the curve, illustrating the DC voltage existing across the load resistor, in Figure 6, with that of Figure 2, **and note that we have twice the number of peaks of current per cycle of the supply current. It will require less capacity to "smooth out" the current delivered by the full-wave rectifier than is required by the output of the half-wave rectifier. This is due to the fact that there are more "impulses" of current in the same length of time. A condenser of a given capacity will maintain a higher voltage level, in the load, with a full-wave circuit, than in the case of the half-wave rectifier circuit, because it needs supply current for much shorter periods of time between impulses of current.** This is evident if you will compare Figure 7 with Figure 4.

The pulsating current obtained from a rectifier, even with a condenser connected to the circuit, **is not suitable for "B" supply** in a radio receiver or amplifier, **because the remaining pulsations or ripple would still give rise to a very strong and objectionable hum** in the loud speaker.

Increasing the capacity of the condenser connected across the load, at the output of the rectifier, will not decrease the hum below a certain value, inasmuch as **the "charging voltage" applied to the condenser must fall to a certain extent before the condenser discharges its current into the circuit. Likewise, the "charging voltage" must rise to a certain extent before it can begin to replenish the charge in the condenser.** Thus—we see that **we can reduce the "amplitude,"** which means the height from the lowest to the highest point of the **voltage variation, or ripple, by the use of a condenser, but that above a certain value of capacity, depending upon the load and frequency of the supply voltage, there will be no further reduction in the amplitude of the ripple in the current supply. It will be necessary to use some means,** in addition to the condenser, **to entirely eliminate the ripple** from the supply voltage, in order that there may be a pure direct current for use in either the receiver or amplifier. The most convenient means of doing **this is by the use of a "choke."**

ACTION OF CHOKES

The word **"CHOKE"** is applied to a piece of equipment properly termed an "Inductor." An "Inductor" is a piece of apparatus having an electrical property which is termed "Inductance." **"Inductance" "Opposes" any sudden INCREASE of Current through an inductor, and "Delays" any Sudden Decrease of current through an inductor.**

The explanation of the action which causes the property of inductance follows:

Any conductor carrying a current has a magnetic field at right angles to the longitudinal axis of the inductor. **This magnetic field extends radially outward** from the conductor, **a certain distance, depending upon the intensity or amount of current flowing in the conductor. If the current** through the conductor **is increased, the magnetic field will expand. If the current is reduced, the magnetic field will contract.** Thus, we have a "Moving Magnetic Field," **the direction and speed of motion of which is determined by the "Rate" of increase or decrease of current in the conductor.** NOTE—There is no "motion" when the current is flowing at a steady rate.

A fundamental law of electricity is **"when a moving magnetic field 'cuts through' a conductor, there will be a voltage induced in the conductor, the polarity of the induced voltage depending upon the direction of motion of the magnetic field."** If we take a straight conductor and coil it, we will have an arrangement whereby **if we "increase or decrease" a current flowing through the coiled** conductor, **we will have a "moving magnetic field,"** which, due to the proximity of **turns, will "cut through" several conductors; i. e.,** adjacent turns of the coil. **If we increase or decrease the current flowing through a coil of** wire, **we will have a "self induced" current** in **the coil in addition to the "applied or driving" current. This "induced current" is of opposite polarity** to the "applied or driving" current. Therefore, **AN INCREASE OF CURRENT THROUGH AN INDUCTOR IS OPPOSED BY THE SELF-INDUCED CURRENT IN THE COIL, WHICH IS USUALLY CALLED THE "COUNTER-ELECTROMOTIVE-FORCE."**

In line with this explanation of the action taking place during an **increase** of current, it is easy to see that **A DECREASE IN CURRENT WILL GENERATE A COUNTER-ELECTROMOTIVE-FORCE WHICH WILL OPPOSE THE DECREASE IN CURRENT.**

The **amount of inductance** in a coil of wire **is dependent upon the number of turns and the nature of the material used for the core.** Air is the poorest material, in that it is not a good magnetic conductor. **If we use an iron core, the inductance will be much higher,** because iron is an excellent magnetic conductor.

In the discussion of rectifier circuits, it was pointed out that it was necessary to find some means of "holding down" the peaks of the ripple in the current supplied by the rectifier, so as to obtain a steady flow of current for use as "B" supply in a receiver or amplifier; therefore, it appears that an inductor or choke is ideally suited for this action.

BASIC FILTER CIRCUIT ACTION

At this point we are ready to describe the action taking place in **a "filter" circuit;** i. e., a circuit **composed of capacity and inductance** which will "smooth out" the pulsating current delivered by a rectifier; into the smooth pure direct current necessary for "B" supply. Figure 8 shows the connections of the iron cored inductor "choke," and two condensers which comprise the simplest and basic type of filter circuit.

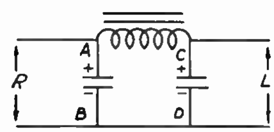


FIGURE 8

The letters "R" and "L" in Figure 8 indicate respectively, the rectifier and load. The **condenser** at **the "Input"** has the same action upon the circuit as the condenser described in the chapter on rectifiers. This condenser **acts as a reservoir** to **supply current to the load during the zero current periods** in the current supply from the rectifier.

The choke in the circuit of Figure 8 **opposes any sudden increase or decrease of current** because of its inductance.

At this point in our explanation, we have a current supplied to a load ("L" in Figure 8) through a choke which opposes and prevents any sudden increase in the current, and we have a condenser at the rectifier output which will supply current when the rectifier can not. Thus, **the choke prevents the "peak of the ripple" from getting into the load, and the condenser "fills in the hollows" in the supply.** Or, we may explain the action up to this point by saying that **we have reduced the "amplitude"** of **the "ripple" in the current.**

Inasmuch as the choke prevents any sudden increase in current, or in other words, maintains a steady current flow, **it is necessary to provide a means of supplying current to meet any sudden demand** for current **made upon the filter. Without such an "auxiliary" current supply, we would be forced to "wait" for an increase of current to come through the choke.** We have in reality, a need for a "reservoir," and in the chapter **"THE HOW AND WHY OF CONDENSERS,"** we learned **that a condenser is just such an "electrical reservoir."** Therefore, we see **the reason for the condenser across the load side of the filter circuit** shown in Figure 8.

Due to the fact that all chokes have more or less resistance (because of the natural resistance of the wire used to wind them), **there is a voltage drop across the choke which subtracts from the effective voltage useful for plate supply.**

In addition to a tube requiring a plate voltage, it also requires a negative bias voltage which is applied to the grid. If we can obtain both our plate and bias voltages from the "B" supply, or, in simpler words, make full use of the voltage from the "B" supply, we will be effecting an economy.

Inasmuch as the bias voltage must be negative in respect to the cathode of the tube, we can easily accomplish the action of obtaining both our "B" and "C" "bias" voltages in the following manner:

Due to the fact that it is convenient and economical to use the chassis as the negative side of the circuit, **it is possible to insert a resistance, between the center tap, of the high voltage winding on the power transformer, and the chassis. This will make the center tap of the transformer negative in respect to the chassis.** If we connect the cathode, or filament center tap of our tubes directly to the chassis, and connect the grids to the center tap of the transformer, **the grid will be negative, in respect to the cathode, by the amount of voltage drop obtained across the resistance.**

The voltage drop obtained across the resistance, as outlined in the previous paragraph, is caused by the current in the "load;" i. e., the sum of all the plate currents and "bleed" currents of the receiver. The voltage drop across the resistance is equal to the current times the resistance. **For any given current, we can obtain any desired negative voltage by selecting the proper value of resistance.**

Before proceeding further on this phase of the use of the choke in the negative side of the circuit, we wish to point out that it is not the only reason for placing the choke in the negative lead, inasmuch as there are other considerations in certain designs. Because bias voltage is the usual reason for using the choke in this position, we shall proceed with a further explanation of this usage.

The introduction of the dynamic speaker enabled designers to "kill two birds with one stone," in that **the dynamic speaker could be used as the choke.** Inasmuch as the magnetic circuit of the field in a dynamic speaker must necessarily include a "gap" (for the movement of the voice coil), we have the makings of a choke, as we have a coil of wire on an iron core, and the core is provided with an air gap. **The use of the field of a dynamic speaker as a choke is economical as the saving in the cost of the choke offsets part of the cost of the speaker.**

An additional advantage, is that inasmuch as the field of the speaker requires several watts for its proper excitation, there will be considerable voltage drop across it.

If the speaker field were placed in the positive lead, the voltage drop across the field would be subtracted from the voltage available from the rectifier, which voltage of course, would have to be raised to offset this. In addition, if a separate voltage dropping resistor were used, either at the tube or in the negative lead to the transformer, to secure the necessary bias voltage, the rectifier output voltage would of necessity have to be large enough to include this voltage. **What could be more natural than to utilize the voltage drop across the field as the bias voltage, and thereby make a saving in the power transformer?** The result of this is the use of the field in the negative lead; i. e., between the chassis and center tap of the power transformer.

Figure 13 shows the simplest type of filter circuit wherein the choke is in the negative lead.

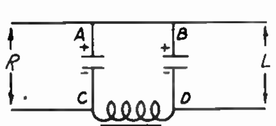


FIGURE 13

Because the same filtering action can be obtained with the choke in the negative lead as is obtained with the choke in the positive lead, we can expect to find the same types of circuits as previously described, with the chokes in the negative side of the circuit instead of in the positive. See circuits 4, 5, and 26 on pages 208 and 209.

Due to the fact that the wattage required to be expended in the field coil may not be of such a value as to give a convenient voltage drop, it is sometimes necessary to adopt the expedient shown in Figure 14.

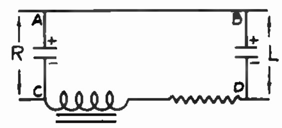


FIGURE 14

Here we see the same circuit as shown in Figure 13, **except that there has been a resistance added in series with the choke; i. e., the field coil; in order that the voltage drop between the load and rectifier may be sufficient for use as bias voltage.** It is of no great importance as to which side, of the choke, the resistor is connected, inasmuch as the resistor offers an "impedance" to the ripple voltage, the same as would an inductive "reactance" of the same ohmic value. In case the voltage drop across the field is **too great,** a divider network is placed across the field so as to tap off the desired voltage.

RESONANT ELEMENT FILTER CIRCUITS

Our discussion to this point has been confined to the type of filter circuit vulgarly known as the "Brute Force" type. However, there is another type of filter circuit wherein use is made of a resonant circuit.

Such a "resonant circuit" type of filter circuit is shown in Figure 15.

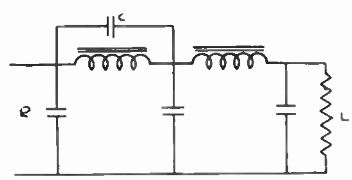


FIGURE 15

The circuit shown in Figure 15 is practically the same as that of Figure 11, **with the exception of the small condenser C which is shunted across the first choke.**

The capacity of the condenser "C" is so chosen that it "tunes" the choke to resonance with the "hum frequency." The result of tuning this choke is **that a tuned circuit of this type offers a very high "impedance," or more simply, "opposition" to the hum frequency.** The action of this tuned circuit is often described by saying that **it "absorbs" the particular alternating current,** in this case, the ripple current, **which is applied to it.**

The "tuned choke" type of filter circuit is nearly always used with the full-wave type of rectifier, although it is possible, but not convenient or advisable, to use it with the half-wave type of rectifier.

It is well to point out that all filter circuits described have been of the "Low Pass" type; i. e., CIRCUITS THAT WILL PASS ALL FREQUENCIES BELOW A CERTAIN VALUE and prevent all frequencies "above" this certain value from passing through the circuit.

The "cut-off" point; i. e., the frequency below which the filter is ineffective, must be below the frequency of the hum voltage, or ripple, and in good design, it should be below the lowest frequency which will be handled by the audio amplifier receiving "B" supply current from the circuit. In addition, it is very important that the resonant frequency of the filter circuit should not be the same as the frequency of the supply current fed to the transformer.

In addition to the low pass type of filter circuit, **there is a "high pass" filter circuit; i. e., one which prevents the passage of all frequencies BELOW the "cut-off" point, but ALLOWS THE PASSAGE OF ALL FREQUENCIES ABOVE THE CUT-OFF POINT.**

A combination of the high pass and low pass filter would be most effective for use as a "B" circuit filter, **provided that the cut-off point of the high pass filter is ABOVE the ripple frequency and the cut-off point of the low pass filter is BELOW the ripple frequency.** The most effective arrangement of such a combination circuit would be to have the high pass filter between the rectifier and the low pass filter.

An "absorption" type of filter next to the rectifier is shown in Figure 16.

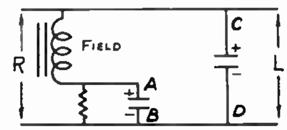


FIGURE 16

In this circuit **the field coil of a speaker is used as the inductance, which with the capacity of the series condenser, resonates at the ripple frequency. Inasmuch as it is a "series resonant" circuit, it offers a short circuit for the ripple frequency current.** This current is not suitable for use as a field supply. The resistor is shunted across the condenser in order to provide a path for the necessary DC current.

The resistor is of a much higher value than the value of the capacity reactance of the condenser at the frequency involved. The resistor does "broaden the peak of resistance" of the circuit and this offsets any slight discrepancy in capacity value of the condenser.

Figure 17 is a more practical, although more expensive, method of using a resonant circuit in a filter.

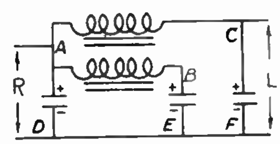


FIGURE 17

This circuit shows the use of an inductance and an electrolytic condenser, **the sole purpose of which is to "short circuit" the hum frequency.** In some instances, the two chokes shown in Figure 17 are in reality two windings on a common core. In other words, a transformer. There is a simpler and less expensive way of obtaining the same action. This method is shown in Figure 18.

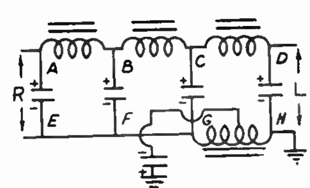


FIGURE 18

The portion of the circuit in which we are interested in Figure 18, is the tapped choke in the negative lead. **Note the condenser connected between the chassis and the tap on the choke.** The action taking place in this circuit follows: **The tapped inductance acts as an auto-transformer, the primary of**

which is the whole winding, as the secondary is the circuit formed by a portion of the winding and the condenser connected from the tap to one end (through the chassis) of the winding. The "resonant period" of this "tuned secondary" is equal to the disturbing ripple, and therefore, it appears as a short circuit to the ripple frequency, which means that the energy of the ripple frequency is expended in this circuit.

Before taking up the more complex rectifier-filter circuits, we wish to call your attention to the fact that under certain conditions a resistor may be used in place of a choke in a filter circuit. This is shown in Figure 19.

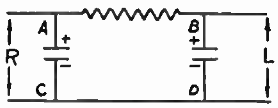


FIGURE 19

This circuit is seen to consist of a resistor and two condensers arranged in the same manner as the simplest and the first described filter circuit. **This type of circuit is not nearly as efficient as one using a choke.** It is much cheaper, as there is a large difference in cost between the price of a resistor and that of a good choke.

The action in this circuit is rather simple, in that **the resistor sets up a voltage drop in any current passing through it,** the voltage drop being determined by the current flowing through the resistor. **For use as a filter, there will be a greater voltage drop in the direct current than there will be in the ripple current, because of the fact that the DC current is greater than that of the ripple current,** or, we might state that the DC voltage applied to the resistor is much greater than the ripple voltage. **It will require a rather large resistor to give appreciable drop in the ripple current flowing through the resistor, and for this reason, such a circuit can not be used except where the load on the filter is small.** An additional disadvantage is that large capacitors must be used with such a circuit.

We now have a complete circuit consisting of a transformer, rectifier and filter, which enables us to draw a pure DC current from an alternating current source or supply. The true picture is not nearly so "rosy" as one might be led to believe by the description presented thus far. There are a number of factors which limit the efficiency of the various parts of our circuit, particularly the filter.

FILTER COMPONENT LIMITATIONS

In order to present a clear picture of the action of a filter circuit, we have deliberately avoided the introduction of any of the limiting factors which must be considered in the design, application and repair of a filter circuit, or parts thereof.

First, let us consider the limitations of our choke. A serious limitation in the action of a choke is that **if too large a current is passed through it, the core material will become "saturated;"** i. e., it cannot absorb or carry but a limited amount of magnetic lines of force. **When this point is reached, a sudden increase of current will be unopposed** because the magnetic field cannot increase. **There is a method of preventing this "saturation," and that is to leave a "gap" in the core.** This is a limited blessing, for, although the gap will prevent, to a certain extent, **"saturation" of the core, it also reduces the "inductance" of the choke,** which means that the "smoothing effect" of the choke will be reduced. Here we have a choice between two evils—**one of which is loss of inductance, and the other—loss of current capacity.** We can secure some relief from the former by increasing our condenser capacity. There is a sharp limitation even to this.

FIGURE 9—MALLORY DRY ELECTROLYTIC CONDENSER VOLTAGE RATINGS

DC Operating Volts	Maximum Surge	Maximum Peak AC Ripple Voltage at 120 Cycles							
		Mfd. 1-3	Mfd. 4-5	Mfd. 6-9	Mfd. 10-12	Mfd. 13-16	Mfd. 17-25	Mfd. 26-35	Mfd. 36-50
25	40	10	10	10	10	10	8	8	5
50	75	15	15	15	15	10	8	8	5
100	150	25	20	20	20	15	10	8	5
150	200	25	20	20	20	15	10	8	5
200	250	30	27	25	20	15	10	8	5
250	300	30	27	25	20	15	10	8	5
300	350	30	27	25	20	15	10	8	5
350	400	30	27	25	20	15	10	8	5
450	525	30	27	25	20	15	10	8	5
475	525	30	27	25	20	15	10	8	5
500	525	30	27	25	20	15	10	8	5

In our discussion of a condenser and its action, we have thus far omitted any reference to its limitations. One of these is resistance, which causes loss of power and heating of the condenser if it is not considered.

The effect of resistance in an electrolytic condenser is that it limits the amplitude (voltage variation) of the ripple which can be applied to the condenser. Remember—that this ripple must "flow through" the condenser, because it is an "increasing and decreasing" or alternating current.

Figure 9 is a table which gives full information on this subject.

SURGE VOLTAGE

When first turned on, many radio receivers and amplifiers develop an unusually high "surge" voltage across the filter circuit, because there is little, if any, load on the filter. This is especially true where heater type tubes are used, with a rectifier of the filament type.

In order to explain the effects of surge voltage, and the reason that it is a limiting factor in the use of electrolytic condensers, it is necessary to familiarize yourself with the chapter entitled "The How and Why" of Condensers.

In this article it was pointed out that an electrolytic condenser is limited in the amount of voltage which may be impressed upon it because of the puncturing of the dielectric film on the plate when the voltage exceeds the limitations imposed by the electrolyte.

The voltage at which the film of an electrolytic condenser starts to puncture is called the surge voltage. The highest value generally obtained is approximately 525 volts. (Be sure to read "Mallory Replacement Condensers and Accessories," page 212.)

Electrolytic condensers are correctly rated as follows:

Working voltage, 450; "Surge" voltage, 525.

The meaning of this is that **the condenser is designed to work continuously at a DC potential of 450 volts. Superimposed upon this is of course the ripple voltage. Figure 9 gives the practical limit for the ripple voltage** which may be applied to different electrolytic condenser ratings.

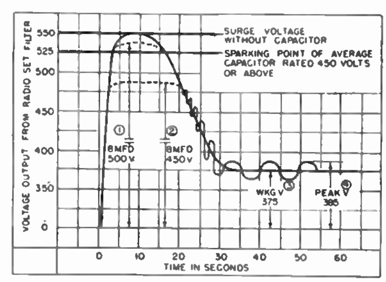
The term "Peak Voltage" is relatively unimportant but refers to the total of the DC working voltage plus the AC ripple safe for continuous operation. This term is often misused for "Surge Voltage."

The "Surge Voltage" is usually considered the maximum voltage that may be applied to the unit through some limiting resistance for a few seconds without damage. Continuously applied, it will generally ruin an ordinary condenser in a short time, because of the development of heat within the unit.

Few dry electrolytic condensers will withstand a surge greater than 525 volts. **You will note in Figure 9 that the 450, 475, and 500 volt DC ratings** all carry the same surge rating. **For this reason it is possible to replace 475 and 500 volt units with 450 volt Mallory units as far as the surge is concerned. We recommend this practice as long as the surge does not exceed 525 volts and the continuous working voltage does not exceed 450 volts.**

MALLORY CONDENSERS OF THE 450-VOLT RATING HAVE BEEN PURPOSELY DESIGNED TO SOMEWHAT LIMIT THE SURGE VOLTAGE AT THEIR TERMINALS. THE LEAKAGE CURRENT CHARACTERISTIC OF THESE UNITS IS SLIGHTLY HIGHER THAN WHAT MIGHT BE EXPECTED BY COMPARISON WITH MALLORY 250-VOLT CONDENSERS. THE SPECIAL PROCESS INVOLVED PROVIDES A MAXIMUM OF USEFULNESS FOR GENERAL REPLACEMENT SERVICE. RELATIVELY HIGH LEAKAGE AT VOLTAGES ABOVE THE WORKING VOLTAGE IN THIS CASE IS THEREFORE TO BE DESIRED.

Apparently, some manufacturers used 475 or 500 volt units in original equipment rather than 450 volt units, believing this would reduce field trouble from surges. **As a matter of fact, the 450 volt units are no more likely to break down from surges than the higher voltage units as they draw more current past their rating and help to hold the surge down.** This is clearly shown in Figure 9A.



Figs. 1 and 2 show how leakage of condenser regulates the surge voltage—note that surge with 450-volt condenser is greatly reduced. Excessively high working voltage ratings do not necessarily mean added safety

FIGURE 9A

MEASURING SURGE VOLTAGES

The best practical way to make this measurement is to disconnect all filter condensers and install a 1 mfd. paper condenser, at the output of the rectifier. A 1,000 ohm per volt meter applied at the paper condenser terminals, **will then indicate the voltage applied to the condensers during the heating cycle of the tubes. BE SURE THAT THE TUBES ARE COLD AND THE METER IS ATTACHED BEFORE THE SET IS TURNED ON. The maximum swing of the meter may then be taken as the maximum surge.** The paper condenser may be connected to the terminals of the voltmeter if this is more convenient.

It will pay you to make this measurement where high surges are suspected **as this initial surge affects all the filter sections.**

Surge voltage should always be measured wherever the line voltage is high; i. e., above the standard level of 110 volts, as **in many localities the line voltage may rise to 125 volts or more.**

Many servicemen are of the opinion that it is not necessary to measure the surge. This impression has probably been gleaned from statements that "it is not necessary to measure the surge." Following the above reasoning, "it is not necessary to look to see if the train is coming." However, just as with surge, it is the safest thing to do.

Obviously, where the ordinary type of condenser is used, the speaker plug should never be removed while the set is on as this removes all load and may damage the first filter condenser. If there is a possibility of this happening, as on amplifiers, we suggest the use of Mallory Type HS Condensers.

Should a particular receiver give trouble due to repeated failure of condensers, **we suggest using one of the Special Mallory High Surge units developed for this purpose.** These condensers are especially designed to withstand any surge condition likely to be met in the field. Since they cost more than ordinary units they are recommended only for severe cases.

FILTER CIRCUIT ACTION

In the previous chapters we have discussed the actions which take place in each part and component and their limitations with respect to the simple type of filter circuit which is shown in Figure 8. There is one type of filter circuit which is not covered.

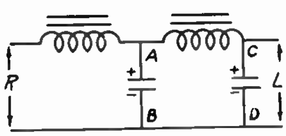


FIGURE 10

Figure 10 is a circuit wherein there is no condenser connected across the output of the rectifier. **This circuit is commonly known as the "choke input" type of circuit.** The choke, which is connected directly to the output of the rectifier, is often termed the "swinging choke."

Inasmuch **as there is no "reservoir" action at the input to the filter, there will be a lower output voltage from the filter, because of the "hollows" in the current supply from the rectifier. Because we have an extra choke** over that of the circuit shown in Figure 8, **we will have a much smoother current.**

The voltage output of the "choke input" type of filter circuit is smoother for lower values of load, than the corresponding capacity input type of filter. The voltage is lower except for higher loads. This type of circuit is useful where there is a large variation in load.

MULTIPLE CHOKE FILTER CIRCUITS

Due to the facts outlined in the chapter on "Limitations of Filter Circuits," it is often necessary to employ a filter circuit such as shown in Figure 11.

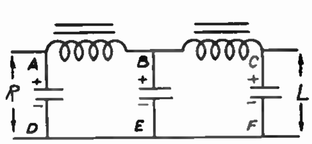


FIGURE 11

The circuit shown in Figure 11 is seen to consist of **two chokes with condenser input and output, and in addition, a condenser from the point of connection of the two chokes to the negative side of the circuit.** We have in reality two of the simple filter circuits placed end to end with the advantage that we can obtain a much better filtering action because we have two chokes and three condensers.

Since the introduction of the electrolytic condenser with its advantages of low cost and small size for an extremely large capacity, it is rare that one encounters a filter circuit of more than two "stages." In older receivers wherein the designers were forced to use paper condensers, which were uneconomical to use in capacity values greater than approximately 2 mfds., it was necessary to use a circuit as shown in Figure 12.

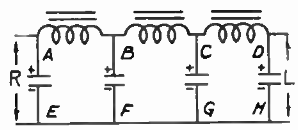


FIGURE 12

A three-section filter is shown in the circuit of Figure 12. This circuit is seen to consist of three chokes and four condensers. In other words, we have three of the common, or simple, filter circuits placed end to end.

Even with extremely low values of capacity, this circuit is capable of very good filtering, inasmuch as there is an over-abundance of inductance to counteract the usual lack of capacity which was pointed out in a previous paragraph on this circuit; i. e., the use of low capacity paper condensers.

In the filter circuits so far discussed, you will have noticed that the chokes are all located in the positive lead of the circuit. This is because of the general use of the chassis as the negative part of the circuit. **Just as good filtering can be obtained if the chokes are all in the negative side of the circuit.**

There are certain conditions of design wherein it would be advantageous to have the choke in the negative side of the circuit, in order to make some use of the otherwise wasteful voltage drop caused by the resistance of the choke.

COMPLEX FILTER CIRCUITS

Present day filter circuit design is for the most part simple and direct. Several years ago, and in occasional cases, even today, one may encounter rather complex filter circuits. These circuits often are not as complicated as they may seem at first glance, as **they are usually combinations of filter circuits and load distribution circuits** with associated by-pass condensers, arranged in such a manner that the schematic of the whole circuit with all the various connections involved, appears to be extremely complex.

Study will enable one to disassemble such a complex circuit into its various functions as to filter and load distribution. There are some complex and involved filter circuits designed to meet specific conditions existing in a receiver or amplifier. Even these more complex circuits are in reality made up of combinations of the circuits which we have discussed in the previous chapters. We will present two new circuits which have not been discussed. The first of these circuits is illustrated by Figure 20.

This circuit is seen to consist of the ordinary single section "Brute Force" filter with a choke connected

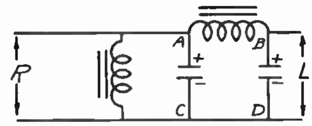


FIGURE 20

across the filter input. The purpose of connecting a choke, or in reality a field coil, across the circuit at this point is to effect an economy in the filter design. The current supplied to the field coil does not need to be as ripple free as that which is supplied to the plates of the tubes. In addition, the current drawn by the field coil is rather large. **If the field coil were connected across the output of the filter, it would increase the voltage drop across the choke, and in addition, would call for a much larger choke** (in physical size) **to obtain the necessary smoothness in the current** to be applied to the load; i. e., the tube plates. It is economical to place the field coil across the input to the filter, as this will enable the use of a smaller choke.

The principal use for such a circuit is in AC-DC receivers, wherein a half-wave rectifier is generally used, and inasmuch as a half-wave rectifier requires the use of large capacitors, and a good inductance, any unnecessary increase in these items would be uneconomical.

There is one point which must be borne in mind with such a circuit. **The combination of inductance of the field coil, together with the capacity of the input condenser, should not be of such values as to form a tuned circuit resonant at the ripple frequency. Such a tuned circuit in this position would cause a high voltage to be developed across it.**

The circuits shown in Figures 27 and 38 on page 209, are practically identical, except that the choke is in the negative lead. Note the unusual connection to the rectifier tube in the circuit of Figure 38. The two halves of the tube are in parallel. In addition, the tube is in the negative side of the circuit. This is unusual, as the tube is nearly always in the positive side of the circuit. The **tube acts in the ordinary manner, in that current flows through the entire circuit and the rectifier tube when the cathodes are negative in respect to the plates.** A much better circuit than that described is shown in Figure 21.

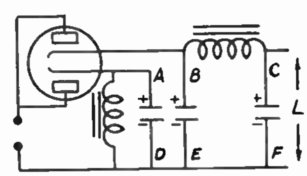


FIGURE 21

This circuit is really very simple. We have a rectifier tube which has two separate and distinct half-wave rectifiers within its envelope, such as the Type 25Z5 Tube. **We have a half-wave rectifier and filter system to supply current to the load, and another half-wave rectifier which supplies current to the field coil.**

The condenser connected across the field coil is for the purpose of filtering the current flowing through it. Otherwise there would be quite a bit of hum due to the ripple current passing through; whereas, **with the condenser in parallel with the field coil, the peak of the ripple is absorbed and the condenser discharges through the field coil during the period of no current flow from the rectifier. Steadier "average" current is maintained through the field coil.**

The circuit illustrated in Figure 11, on page 208 is identical, except that it has the choke for the load filter in the negative lead.

VOLTAGE DOUBLER CIRCUITS

Although the principal and action of the voltage doubling type of rectifier-filter circuit was known for many years, it was not until the introduction of the popular AC-DC receivers that there was any commercial reason for using such a circuit.

A "voltage doubler" circuit is one which will deliver twice the voltage applied to it. Off hand, one might think that this is done with an ordinary transformer. **The true voltage doubler circuit does not use a transformer, but rather obtains the voltage doubling by means of condenser action.**

The circuit shown in Figure 22 is one of the simplest types of voltage doubling circuit. However, to those **servicemen who are not "up on their toes" in regard to theory of current flow,** it may be a little difficult to understand. We will present a clear picture and ask that you thoroughly study it.

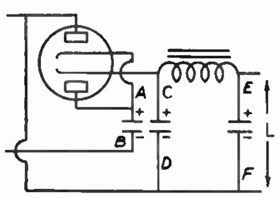


FIGURE 22

In order to facilitate the explanation of this circuit, we present Figure 23, which is a break-down of the circuit showing the action that takes place in the first half of a single cycle of the alternating current supply.

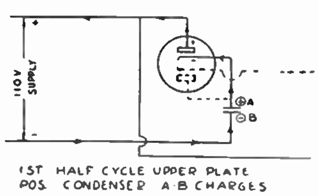


FIGURE 23

Notice the polarity marked on the supply line; i. e., positive at the top, and negative at the bottom.

In one of the earlier chapters devoted to rectifier action, it was explained that **whenever the plate of the tube becomes positive, electrons are attracted to it from the cathode. THIS ELECTRON MOVEMENT CONSTITUTES AN ELECTRIC CURRENT regardless of whether it is a flow of electrons from cathode to plate, or whether it is a current flowing in a wire. Remember this rule—"An electric current is a movement of electrons and is always in the direction of negative to positive polarity."**

In Figure 23, we see that the upper plate is positive. Therefore, current is attracted. This current flows in from the negative line through the condenser to the cathode. This completes the circuit. The actual current flow is of very short duration, because it establishes an electrostatic charge in the condenser. The action taking place in the circuit on the first half of the cycle, is merely THE CHARGING OF THE CONDENSER "AB." The direction of current flow during the first half of the cycle is indicated by the arrows.

The action which takes place in the second half of the cycle is shown in Figure 24.

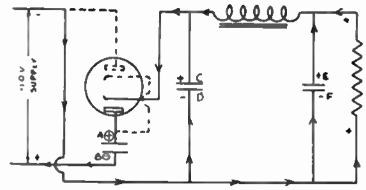


FIGURE 24

At this point **make sure that you clearly understand the explanation given so far.** It is not necessary to consider the other tube elements in the action up to this point. **It is also advisable that you be thoroughly familiar with all the subjects which have been treated in this article up to this point.** Otherwise, you may find some difficulty in understanding the explanation of this voltage doubling circuit.

We now have condenser "AB" fully charged to 110 volts, and with a polarity as marked in Figures 23 and 24.

Note that in the second half of the cycle of supply voltage, **that the polarity shown in Figure 24 is opposite that shown in Figure 23.** The bottom supply line is now positive, and the upper negative. **The positive polarity of the bottom line attracts current which flows from the negative line through the load and choke to the lower cathode of the rectifier tube. Inasmuch as the lower plate of the tube is positive,** because it is connected to the positive line through the condenser **"AB," the current will flow from the cathode to the plate.** It encounters the charge in condenser **"AB."**

We now have 110 volts applied to the circuit, and also 110 volts of charge in condenser "AB." NOTE THAT THE POLARITY OF THE CHARGE IN THE CONDENSER AND THE POLARITY OF THE CURRENT FROM THE LINE ARE ADDATIVE; I. E., POSITIVE TO NEGATIVE, AND NEGATIVE TO POSITIVE.

We have added two separate charges of 110 volts each together. Inasmuch as they are ADDATIVE, the resulting voltage is 220. In reality, the voltage is equal to twice the "peak" voltage of the supply circuit. This exists only in an extremely low load, and is not true in practical use. **The resulting voltage in such a circuit is usually equal,** or very nearly so, **to twice the RMS value of the applied voltage.**

From the description of the voltage doubler circuit, it is easy to see that **this circuit may only be used with an alternating current supply,** and can not be used in an **AC-DC** receiver **which may be operated on direct current,** inasmuch as **there is no reversal of polarity in a direct current circuit.** Therefore, the circuit illustrated in Figure 22 cannot be used where the line supply is direct current.

Circuit 9 on page 208 is a voltage doubler circuit with slightly different connections, but with the same action as that of the circuit which we have just described and illustrated.

In order to provide for the operation of a receiver using a voltage doubler on either AC or DC sources of supply, it is necessary to provide some means of changing the circuit. Such a means is the switch shown in the circuit of Circuit 45, on page 210. A study of this circuit will reveal that when used on an **AC** supply, **with the switch in the AC position, the circuit is a voltage doubler,** but that when the receiver is to be used on a **DC** source of supply, the switch must be turned to the **DC** side and the circuit then acts as a common half-wave rectifier.

We sincerely hope that you have been patient and studious in reading this presentation on the action of filter circuits, inasmuch as the knowledge which you can gain from this article will be of inestimable value to you in your work.

We sincerely regret that space limitations prohibit going into the deeper subject of engineering and design of these circuits. Because of the scope of these subjects, it is impossible to attempt it.

REPLACEMENT OF FILTER CONDENSERS

It is practically impossible to present exact details for the replacement of condensers in every circuit. The extremely wide range of capacities, circuit connections and combinations prohibit a thorough discussion of this subject.

We suggest that you study the circuits on pages 208 to 211 and read the notes on pages 200 to 207, and familiarize yourself with customary condenser capacity values used in the various circuits in order that you may be thoroughly familiar with the entire subject in its practical aspects.

CAPACITY OF FILTER CONDENSERS

The capacity values assigned to condensers for filter circuit work is not extremely critical, and a shift of several mfds. in either direction will not introduce any observable changes, except in very rare instances, such as in replacing the capacity used to tune a filter choke or at the input to a filter circuit (see Chapter "Easy Replacement of Unmarked Condensers"—page 199).

The Mallory Universal replacement condenser line contains all the capacities or combinations of capacities necessary for replacement work, and in addition, the line is arranged **FOR YOUR CONVENIENCE.**

NON-POLARIZED CONDENSERS

There are quite a number of applications where it would be dangerous to use the usual DC electrolytic condenser. In cases where the polarity applied to the condenser may be reversed, the heat generated by the heavy current flowing through the condenser would severely damage, if not totally destroy the unit. This is due to the unidirectional property of the dielectric film which retards the current flow in one direction, but offers no resistance in the other or reversed polarity direction.

Note that we say "usual DC condenser" in the above paragraph, because **there is a simple means of providing an electrolytic condenser which may be used in any circuit wherein the polarity may be accidentally, or intentionally reversed.** Such a condenser is called a non-polarized type.

Properly speaking, a non-polarized condenser is one in which there is no polarity; i. e., either one of the terminals may be connected to the positive side of the potential source.

Such an electrolytic condenser is easily made by either one of two methods. The first method is to build the condenser with two "formed" plates, or second—**to connect two electrolytic condensers together negative to negative, using the remaining positive terminals for connection to the circuit.**

The most general use for non-polarized electrolytic condensers is in receivers to be operated from a DC line, although they are frequently used in receivers which are to be operated from batteries.

Inasmuch as there is not a very large number of direct current receivers in use, the demand for non-polarized condensers is not sufficient to enable a distributor to stock them.

We present a sensible and economical method, whereby you may replace a non-polarized condenser, quickly and easily.

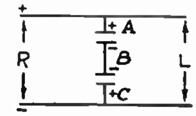


FIGURE 25

Figure 25 will clarify the method which is recommended for the replacement of non-polarized condensers.

Supposing you have need for a 4 mfd. non-polarized condenser in a round can to operate at 300 volts. The proper replacement is Type RN242. This condenser consists of two 8 mfd. units with a common negative lead.

To use the Type RN242, it is only necessary to connect the two red, i. e., positive, leads, to the circuit, and disregard the black negative lead. When making this installation, it is advisable to cut off the black negative lead and tape it, to prevent any accidental shorting.

The result of the foregoing procedure is clearly shown in Figure 25.

It should be noted that **the capacity** resulting from such an arrangement of condensers **is equal to one-half the capacity of either section.** In addition, **BOTH SECTIONS OF A CONDENSER SO USED SHOULD BE OF THE SAME CAPACITY.**

The working voltage of the capacity resulting from the connections described, and illustrated in Figure 25, **is that of one section, and not twice the rating of the one section.** Thus—two 450 volt condensers so connected will have a working voltage of 450 volts.

Although Type RN (common negative) type condensers were mentioned in the explanation of the method used to replace the non-polarized unit, **we would like to point out that two single unit condensers may be so connected.**

Where it is necessary, that the replacement should be in one container **and above 4 mfd. rating,** Type RM (Multiple separate section) type condensers may be used. For instance, the RM257 can easily be wired to replace an original 8 mfd. round can non-polarized unit, by connecting the two 8 mfd. sections in parallel, and the negative leads of these two sections to the negative lead of the 16 mfd. section. This will give two 16 mfd. sections with their negative leads jointed ogether, resulting in a non-polarized capacity of 8 mfd.

The carton types corresponding to the round can types given for illustration, are as follows: CN152 and UR191.

THEORY OF CONDENSER ACTION

The explanation of condenser action given in the opening chapter is so arranged as to bring out the action taking place when a condenser is used as a filter condenser. This explanation does not go into the real action which takes place in a condenser; therefore, let us see what does happen in a condenser.

A condenser consists of two conducting plates separated by a dielectric material. By "dielectric material" we mean a non-conducting material; i. e., one that will not serve as a conductor of electric currents. In order to thoroughly explain the action taking place in a condenser we refer first to Figure 26, which shows a condenser, battery and switch.

The dielectric of this condenser is the cross-hatched block between the two plates.

Now, in order to thoroughly understand the action of a dielectric material, it is necessary to go into the structure of such a material.

The structure of all materials, including dielectrics, is as follows: A molecule is generally considered the smallest individual part of the material which has all the characteristics of the material. However, a molecule is made up of one or more atoms. An atom is the smallest possible particle of one of the known 92 elements, and an atom is composed of an arrangement of electrons and protons. It is sufficient to say that an electron is a negatively charged particle and a proton is the positively charged particle of greater mass than an electron.

An atom is composed of a certain arrangement of protons and electrons. However, there may be more electrons than protons. In addition, some of the electrons, or in rare cases, even a proton, may not be firmly attached to the atomic structure, although in the main the arrangement of an atom and the balance of electrons and protons is something that cannot be disturbed. Thus—if by some means one of the loosely attached electrons is drawn away from the atom, **the atom looses its "state of balance" and acquires an attractive power for any other "loose" electron which is in its immediate vicinity.**

At this point, we have shown that under certain circumstances, an atom may lose an electron, and that when it loses this electron, it is immediately attractive to any other electron which is "free." This situation might be expressed by saying that if we remove a negatively charged particle from the atom, we destroy the balance, or, "neutrality;" i. e., neutral state, of the atom. Thus—since we have removed a negative particle; i. e., an electron, from our atom, it is no longer in the state of balance, or, neutrality, but is positive. By positive, we mean that it has an attraction for a negative particle; i. e., an electron.

We have previously explained that a molecule is the smallest particle of a material which has all the characteristics of that material, but that a molecule is made up of atoms. Thus—a molecule of steel will be composed of atoms of iron, carbon, and atoms of various other substances which go to make up the material known as steel. The same thing is true of a dielectric material such as paper.

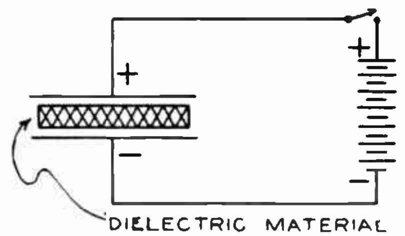


FIGURE 26

Returning to Figure 26, note that if the switch is closed, there will be an electrical potential applied to two sides of the dielectric material. The result of such an action is that the free electrons existing in atomic structure of the dielectric material are attracted and drawn toward the positively charged plate. Those atoms in contact with the positive plate loose their free electrons, which travel from the plate to the battery, and around to the negative plate, thus creating a preponderance of electrons at the dielectric material in contact with the negative plate and a scarcity of electrons at the positive plate. The atoms which lose their free electrons to the positive plate now have a terrific attraction, or affinity, for electrons. However, **the nature of the material;** i. e., not conducting, **prohibits the free motion of electrons** from neighboring atoms deeper within the dielectric material. Thus—a greatly magnified cross section of the dielectric material would reveal that on one side there is a positive affinity, and (progressing from the positive toward the negative side of the material), there is a decreasing intensity in the positive attraction until a point is reached where there is a state of balance.

Further progress along this same line of direction will reveal an ever increasing negative, or repulsive condition; i. e., the positive is attractive, and the negative is repulsive in nature. This repulsive; i. e., negative, intensity increases until its maximum is reached at the surface of the dielectric material which was in contact in the negative plate.

It is possible to plot a curve showing the lack of electrons on one side of the material, and the abundance of electrons on the other side of the material. When this is "plotted" with intensity on the vertical scale, and distance on the horizontal scale, the resulting curve will be that of the potential difference existing across a charged condenser.

The action so far described, is that which is known as "charging" a condenser, and, in a previous paragraph we abandoned the description with a full charge in the condenser.

Now, that we have a "charged" condenser, let us see what happens when the condenser discharges. This is shown in Figure 27.

Figure 27 shows the charged condenser, which is prevented from discharging by the open switch. **Remember the situation existing in the dielectric material when the condenser was charged.**

Before explaining what happens in the circuit when the switch in Figure 27 is closed, it is necessary to point out that **the difference between a non-conducting and a conducting material is that the conducting material has such atomic structure that the free electrons are easily displaced. If electrons are removed from one end of a conductor, a corresponding number of electrons MUST ENTER THE OTHER END OF THE CONDUCTOR.**

When the switch in the circuit of Figure 27 is closed, electrons are attracted from the positive plate by the atoms in the dielectric material, which is in contact with the plate, remembering from our previous discussion, that these atoms had been robbed of their free electrons, and therefore, they were attractive toward any free electrons in their immediate vicinity. Therefore, when the switch is closed, these atoms attract the free electrons from the atoms composing the molecules of the positive plate, the atoms of which in turn attract the free electrons in the conducting path which extends around to the negative plate. **Remember—That there existed an over abundance of electrons in the atomic structure of the dielectric material next to the negative plate.** Therefore, the attraction for free electrons begins in the dielectric material next to the positive plate and extends around through the circuit to the negative plate, where there is an over-abundance of electrons. These "extra" electrons are enough to satisfy the attraction existing throughout the circuit. Therefore, when the switch is closed, the dielectric material absorbs electrons from the plate, the plate from the conducting circuit, and the conducting circuit absorbs the free electrons in the negative side of the dielectric material. **A discharge of a condenser in reality is the restoration of balance of electrons in the atomic structure of a dielectric material.**

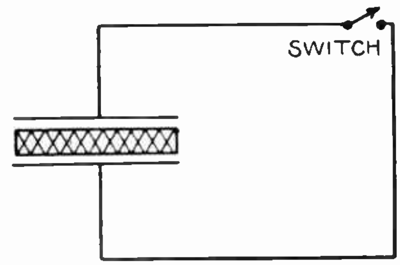


FIGURE 27

At this time, it is well to point out that the electron movement in the discharge circuit described and illustrated in Figure 27, is not of any great length; i. e., the electrons do not move from the negative plate around to the positive plate; they merely move from one atom to another. Thus—the flow of current which occurs through the circuit when a condenser is discharged, is nothing but the movement of electrons from one atom to an adjacent atom, which is a distance far too small to be conceived by the human mind.

An alternating current apparently flows through a condenser, but a direct current does not. To be more explicit, when a direct current potential is applied to the terminals of a condenser, there is a very small surge of current which flows through the circuit, but not through the condenser, **because there is not a progressive motion of electrons from one atom to another along the path of the circuit which is occupied by the dielectric.**

If you do not understand this statement, read the description of the charge and discharge of a condenser.

When the statement is made that alternating current flows through a condenser, it is in the very strict sense of the word, not exactly so, because the dielectric material in a condenser offers no more conductance to an alternating current than it does to a direct current. However, due to the reversal of polarity which occurs in an alternating current circuit, the condenser charges and discharges on each half cycle of the applied current. Therefore, there is current flowing in the circuit, but not "through" the condenser.

This statement may be "hard to swallow," but it is an absolutely true statement, because the dielectric material in the condenser is not a conductor. How, then, does alternating current flow through a circuit containing a condenser? the answer is to be found in the actions which take place in the charge and discharge of a condenser. When a condenser is charged, there is an abundance of electrons at the negative plate, and a scarcity of them at the positive plate. If the polarity of a circuit attached to a condenser is such that **the positive side of the circuit** is connected to the negative plate, **and the negative side of the circuit** is connected to the positive plate of the condenser, the extra electrons existing at the negative plate of the condenser will move into the circuit, establishing an over-abundance of electrons in the circuit. The electrons leave the circuit to satisfy the deficiency of electrons existing at the positive plate of the condenser. **WHEN THE ELECTRONIC BALANCE OF THE ATOMIC STRUCTURE FOR THE ENTIRE CIRCUIT IS RESTORED, THE POTENTIAL DIFFERENCE; I. E., VOLTAGE, IS ZERO.**

CONDENSER ACTION IN AC CIRCUITS

We are now ready for the explanation of the action of a condenser when used in an alternating current circuit. Remember, that the "apparent" flow of alternating current through a non-conducting material; i. e., dielectric of a condenser, is not possible in the strict sense of the word. However, there is a flow of current in an alternating current circuit which includes a condenser.

In order to thoroughly explain this action, we must have recourse to illustrations. The first of these is Figure 28.

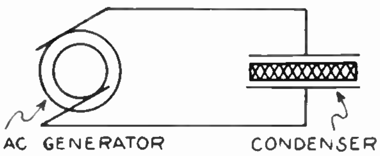


FIGURE 28

This illustration shows a condenser connected in a circuit with an alternating current generator. As the generator revolves, and starts a cycle, we will assume that the upper portion of the circuit is positive, and the lower part of the circuit is negative. The voltage rises from zero to a maximum, and then falls to zero, thus completing one-half of a cycle. At this point, the polarity of the circuit reverses; i. e., the top half of the circuit becomes negative, and the bottom half positive, and again the voltage rises to a peak and falls back to zero, whereupon the polarity again reverses and becomes the same as at the start, that is, one cycle has been completed.

When the voltage rises on the first half of the cycle, the condenser is charged. After the voltage reaches the peak, it falls to zero (at the same rate at which it rose to the peak). We now have a condition wherein **we have a charged condenser, and a conducting circuit from one plate of the condenser to the other** (through the generator).

Remember—**That a charged condenser will discharge, if there is a conducting path from one terminal of the condenser to the other.**

Therefore, the condenser will discharge through the circuit. However, before this discharge is complete, the voltage from the generator is rising on the second half of the cycle.

The rising voltage of the second half cycle of the alternator is of such a polarity that it aids the completion of the discharge of the condenser, and then recharges the condenser (but with opposite polarity to that of the first charge). The voltage from the alternator again falls to zero, and of course, the condenser discharges through the circuit.

The peculiar part of this whole action of charge and discharge, is that **THE CURRENT IN THE CIRCUIT "LEADS" THE VOLTAGE**; i. e., the current in the circuit reaches its maximum intensity before the voltage reaches its highest value.

So far, our discussion has been centered around a perfect condenser; i. e., one in which there is no losses. In actual practice, all condensers have a certain amount of loss. These losses which occur in condensers are of two types; first, there is a "hysteriesis" loss which is due to molecular friction. Friction is generated in the molecules or molecular structure of the dielectric by the atoms attempting to rearrange themselves when under the stress of the applied voltage.

The second type of loss is that due to leakage in the dielectric. **All insulating materials; i. e., dielectrics have a certain amount of conductance,** that is, they are not perfect insulators but allow the passage of minute currents. We find that even the best insulating materials have a resistance of several megohms when measured by sensitive instruments. The first type of loss in a condenser is usually pictured by a symbol of a perfect condenser with a "series" resistor which represents the loss. This is illustrated in Figure 29.

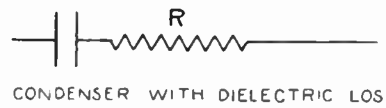


FIGURE 29

The second type of loss in a condenser is pictured as a resistance in "shunt" with a condenser as shown in Figure 30.

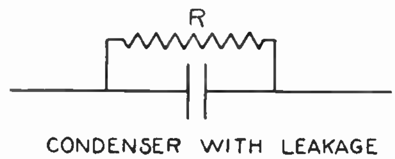


FIGURE 30

The result of these losses in a condenser is a decrease in efficiency; i. e., a loss of power. The efficiency of a condenser is expressed in the term "Power Factor." The meaning of this term is that if a condenser has a "power factor" of 2% that there is a loss of 2% of the applied power.

The power factor of a condenser (expressed in percentage) is equal to $\frac{W \times 10^6}{w\,C\,V^2}$ wherein W is the wattage lost, "w" is twice "pi" or 6.28, C is the capacity (in microfarads), V^2 is the voltage squared and 10^6 is 10 to the sixth power or 1 million.

BY-PASS CONDENSER CIRCUITS

Many circuits in radio receivers or amplifiers carry both alternating and direct current. It is necessary to provide separate paths for the flow of these two different currents, in order to accomplish certain actions. A circuit may carry direct current for plate supply and an AC signal current at the same time. It is necessary to provide a path for the signal voltages so that they may be applied only to certain portions of the circuit. In other words, it is necessary to separate the direct current and the alternating signal current.

A convenient means of obtaining this separation is to use a condenser to provide a path for the alternating current, because the direct current does not flow through a condenser, therefore we can obtain the desired separation.

This action is perhaps best illustrated by Figure 31.

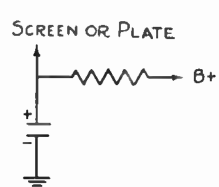


FIGURE 31

This circuit shows the use of a condenser to allow the passage of alternating signal current, from the screen circuit of a tube to ground, the resistor prohibits the AC current from getting into the "B" supply where it might cause trouble; i. e., feed back and howls. In most instances the resistor is necessary to provide the correct voltage for the screen, therefore it readily serves two purposes.

The action of the condenser whereby it provides the path for the alternating current, is described in the chapter headed "Condenser Action in Alternating Current Circuits."

An additional illustration of the use of a condenser to provide a path for alternating current, is illustrated in Figure 32.

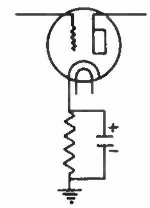


FIGURE 32

The action taking place in the circuit of Figure 32 follows: The resistor shown connected from the cathode of the tube to ground, is for the purpose of supplying a bias voltage for the grid of the tube. This resistor is usually of several thousand ohms resistance, and would offer an impedance of this value to the flow of the signal current. Such an impedance to signal currents at this point would introduce regeneration, and this is usually to be avoided. If we connect a condenser across the resistor, we will provide a path for the alternating current, which will not affect the required voltage drop across the resistor necessary for bias supply.

CAPACITY OF BY-PASS CONDENSERS

The capacity of a by-pass condenser is regulated by the frequency of the current to be handled, and in addition, the resistance of the circuit to be by-passed. It is a general rule, that the capacitive reactance of a condenser should be approximately one-tenth, or less, the resistance value of the circuit to be by-passed.

Capacitive reactance is the "impedance;" i. e., opposition of a condenser to the flow of an alternating current. This reactance is expressed in ohms by the formula $X = \frac{1}{w\,F\,C}$, where w is 6.28, F is the frequency in cycles per second, and C is the capacity in Farads.

To those mathematically inclined, the above formula shows that for a given value of capacity, the reactance decreases with increasing frequency. For practical illustration, let us say that a 1 mfd. condenser has a reactance of 1592 ohms at 100 cycles, but that for 200 cycles, the reactance is only 796 ohms.

To find the correct capacity value to be used for by-pass condensers, it is only necessary to know the resistance of the circuit to be by-passed, and the lowest frequency which will appear in the circuit. Then find the capacity value, the reactance of which is approximately one-tenth or less of the resistance of the circuit to be by-passed, at the lowest frequency which appears in the circuit.

ELECTROLYTIC BY-PASS CONDENSERS

Inasmuch as many circuits to be by-passed are of very low resistance, or are carrying a low frequency current, it requires a large capacity to affect the proper by-passing action.

Previous to the introduction of the electrolytic condenser, large values of capacity were extremely expensive. However, in electrolytic condensers, particularly at low voltages, it is possible to obtain a very large value of capacity at low cost, and in a small space. For instance, the usual capacity required for by-pass in the circuit of Figure 32, is in the order of 20 mfds. at a potential difference of approximately 25 volts or less.

An electrolytic condenser suitable for use in this circuit will occupy a space of only 7/8" diameter x 2 1/4" long. These are the dimensions for the Type TS102, which has a capacity of 20 mfds., and a working voltage of 25 volts. Such a capacity value in a paper condenser would occupy quite a few cubic inches of space.

Wherever a large capacity is required for a by-pass condenser, and where there is a DC voltage, it is advisable to use an electrolytic condenser. For very high frequencies, a paper condenser should be used, inasmuch as electrolytic condensers are not suitable for use as by-pass condensers at frequencies above several kilocycles.

Where a circuit to be by-passed carries both Audio and RF currents it is often advisable to use both an electrolytic condenser and a paper condenser. Such arrangements are found in many receivers.

EASY REPLACEMENT OF UNMARKED CONDENSERS

Read this chapter and save yourself time and labor when it is necessary to replace a condenser which is not marked as to capacity and working voltage.

This easy, quick, step-by-step method requires quite a few words to explain, but is easy to follow and saves a lot of time in repairing a receiver.

First: **Ascertain the working and surge voltages.** A method of doing this is outlined in the chapter "Surge Voltage."

Second: With the voltage known, the condenser is semi-classified, and the replacement will necessarily fall in one of the three groups of condensers; i. e., 250 volts, 450 volts, or High Surge types.

The next most important step is to ascertain the capacity value.

PROCEDURE FOR FILTER CONDENSERS

A. **FOR SINGLE UNIT CONDENSERS** of either the can or carton type, use 8 mfd. or larger, **except at the input to a filter.**

Note—When replacing original paper condensers, which rarely exceed 2 mfd., it is advisable not to use more than 4 mfd., as values above this may cause the output voltage to rise to too high a value. On the other hand, half-wave rectifiers require a large capacity value at the input to the filter. In AC-DC receivers, the input capacity for half-wave rectifier is usually in the order of 25 mfd. (for further details refer to note at the end of this chapter).

B. **FOR BLOCK OR MULTI-SECTION CONDENSERS.**

First. Sketch the circuit and note the connection of the leads of the condensers and their color. For illustration, let us suppose you are working on an AC-DC receiver, and your sketch looks like this:

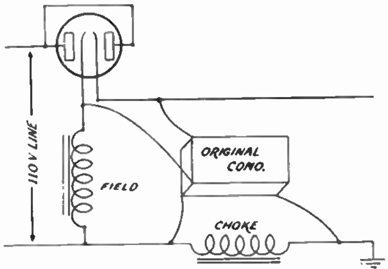


FIGURE 33

Second. **Carefully open the condenser and trace and sketch the connections of the various units.** This will help you to ascertain the way in which the various sections are connected in the circuit.

Next, sketch in the condenser connections to the various parts of the circuit as per Figure 34.

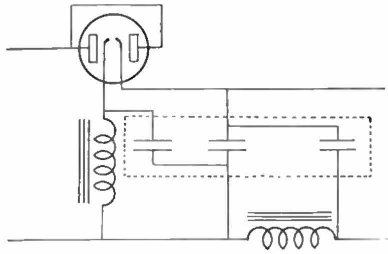
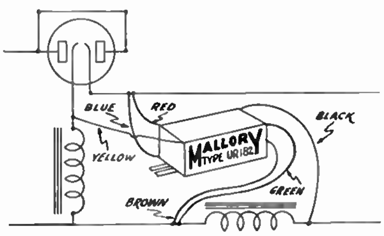


FIGURE 34

Now, refer to the condenser circuits given on pages 208 to 211 and find a circuit such as the one you have sketched. This turns out in this instance to be Circuit 11 (note the figures given beneath the circuit).

Now turn to the "Replacement" section and go up and down the "Circuit" column under the heading "Condensers," until you find this circuit number. When you have found this number, you will also find the correct replacement condenser, because it is given in the next column to the right of the circuit column. For instance, Circuit 11 will be found in the replacement section on page 154 (Zenith Model 710), where you will note that the UR182 is listed as the replacement.



With some circuit numbers you may have to search over several pages. This is advisable, because there are many combinations of condensers which may be used as replacements. Thus, by consulting two or three pages of the replacement section, you may ascertain several different combinations which may be used as a replacement and from these select the types of condensers most suited to your particular job.

Note—The numbers given beneath the circuits on pages 208 to 211 refer to the "B" or condenser notes, given on pages 200 to 207. These notes not only state the replacement condenser, but also give detailed instructions for connecting the replacement condensers into the circuit.

Note—Filter input condensers regulate the output voltage of the filter. With full wave rectifiers, this is not so noticeable as with half wave rectifiers.

There is generally no harm in raising or lowering the input capacity 2 or 3 Mfds. but with half wave rectifiers, too great a reduction in input capacity will cause a loss of voltage.

Figure 35 shows the relation between load and input capacity for various output voltages of a half-wave rectifier.

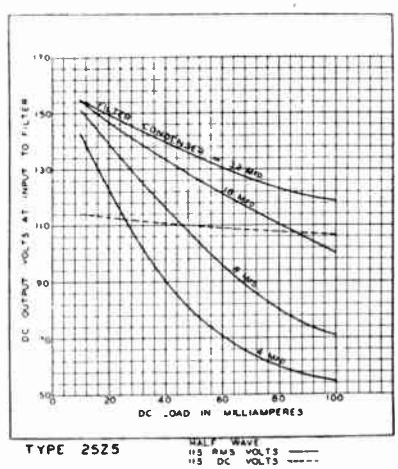


FIGURE 35

BY-PASS CONDENSER REPLACEMENT

When replacing by-pass condensers, follow the same procedure as is given in the preceding paragraphs devoted to filter condenser replacement. **Note**—Low voltage condensers may always be replaced with condensers of a higher voltage rating. Thus, a 5 mfd. 20 volt condenser may be replaced by an 8 mfd. 450 volt condenser. Although the higher voltage condenser may cost a few cents more than the low voltage condenser, there are many times when such a replacement will save you much more than the difference in cost, in the time saved.

HOW TO USE THE "B" NOTES

The extreme right-hand column under the general heading **"CONDENSERS"** in the replacement section of the encyclopedia is the **"NOTE COLUMN,"** in which is listed various numerals preceded by the letter "B," such as "B16."

"B16" refers to one of the notes on the following pages. These notes pertain to the replacement of condensers, and enables us to tell you exactly **WHAT TO DO AND HOW TO DO IT. These notes guide you so that you may make a quick and easy repair.** They also enable us to warn you to watch for certain things, and most of all **TELL YOU HOW TO WIRE IN A CONDENSER REGARDLESS OF THE ORIGINAL COLOR CODE, CHANGE DURING MANUFACTURE, OR PREVIOUS REPAIR.**

CONDENSERS			
Original Part	Circuit	Correct Replacement	*Note
8-8	1	See Note	B3

Here is an illustration of part of the replacement section. **The meaning expressed** in the apparently cryptic message **is that the original condenser combination in the particular receiver is two 8 mfd. units used in Circuit 1, as shown on page 208, and that you are to read "B" note No. 3, which states "B3—Physical characteristics are unknown. We suggest replacing with equivalent Mallory type of equal or higher capacity. Check voltage for higher rating."** You are told that there are two 8 mfd. units used in Circuit 1, but you alone know whether there are two single 8 mfd. units or a single unit containing two 8 mfd. sections. You also know the physical specifications; i. e., whether it is a round can or carton type of condenser, or, condensers.

You have the original before you in the receiver. You know the physical appearance and permissible size. We have given you the capacity and a schematic of the circuit. THIS IS ALL THE INFORMATION ONE COULD ASK TO MAKE A REPLACEMENT. You may now select the proper condenser. The voltage rating should not bother you, for—if the receiver is of an AC type using a transformer, a 450 volt condenser should be used. If the receiver is an AC-DC type, a 250 volt condenser should be used, inasmuch as even with a voltage doubler, the 250 volt rating is always sufficient.

Let us take a more complicated note, for example: **No. B18,** which states: **"Refer to schematic No. 6 and connect UR182 as follows: Green, Brown and Black to points 'C,' and 'D,' Red to point 'A,' Yellow and Blue to point 'B.' "**

Figure 37 shows Circuit 6 with the UR182 connected as per the instruction in Note No. B18.

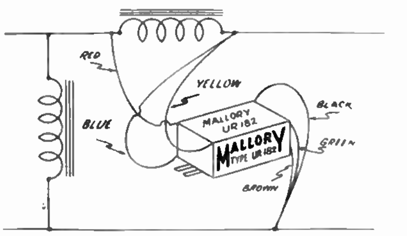


FIGURE 37

Note the procedure. This is clear, direct and saves your time. No longer do you need to puzzle over the question as to which lead goes where.

Let us take up a still more complicated note; for example, No. B49. **"Refer to schematic No. 9 and connect CM165 as follows: One Red to point 'A,' corresponding Black to point 'B,' and other Red to 'B,' corresponding Black to point 'C,' remaining Red to point 'D' and Black to 'E.' Note—In some cases there are two pig-tail resistors between the field and point 'E' which is connected to the chassis."**

Figure 38 shows a pictorial view of Circuit 9 with the CM165 installed as per instructions in note No. B49.

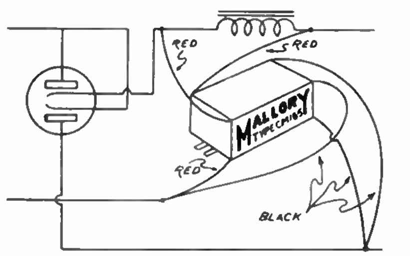


FIGURE 38

This illustration shows how simple and easy it is to make what would otherwise be a difficult installation. Think of the time you might lose in waiting for an exact duplicate which would be no better than the original, whereas, **the readily obtainable Universal Mallory condenser is easily installed and gives you a profit quickly.**

These "B" notes have been written by practical men for practical every-day use. USE MALLORY CONDENSERS AND BE SURE TO LOOK AT THE CIRCUITS AND READ THE NOTES.

AC MOTOR STARTING CAPACITORS
General Design and Use

Millions of AC Dry Electrolytic motor starting capacitors are now in use.

Starting capacitors are used on motors where high starting torque is required and where the power supply is single phase. In such cases, the capacitor, due to phase displacement, permits the design of a two-phase starting winding in the motor, thereby gaining high torque characteristics. (See Fig. 39.) Since electrolytic capacitors should not be left on AC continuously, such motors are provided with an automatic switch which disconnects the capacitor when the motor has reached a given speed. The motor then operates as a single phase motor.

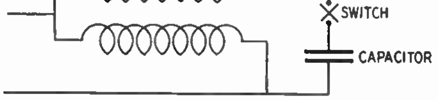


FIGURE 39

The average starting cycle of refrigerator motors (less than one second, two to five times per hour) obviously represents a rather light service condition and should not affect the life of the capacitor.

The major causes for capacitor failures in this field are stalled rotors (due to defective mechanical mechanism), sticking switches (due to contact difficulties) and actual capacitor defects. Stalled rotors or sticking switches allow the capacitor to remain on the line until destroyed by the internal heat generated.

Defective capacitors are usually short or open circuited or have lost their effective capacity. A quick check to determine that the capacitor is definitely defective is to charge it with direct current (through a limiting resistor if necessary). If no discharge is evident on immediate short circuit the capacitor can be assumed to be open or short circuited, or to have lost its effective capacity. Note: If AC only is available, repeat charging cycle several times to be sure capacitor actually has a chance to charge.

When servicing motors where the capacitor failed, always inspect the switch and be sure it is operating properly before making replacement. Also test starting winding as this may have burned out due to abnormal heat caused by failure of motor to start.

There are two kinds of switches in general use—centrifugal and magnetic. Centrifugal switches cut out as the motor reaches a given speed—magnetic switches when the starting current has reduced to a predetermined value. Since the value of capacity changes the amount of current in the starting winding, care should be taken to use the correct capacity for replacement where magnetic switches are employed. This is not so important where centrifugal switches are used.

TERMINAL IDENTIFICATION

Some capacitors are equipped with four terminals marked "T," "TL," "L" and one unmarked terminal. These letters refer to "Thermostat," "Thermostat and Line," and "Line." "T" and "TL" are dummy terminals being used merely as an anchorage point for the motor connections. The capacitor is connected to the "L" and the unmarked terminal. See Fig. 40.

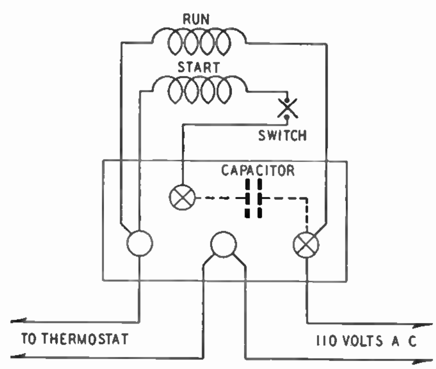


FIGURE 40

Special Notice

Capacitors were originally rated in a single round figure such as 100 mfd., 115 mfd., etc. Capacitors are now rated with their minimum and maximum value, such as 108-120 mfd., 124-138 mfd., etc. All charts give both the new and old ratings for convenience. Old ratings may be converted approximately by multiplying by 120% for the maximum rating and deducting 10% of this figure for the minimum rating.

Most round capacitors have a protective metal end cap at each end. Generally these may be used on the replacement capacitor. If they are loose on the replacement capacitor, they may be squeezed or padded with paper. If too tight, it will be necessary to purchase Mallory end caps. This is due to the use in the past of various insulation thicknesses.

Ring capacitors, because they must be internally insulated, are not guaranteed by the Mallory Company. A bank of standard round capacitors totalling the same capacity as the original is suggested for replacement whenever they may be conveniently mounted near the motor.

For replacement information on motor starting capacitors, see pages 211 and 217.

"B" NOTES

B1—Originally equipped with paper condensers. Electrolytics of equal or greater capacity are O.K. for replacement. Check voltage to determine proper condenser rating.

B2—Input condenser may be paper type. In such cases we suggest the replacement be made with a paper condenser or Mallory HS or HD high voltage units, the choice being determined by the voltage requirements.

B3—Physical characteristics are unknown. We suggest replacing with equivalent Mallory type of equal or higher capacity. Check voltage for proper rating.

B4—Filter condensers may be of paper; if so, replace with Mallory HS or HD types. Working voltage, capacity and mounting will determine type.

B5—Use types UR188 or UR189 to replace a combination such as 16-12, 16-8, 12-12, etc. The dual mfd. low voltage units are intended for by-pass circuits and may be connected in parallel (Yellows together) to obtain a single 10 mfd. section. Connect the two Red leads together to obtain the higher capacity filter section. The UR188 and UR189 contain the same capacities and voltage ratings. Select the unit which may be installed most conveniently.

B6—It is not necessary that the cathode by-pass condensers be in the same container as the filter condenser. Mallory TS units are easily installed within the chassis, the wire leads offering firm support.

B7—Originally equipped with paper condensers. Replace with combination of Mallory TP units of proper voltage and capacity.

B8—When a Mallory Multi-section condenser is recommended to replace an original single section condenser, connect the sections in parallel. This gives a capacity that is equal or greater than the original.

B9—This condenser is enclosed in the original block and tunes the filter choke to the ripple frequency. Replace with Mallory TP unit or combination of units giving the same capacity as the original.

B10—This condenser is used only on the later type of this model.

B11—Requires a non-polarized type of electrolytic for replacement. To obtain a non-polarized capacitor use a Mallory RN or CN type having the same capacity in both sections. Cut off the black lead close to the container and tape to prevent shorting against chassis. Use the two Red leads as the terminals of the condenser. The resulting capacity is equal to one-half the capacity of one section; i. e., CN150 will have an effective non-polarized capacity of 2 mfd. at 450 volts. Thus to secure 4 mfd. non-polarized, it requires the use of a Mallory RN242 or CN152. (See Circuit 39 in the "B" condenser circuit section.) Note: the RM or CM units may also be used by paralleling the sections and then connecting the negative leads together and taping as above.

B12—This additional capacity used on 25 cycle models only.

B13—This power pack is used in many early Mohawk models. Color code of the filter condensers are: Green 2 mfd., Blue 2 mfd., Yellow 1 mfd. In addition there is a .5 mfd. from B positive to B negative. See note B1.

B14—These condensers are used across the secondary of the vibrator transformer. Replace with Mallory VB or OT type condensers of the same capacity value.

B15—Remove old condenser from can and place CN151 in can if desired.

B16—Mount in hole in chassis or use Mallory bracket No. 104-1.

B17—Refer to schematic No. 11 and connect UR182 as follows: Black and Brown to points "D" and "E," Red to point "A," Blue to point "B," Yellow to point "C," and Green to point "F."

B18—Refer to schematic No. 6 and connect UR182 as follows: Green, Brown and Black to points "C" and "D," Red to point "A," Yellow and Blue to point "B."

B19—For this replacement we suggest the use of three CS126 units.

B20—This condenser is used only on later models.

B21—Install beneath chassis and connect Red leads together to positive, Black to negative. Leave old unit in place if desired, but be sure to remove leads from it.

B22—Refer to schematic No. 9 and connect CM165 as follows: One Red to point "A," corresponding Black and another Red to point "B," remaining Red to point "D," remaining Blacks to points "C" and "E."

B23—When Mallory Stud type condensers such as the SR602, SR605, etc., are recommended to replace condensers of the ring clamp mounting type, the stud may be cut off flush with the top of the can. Be careful not to cut into the can.

B24—Connect RN241 or RN231, Blue to positive 4 mfd., Red to positive 8 mfd., Black to chassis. Connect positive of TS101 to cathode of output tube, negative to chassis.

B25—Refer to schematic No. 4 and connect CM172 as follows: Red leads together and to points "A" and "B," one Black to point "C," remaining Black to point "D."

B26—Refer to schematic No. 1 and connect RN241 as follows: Blue to point "A," Red to point "C," Black to chassis at points "B" and "D."

B27—Later type of Model 856 used a 16 mfd. condenser in place of the 8 mfd. No. 27585; in which case use the RS216.

B28—There were two types of filter circuits used in this model; the older type used a dual 4 mfd. as first and second filter with an 8 mfd. in the output. The later type used the same combination but with the 8 mfd. as the input condenser.

B29—Refer to schematic No. 1 and connect UR189 as follows: Blue to point "A," both Reds to point "C," Brown, Black and Green to chassis. Connect one Yellow to cathode of output tube, the other Yellow to cathode of detector tube.

B30—Mount the SR611 by means of the metal flange, cut off and disregard the Blue lead. Two CS133 units may be used if desired.

B31—Refer to schematic No. 11 and connect UR182 or UR193 as follows: Yellow to point "A," Red and Blue to points "B" and "C," Green and Brown to points "D" and "E," Black to point "F" (chassis).

B32—Join two of the CM165 Red leads together and to B positive, one Red lead to Blue lead from switch, corresponding Black to plate of 25Z5, remaining Black to chassis.

B33—Refer to schematic No. 29 and connect CM162 as follows: one Red to point "A," corresponding Black and remaining Red to point "B," remaining Black to point "C." The additional 8 mfd. unit is beneath the chassis and connected Red to point "D," Black to point "E."

B34—Refer to schematic No. 1 and connect one Red to point "A," another Red to point "C," remaining Red to cathode of output tube, Black to chassis.

B35—We suggest the use of UR190 for this replacement.

B36—Refer to schematics Nos. 6 and 15 and connect UR189 as follows: Blue to point "A," both Reds to "B," Brown, Black and Green to chassis at points "C" and "D," one Yellow lead to cathode of detector, remaining Yellow to cathode of output tube.

B37—May require use of condenser bracket No. 104-1.

B38—On some chassis of the model 525 the condenser was in two cartons, the C525C (5 mfd.—25 mfd.) and the C525D (5 mfd.). We recommend the UR182 which replaces both of the units.

B39—Install Mallory condenser in the old can or beneath the chassis.

B40—Use the BN type of by-pass condenser.

B41—Install the RN245 in the chassis hole provided for the original wires. Discard the old condenser cover if desired.

B42—Refer to schematic No. 1 and connect the CN152 as follows: one Red to point "A," remaining Red to point "C," Black to chassis at points "B" and "D."

B43—An .05 condenser was used for buffer on first type only, value of second type unknown.

B44—Models using the F312 vibrator have a .005 mfd. buffer; those using the F221 vibrator have an .04 mfd. buffer.

B45—The original block No. P80902 contained two 4 mfd. condensers and a .1 mfd. paper. Replace with a CN140 and TP438 connected as follows: one Red of CN140 to screen circuit, remaining Red to first audio cathode, Black to chassis. Connect TP438 from RF screen to ground.

B46—Substitute TP441 for TP438 and connect as in note B45.

B47—Refer to schematic No. 29 and connect CM165 as follows: Red to point "A," corresponding Black to "B," another Red to point "B," corresponding Black to "C," remaining Red to "D," and Black to "E."

B48—Refer to schematic No. 4 and note that a resistor is used in place of the choke shown. The RM262 should be mounted in the chassis hole or by means of Mallory bracket No. 104-1; connect both Red leads to points "A" and "B," one Black to point "C," remaining Black to point "D" (chassis).

B49—Refer to schematic No. 9 and connect CM165 as follows: one Red to point "A," corresponding Black to point "B," another Red to "B," corresponding Black to point "C," remaining Red to point "D" and Black to "E." Note—In some cases there are two pigtail resistors between the field and point "E" which is connected to the chassis.

B50—Refer to schematic No. 23 and connect RM262 as follows: Blue and Red to points "A" and "B," Brown to point "C," and Black to point "D." If necessary use Mallory bracket No. 104-1.

B51—Refer to schematic No. 29 and connect CM165 as follows: one Red to point "A," corresponding Black to point "B," another Red to point "B," corresponding Black to point "C," remaining Red to point "D" and Black to "E." Note—In this receiver there may be a pigtail resistor between the field and point "E."

B52—This condenser connects between points "A" and "C" on schematic No. 29.

B53—Refer to schematic No. 29 and connect UR190 as follows: one Red of one of the independent sections to point "A," corresponding Black to point "B," Red of the other independent section to point "B," corresponding Black to point "C," one Red of the common section to point "D," the other Red to 6A7 plate supply, Black to ground at point "E."

B54—This chassis is the same as the Majestic 300, 300A.

B55—Connect RN245 and CN151 as follows: Blacks to high voltage center tap; two Reds of RN245 to output side of filter choke; other Red to screen of first detector. Red of CN151 to cathode of output tube, Blue to first AF plate supply.

B56—Refer to schematic No. 11 and connect RM259 and TS101 as follows: Green of RM259 to point "A," Yellow and Brown to points "D" and "E," Blue and Red to points "B" and "C," Black to "F." Connect TS101 positive to second detector cathode, negative to point "F."

B57—Connect Black leads to chassis; other lead connections are obvious.

B58—Refer to schematic No. 4 and connect RM265 as follows: Red and Blue to points "A" and "B," Black to point "C," Brown and Yellow to point "D," Green to screen circuit.

B59—Refer to schematic No. 1 and connect RM257 as follows: Red to point "A," Black to point "B," Blue and Green to point "C," Brown and Yellow to point "D."

B60—Connect one 8 mfd. section to rectifier side of choke, combine two sections and connect to speaker side of choke, the remaining section to voltage divider at output side of speaker field.

B61—Refer to schematic Nos. 1 and 15 and connect RN232 as follows: one Red to point "C," Black to "D," remaining Red to output cathode.

B62—Combine two of the RN235 Red leads to output screen, remaining Red to detector plate resistor, Black to chassis; positive of TS101 to cathode of output tube, negative to chassis.

B63—Refer to schematic No. 1 and connect RM257 as follows: Brown, Yellow and Black together and tape, Red to choke at point "C," Blue and Green together to point "D," Note—It may be necessary to use two CS126 units installed beneath the chassis. See note B11.

B64—Refer to schematic No. 4 and connect UR193 as follows: Red, Blue and Green to points "A" and "B," Black and Brown to "C," Yellow to "D."

B66—Refer to schematics 1 and 13 and connect RN245 and CS131 as follows: two Red leads of RN245 to point "A"; remaining Red lead to point "C"; Black lead of RN245 together with Black lead of CS131 to points "B" and "D"; and Red lead of CS131 to oscillator plate supply.

B67—Refer to schematic No. 8 and connect RM259 as follows: Green to point "A," Red to point "B," Blue to point "C," Yellow, Brown and Black to points "D," "E," and "F."

B68—Refer to schematic No. 11 and connect RM259 as follows: Green to point "A," Yellow and Brown to points "D" and "E," Blue and Red to points "B" and "C," Black to point "F."

B69—Refer to schematic Nos. 28 and 13 and connect RM265 as follows: Connect Red and Blue together and to point "B" in place of the original red, Black to point "E," Brown and Yellow to chassis at "F," Green to screens of power tubes.

B70—Refer to schematic Nos. 4 and 14 and connect RM265 as follows: Red and Blue to "A" and "B," Black to "C," Brown and Yellow to chassis at "D," Green to bleeder resistor.

B71—Refer to schematic No. 11 and connect the UR190 as follows: Connect the two Red leads (that exit from the same hole in the carton) together and to one of the other Red leads, then connect this assembly to the cathode of the rectifier at point "A;" the three Black leads connect to the line at points "D" and "E," the remaining Red lead connects to the rectifier cathode at point "B."

B72—Refer to schematic No. 29 and connect UR190 as follows: Combine two Reds (that exit from same hole in carton) and connect to point "A," corresponding Black lead to point "B," connect one other Red lead to point "B," corresponding Black lead to point "C," connect remaining Red lead to point "D" and remaining Black to point "E." Point "B" is connected to DC side of switch.

B73—Refer to schematic No. 4 and connect RM262 as follows: Red and Blue to points "A" and "B," Brown to "C" and Black to "D."

B74—Refer to schematics Nos. 1 and 15, and connect RM257 as follows: Blue to "A," Green to "B," Brown, Yellow and Black to chassis at "B" and "D." Red to cathode of output tube. If necessary, use Mallory 104-1 bracket.

B75—Refer to schematics Nos. 1 and 15, connect CM173 as follows: All three Black leads to ground at "B" and "D," one Red each to "A," "C" and cathode of output tube.

B76—Refer to schematics Nos. 1 and 15, and connect RM257 as follows: Red to cathode of output tube, Blue to "A," Green to "C," Brown, Yellow and Black to chassis.

B77—We suggest the use of two UR190 condensers connected as follows: Both Red leads of the common section to cathode of 25Z5, the two other Red leads of this condenser together and to cathode of 12Z3. On the other UR190, connect both Red leads of the common section to the output of the choke, one of the remaining Red leads to cathode of 6C6 and the other Red lead to the cathode of 43, all Black leads to negative line.

B78—See note 68 for installation instructions.

B79—Connect a TS102 from 6F6 cathode to chassis in addition to one section of the BN225.

B80—Refer to schematics 1 and 15 and connect RM257 as follows: Red lead to point "C"; Blue lead to IF screen; Green lead to cathode of output tube; Brown, Yellow and Black leads together and to points "B" and "D" (chassis).

B81—Most of these original condensers employ a Red and Yellow lead; the 8 mfd. section (Red) should be connected on the rectifier side of choke.

B82—Connect RN242 as follows: Black to chassis; one Red to output screen; other Red to tuning eye target. Connect TS101 at socket of audio driver; plus to cathode; negative to chassis. Connect TS107 plus to cathode of output tube; negative to chassis.

B83—Refer to schematic No. 3 and connect one section of the MN277 to "A," connect two of the sections together and to point "B," connect the other section to point "C."

B84—Refer to schematics Nos. 1 and 15, connect both Reds to point "A," Blue to "C," Black, Brown and Green to chassis at "B" and "D," one Yellow to cathode of second detector and the other to cathode of output tube.

B85—Mount the Mallory condenser in the original can.

B86—Refer to schematic No. 4 and connect RM261 as follows: Red and Blue to points "A" and "B," Brown to "C" and Black to "D."

B87—Refer to schematic No. 1 and connect CN141 as follows: Blue to point "A," Red to point "C," Black to "B" and "D."

B88—Refer to schematic No. 27 and connect CM165 as follows: All three Red leads to "A," "B" and "C," two Black leads to "D," "E," remaining Black lead to "F."

B89—Replace with a UR190 mounted beneath the chassis. Refer to schematic No. 29 and connect as follows: one of two Red leads having common exit to point "B"; other Reds together and to points "A" and "D"; Black opposite Reds having common exit to point "C"; one other Black to point "B"; remaining Black to point "E."

B90—In case the RN232 is too long, try the SR605; cut off the mounting stud on the SR605 if necessary.

B91—Refer to schematic No. 1 and connect RN241 as follows: Red to "A," Blue to "C," Black to chassis at "B" and "D."

B92—Refer to schematic No. 1 and connect CN151 as follows: Red to "A," Blue to "C," Black to chassis at "B" and "D," mount by means of one flange, and cut off the other. If desired, cut off or bend the flanges and install in original can.

B93—Refer to schematic No. 4 and connect CM171 as follows: Red and Blue to "A" and "B," Black to "C," Brown to "D." Mount by one flange bent at right angle to support condenser in vertical position, cut off other flange. If preferred, mount condenser in original can.

B94—Refer to schematic No. 27 and connect UR189 as follows: The two Red leads to "A" and "B," Blue to "C," Black to "F," Brown and Green to "D" and "E," Yellow leads together and to cathode of detector.

B95—Refer to schematics Nos. 27 and 15 and connect the UR182 as follows: Red and Blue to "A," "B" and "C," Black and Green to chassis at "F," Brown to line at "D" and "E," Yellow to cathode of Detector (or in some cases the first AF stage).

B96—See Note B3; if round can unit can be installed we suggest RM259 for this installation.

B97—Refer to schematics Nos. 1 and 44, connect all Black leads of the UR190 to B –, the two Red leads (with common exit) together and to chassis, one of the remaining Red leads to each side of the choke.

B98—Refer to schematics Nos. 6 and 15 and connect UR189 as follows: Both Red leads to "A," Blue to "B," Yellow leads to cathode of Detector and output tubes respectively, Brown, Black and Green to chassis.

B99—The chassis type number is the group prefixing the serial numbers. The first run of this chassis used schematic No. 27 with 16 mfd. from cathodes (in parallel) to line, 8 mfd. from cathodes to chassis and 4 mfd. from 6A8 plate supply to chassis, also a .25 paper across the choke. For the first run, connect UR193 as follows: Refer to schematic No. 27, connect Blue to "A" and "B," Red to "C," Brown to line at "D," "E," Black and Green to chassis, Yellow to 6A8 plate supply. In the second run the cathodes of the 25Z5 were separated thus changing the circuit to schematic No. 11 and the .25 mfd. condenser was removed from across the choke and a separate 4 mfd. tubular connected across the field. For this circuit refer to schematic No. 11 and connect UR193 as follows: Blue to "B," Red to "C," Brown to line at "E," Black and Green to chassis at "F," Yellow to 6A8 plate supply. Use an additional CS121 with Red to "A," Black to "D."

B100—Refer to schematic No. 27 and connect CM165 as follows: All Red leads to "A," "B," "C," two Black leads to "D," "E," one Black lead to chassis at "F."

B101—Use the following: one CM164 to replace the 16-16 mfd. section, all Black leads to chassis, one Red lead to each side of the choke. One CN141 to replace the 8-4 mfd. section. Black to chassis, Red to screen of 6A7, Blue to cathode of 25Z5 supplying field. One TS101, positive to 43 cathode, negative to chassis.

B102—Use one CM164 and one UR183; refer to schematics Nos. 8, 13 and 15, and connect units as follows: Black leads of CM164 to chassis, one Red lead to each side of the choke. Black and Brown leads of the UR183 to chassis, Yellow to cathode of output tube, one Red to rectifier cathode supplying the field, one Red to 6A7 screen supply.

B103—Refer to schematic No. 6 and connect two Red leads of the RN235 to point "A," the remaining Red to "B," and Black to chassis at "C," "D."

B104—When AC-DC switch is in AC position the filter circuit is the same as schematic No. 8 with the exception that there is an additional choke connected at point "C." Connect UR182 as follows: Red to point "C," Black to point "F," Yellow to point "A," Blue to point "B," Green to the AC side of the AC-DC switch connected to the speaker field, and Brown to points "D" and "E."

B105—Refer to schematic No. 45 and connect UR190 as follows: One each of the two Red leads (having a common exit from the carton) to points "D" and "E," the Black of this section to chassis at "F," one of the remaining Red leads to point "A," corresponding Black connects to the remaining Red and to point "B," the remaining Black to the chassis at point "C."

B106—Refer to schematics Nos. 4 and 17 and connect RM265 as follows: Red and Blue to points "A" and "B," Black to "C," Brown and Yellow to "D," Green to filament center tap resistor.

B107—Connect CM173 as follows: One Red to junction of filter choke and RF choke, another Red to the screen of the first detector, remaining Red to "B" plus of the audio-transformer, and all Blacks to chassis.

B108—Refer to schematics Nos. 8 and 15 and connect RM259 as follows: Blue and Green together to point "C," Red to point "B," Black, Brown and Yellow to chassis at "E" and "F." Connect RN232 Black to chassis at "D," one Red to point "A," and remaining Red to cathode of output tube.

B109—To replace RC501 refer to schematics Nos. 13 and 15, and connect CN151 as follows: Blue to osc. plate supply, Red to cathode of output tube, and Black to chassis. For RC502 refer to schematics Nos. 13 and 14, and connect CN150 as follows: one Red to junction of 20M ohms and 500M ohms resistors in the first AF plate supply, remaining Red to first AF screen, and Black to chassis.

B110—If the filter and by-pass condensers are all in one block, refer to schematics Nos. 6 and 15, and use UR182 connected as follows: Connect Blue to point "A," Yellow to point "B," Black, Green and Brown together to points "C" and "D," remaining Red to detector cathode.

B111—Refer to schematics Nos. 1 and 15, connect CN155 and TN111 as follows: Two Reds of CN155 to point "A," remaining Red to point "C," Black of CN155 and negative of TN111 to chassis (that is, points "B" and "D"). Connect one positive of TN111 to detector cathode, remaining positive to cathode of output tube.

B112—Refer to schematic No. 25 and connect CM172 and TS102 as follows: One Red of CM172 to point "A," corresponding Black to point "C," remaining Red to point "B," the other Black to point "D," connect TS102, positive to point "D," negative to point "C."

B113—Refer to schematic No. 4 and connect SR620 as follows: Red to points "A" and "B"; Yellow to point "C"; Black to point "D." Some of these sets used a can type unit for which we recommend an RM259 connected as follows: Red, Blue, and Green to points "A" and "B"; Black and Brown to point "C"; Yellow to point "D."

B114—Refer to schematics Nos. 6 and 15 and connect UR182 and TS101 as follows: Blue to point "A," Red and Yellow to point "B," Black, Brown, Green and negative of TS101 to chassis. Positive of TS101 to cathode of output tube.

B115—Refer to schematic No. 27 and connect as follows: Red, Blue and Yellow to points "A," "B" and "C," Brown and Green to points "D" and "E," Black to chassis at point "F."

B116—Refer to schematics Nos. 3 and 14 and connect HS692 as follows: Red to point "A," Black to point "D." Connect UR191, the two Red leads (with common exit) together and to point "B," corresponding Black to point "E," one of the two remaining Red leads to point "C," the other to the 100-volt tap on the voltage divider, both remaining Black leads to point "F."

B117—Refer to schematic No. 4 and connect CM165 as follows: All Red leads together and to points "A" and "B," two Blacks to switch (point "C") and the remaining Black to chassis (point "D").

B118—Refer to schematic No. 11 and connect UR182 as follows: Yellow to point "A," Red and Blue together and to points "B" and "C," Green and Black together and to point "F," and Brown to point "E." This connection is not the same as the standard described in note 31. However, the wiring used in note 31 is applicable in some cases of noticeable hum.

B119—Refer to schematics Nos. 6 and 15 and connect CN145 and TS102 as follows: two Reds of CN145 to point "A," remaining Red to point "B," Black to point "C." Connect TS102 positive to output cathode, negative to point "D."

B120—Refer to schematics Nos. 2 and 13 and connect CN155 and CN142 as follows: Two Reds of CN155 to point "A," remaining Red to point "C," Black to chassis at points "B" and "D." Connect one Red of CN142 to terminal 6 of original block, remaining Red to original terminal 4, and Black to chassis.

B121—If receiver should be disconnected from the power pack the voltage rises to 900 volts for 9P6 and correspondingly for the other similar power packs; therefore, we advise the use of HS (High Surge) units for replacement.

Schematic No. 47 gives a view of a replacement made with HS carton units.

The by-pass sections of the original may be replaced with larger capacity units of electrolytic type, thereby giving better filtering action at the by-pass point.

The illustration in schematic No. 47 shows an installation of two HS692 and two HS690 condensers replacing the original block.

B122—Mount CN145 and TS101 in the original can. Refer to schematics Nos. 6 and 15 and connect as follows: Two Reds of CN145 to point "A," remaining Red to point "B," and Black to points "C" and "D." Connect Positive of TS101 to output cathode, and negative to point "D."

B123—Mount CN151 and TS101 in the original can. Refer to schematics Nos. 1 and 15 and connect as follows: Red of CN151 to point "A," Blue to point "C," and Black to points "B" and "D" (chassis). Positive of TS101 to output cathode, and negative to chassis.

B124—Refer to schematic No. 6 and connect CN145 as follows: Two Reds together and to point "A," remaining Red to point "B," and Black to points "C" and "D."

B125—Condenser supplied on order. State part, make and model number of receiver.

B126—To replace P80956 refer to schematic 25 and connect RM262 and TS102 as follows: Red of RM262 to point "A," Black to point "C," Blue to point "B," and Brown to chassis. Connect TS102 negative to point "C," and positive to chassis.

B127—To replace P80937 refer to schematics Nos. 14 and 15 and connect RN231 as follows: One Red to IF screen, the other Red to second detector cathode, and Black to chassis.

B128—Original is a dual 12 mfd. unit, physical characteristics unknown. If of the can type, an RN245 may be used. Combine two of the sections and connect to the input side of speaker field, the other section to the output side of the field, Black to chassis.

Although the CN152 will satisfactorily replace the original part (No. B166143) some may desire to use a CS133 and TS101, which is entirely satisfactory in every way.

B129—Since these condensers originally had a screw-socket base, we recommend replacement with a carton beneath the chassis.

B130—Refer to schematics Nos. 1 and 15 and connect CN151 and TS101 as follows: Blue of CN151 to point "A," Red to point "C," and Black to points "B" and "D." Connect TS101 positive to AF output cathode, negative to chassis.

B131—Connect CN151 as directed in note 130.

B132—Refer to schematic No. 1 and connect RN241 as follows: Blue to point "A," Red to point "C," Black to chassis at points "B" and "D."

B133—Original unit was combination of .25 mfd. and .5 mfd. paper, and 8 mfd. electrolytic. Replace with combination of TP420, TP432 and TS101 respectively.

B134—Refer to schematics Nos. 8 and 15 and connect UR189 as follows: Blue to point "A," one Red to point "B," the other Red to point "C," Black, Brown and Green to points "D," "E" and "F," one Yellow to cathode of detector and output tube respectively.

B135—Refer to schematics Nos. 14 and 15 and connect CN152 and TP420 as follows: One Red of CN152 to oscillator plate supply, remaining Red to cathode of first audio tube, and Black to chassis. Connect TP420 to the junction of 25M ohms and 250M ohms resistors in the second Detector plate lead, and to the chassis.

B136—The original condenser had two .25 mfd. and one .5 mfd. paper sections, and one 20 mfd. electrolytic. To replace electrolytic section, use TS102, connecting positive to cathode of output tube, negative to chassis.

B137—Refer to schematics Nos. 13 and 14 and connect UR181 as follows: Red lug to driver plate supply, Blue lug to IF screen circuit, and Green lugs to first AF plate resistor.

B138—Refer to schematics Nos. 13 and 14 and connect UR181 as follows: Red lug to IF screen circuit, Blue lug to driver plate supply, Green lugs to plate resistor.

B139—Refer to schematics Nos. 1 and 19 and connect RN242 as follows: One Red to point "C," remaining Red to chassis, Black to points "B" and "D."

B140—Refer to schematic No. 49 and connect RN235 as follows: To replace first section, connect Red to point "A," two Reds to point "B," Black to point "C." To replace second section connect Red to point "D," two Reds to point "E," Black to point "F" (chassis).

B141—Refer to schematics Nos. 1 and 19 and connect RN245 as follows: One Red to point "A," one Red to point "C," remaining Red to chassis, Black to points "B" and "D."

B142—Refer to schematic No. 13 and connect UR181 as follows: Red lug to anode grid supply of first detector, Blue lug to IF plate supply, Green lugs to screen circuit.

B143—Refer to schematics Nos. 1 and 15 and connect RM259 as follows: Red to point "A," Blue to point "C," Black, Brown and Yellow to chassis, Green to cathode of output tubes.

B144—We advise the use of two CS126 and one CN142 units connected as in schematics Nos. 41 and 15 as follows: Red of one CS126 to point "A," Red of the other CS126 to point "B," one Red of CN142 to point "C," remaining Red to cathode of output tube, all Blacks to points "D," "E," and "F."

Note—The CM164 may be used in place of the two CS126's.

B145—Refer to schematics Nos. 1 and 19 and connect RN245 as follows: Two Reds to point "A," one Red to chassis, Black to points "B" and "D."

B146—Refer to schematics Nos. 13 and 14 and connect UR181 as follows: Red lug to audio plate supply, Blue lug to IF screen circuit, Green lugs to anode grid supply of first detector.

B147—Refer to schematics Nos. 13 and 14 and connect UR181 as follows: Red lug to second detector plate supply, Blue to IF screen circuit, Green lugs to anode grid supply of first detector.

B148—Refer to schematics Nos. 13 and 14 and connect UR181 as follows: Red lug to driver plate supply, Blue lug to IF screen circuit, one Green lug to first audio screen, remaining Green lug to oscillator plate supply.

B149—Refer to schematics Nos. 13 and 14 and connect UR181 as follows: Red lug to first detector screen, Blue lug to driver plate supply, one Green lug to second detector plate resistor, remaining Green lug to first detector anode grid supply.

B150—Refer to schematics Nos. 13 and 14, connect UR181: Red lug to IF screen circuit, Blue lug to first detector anode grid supply, Green lugs to driver plate supply.

B151—Refer to schematic No. 13 and connect UR181 as follows: Red and Blue lugs to first detector screen circuit, and Green lugs to second detector plate resistor.

B152—Connect Red leads in place of original lugs, Black to chassis.

B153—Refer to schematics Nos. 13 and 14 and connect UR181 as follows: Red lug to oscillator plate supply, Blue lug to RF plate supply, one Green lug to second audio plate supply, and remaining Green lug to second detector plate resistor.

B154—Refer to schematic No. 11 and connect UR182 and CS121 as follows: Yellow of UR182 to point "A," Red and Blue to points "B" and "C," Green and Brown to points "D" and "E," Black of UR182 and CS121 to point "F," Red of CS121 to osc. anode resistor.

B155—Refer to schematic No. 27 and connect UR182 as follows: Blue, Red and Yellow together and to points "A," "B," and "C," Brown to points "D," "E," and Black and Green together and to point "F."

B156—These two 4 mfd. sections are contained in the same unit with several small capacity condensers of the paper type. For the replacement of the filter section use a non-polarized unit as in note B11. The 4 mfd. by-pass section may be replaced with TS105 installed at the socket.

B157—Refer to schematic No. 50 and connect RM257 as follows: Red to point "A," Black to point "C," Blue and Green together to point "B," Brown and Yellow to point "D."

B158—These condensers are contained in a capacitor block with several small paper condensers. To replace these units we recommend for external replacement a CM175 connected as follows: Two Reds to points "A" and "B," one Black to point "C," two remaining Blacks to point "D," remaining Red to screens.

B159—Refer to schematics Nos. 6 and 15 and connect RM259 as follows: Red to point "A," Blue to point "B," Black, Brown and Yellow to points "C" and "D," Green to cathode of output tube.

B160—The original block contained two 10 mfd. electrolytics and a .5 mfd. paper. Replace with CN152 and TP431. Connect one Red of the CN152 to the screen of output tubes, the remaining Red to the cathode of detector tube, Black to negative line. TP431 replaces the coupling condenser between the 37 plate and the interstage transformer.

B161—Refer to schematics Nos. 13, 14, 15 and 19, and connect SR612 and TS101 as follows: One Red of SR612 to RF screen, remaining Red to driver plate supply, Black to HV. center tap, Blue to first audio cathode (be sure to ground can). Connect TS101 positive to driver cathode, negative to chassis.

B162—Refer to schematics Nos. 13, 14, 15 and 19 and connect SR612 as follows: One Red to RF screen, remaining Red to the junction of the resistors in the first AF plate supply, Black to center tap of high voltage, and Blue to first AF cathode (be sure can is grounded).

B163—Refer to schematics Nos. 13, 14 and 19 and connect CN151 and TS101 as follows: Red of CN151 to RF screen, Blue to first AF plate supply, Black to chassis. Positive of TS101 to chassis, negative to high voltage center tap.

B164—Refer to schematics 13 and 14, connect CN151 and TS101 as follows: Red of CN151 to RF screen, Blue to first AF plate supply, Black to chassis. Connect TS101 positive to shield wire, negative to chassis.

B165—Refer to schematics Nos. 15 and 19 and connect CM162 as follows: One Black to transformer center tap, corresponding Red to chassis, remaining Red to first AF cathode, Black to chassis.

B166—This block contains the filter condensers and the output choke and condenser. When replacing by section be sure to leave output assembly intact.

B167—For replacement of this entire block, we recommend purchase of original block from manufacturer. However, in case of emergency, the block may be taken apart and replacement accomplished by using the CN150 unit or exterior application may be made. Precaution should be taken to preserve the original block wiring, not affected by the replacement.

B169—This condenser is contained in a block with several paper condensers and this replacement is suggested to replace this section only and the rest of the block must be left in the receiver as connected.

B170—Refer to schematics Nos. 27 and 19 and connect RM259 and TS101 as follows: Red, Blue and Green of RM259 together and to points "A," "B" and "C," Black and Yellow together and to points "D" and "E," Brown to point "F." Connect TS101 positive to output tube cathode, negative to resistor tap in output tube grid circuit.

B171—Refer to schematics Nos. 9 and 15 and connect UR190 and CM161 as follows: One Red of common negative section of UR190 to point "B," remaining Red to point "A," Black to point "C," Red of one independent section to point "A," Black to point "B," remaining Red to point "D," Black to output cathode. Connect CM161, Blue to point "D," Brown to point "E," Red to output cathode, Black to point "E."

B172—Connect UR189 as follows: One Red to rectifier cathode, Green and Black to negative line, remaining Red to RF screens, Blue to output plate supply, Brown and both Yellow to output cathode.

B173—For replacement of this entire block we advise purchase of a duplicate from the manufacturer. In case of emergency, the block may be taken apart and replacement accomplished by using the CN152 unit. Wiring to parts of the block not affected by the replacement should be left intact.

B174—This assembly contains an 8 mfd. electrolytic, a .5 mfd. and a .25 mfd. paper condenser and the driver transformer. We advise the CS133 unit for external replacement of the 8 mfd. section.

B175—Refer to schematics Nos. 1, 13 and 15 and connect CN151 and CN140 as follows: Red of CN151 to point "C," Blue to anode grid supply of first detector, Black to chassis. One Red of CN140 to RF screen, remaining Red to detector cathode, Black to chassis.

B176—Refer to schematics Nos. 13 and 15 and connect CN150 and CN141 as follows: One Red of CN150 to output plate supply, remaining Red to anode grid, Black to chassis. Red of CN141 to Det. cathode, Blue to screen supply, Black to chassis.

B177—Refer to schematics Nos. 13 and 15 and connect RN245 as follows: One Red to first AF plate supply, another Red to RF screen supply, remaining Red to first AF cathode and Black to chassis.

B178—Refer to schematics Nos. 14, 15 and 19 and connect RN231 and TS101 as follows: Red of RN231 to first Audio cathode, Blue to RF screens, Black to chassis. Pos. of TS101 to chassis, negative to power transformer HV. center tap.

B179—Refer to schematics Nos. 13, 14 and 19 and connect RN241 and TS106 as follows: Red of RN241 to screen circuit, Blue to second Det. plate supply, Black to chassis. Pos. of TS106 to chassis, negative to power transformer HV. center tap.

B180—Refer to schematics Nos. 9 and 15 and connect CM173, CM160 and TS102 as follows: One Red of CM173 to point "A," corresponding Black to point "B," another Red to point "B," remaining Black to point "C," remaining Red to point "A." Red of CM160 to point "D," corresponding Black to cathode of output tube, remaining Red to RF screen circuit, Black to point "E." Pos. of TS102 to output cathode at tube socket, negative to point "E."

B181—Refer to schematic No. 3 and connect CN151 as follows: Blue to point "B," Red to point "C," and Black to "E" and "F."

B182—The UR182 replacement has higher capacity values than the original. However, the UR182 will not cause any change in the operation of the set.

B183—Refer to schematics 12, 13 and 19 and connect CN142 and TS104 as follows: One Red of CN142 to screen of AF output, remaining Red to RF screen, Black to chassis. Connect TS104 positive to chassis, negative to B minus.

B184—Substitute TS101 for TS104 and connect as in Note 183.

B185—Refer to schematic No. 9 and connect RM257 as follows: Blue to point "A," Red and Green to points "B" and "C," Black and Brown to points "D" and "E," Yellow to point "F."

B186—Refer to schematic No. 52 and connect RM259 and TS101 as follows: Red and Green of RM259 to point "A," Black and Yellow to point "D," Blue to point "B," Brown to point "E." Connect TS101 Positive to point "F," negative to point "D."

B187—Substitute TS102 for TS104 and connect as in Note B183.

B188—Substitute TS103 for TS104 and connect as in Note B183.

B189—Refer to schematics Nos. 24 and 15 and connect UR189 as follows: Both Reds to point "A." Blue to point "B," Black, Brown and Green to points "C" and "D," one Yellow to output cathode, remaining Yellow to Det. cathode.

B190—The original condenser had three leads, Red-positive 10, Yellow-positive 20 and Black-common negative. Due to lack of circuit information we can give replacement instructions for the oirginal only. Use RN245 and connect one Red to the original Red, the two remaining Reds to the original Yellow, and Black to the original Black. The Mallory bracket 104-1 should be used for installation.

B191—Refer to schematics Nos. 1 and 13 and connect RM259 as follows: Red to point "A." Black to point "B," Blue to point "C," Brown to point "D," Green to original bypass lead, and Yellow to chassis.

B192—Refer to schematics Nos. 4 and 13 and connect RM265 as follows: Red to point "A," Black to point "C," Blue to point "B," Brown to point "D," Green to oscillator plate supply, and Yellow to chassis. Use Mallory No. 104-1 mounting bracket for this installation.

B193—Refer to schematics Nos. 1 and 15 and connect RN245 and TS101 as follows: Two Reds of RN245 to point "A," remaining Red to point "C," Black of RN245 and negative of TS101 to "B" and "D," Pos. of TS101 to output cathode.

B194—This model originally used two 8 mfd. carton type condensers. If both units are defective, CN152 affords an ideal replacement.

B195—The filter condenser for this receiver is contained in a block which is of the plug-in type. We advise replacing the defective sections with Mallory Carton type units of the same voltage and capacity beneath the chassis.

B196—When two units are specified for a non-polarized replacement, connect the negative leads together and tape. Use the two positive leads for wiring into the circuit. Also see Note B11.

B197—Refer to schematics Nos. 6 and 15, and connect UR192 and TN111 as follows: Connect UR192, one Red to point "A," remaining Red to point "B," both Blacks to chassis. Connect TN111, one positive to detector cathode, remaining positive to output cathode and negative to chassis.

B198—Refer to schematic No. 25 and connect CM171 as follows: Blue to point "A," Red to point "B," Brown to point "C," and Black to point "D."

B199—Refer to schematic No. 25 and connect CM171 as follows: Red to point "A," Blue to point "B," Black to point "C," Brown to point "D."

B200—Refer to schematics Nos. 30 and 14 and connect UR191 as follows: the two Red leads (having common exit) to points "A" and "B," and corresponding Black to points "D" and "E," one remaining Red to point "C," the other to the IF plate supply, both remaining Blacks to chassis at point "F."

B201—Refer to schematics Nos. 3 and 13 and connect UR191 as follows: One Red each to points "A," "B," and "C," remaining Red to first AF plate supply, all Black leads to chassis (points "D," "E," and "F").

B202—Refer to schematic No. 25 and connect CM171 and TS102 as follows: Red of CM171 to point "A," Blue to point "B," Black to point "C," and Brown to point "D." Connect TS102, positive to point "D," and negative to point "C."

B203—Refer to schematic No. 57 and connect CN155 as follows: One Red to each of the following points: "B," "D" and "G." Black to point "H" (chassis).

B204—Refer to schematic No. 57 and connect CS131 and CN152 as follows: Red of CS131 to point "A," one Red of CN152 to point "C," remaining Red to points "E" and "F," all Blacks to points "H" (chassis).

B205—Refer to schematic No. 56 and connect CM175 as follows: two Red leads to point "A," the two corresponding Black leads to point "C," remaining Red to point "B," remaining Black to point "D" (chassis). This unit may be installed in the original case.

B206—Refer to schematic No. 30 and connect CM175 as follows: One Red to point "A," corresponding Black to point "D," another Red to point "B," corresponding Black to point "E," remaining Red to point "C," remaining Black to point "F" (chassis).

B207—Refer to schematics Nos. 8 and 15 and connect RM257 and TS101 as follows: Blue of RM257 to point "A," Red to point "B," and Green to point "C." Connect Brown, Yellow and Black together and to points "D," "E" and "F." Connect TS101, positive to AF output cathode and negative to point "F."

B208—To replace with CM173 and TS107, connect as follows: Connect one Red of CM173 to center tap of output transformer, another Red to the driver plate supply, remaining Red to IF plate supply, all Blacks to chassis. Connect TS107 positive to driver cathode, negative to chassis.

B209—Connect RN231, Blue to "B" plus 135V., Red to RF screen, and Black to chassis. Some models used a non-polarized filter condenser. RN231 is satisfactory for this replacement if the proper battery polarity is observed. Be sure to check this point, as a reversal of polarity may result in serious damage to the receiver.

B210—Refer to schematics Nos. 8 and 15 and connect UR182 and TS101 as follows: Connect Yellow of UR182 to point "A," Blue to point "B," Red to point "C," Black, Brown and Green together and to points "D," "E" and "F." Connect TS101 positive to output tube cathode, negative to point "F."

B211—Refer to schematics Nos. 1 and 15 and connect RN245 as follows: One Red to point "A," another Red to point "C," remaining Red to output tube cathode, and Black to points "B" and "D" (chassis).

B212—Refer to schematics Nos. 1, 13 and 15 and connect RN245 as follows: One Red to screen of output tube, another Red to the first detector plate supply, remaining Red to cathode of output tube, and Black to chassis.

B213—Refer to schematic No. 25 and connect RM261 and TS102 as follows: Red of RM261 to point "A," Blue to point "B," Black to point "C," and Brown to point "D." Connect TS102, positive to point "D," and negative to point "C."

B214—Refer to schematics Nos. 11 and 15 and connect UR182 and TS101 as follows: Connect UR182, Yellow to point "A," Blue and Red together and to points "B" and "C," Green and Brown together and to points "D" and "F," and Black to point "F." Connect TS101 positive to detector cathode and negative to point "F."

B215—Refer to schematic No. 11 and connect RM257 as follows: Blue to point "A," Green and Red to point "B," Black, Brown, and Yellow to points "D" and "E."

B216—In some cases this condenser is a single 8 mfd. unit; we recommend the use of RS213 for these cases in place of RM262.

B217—Refer to schematics Nos. 13 and 15 and connect RN241 as follows: Blue to oscillator plate supply, Red to cathode of output tube, and Black to chassis.

B218—Refer to schematic No. 11 and connect RN235 as follows: One Red to point "A," two Reds to point "B," Black to point "D." To replace second condenser connect RN231, Red to point "C," Blue to osc. anode grid supply, Black to point "F."

B219—Refer to schematics Nos. 1 and 15 and connect SR611 as follows: One positive 8 mfd. lug to point "A." The other positive 8 mfd. lug to point "C," Black lead to points "B" and "D," Blue lead to second AF cathode. It may be of assistance in installing if the leads of the old unit are cut close to the carton and these leads used for connecting the new unit.

B220—Refer to schematics Nos. 1 and 15 and connect CN152 and TN110 as follows: One Red of CN152 to point "A," remaining Red to point "C," Black to points "B" and "D." One positive of TN110 to detector cathode, remaining positive to output cathode and negative to chassis.

B221—Refer to schematics 27 and 15 and connect UR182 as follows: Red and Blue leads together and to points "A," "B," "C." Brown lead to points "D," "E." Black and Green leads together and to point "F" (chassis) and Yellow lead to detector cathode.

B222—Refer to schematic 27 and connect RM257 as follows: Red, Green and Blue leads together and to points "A," "B," "C"; Black lead to points "D," "E," Brown and Yellow leads together and to point "F" (chassis).

B223—Refer to schematics 63 and 15 and connect UR192 and TN110 as follows: One Red lead of UR192 to point "B," remaining Red lead to point "C," and both Blacks to points "D," "E" (chassis). Connect TN110, one positive lead to the 1AF cathode, remaining positive lead to the output tube cathode and negative lead to chassis.

B224—Refer to schematics 13 and 15 and connect CS123 and TS103 as follows: Red lead of CS123 to IF screen; Black lead to chassis; Positive lead of TS103 to first audio cathode; Negative lead to chassis.

B225—Mount the CM164 unit on the rear side of the chassis support (immediately in back of the original unit). There are two holes already drilled in the chassis that serve nicely for mounting use. Refer to schematic 27 and connect as follows: Both Reds together and to points "A," "B," "C"; one Black to points "D," "E;" and remaining Black to point "F" (chassis).

B226—The use of two UR182 condensers is recommended for this replacement. Refer to schematics 64 and connect as follows: Both Blue leads and one Red lead to point "A"; remaining Red lead to point "B"; both Yellow leads to point "C"; both Brown leads and both Green leads to point "D"; and both black leads to point "E." The following color code replacement is applicable to the Detrola Model 1200. Both Yellow leads together replace the original Yellow lead. Both Green leads and both Brown leads together replace the original Black lead. Both Blue leads together replace the original Red lead. The two Red leads replace the two original lugs marked +8. Both Black leads together replace the original lug marked — (neg). The Mallory terminal connector A-016 is helpful for ease of installation.

B227—Install the MN278 unit with the 9 mfd. sections in parallel, and wire in as a three section condenser.

B228—Refer to schematic No. 4 and connect CM175 as follows: All Red leads together and to points "A" and "B," one Black lead to point "C," and the two remaining Black leads to point "D."

B229—Refer to schematics No. 26 and 14 and connect UR191 as follows: One of the two Red leads having common exit to the IF screen, the remaining Red lead of the common section together, with the red leads of the independent sections to points "A," "B," and "C." Connect the Black lead of the common section to point "F," and the remaining Black leads to points "D" and "E."

B230—This unit contains a 16 mfd. electrolytic and two paper dielectric sections. Replacement of the electrolytic section with a Mallory TS102 mounted at the output tube socket is recommended.

B231—Refer to schematic No. 1 and connect CN155 as follows: Two Red leads to point "A," remaining Red lead to point "C" and Black lead to points "B" and "D" (chassis).

B232—Although the original unit is of unusual shape, replacement may be accomplished by using the Mallory CN155 condenser, mounted in any convenient position.

B233—Refer to schematic No. 59. The condenser connected between points "A" and "D" is a 4 mfd. paper, the condenser connected between points "B" and "E" is an 8 mfd. electrolytic. There are two condensers connected in parallel between points "C" and "F," an 8 mfd. electrolytic and a 4 mfd. paper. We recommend replacement of the two 4 mfd. sections with a CN150 unit. The 8 mfd. electrolytics are easily replaced with CS133 units.

B234—Refer to schematic No. 57 and connect CS131 and CN152 as follows: Red lead of CS131 to point "A," Black lead to point "H," one Red lead of CN152 to point "C," remaining Red lead to point "E," "F" and Black lead to point "H."

B235—Refer to schematic 67 and connect RM257 as follows: Red lead to point "A," Black, Brown and Yellow leads together and to point "B," Green and Blue leads together and to point "C."

B236—Refer to schematic No. 1 and connect MN275 as follows: one terminal to point "A," remaining two terminals together and to point "C." In some cases a 2½" diameter can with 5 and 15 mfd. sections may have been used. Replace this unit with the Mallory type MN273.

B237—Refer to schematic No. 28 and connect RM265 as follows: Red lead to point "A," Blue lead to point "B," Green lead to point "C," Black lead to point "D," Brown lead to point "E" and Yellow lead to point "F."

B238—Refer to schematics No. 1 and 19 and connect CM171 and TS101 as follows: Red lead of CM171 to point "A," Blue lead to point "C," Black and Brown leads and the negative lead of the TS101 to points "B" and "D," and positive of TS101 to chassis.

B239—Refer to schematics 1 and 19 and connect CM171 and TS101 as follows: Blue lead of CM171 to point "A," Red lead to "C," Black and Brown leads of CM171 point together with negative lead of TS101 to points "B," "D" and positive lead of TS101 to chassis.

B240—Substitute TS102 for TS101 and connect as directed in note B239.

B241—Refer to schematics 1 and 15 and connect CN155 and TS101 as follows, one Red lead of CN155 to point "A," the two remaining Red leads to point "C," and Black lead to points "B," "D." Connect positive of TS101 to output tube cathode and negative lead to chassis.

B242—Refer to schematics 1, 13, and 15 and connect RN245 and TS101 as follows: one Red lead of RN245 to point "A," another Red lead to point "C," the remaining Red lead to the oscillator plate supply and the Black lead to points "B," "D." Connect TS101, positive to output tube cathode and negative to chassis.

B243—When this condenser was used originally as a two-section condenser by paralleling the two lower capacity sections, replace with an RN242 condenser. If the original has all three sections in parallel (for 25 cycle use) replace with a single RS216. If the original is used as a three-section unit, replace with an RN245.

B244—Refer to schematics 1 and 15 and connect RN245 and TS101 as follows: Two Red leads of RN245 to point "A," remaining Red lead to point "C" and Black lead to points "B," "D." (Caution: this lead is not to chassis). Connect the positive lead of TS101 to the output tube cathode and the negative to the Black lead of the RN245.

B245—Refer to schematic No. 3 and connect RN245 as follows: two Red leads to point "A," remaining Red lead to point "B" and Black lead to points "D," "E," and "F."

B246—These filter sections are contained in a block with several small paper dielectric by-pass sections. We recommend external replacement of the defective filter section or sections, with CS type units of the proper capacity, or the purchase of a complete block from the original manufacturer.

B247—The filter condensers are in a large plug-in type block with connections as follows: (starting with the large pin opposite the grounding pin and proceeding in a clockwise direction). Pin No. 1-negative 16 mfd. second filter and negative 8 mfd. power tube bias by-pass; Pin No. 2-positive 4 mfd. 350V. 1AF plate filter; Pin No. 4-positive 8 mfd. 100V first detector cathode by-pass; Pin No. 5-common negative to all pins except Nos. 2 and 8; Pin No. 6-positive 4 mfd. 100V 1AF cathode by-pass; Pin No. 7-positive 4 mfd. 100V driver tube cathode by-pass; and Pin No. 8-positive 16 mfd. second filter. In 25 cycle models Pin No. 8 is positive 20 mfd. In an emergency individual sections may be replaced with Mallory carton type units of proper capacity and voltage ratings mounted beneath the chassis. However for complete replacement we recommend the purchase of an entire block from the set manfuacturer.

B248—Filter capacitors are in a large plug-in block with connections as follows: Pin No. 1—8 mfd. 450V first filter; Pin No. 2—4 mfd. 450V power screen by-pass; Pin No. 3—4 mfd. 450V (60 cycle) or 12 mfd. 450V (25 cycle) filter output; Pin No. 4—8 mfd. 20V IF cathode by-pass; Pin No. 5 common negative; Pin No. 6—4 mfd. 20V 55 cathode by-pass; Pin No. 7—4 mfd. 450V second filter. In an emergency individual sections may be replaced with Mallory carton type units of the proper voltage and capacity ratings mounted beneath the chassis. However, for complete replacement we recommend the purchase of an entire block from the set manufacturer.

B249—These condensers are contained in a large plug-in type block. The connections are as follows: (starting with the large pin opposite the grounding pin and proceeding in a clockwise direction)—Pin No. 1 negative 16 mfd. 450V and negative 8 mfd. 100V; Pin No. 2-positive 4 mfd. 350V 1AF plate filter; Pin No. 3-positive 16 mfd. 450V third filter; Pin No. 4-positive 8 mfd. 100V IF cathode by-pass; Pin No. 5-common negative for all pins except Nos. 2 and 8; Pin No. 6-positive 4 mfd. 100V, 1AF cathode by-pass; Pin No. 7-positive 4 mfd. 250V driver bias by-pass; Pin No. 8-positive 16 mfd. 450V, second filter. In an emergency individual sections may be replaced with Mallory carton type units of proper voltage and capacity ratings mounted beneath the chassis. However, for complete replacement we recommend the purchase of an entire block from the set manufacturer.

B250—Refer to schematic No. 4 and connect CM175 as follows: one Red to point "A"; corresponding Black to point "C"; remaining Red leads to point "B"; and remaining Black leads to point "D."

B251—Refer to schematics 3 and 14 and connect RM265 as follows: Red to point "B"; Black to point "E"; Blue to point "C"; Brown to point "F"; connect Green wire to IF screen supply; Yellow to chassis.

B252—Refer to schematics 1 and 15 and connect RN231 and TS101 as follows: Blue of RN231 to point "A"; Red to point "C"; and Black to points "B" and "D." Connect TS101 positive to output tube cathode, negative to ground (chassis).

B253—Refer to schematic No. 4 and connect CM171 as follows: Red and Blue to points "A" and "B"; Brown to point "C"; Black to point "D."

B254—Refer to schematics 1 and 15 and connect RN241 and TS101 as follows: Blue to point "A"; Red to point "C"; Black to chassis at points "B" and "D." Connect TS101 positive to cathode of output tube; negative to chassis.

B255—Connect two Red leads together and to output screens; remaining Red lead to IF screen; Black to chassis.

B256—Refer to schematics 24 and 15 and connect UR189 and CS126 as follows: Reds of UR189 to point "A"; Black, Brown and Green to chassis at "C" and "D." Blue to screen of 43; one Yellow to cathode of 6C6; other Yellow to cathode of 43. Connect Red lead of CS126 to point "B"; Black to chassis.

B257—Refer to schematic 40 and connect RM265 as follows: Red, Blue and Green to points "A" and "B"; Black to point "C"; Brown and Yellow to point "D."

B258—Refer to schematics 4 and 13 and connect UR182 as follows: Blue and Red leads to points "A" and "B"; Brown lead to point "C"; Black and Green leads to point "D"; and Yellow to detector screen supply.

B259—Refer to schematics 4 and 13 and connect UR182 as follows: Blue and Red leads to points "A" and "B"; Brown lead to point "C"; Black and Green leads to point "D"; and Yellow to detector cathode.

B260—Refer to schematic No. 11 and connect RM257 as follows: Blue to point "A"; Green and Red to points "B" and "C"; Brown and Black to points "D" and "E"; Yellow to point "F."

B261—Refer to schematic 23 and connect as follows: Red and Green to point "A"; Blue to point "B"; Black and Yellow to point "C"; Brown to point "D."

B262—Refer to schematics 8 and 15 and connect SR630 as follows: Green and Black to point "F"; Red and Yellow to point "C"; Blue to output cathode.

B263—Refer to schematic 27 and connect RM255 as follows: Red, Blue and Green to points "B" and "C"; Black and Brown to point "E"; Yellow to point "F."

B264—Refer to schematic No. 11 and connect UR193 as follows: Yellow to point "A"; Red and Blue to points "B" and "C"; Green and Brown to points "D" and "E"; Black to point "F."

B265—Refer to schematics 11 and 13 and connect UR193 and CS121 as follows: Red and Blue of UR193 to points "B" and "C"; Brown to point "E"; Black and Green to point "F"; Yellow to oscillator anode return. Connect CS121 Red to point "A"; Black to point "D."

B266—Refer to schematics 75 and 15 and connect RM259 and TN111 as follows: Red of RM259 to point "A"; Blue and Green to point "B"; Black, Brown, and Yellow together and to points "D" and "F." Connect negative of TN111 to chassis; positives to cathodes of AF amplifiers. Connect RS207 Red to point "C"; Black to point "E."

B267—Connect one Red of CM164 to 25Z5 cathode; Blacks to chassis; remaining Red to output of filter choke. Red of CN141 to RF screen; Blue to cathode supplying field exitation; Black to chassis; positives of TN110 to cathodes of audio tubes; negative to chassis.

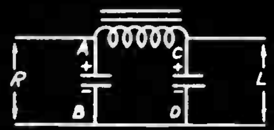
B268—Refer to schematics 24 and 15 and connect UR182 as follows: Blue to point "A"; Red to point "B"; Brown, Black and Green to points "C" and "D"; Yellow to cathode of audio tube.

B269—Refer to schematics 1 and 13 and connect UR182 as follows: Blue to point "A"; Red to point "C"; Brown, Black and Green to points "B" and "D"; Yellow to cathode of audio tube.

B270—Refer to schematic No. 40 and connect CM175 as follows: Blacks to points "A" and "B"; one Red to point "C"; other two Reds to point "D."

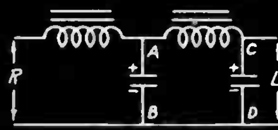
B271—Refer to schematic No. 1 and connect RM259 as follows: Red to point "A"; Black, Brown, and Yellow to points "B" and "D"; Blue and Green to point "C."

1



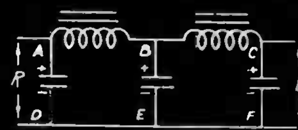
Notes 59, 75, 91, 97, 111

2



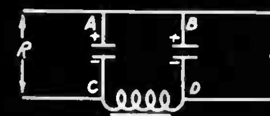
Note 120

3



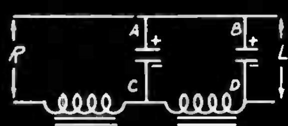
Notes 83, 116, 181, 201

4

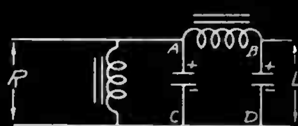


Notes 25, 58, 70, 73, 113

5

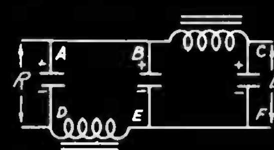


6

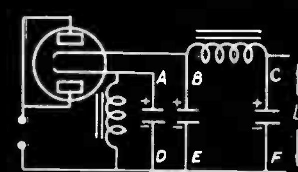


Notes 18, 36, 65, 103, 119

7

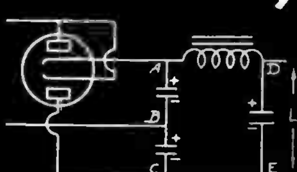


8



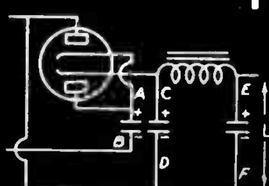
Notes 67, 104, 134, 207, 210

9

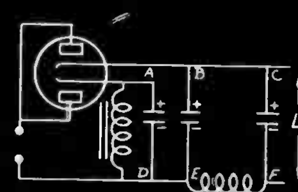


Notes 22, 49, 171, 185

10

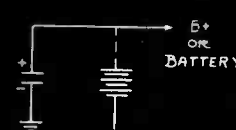


11



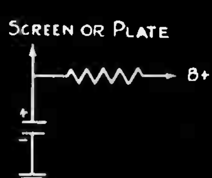
Notes 31, 56, 71, 154, 214

12



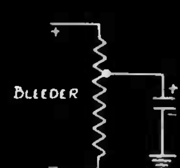
Note 183

13



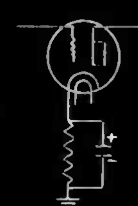
Notes 176, 201

14



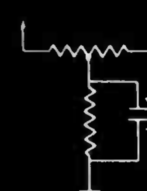
Note 70

15

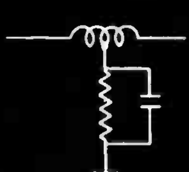


Notes 75, 111, 119, 134, 210

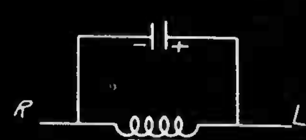
16



17

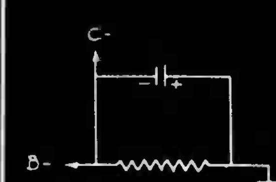


18

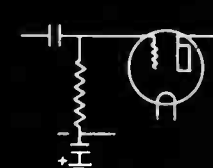


REVERSE FOR FIELD USE

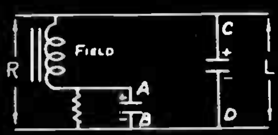
19



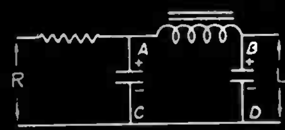
20



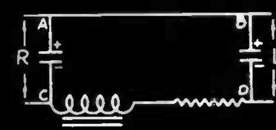
21



22

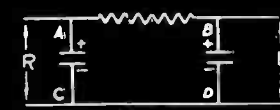


23



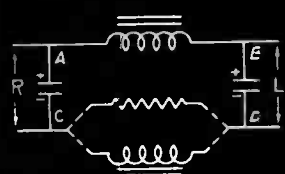
Note 50

24



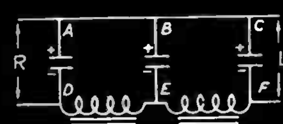
Note 189

25

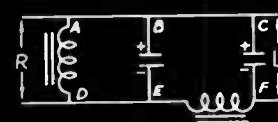


Notes 12, 198, 199, 213

26

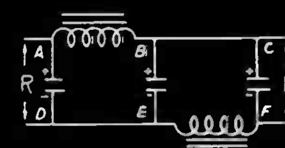


27



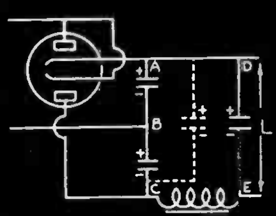
Notes 88, 94, 155, 170

28

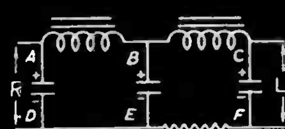


Note 69

29

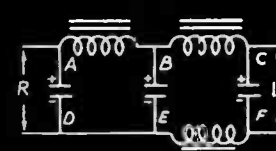


30

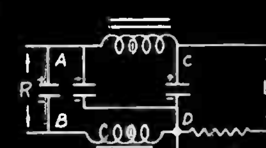


Notes 200, 206

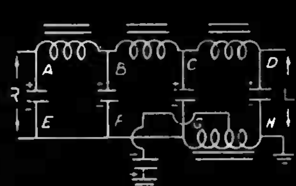
31



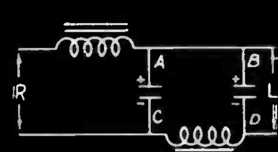
32



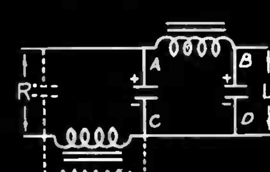
33



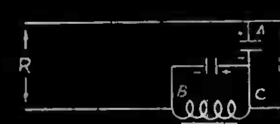
34



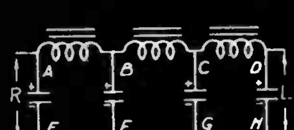
35



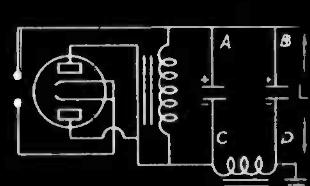
36



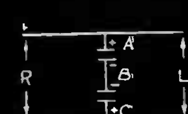
37



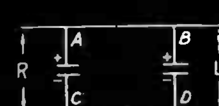
38



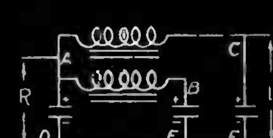
39



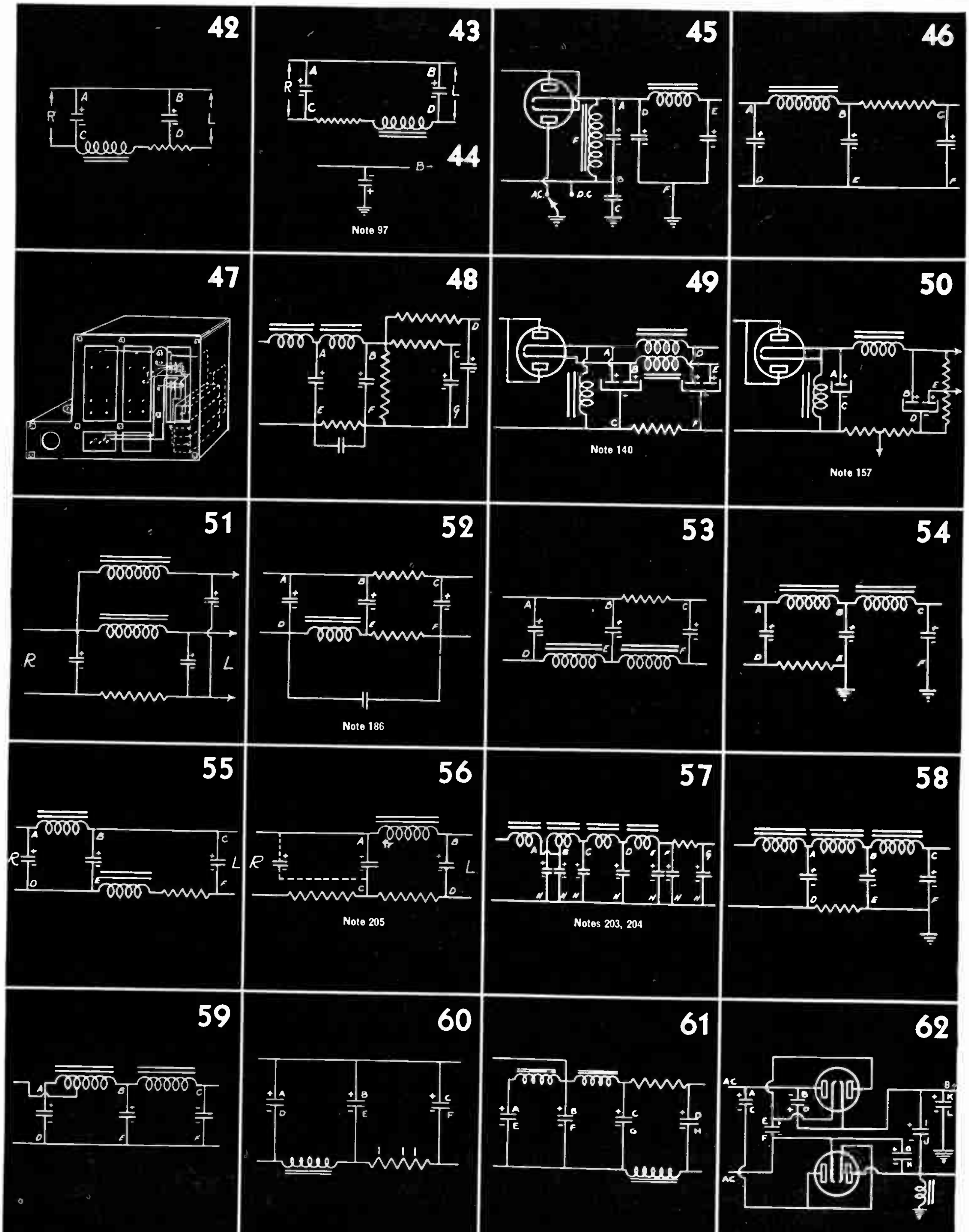
40

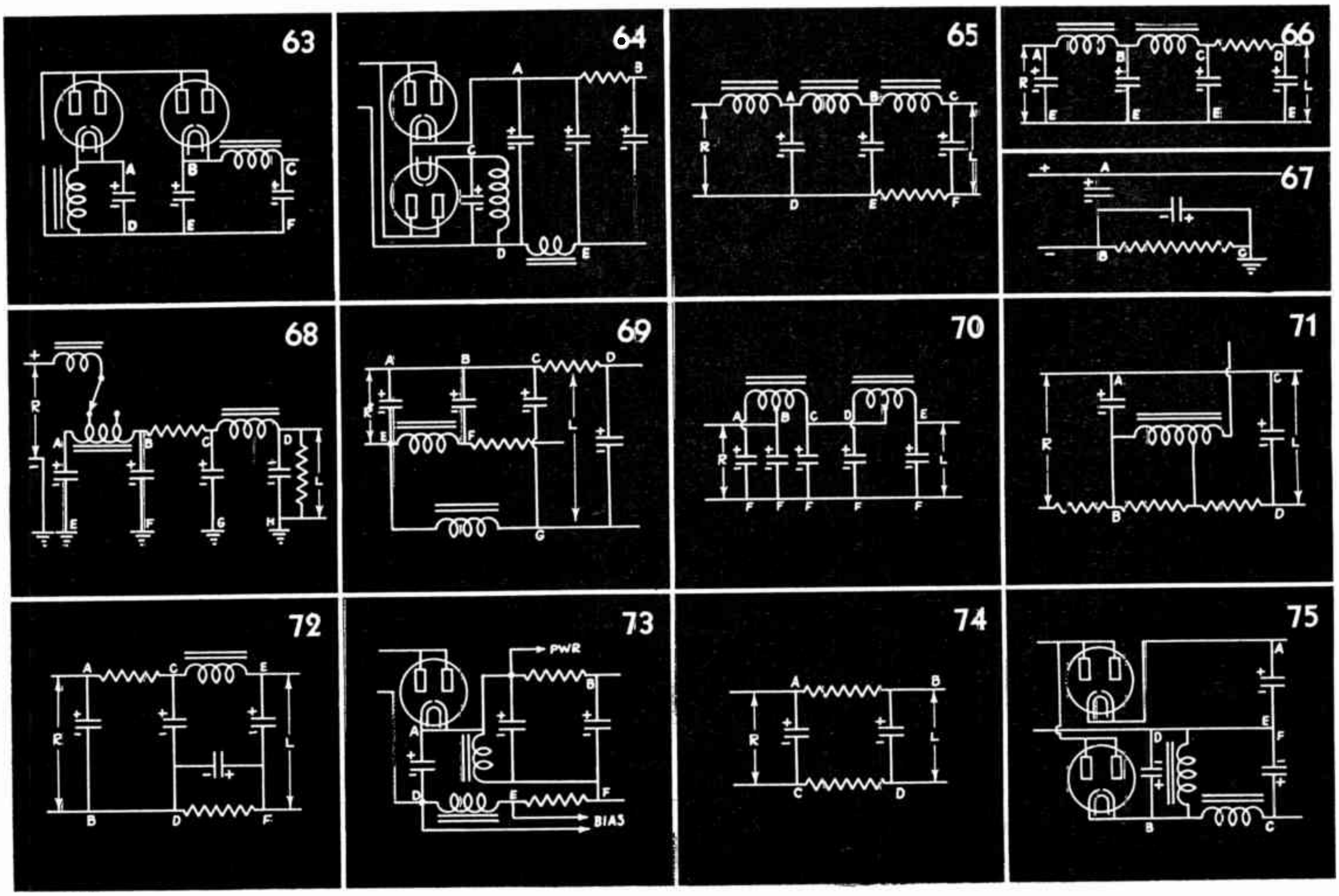


41



Note 144


42
43
44
B-
Note 97
45
46
47
48
49
Note 140
50
Note 157
51
52
Note 186
53
54
55
56
Note 205
57
Notes 203, 204
58
59
60
61
62



AC CAPACITOR REPLACEMENT INFORMATION

It is entirely possible to make satisfactory replacement of defective units without necessarily using new units of exactly the same characteristics or physical appearance.

In the interests of economy and prompt service, Mallory, therefore, recommends that consideration be given the carefully selected Replacement types shown.

It is essential that the information on general design and use be studied before attempting to make any capacitor replacement.

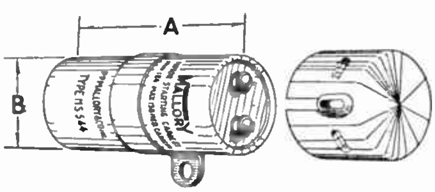


FIGURE 1

Because of electrical requirements involved, it is generally poor practice to substitute lower capacities than originally specified by the motor manufacturer. However, higher capacities, even 40% more than the original, may be used in most cases. Motors with centrifugal switches are not critical as to capacity excess but care should be taken on magnetic switch types to see that over-capacity does not effect the opening of the switch.

Round type Mallory AC capacitors, Fig. 1, are equipped with an outside insulating tube. They may be mounted in the original clamp or housing attached to the motor. When the capacitor diameter is less than that of the clamp or housing, sufficient padding with corrugated board should be used.

Mallory round type AC capacitors may be used to replace rectangular types by mounting and padding inside the original housing, or by mounting elsewhere on the motor, or other convenient place. Protective end cap and a special mounting bracket are available for this purpose. (Note: Bracket not generally required on 1 3/8" diameter units.) Fig. 2 shows a round unit mounted alongside of the original rectangular housing by means of the strap.

Some original capacitors have four terminals marked "T," "TL," "L" and an unmarked terminal, as previously explained, "T" and "TL" being dummy terminals as far as the capacitor is concerned.

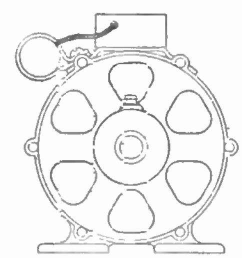


FIGURE 2

The original capacitor may be left in the housing and the capacitor mounted outside. In such cases, disconnect the leads from the unmarked and "L" terminals and splice capacitor leads to them, not disturbing the other connections.

If the replacement capacitor is to be mounted in place of the original inside the housing, connect one lead from the replacement capacitor to the original wire attached to the unmarked terminal. Connect the other lead to both wires originally connected to the "L" terminal. Both wires originally connected to the "T" terminal must be spliced together, and likewise, both wires originally connected to the "TL" terminal. All splices should be carefully taped.

See page 220 for a complete listing of Mallory AC capacitors. Where the end cap and clamp are required, they may be ordered separately.

P. R. MALLORY & CO., Inc.

MALLORY

REPLACEMENT CONDENSERS AND ACCESSORIES

The Dry Electrolytic Condenser is the invention of Samuel Ruben, long an associate of the Mallory Co., and the pioneer patents in the field are the two Ruben Patents 1710073 and 1714191.

INTELLIGENT and systematic research is the backbone of all progress. Experience and common sense the medium for the successful application of any new development. P. R. Mallory & Co., Inc., have for many years been the major supplier of original condenser equipment to radio receiver manufacturers. Representing the pioneer manufacturer in the dry electrolytic condenser field, it is not surprising that the majority of worthwhile contributions to the art have been made by Mallory. These contributions were the direct result of extensive research, efficiently applied to the problems involved. For several years the need for a systematic and efficient replacement condenser program has been acknowledged by the Mallory management personnel. Time and again the thought of launching such a program was discussed—only to be shelved temporarily as not worthy of the standards of progress set by those who have led the Mallory Company to its present successful standing in the industry. Finally, after a diligent investigation of the requirements of the radio replacement field, and with the help of thousands of radio service engineers throughout the country, the Mallory Company announced the now famous "Universal Condenser Replacement Program." This announcement was made in January, 1936, just one year ago. It marked a new departure in the replacement field. The success of the Mallory program is now history, but it is gratifying indeed to review the outstanding acclaim it received and the precedents set. While imitation has been called the sincerest form of flattery, it is amusing to record the extent to which this has been attempted.

With pardonable pride we reveiw a few of the outstanding and revolutionary Mallory achievements in the replacement condenser field.

1. **First Replacement Condenser Manual**—the greatest assistance ever offered the service engineer.
2. **First Complete Universal Condenser Line**—Made condenser servicing a pleasure and took it out of the penny profit class.
3. **First Practical Mounting for Carton Type Condenser**—The famous metal flange. Everyone wonders why it was never done before.
4. **First Universal Mounting for Round Type Condensers**—Astounding! But so simple and practical.
5. **First Complete Line of Compact, Space-Saving Condensers**—Every condenser the right size for **all** applications.
6. **First Internal Metal Seal for Carton Condensers**—Even the Pittsburgh flood failed to harm them.
7. **First With Correct Size Lead Wires**—Not designed for 5 Horsepower motors, but for radio condenser replacements.
8. **First Really High Surge Condensers**—They can take it. If one didn't—we haven't heard about it.
9. **First With Cellophane Separators**—Surge voltage breakdown? What is it?
10. **First With the "Terminal Connector"**—Change a "haywire" job to a neat assembly.

In spite of these innovations, and many others, Mallory is still not satisfied. They are constantly striving to improve the original program.

Use Mallory and you'll save time, have success with your work, a healthy profit, and no regrets.

MALLORY CONDENSER TYPE CODE

AG	**A**uto **G**enerator Units
AM	**AM**meter By-Pass Units
BN	Round Can **B**y-Pass Units Common **N**egative
BT	**B**akelite Base **T**rimmer Units
CB	**C**ased **B**y-Pass Units
CM	**C**arton Type Condensers **M**ultiple Separate Sections
CN	**C**arton Type Condensers Multiple Units Common **N**egative
CS	**C**arton Type Condensers **S**ingle Units.
CT	**C**eramic Base Midget **T**rimmer Units
CTD	**C**eramic Base **T**rimmer Units **D**ual Sections
CTX	**C**eramic Base **T**rimmer Units Single Sections
DL	**D**ome **L**ight Unit
FM	**F**ord Auto Generator Unit
HD	**H**eavy **D**uty Units
HS	Special **H**igh **S**urge Units
MC	**M**ica **C**ondensers
MN	Large Round Can Units **M**ultiple Common **N**egative
MSR	**M**otor **S**tarting **R**eplacement AC Capacitors
OT	**O**il-Impregnated Oil-Filled **T**ubular Units
OW	**O**il-Impregnated **W**ax-Filled Units
RF	**R**adio **F**requency Chokes or Condensers
RM	**R**ound Can Type Condensers **M**ultiple Separate Sections
RN	**R**ound Can Type Condensers Multiple Units Common **N**egative
RS	**R**ound Can Type Condensers **S**ingle Units
SR	**S**pecial **R**eplacements
TN	**T**ubular Dual Section Common **N**egative Units
TP	**T**ubular **P**aper Units
TS	**T**ubular **S**ingle Units
TX	**T**ransmitting Condensers Rectangular Type
TZ	**T**ransmitting Condensers Round Can Units
UB	**U**ncased Filter **B**lock Sections
UR	**U**niversal **R**eplacements
VB	**V**ibrator **B**y-Pass Units
VL	**V**ibrator By-Pass Units **L**ong Type
VO	**V**ibrator **O**val Type Units
WE	**W**et **E**lectrolytics

SMALL SIZE PRECISION QUALITY

Small size without High Quality would defeat any practical advancement in this field. Mallory policy prohibits any sacrifice of quality. The introduction of new Mallory Replacement Condensers, **all small in size**, is in strict accordance with this policy. **Every size is the right size!**

Every Mallory condenser has equal or better characteristics, including life expectancy, to any unit offered heretofore.

Every unit is designed expressly for outstanding performance. **Size was a secondary consideration. Mallory Condensers must undergo a severe life test before release for sale is permitted.** In this respect, not a few, but hundreds of units are placed on life test. This life test is not only conducted under actual conditions as experienced in the field but is much more severe. Besides subjecting condensers to their **maximum** DC working voltage on life test, an AC component greater than ever present in field service is also imposed over and above the DC voltage.

Radio sets in general and Midget sets in particular produce relatively high internal temperatures. There**fore life tests run at room temperature have no significance. The Standard Mallory life test specifications call for the use of an industrial oven constantly maintained at 140° F. for the duration of the test! A thousand hours in this oven under the severe voltage applied is equal to over a year's service in the field.** No Mallory unit is acceptable for service if it shows any inclination to change appreciably in characteristics at this interval. **All Mallory life tests are continued even after the 1,000 hour mark** and several thousand hours' life under these extreme conditions is the rule and not the exception.

GENERAL CONSTRUCTION AND DESIGN

Mallory, to make the ideal condenser, has given a great deal of thought to design and constructional points that at first might seem relatively unimportant.

All Mallory carton type units utilize standard wax impregnated fibre-board exactly the same as used universally on large production orders for radio set manufacturers. This type of material is used because it actually impregnates better than coated types of board having a silver or gold finish. This wax impregnation is highly important to the proper performance of the unit.

All Mallory carton units have square **corners and sides** that **do not bulge.** Besides adding to their appearance this indicates proper engineering. By designing the condenser correctly, no attempt to squeeze it into the carton is necessary.

The wire supplied on all Mallory units is especially selected for ample insulation and ease of installation. For this reason, on all but the tubular units, stranded push-back wire of the correct size and flexibility is used.

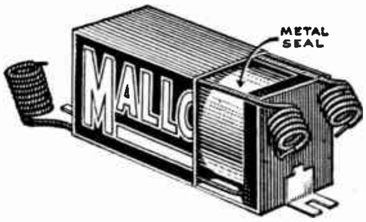
All Mallory replacement condensers are stamped with the necessary information directly on each container rather than on paper labels pasted to the container. **This type of marking provides permanent identification.** Paper label types are apt to become unglued and leave the unit without identity.

There are no common positive units in the Mallory line. These list at the same prices as the separate section type where each unit has its own pair of leads. The separate section type may, of course, be connected, when installing, either with the positives or the negatives common as well as other combinations. In the interests of reduced stock, the common positive type was purposely omitted.

SEALED IN METAL HUMIDITY-PROOF

Temperature is an extremely important factor. The use of Dry Electrolytic Condensers where high temperatures are involved may severely affect their life. All Mallory Condensers are designed to function in temperatures up to 140° F. This is ample to cover the usual temperature rise to be expected in the field. Care should be taken, however, not to install the condenser next to, or between other components producing high temperatures in or on the radio chassis. This refers to rectifier tubes, power tubes and voltage divider resistances and transformers. In some Midget sets, it is impossible to make an ideal installation in this respect.

A certain amount of moisture is included in the electrolyte of all Dry Electrolytic Condensers. The proper operation of the condenser is greatly dependent upon this moisture. In unprotected condensers this moisture may be lost, or on the other hand, the condenser may absorb more moisture, affecting the balance originally provided. **Mallory Condensers** have been designed with this point in view. All units **are effectively sealed including the cardboard carton types.** This is accomplished in the latter case **by the use of a metal seal of ingenious construction inside of the carton** which has been found to stabilize this characteristic.



You will note from the above illustration that **the metal seal completely seals the unit enclosed inside of the carton.** This Mallory feature throws the burden of stabilized humidity on the metal seal and not the carton alone as in ordinary condensers. The carton is thoroughly impregnated in wax affording double protection against humidity.

Because of this metal seal, these units will perform satisfactorily in tropical climates.

CELLOPHANE SEPARATORS
Etched Anodes—Stitched Anode Leads

All recent important improvements pioneered or developed by Mallory—are incorporated into Mallory Condensers wherever they add to quality and utility.

MALLORY TERMINAL CONNECTOR

AGAIN MALLORY SOLVES A PROBLEM IN A PRACTICAL WAY

This device will prove a great help whether used with condensers or for other purposes.

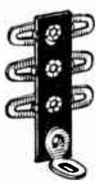


FIGURE 1

The Mallory Terminal Connector (Figure 1) is designed to provide an anchorage for the lead wires from the condenser where ordinarily splicing would be necessary. For example, when replacing an original unit having soldering lugs, the leads from the replacement unit may be cut short and the Terminal Con nector used to join them with the set wiring.

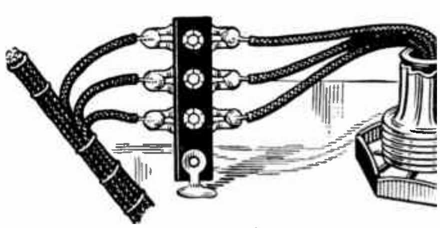


FIGURE 2

Solder (or bolt) the Connector strip to the chassis in an upright position as near as possible to the replacement condenser unit. Cut off the lead wires from the condenser to the proper length to reach the Terminal Connector and solder each one to a lug on the Connector as in Figure 2. (**Note**—All Mallory leads are push-back wire.) Now solder the circuit wires to the opposite lugs on the Terminal Connector in their proper order.

Obviously if more than three wires are involved, it will be necessary to use more than one Terminal Connector or splice the remaining leads. Generally, the black or negative lead is soldered to the chassis and need not use a lug.

Should the Terminal Connector be too high for the depth of the chassis it may be bent over to reduce its height.

MALLORY UNIVERSAL MOUNTING FLANGES for Carton Types

The mounting of carton type condensers has always been a problem from a replacement standpoint. An almost unanimous appeal for something new and practical was noted in the response to the Mallory Service Questionnaire. Mallory Engineers have studied the problem from the service man's angle.

All Mallory carton type condensers are equipped with a new type of mounting flange—**the first practical Universal mounting feature ever designed.**

Since there are several ways in which it may be used, complete instructions are given:

A. The unit may be mounted by the use of nuts and bolts or self-tapping screws in the usual manner as in Figure 3.

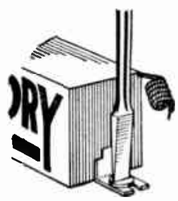


FIGURE 3

B. One end may be pushed under any screw head on the chassis without removing the screw as in Figure 4. The other end may be left loose or soldered to the chassis as in Figure 5.

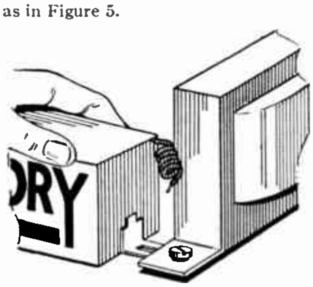


FIGURE 4

C. One flange or both flanges may be soldered to the chassis as in Figure 5. Tin the chassis first, then solder in place.

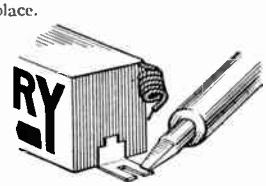


FIGURE 5

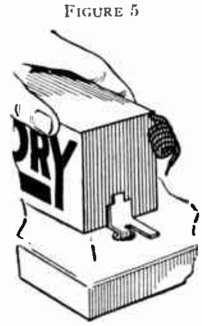


FIGURE 6

D. One half of the flange may be bent down as in Figure 6 and pushed through any convenient hole in the chassis. Bend back the flange after it is through the hole.

E. Both flanges may be bent flat against the side of the carton and the unit held in place by its wire leads.

In bending the flanges, hold your thumb tightly on the part attached to the carton to prevent tearing the carton.

Mallory Universal Mounting flanges have been widely copied, proving their merit and worth to service men. Constant improvement may be expected from Mallory—as their leadership in the replacement parts field will be maintained.

MALLORY UNIVERSAL MOUNTING FEATURES for Round Can Types RS, RN and RM

Round can condensers in general have been mounted by the use of one of five different methods, each varying enough to prohibit the use of any other type in making a replacement. This situation has now been overcome by the special features provided on all Mallory round can replacements. The universal nature of the newly designed units does away with the necessity of stocking duplicate ratings in several mounting types and consequently reduces the stock investment. **It is the first practical universal mounting feature for round can type condensers.**

The five methods of mounting referred to are:

1. **Stud mounting having a 5/8″ neck.**
2. **Stud mounting having a 3/4″ neck.**
3. **Stud mounting having a 7/8″ neck.**
4. **Ring Clamp mounting.**
5. **Spade bolt mounting.**

STUD MOUNTING

Types 1, 2 and 3 are so familiar they require no illustration. The originals having the 5/8″ or 3/4″ neck generally had but one lug or one or more flexible leads. The 7/8″ neck was usually of the moulded composition type and was generally equipped with from one to three lugs, this type seldom being supplied with flexible leads.

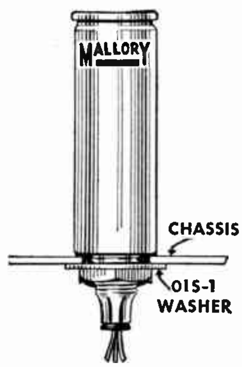


FIGURE 7

Due to their reduced size many Mallory round can units are supplied with 5/8″ necks and a few of higher ratings have 3/4″ necks. There are no 7/8″ necks in the Mallory Replacement Condenser line. Obviously no instructions are needed to mount a 5/8″ neck type Mallory unit in a 5/8″ hole. You will find, however, that the 5/8″ neck may be also satisfactorily mounted in a 3/4″ hole without special accessories by simply centering the unit as the mounting nut is tightened. This holds true for the 3/4″ neck unit when mounting in a 7/8″ hole.

If the 5/8″ neck is to be mounted in a 7/8″ hole Mallory Type 015-1 washer supplied with the unit should be used beneath the chassis to afford the lock nut a better grip on the chassis (See Figure 7). No washer is necessary on top of the chassis in this case.

RING CLAMP MOUNTING

Where clamp mounting was used originally and the Mallory replacement is of the 1 3/8" can size it may be mounted in the same way as the original (See Figure 8); the threaded neck portion will protrude when mounted.

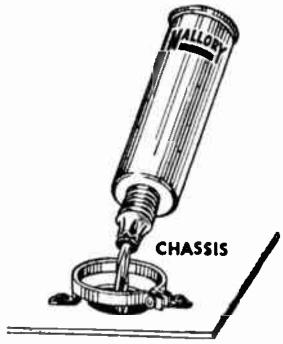


FIGURE 8

In replacing a clamp mounted unit with a 1" Mallory can size use the special Mallory 1 3/8" washer Type No. A-017. (Not supplied with the unit—List price $0.05). This washer is put on the unit and the nut tightened first, then fitted to the clamp as in Figure 9. The washer may be used with the flanged

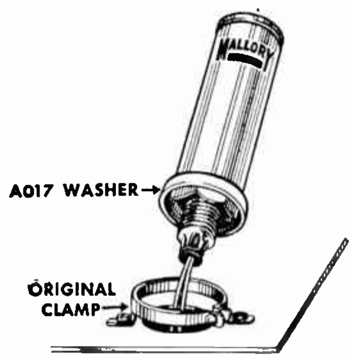


FIGURE 9

side up or down according to the space available for the threaded neck portion of the condenser below the chassis. The washer is not supplied with the unit due to the relatively few cases in which they are required. Their cost is so nominal compared to the reduced stock affected that a supply should always be kept on hand.

In cases where a 1 1/2" unit was used originally, if the clamp will not contract enough to fit the 1 3/8" diameter of the replacement, pad the clamp with a small strip of cardboard. Mallory units are insulated from their containers. It is not necessary that the clamp make electrical contact to the unit.

These features are not provided in the large 2 1/2" and 3" round can units. (See Type MN).

SPADE BOLT MOUNTING

Pictured in Figure 10, it should be noted that generally the holes punched in the chassis to accommodate this type were made with the same punch used

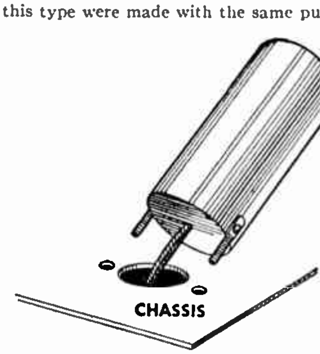


FIGURE 10

for the wafer type tube sockets. The large center hole is about 1" in diameter but the Mallory 1 3/8" can units will mount satisfactorily using the Mallory Type No. 015-2 washer (supplied with the unit) beneath the chassis similar to Figure 7. The unit should be centered, of course, when tightening the mounting nut.

The 1" can type units require two Mallory Type No. 015-2 washers one above and one below the chassis to replace the spade bolt type (See Figure 11). These washers are not supplied with the 1" can units and list

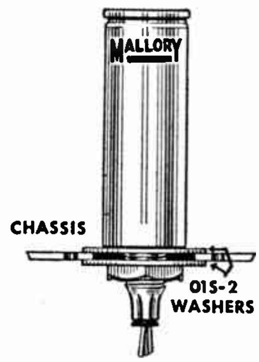
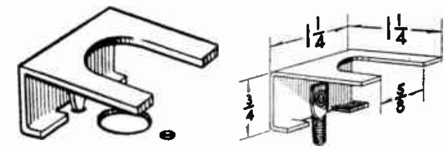


FIGURE 11

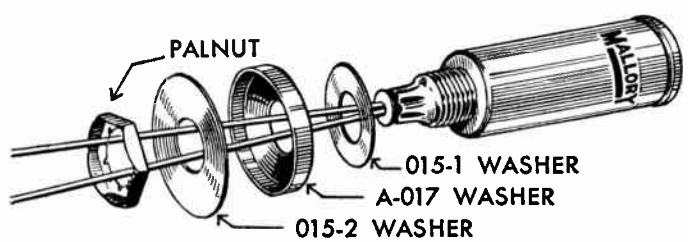
for $0.03 each. We suggest that you save these washers when using 1 3/8" Mallory units in mountings not requiring them. (All 1 3/8" units are supplied with one of these washers.) These flat washers are not lock washers and since the nut is self-locking, need not be used except as stated.

All Mallory round can dry electrolytic replacement units are insulated internally so that the can is not the terminal in any case. A separate wire is always brought out for the cathode connection. It is never necessary to use insulating washers with Mallory round can dry electrolytic units. **This does not apply to type MN.**



UNIVERSAL MOUNTING BRACKET

The Universal Mounting Bracket No. 104-1 is for mounting threaded neck round can units on chassis originally provided with ring clamp or spade bolt mountings. The Mallory Ring Clamp, available in 5 sizes, is for mounting all types of round can condensers.



Modern Methods of Obtaining Bias

MALLORY BIAS CELLS

One of the most perplexing problems faced by the radio design engineer has been the method of obtaining bias for various tubes. Unless large by-pass condensers are used with a filter network, cathode bias, or bias derived from the voltage drop in the negative lead of the power supply system, has many disadvantages. Common impedance, and voltage fluctuations with signal in the power supply circuit causes a continuous variation of bias voltage. The bias voltage variation is responsible for many undesirable effects, such as instability, loss of bass note amplification, and distortion. As previously explained, the by-passing efficiency of a condenser varies with the frequency. At the low frequencies where the by-passing action is most needed, the efficiency of the condensers is the lowest. Condensers of sufficient size to prevent objectionable bias variation are both bulky and expensive. Cathode bias has the further disadvantage of placing the cathode at a different potential from the heater, so that electronic emission from the heater will frequently cause an objectionable amount of hum.

In the past the only alternative methods of obtaining bias were through the use of separate "C" bias power supply, requiring a separate rectifier tube, choke and filter condensers, or by using a common "C" battery. It will be generally agreed that a "C" battery has little place in a modern AC receiver, transmitter, or PA amplifier as such batteries have a tendency to become noisy and develop high resistance with age, and frequently fail when most needed.

Stated briefly what was needed was an independent source of "C" bias that was inexpensive, compact, absolutely quiet, and having a life equal to the other components of the circuit—the tubes, resistors, and condensers. It was unnecessary for the bias supply to furnish current or power because no appreciable grid current flows in an amplifier tube operated under Class "A" operating conditions.

After many years of research the problem was successfully solved by the design of the Mallory Grid Bias Cell. Over three million Mallory Bias Cells are now in use. They are standard original equipment in most modern receivers.

WHAT IS A BIAS CELL?

CHARACTERISTICS

Physicially, the Mallory Grid Bias Cell is a small acorn-shaped device 5/8" in diameter and 11/32" deep. The black disc is the positive electrode, the metal container is the negative electrode.

VOLTAGE

Mallory Bias Cells are produced in two types: the standard 1-volt cell, and the new 1 1/4-volt cell. The two types may be distinguished by the fact that the 1 1/4-volt cell has indentations or concave depressions in the electrodes, while the 1-volt type is smooth.

For experimental applications the choice between the two types of cells should be made on the basis of the voltage that is required. When making repairs on commercial receivers, replace with the type of cell that was used as original equipment.

CURRENT—(DC)

The cell is strictly a potential, or voltage, cell and should not be used in circuits in which currents of over one microampere or .000001 ampere is drawn from the cell.

CURRENT—(AC)

The characteristics of the cell are unaffected by superimposed AC as high as 360 microamperes of any frequency.

TEMPERATURE

The cells may be used in ambient temperatures from 40° below zero to 120°F. The voltage of the cell remains reasonably constant throughout this wide temperature range. It is recommended, however, that wherever possible the bias cell be placed in the coolest location.

HUMIDITY

The cell exhibits no change in characteristics when exposed to a relative humidity of 90% at 120°F.

IMPEDANCE

The Mallory Grid Bias Cell is non-reactive at audio frequencies and the DC resistance ranges between 11,000 and 50,000 ohms.

NOISE

The cell does not cause the development of any noise.

GENERAL

Under no circumstances should the Mallory Grid Bias Cell be checked with an ordinary voltmeter, regardless of the sensitivity of the meter. If for any reason it is desired to read the voltage of the cell, a vacuum tube voltmeter similar to that shown in Figure 1 should be used. An ordinary voltmeter plus a dry battery and voltage divider may be used to calibrate the vacuum tube voltmeter by substituting the voltage obtained from the dry cell for the voltage of the Grid Bias Cell, as shown by the dotted lines in Figure 1.

RECOMMENDED TEST METHOD

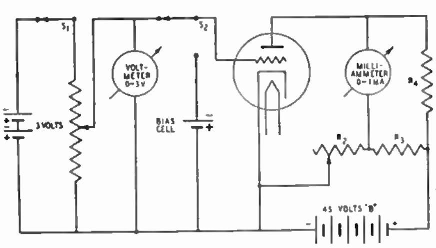


FIGURE 1

Since the Mallory Bias Cell potential is affected by a load as high as 10 megohms, it is necessary to use a device which draws no current when measuring cell potentials.

A vacuum tube voltmeter, which has no resistance connected to the grid but obtains its bias through the source it is measuring and thus indicates DC voltage, may be used to measure the bias cell potential.

A vacuum tube indicator, which compares the cell potential with an accurate low resistance voltmeter as shown in Figure 1, is very convenient for use in checking bias cells.

A list of parts suitable for making the Mallory Bias Cell test set is given. Any type of medium mu triode such as 27, 56, 37, 76, 30, 6C5, 6C5G, 6J5, 6J5G, 1H4G or 6L5G may be used.

RESISTOR LIST

Part	Mallory-Yaxley Part No.
Calibrating Potentiometer	C15MP
R_2	C15MP
R_3	10,000 ohm, 1 watt
R_4	10,000 ohm, 1 watt
S_1 and S_2	No. 2006 Push Button Switch

PERFORMANCE ADVANTAGES

The curves show the extent to which low frequencies are reduced by a small cathode by-pass condenser. If good low-frequency amplification is required, a Mallory Bias Cell is more economical than a sufficiently large by-pass. The curves were taken with a type 6F5 tube, but similar results would be obtained with other types of tubes such as the 75, 2A6, and 6Q7.

Typical applications and circuits using Mallory Grid Bias Cells are given in the following diagrams. Service engineers should study these closely since these hook-ups are used in many modern receivers and amplifiers.

Figure 2 shows the use of Mallory Bias Cells for biasing the first audio stage of a superheterodyne receiver, and for furnishing residual bias to the AVC system. This is a very satisfactory circuit and is to be recommended to experimenters who build their own receivers. The AVC action is exceptionally smooth and the tone quality is superb.

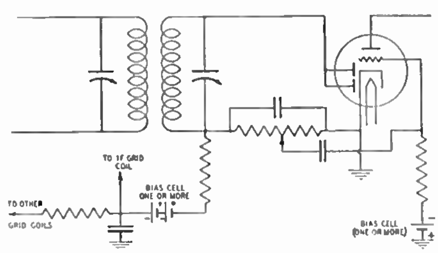


FIGURE 2

Figure 3 shows a slight modification of Figure 2, in that the bias cell is connected "above ground," between the grid leak and grid.

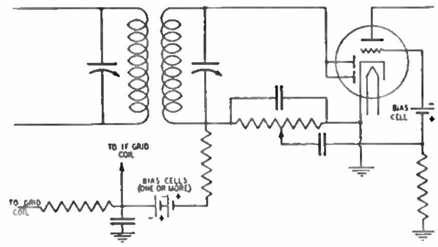


FIGURE 3

Figure 4 shows the use of Mallory Bias Cells in a high-gain Microphone Amplifier. Radio amateurs frequently apply this same circuit to twin triode tubes such as the 79, 6A6, 6N7, and 6Y7G, to obtain a high-gain two-stage amplifier that is very compact because it uses only a single tube. By grounding the cathode and using separate sets of bias cells for each grid, any tendency toward motorboating and instability is eliminated. The twin elements of the tube are of course operated in cascade.

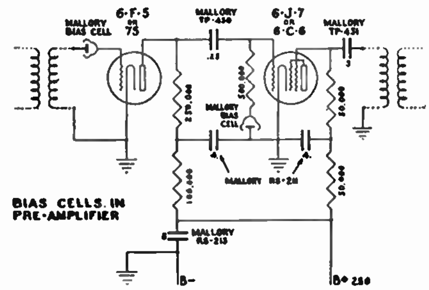


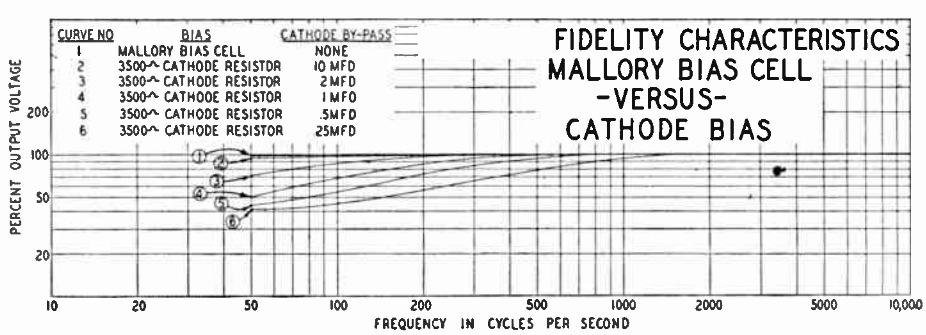
FIGURE 4

PRECAUTIONS

To insure complete satisfaction from the use of the Mallory Bias Cells, the following simple precautions should be observed:

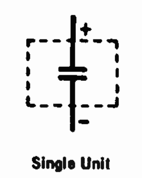
1. Bias cells should not be used to bias oscillators, power output tubes, or amplifier tubes in which grid current may exist.
2. The new 1 1/4-volt Mallory Bias Cells may be mounted in any position.
   The standard Mallory 1-volt bias cells may be mounted in any position except with the black electrode in a horizontal plane at the top of the cell.
3. To avoid accidental short-circuiting of the cell, keep it in its envelope. Do not permit cells to be carried loose in a pocket with metal objects such as coins and keys.
4. When soldering bakelite insulated holders use care not to over-heat connections or loose terminals will result.
5. Many of the new model receivers and amplifiers are using 1 1/4-volt Mallory Bias Cells, mounted in wire spring-type clips.

Should it be desired to replace these cells, care should be taken not to deform the clip, or to bend it so far that inadequate contact pressure will be maintained on the electrodes. The wire clips can best be spread by using a special tool that is made for the purpose; lacking this, a pair of long-nose pliers can be employed if the outer faces of the jaws are notched slightly to prevent slipping.

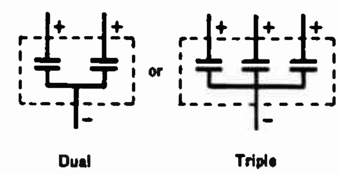


6F5 Tube, EP = 250V Through 250,000 ohms

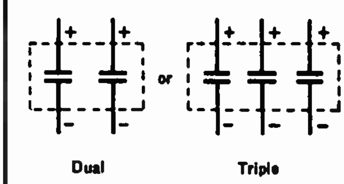
CS (CARTON) OR RS (CAN) TYPE



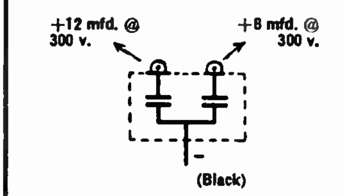
CN (CARTON) OR RN (CAN) TYPE



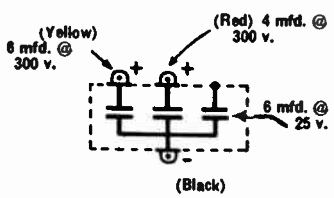
CM (CARTON) OR RM (CAN)



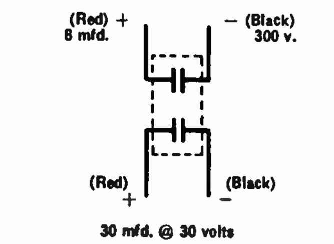
SR 601 (CARTON)



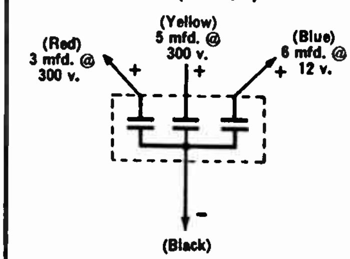
SR602 (STUD MOUNTING CAN)



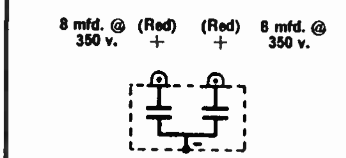
SR603 (CARDBOARD TUBE)



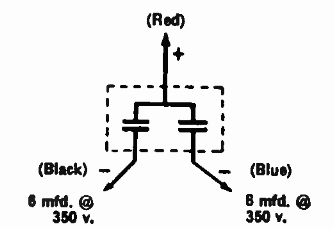
SR 604 (CARTON)



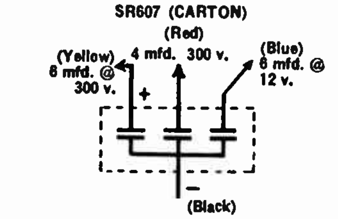
SR605 (STUD MOUNTING CAN)



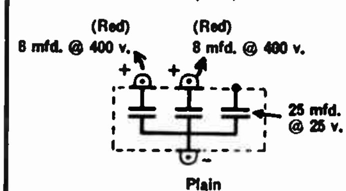
SR606 (CARDBOARD CARTON)



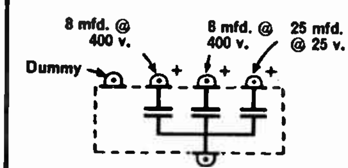
SR607 (CARTON)



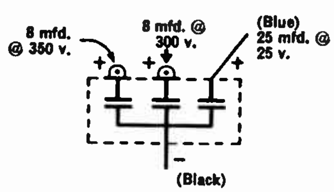
SR609 (CAN)



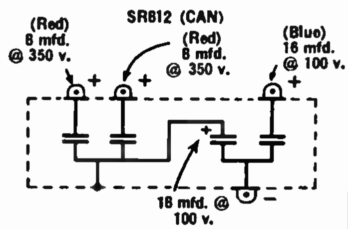
SR610 (CARTON)



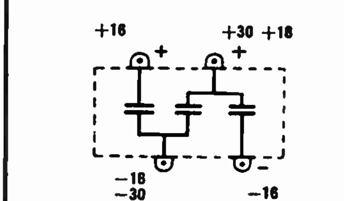
SR611 (CARTON)



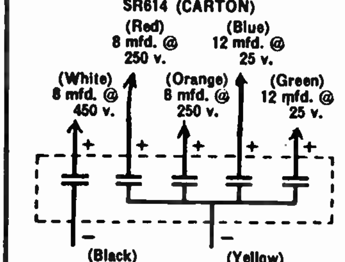
SR612 (CAN)



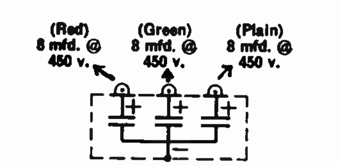
SR613 (CARTON)



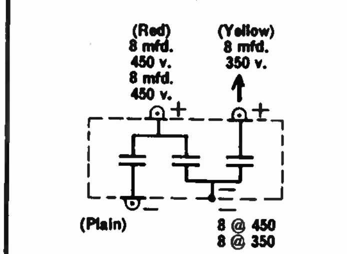
SR614 (CARTON)



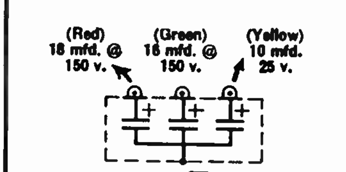
SR615 (CAN)



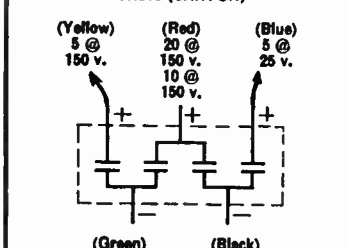
SR616 (CAN)



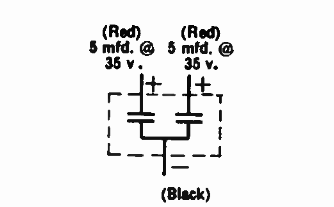
SR617 (CAN)



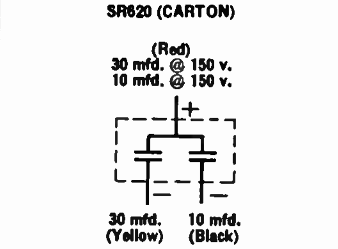
SR618 (CARTON)



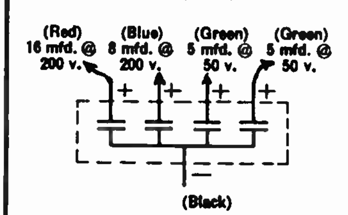
SR619 (CARTON)



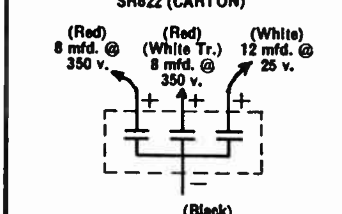
SR620 (CARTON)



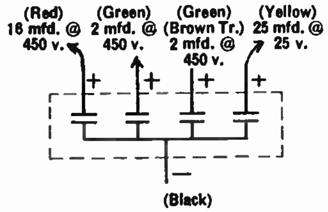
SR621 (TUBE)



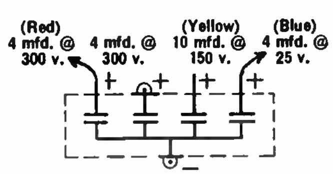
SR622 (CARTON)



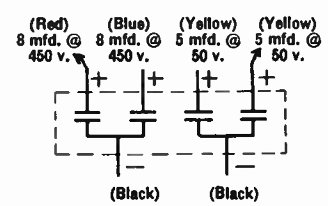
SR623 (CARDBOARD TUBE)



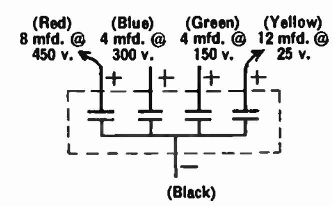
SR624 (CARTON)



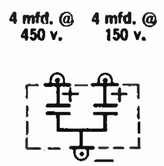
SR625 (CARTON)



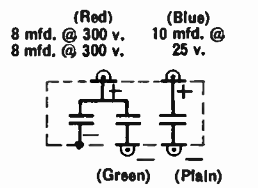
SR626 (CARTON)



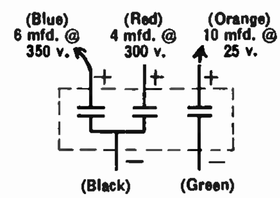
SR627 (CARTON)



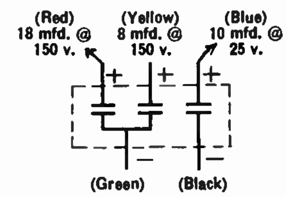
SR628 (CAN)



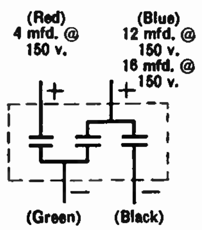
SR629 (CARTON)



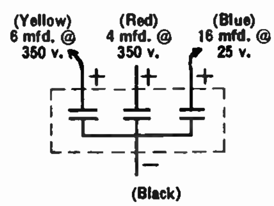
SR630 (CARTON)



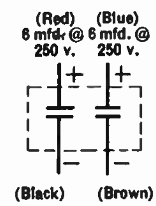
SR631 (CARTON)



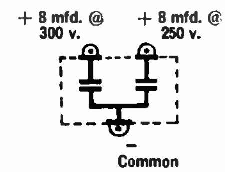
SR632 (TUBE)



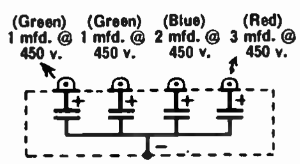
SR633 (TUBE)



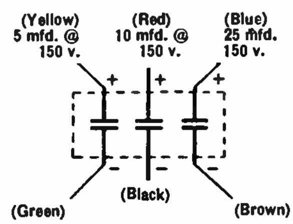
UR180 (CARTON)



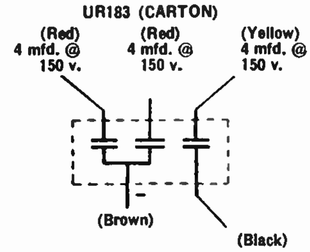
UR181 (CAN)



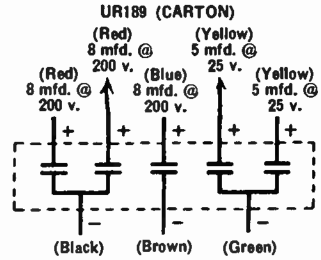
UR182 (CARTON)



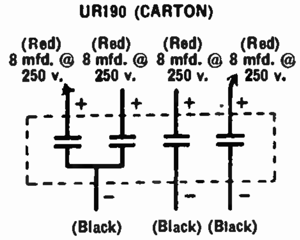
UR183 (CARTON)



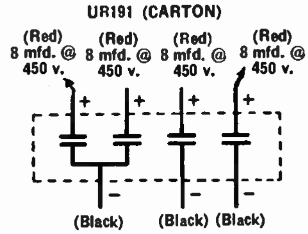
UR188 (SPADE BOLT MOUNTING)
UR189 (CARTON)



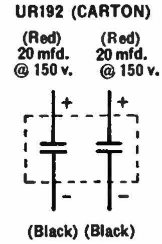
UR190 (CARTON)



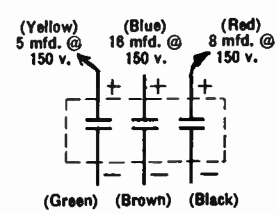
UR191 (CARTON)



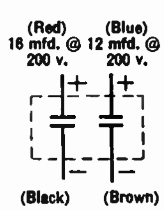
UR192 (CARTON)



UR193 (CARTON)



UR194 (TUBE)



Dry Electrolytic Filter Condensers

CARDBOARD CARTON TYPES

CS—Single Type

Capacity	Wkg. V.	Max. Surge	Size B x C x A	Cat. No.
4	250	300	1/2 x 3/4 x 2 7/16	CS121
8	250	300	5/8 x 7/8 x 2 7/16	CS123
10	250	300	5/8 x 1 x 2 7/16	CS124
12	250	300	5/8 x 1 x 2 7/16	CS125
16	250	300	11/16 x 1 1/8 x 2 7/16	CS126
2	450	525	1/2 x 3/4 x 2 7/16	CS130
4	450	525	5/8 x 7/8 x 2 7/16	CS131
6	450	525	5/8 x 1 x 2 7/16	CS132
8	450	525	5/8 x 1 x 2 7/16	CS133
10	450	525	11/16 x 1 1/8 x 2 7/16	CS134
12	450	525	11/16 x 1 1/8 x 2 7/16	CS135
16	450	525	1 x 1 1/4 x 2 7/16	CS136

CN—Common Cathode Type

Capacity	Wkg. V.	Max. Surge	Size	Cat. No.
4-4	250	300	5/8 x 1 x 2 5/8	CN140
4-8	250	300	5/8 x 1 x 2 5/8	CN141
8-8	250	300	3/4 x 1 1/8 x 2 5/8	CN142
8-8-8	250	300	7/8 x 1 1/4 x 3	CN145
4-4	450	525	3/4 x 1 1/8 x 2 5/8	CN150
4-8	450	525	7/8 x 1 1/4 x 2 5/8	CN151
8-8	450	525	7/8 x 1 1/4 x 2 5/8	CN152
8-8-8	450	525	1 1/2 x 1 1/4 x 3	CN155

CM—Separate Section Type

Capacity	Wkg. V.	Max. Surge	Size	Cat. No.
4-4	250	300	3/4 x 1 1/8 x 2 5/8	CM160
4-8	250	300	3/4 x 1 1/8 x 2 5/8	CM161
8-8	250	300	7/8 x 1 1/4 x 2 5/8	CM162
8-8-8	250	300	1 3/8 x 1 x 3	CM165
16-16	250	300	1 3/8 x 1 x 2 5/8	CM164
4-4	450	525	3/4 x 1 1/8 x 2 5/8	CM170
4-4-4	450	525	1 1/2 x 1 1/4 x 3	CM173
4-8	450	525	7/8 x 1 1/4 x 2 5/8	CM171
8-8	450	525	1 3/8 x 1 x 2 5/8	CM172
8-8-8	450	525	1 1/2 x 1 1/4 x 3	CM175

ROUND ALUMINUM CAN TYPES

RS—Single Type

Capacity	Wkg. V.	Max. Surge	Size A x B	Cat. No.
50	25	40	2 3/4 x 1	RS200
4	250	300	2 3/4 x 1	RS201
8	250	300	2 3/4 x 1	RS203
12	250	300	2 3/4 x 1	RS205
25	250	300	3 1/2 x 1	RS207
50	300	350	3 3/4 x 1 3/8	RS208
4	450	525	2 3/4 x 1	RS211
8	450	525	2 3/4 x 1	RS213
12	450	525	2 3/4 x 1	RS215
16	450	525	3 1/2 x 1	RS216

RN—Common Cathode Type

Capacity	Wkg. V.	Max. Surge	Size	Cat. No.
4-8	250	300	3 x 1	RN231
8-8	250	300	3 x 1	RN232
8-8-8	250	300	3 x 1 3/8	RN235
4-8	450	525	3 x 1	RN241
8-8	450	525	3 x 1 3/8	RN242
8-8-8	450	525	3 1/2 x 1 3/8	RN245

RM—Separate Section Type

Capacity	Wkg. V.	Max. Surge	Size	Cat. No.
4-8	250	300	3 x 1 3/8	RM251
8-8	250	300	3 x 1 3/8	RM252
8-8-8	250	300	3 1/2 x 1 3/8	RM255
8-8-16	250	300	3 1/2 x 1 3/8	RM257
8-16-16	250	300	3 1/2 x 1 3/8	RM259
4-8	450	525	3 x 1 3/8	RM261
8-8	450	525	3 x 1 3/8	RM262
8-8-8	450	525	4 x 1 3/8	RM265

Dry Electrolytic Bypass Condensers

CARDBOARD TUBULAR TYPES

TS—Single Type

Capacity	Wkg. V.	Max. Surge	Size A x B	Cat. No.
10	25	40	1 3/4 x 3/4	TS101
20	25	40	2 1/4 x 7/8	TS102
25	25	40	2 1/4 x 7/8	TS103
50	25	40	2 3/4 x 1	TS104
5	50	75	1 3/4 x 3/4	TS105
10	50	75	2 1/4 x 7/8	TS106
25	50	75	2 3/4 x 1	TS107
50	50	75	3 1/8 x 1 1/8	TS108

TN—Common Cathode Type

Capacity	Wkg. V.	Max. Surge	Size	Cat. No.
5-5	25	40	1 3/4 x 3/4	TN110
10-10	25	40	2 1/4 x 7/8	TN111
5-5	35	50	1 3/4 x 7/8	TN112
5-5	50	75	2 1/4 x 7/8	TN113

Dry Electrolytic Bypass Condensers

ROUND ALUMINUM CAN TYPE BN

Capacity	Wkg. V.	Max. Surge	Catalog No.
10-10	50	75	BN225
10-10	50	75	BN226

Large Round Can Condensers

DRY ELECTROLYTIC TYPE MN

MN—Mulitple Section Common Cathode Type (Common Negative) (All Cathodes to Can)

Capacity	Size A x B	Catalog Number
8-8	4 1/8 x 2 1/2	MN272
5-15	4 1/8 x 2 1/2	MN273
8-8-8	4 1/8 x 3	MN275
8-8-8-8	4 1/8 x 3	MN277
9-9-18-18	4 1/8 x 3	MN278

Old Style Condensers

DRY ELECTROLYTIC

Original Large Size

Capacity	Wkg. V.	Max. Surge	Size A x B x C	Cat. No.
Single Unit in Carton with Two Leads				
4	450	525	4 1/8 x 1 3/8 x 11/16	14450
8	450	525	4 1/8 x 1 3/8 x 15/16	18450
Dual Unit in Carton with Four Leads				
4-8	450	525	4 3/8 x 1 1/2 x 1 3/4	148450
8-8	450	525	4 3/8 x 1 1/2 x 2	188450
Single Unit in Round Can with One Lug				
8	450	525	3 3/4 x 1 3/8	TM2-8
Single Unit in Round Can with Two Leads				
8	450	525	4 7/16 x 1 3/8	M2-753
Dual Unit in Round Can with Four Leads				
8-8	450	525	4 7/16 x 1 1/2	M2-585

Wet Electrolytic Condensers

TYPE WE

Capacity	Wkg. V.	Peak V.	Size B x A	Cat. No.
4	450	475	1 x 2 15/16	WE447
8	450	475	1 x 3 1/16	WE847
8	450	475	1 3/8 x 3 15/16	WE847A
12	450	475	1 3/8 x 3 1/16	WE1247
16	450	475	1 3/8 x 3 15/16	WE1647
18	450	475	1 3/8 x 3 15/16	WE1847
25	450	475	1 3/8 x 4 15/16	WE2545
35	450	475	1 3/8 x 4 7/16	WE3540
40	450	475	1 3/8 x 4 15/16	WE4045

Heavy Duty and High Surge Types

HD—500 Working Volts DC

Capac.	Container	Size	Cat. No.
4	Carton	5/8 x 1 x 2 7/16	HD680
4	Round Can	1 x 2 3/4	HD681
8	Carton	11/16 x 1 1/8 x 2 7/16	HD682
8	Round Can	1 x 3 1/16	HD683

HS—600 Working Volts DC

Capac.	Container	Size	Cat. No.
4	Carton	7/8 x 1 1/4 x 3	HS690
4	Round Can	1 3/8 x 3 1/2	HS691
8	Carton	1 1/4 x 1 1/2 x 3	HS692
8	Round Can	1 3/8 x 4 3/4	HS693

Hardware and Accessories

DESCRIPTION	Catalog No.
Mallory Terminal Connector	A-016
Washer for Clamp Mounting 1" Cans	A-017
Washer for 7/8" Hole Mounting 1" Cans	015-1
Washer for Spade Bolt Mounting 1" and 1 3/8" Cans	015-2
Ring Clamp for 1" Round Unit	105-1
Ring Clamp for 1 3/8" Round Unit	106-1
Ring Clamp for 1 1/2" Round Unit	107-1
Ring Clamp for 2 1/2" Round Unit	108-1
Ring Clamp for 3" Round Unit	109-1
Special Mounting Bracket	104-1

Universal and Special Types

UR—SPECIAL UNIVERSAL UNITS

Capacity	Wkg. V.	Container	Size	Catalog No.
8-8	250–300	Carton	1 1/8 x 1 1/8 x 2 1/4	UR180
3-2-1-1	450	Round Can	1 3/8 x 2 3/4	UR181
5-25-10	150	Carton	1 5/16 x 1 3/8 x 2 3/8	UR182
4-4-4	150	Carton	5/8 x 1 1/4 x 2 1/4	UR183
8-8-8, 5-5	200, 25	Cardboard Tube	1 3/8 x 3 3/4	UR188
8-8-8, 5-5	200, 25	Carton	1 1/4 x 1 1/2 x 3	UR189
8-8-8-8	250	Carton	1 1/4 x 1 1/4 x 3	UR190
8-8-8-8	450	Carton	1 5/8 x 1 3/4 x 3	UR191
20-20	150	Carton	1 5/16 x 1 5/8 x 2 3/8	UR192
5-8-16	150	Carton	1 x 1 1/4 x 2 1/2	UR193
16-12	200	Cardboard Tube	1 3/8 x 3 1/4	UR194

SR—SPECIAL UNIVERSAL UNITS

Capacity	Wkg. V.	Container	Size	Catalog No.
8-12	300	Carton	1 1/4 x 1 7/8 x 2 3/8	SR601
6-4-6	300–300–25	Round Can	1 3/8 x 2 5/8	SR602
8-30	300–30	Cardboard Tube	1 1/4 x 4 5/8	SR603
3-5-6	300–300–12	Carton	1 1/8 x 3/16 x 2	SR604
8-8	350	Round Can	1 3/8 x 3 1/8	SR605
6-6	350	Carton	1 1/16 x 1 9/16 x 2 7/8	SR606
6-4-6	300–300–12	Carton	1 1/16 x 1 9/16 x 2 7/8	SR607
65	30	Cardboard Tube	1 1/4 x 2 1/4	SR608
8-8-25	400–400–25	Round Can	1 3/8 x 2 3/4	SR609
8-8-25	400–400–25	Carton	1 9/16 x 1 9/16 x 2 3/8	SR610
8-8-25	350–300–25	Carton	2 x 2 x 2 1/2	SR611
8-8, 16-16	350, 100	Round Can	1 3/8 x 4 3/4	SR612
16-30-16	200	Carton	1 3/4 x 1 15/16 x 4	SR613
8, 8-8, 12-12	450, 250, 25	Carton	1 7/8 x 2 3/4 x 2 13/16	SR614
8-8-8	450–450–350	Round Can	1 3/8 x 2 3/4	SR615
8-8-8	450–450–350	Round Can	1 3/8 x 4 3/4	SR616
16-16-10	150–150–25	Round Can	1 3/8 x 2 3/4	SR617
5-20-10, 5	150–150–150–25	Carton	1 11/16 x 1 15/16 x 2 7/16	SR618
5-5	35	Carton	3/4 x 3/4 x 1 1/2	SR619
30-10	150	Carton	3/4 x 1 3/4 x 3 1/2	SR620
8-16-5-5	200–200–50–50	Cardboard Tube	1 3/8 x 2 3/4	SR621
8-8-12	350–350–25	Carton	1 5/8 x 1 5/8 x 2 5/32	SR622
16-2-2-25	450–450–450–25	Cardboard Tube	1 1/2 x 3 1/2	SR623
4-4-10-4	300–300–150–25	Carton	1 9/16 x 1 9/16 x 3 13/16	SR624
8-8-5-5	450–450–50–50	Carton	1 7/8 x 1 11/16 x 4 1/8	SR625
8-4-4-12	450–300–150–25	Carton	1 9/16 x 1 5/8 x 3 7/8	SR626
4-4	450–150	Carton	1 x 1 9/16 x 3 3/4	SR627
8-8-10	300–300–25	Round Can (Stud)	1 1/2 x 2 3/4	SR628
6-4-10	350–300–25	Carton	1 1/4 x 1 3/8 x 4 1/2	SR629
16-8-10	150–150–25	Carton	1 1/2 x 1 1/2 x 4	SR630
4-12-16	150	Carton	1 1/4 x 1 1/4 x 2 3/4	SR631
6-4-16	350–350–25	Cardboard Tube	1 x 3 3/4	SR632
6-6	250	Cardboard Tube	1 1/4 x 3 1/4	SR633

Compact Type BB

DRY ELECTROLYTIC METAL CASED TUBULAR CONDENSER

Mallory Type BB tubulars are extremely small in size and excellent for general service applications. Small size without loss of quality is accomplished through the use of Mallory FP anodes instead of the usual etched foil construction. Available in the following newly standardized ratings:

See General Catalog, Form M760 for revised ratings on Type BB Condensers, effective April 11, 1938.

Catalog No.	Voltage	Capacity	Size
BB70	450	5	1 5/8 x 11/16
BB71	450	10	[illegible]
BB40	300	5	1 5/8 x 11/16
BB41	300	[illegible]	[illegible]
BB42	300	15	2 x 7/8
BB20	150	5	1 5/8 x 11/16
BB21	150	10	1 5/8 x 11/16
BB22	150	15	1 5/8 x 11/16
BB23	150	[illegible]	[illegible]
BB24	150	30	2 x 7/8
BB11	25	10	1 5/8 x 11/16
BB12	25	40	1 5/8 x 11/16

Tubular Paper Dielectric Condensers

TYPE TP—WAX IMPREGNATED

Capacity	Size A x B	S	Catalog No.
Type TP—600 Volts			
.0001	1 1/16 x 5/16	10	TP401
.00025	1 1/16 x 5/16	10	TP402
.0005	1 1/16 x 5/16	10	TP403
.001	1 1/16 x 5/16	10	TP404
.002	1 1/16 x 5/16	10	TP405
.003	1 1/16 x 5/16	10	TP406
.004	1 1/16 x 5/16	10	TP407
.005	1 1/16 x 3/8	10	TP408
.006	1 1/16 x 3/8	10	TP409
.01	1 1/16 x 7/16	10	TP410
.02	1 3/8 x 7/16	10	TP412
.03	1 3/8 x 7/16	10	TP413
.04	1 3/8 x 9/16	10	TP414
.05	1 1/2 x 9/16	10	TP415
.06	1 1/2 x 9/16	10	TP416
.1	1 11/16 x 5/8	10	TP418
.15	2 x 11/16	10	TP417
.2	2 x 3/4	10	TP419
.25	2 x 13/16	10	TP420
.5	2 1/8 x 1	5	TP432
1.0	2 1/2 x 1 1/4	5	TP433
Type TP—1000 Volts			
.01	1 3/8 x 1/2	10	TP434
.02	1 11/16 x 1/2	10	TP435
.05	1 11/16 x 11/16	10	TP437
.1	2 x 13/16	10	TP439

DUAL CONDENSERS

Capacity	Size A x B	S	Catalog No.
Type TP—400 Volts DC			
.01-.01	1 1/2 x 7/16	5	TP446
.05-.05	1 7/8 x 5/8	5	TP447
.1 -.1	2 1/4 x 11/16	5	TP448
Type TP—200 Volts DC			
.25-.25	2 1/2 x 3/4	5	TP449
Type TP—200 Volts			
.05	1 3/8 x 7/16	10	TP436
.1	1 3/8 x 9/16	10	TP438
.25	2 x 5/8	10	TP440
.5	2 1/16 x 3/4	10	TP441
1.0	2 1/8 x 1	5	TP443
Type TP—400 Volts			
.01	1 1/16 x 3/8	10	TP421
.02	1 1/4 x 7/16	10	TP423
.03	1 1/4 x 1/2	10	TP424
.04	1 1/4 x 9/16	10	TP425
.05	1 3/8 x 1/2	10	TP426
.06	1 3/8 x 1/2	10	TP427
.1	1 5/8 x 9/16	10	TP428
.2	1 5/8 x 3/4	10	TP429
.25	2 x 11/16	10	TP430
.5	2 1/8 x 13/16	10	TP431
1.0	2 1/2 x 1	5	TP422

TYPE OW—OIL IMPREGNATED, WAX FILLED

Capacity	Size A x B	Catalog No.
Type OW—1200 Volts DC		
.0025	1 3/8 x 3/8	OW331
.005	1 5/8 x 1/2	OW332
.0075	1 5/8 x 1/2	OW333
.01	1 5/8 x 9/16	OW334
.015	1 5/8 x 5/8	OW335
.02	1 5/8 x 3/4	OW336
.03	2 x 3/4	OW337
.04	2 3/16 x 3/4	OW338
.05	2 3/16 x 13/16	OW339

TYPE OT—OIL IMPREGNATED, OIL FILLED

Capacity	Size A x B	Catalog No.
Type OT—1600 Volts DC		
.005	1 1/4 x 5/8	OT371
.0075	1 1/4 x 5/8	OT372
.01	1 9/16 x 11/16	OT373
.0125	1 3/4 x 11/16	OT374
.015	1 3/4 x 11/16	OT375
.02	1 3/4 x 3/4	OT376
Type OT—2000 Volts DC		
.0025	1 9/16 x 5/8	OT458
.05	1 5/8 x 3/4	OT459
.0075	2 1/16 x 3/4	OT460
.01	2 1/16 x 3/4	OT461
.0125	2 5/16 x 3/4	OT462
.015	2 5/16 x 3/4	OT463
.02	2 9/16 x 3/4	OT464
.03	2 9/16 x 15/16	OT465
.04	2 9/16 x 15/16	OT466
.05	2 9/16 x 15/16	OT467

Auto Radio Condensers

PAPER DIELECTRIC TYPE VB

Capacity	Size A x B x C	Fig.	Catalog No.
1600 Volts DC			
.0075	7/8 x 5/8 x .3	1	VB470
.01	7/8 x 5/8 x .3	1	VB471
.0125	5/8 x 1 x .3	1	VB472
.015	7/8 x 1 1/16 x .3	1	VB473
.02	7/8 x 1 1/16 x .3	1	VB474
.03	1 x 15/16 x 13/32	1	VB475
.04	1 x 15/16 x 7/16	1	VB476
.05	1 x 1 x 1/2	2	VB477

PAPER DIELECTRIC TYPES VL and VO

Cap.	DC Volts	Size A x B x C	Fig.	Catalog No.
.01	2000	3 x 17/32 x 3/8	3	VL478
.5	200	3 x 27/32 x 3/8	3	VL479
.5	120	2 1/8 x 3/4 x 7/16	4	VO480

MISCELLANEOUS TYPES AG, AM, FM, RF, DL

Capacity	Size B x A	Fig.	Catalog No.
.25	5/8 x 1 13/16	5	AG444
.5	11/16 x 1 13/16	5	AG451
1.0	1 x 2 3/16	5	AG452
.5*	3/4 x 1 3/4	5	AG453
.5	5/8 x 2	6	AM454
.5	11/16 x 2	7	FM442
.5	1 x 2 3/8	9	DL445
.5	3/4 x 1 3/8	8	RF481
1.0	7/8 x 1 5/8	8	RF482
90 x 16 Choke†	1 x 1 1/2	10	RF581
55 x 16 Choke†	1 x 1 3/16	10	RF582
55 x 12 Choke†	1 5/16 x 1 5/8	10	RF583

Transmitting Condensers

RECTANGULAR TYPE TX

Cap.	Size A x B x C x D	Catalog No.
600 Volts DC		
1	1 1/4 x 1 15/16 x 2 1/8 x 2 3/8	TX801
2	1 1/4 x 1 15/16 x 2 5/8 x 2 3/8	TX802
4	1 1/4 x 1 15/16 x 4 9/16 x 2 3/8	TX803
1000 Volts DC		
1	1 1/4 x 1 15/16 x 2 1/8 x 2 3/8	TX804
2	1 1/4 x 1 15/16 x 3 1/2 x 2 3/8	TX805
4	1 3/4 x 2 1/2 x 4 9/16 x 2 15/16	TX806
1500 Volts DC		
1	1 1/4 x 1 15/16 x 3 1/2 x 2 3/8	TX807
2	1 7/16 x 2 3/16 x 4 9/16 x 2 5/8	TX808
4	2 x 2 3/4 x 4 9/16 x 3 3/16	TX809
2000 Volts DC		
1	1 1/4 x 1 15/16 x 4 9/16 x 2 3/8	TX810
2	1 3/4 x 2 1/2 x 4 9/16 x 2 15/16	TX811
2500 Volts DC		
1	1 7/16 x 2 3/16 x 4 9/16 x 2 5/8	TX812
2	2 x 2 3/4 x 4 9/16 x 3 3/16	TX813
3000 Volts DC		
1	1 3/4 x 2 1/2 x 4 9/16 x 2 15/16	TX814
2	2 5/8 x 3 x 4 9/16 x 3 7/16	TX815

ROUND CAN TYPE TZ

Capacity	Size A x B	Catalog No.
600 Volts DC		
1	2 3/4 x 1 1/2	TZ381
2	4 3/4 x 1 1/2	TZ382
1000 Volts DC		
1	3 3/4 x 1 1/2	TZ384
2	4 3/4 x 1 1/2	TZ385
1500 Volts DC		
.5	3 3/4 x 1 1/2	TZ386
1	4 3/4 x 1 1/2	TZ387

Trimmer and Padding Condensers

Capacity in Mmfd. Min.	Max.	Fig.	Catalog No.
3	30	1	BT961
3	30	2	BT962
3	30	3	BT963
3	30	4	BT964
3	30	5	CT959
20	100	6	CTX954
60	240	6	CTX955
180	560	6	CTX956
480	1640	6	CTX957
660	2100	6	CTX958
18	100	7	CTD951
60	230	7	CTD952
240	670	7	CTD953

Mica Condensers

TYPE MC

Capacity Mfd.	Fig.	Catalog No.
.000005	A	MC831
.0000075	A	MC832
.00001	A	MC833
.000025	A	MC834
.00003	A	MC835
.00004	A	MC836
.00005	A	MC837
.000075	A	MC838
.0001	A	MC839
.00015	A	MC840
.0002	A	MC841
.00025	A	MC842
.0003	A	MC843
.0004	A	MC844
.0005	A	MC845
.001	A	MC846
.0015	A	MC847
.002	B	MC848
.0025	B	MC849
.003	B	MC850
.004	B	MC851
.005	B	MC852
.006	B	MC853

Cased Bypass Condensers

TYPE CB

Cap.	Size A x B x C x D	Fig.	Catalog No.
600 Volts DC			
.1	1 3/4 x 7/8 x 3/4 x 2 1/8	1	CB313
.25	1 3/4 x 1 x 7/8 x 2 1/8	1	CB314
.5	2 x 1 3/4 x 7/8 x 2 3/8	1	CB315
2 x .1	2 x 1 3/4 x 7/8 x 2 3/8	2	CB316
3 x .1	2 x 1 3/4 x 7/8 x 2 3/8	2	CB317
400 Volts DC			
.1	1 3/4 x 7/8 x 3/4 x 2 1/8	1	CB301
.25	1 3/4 x 7/8 x 3/4 x 2 1/8	1	CB302
.5	2 x 1 3/4 x 7/8 x 2 3/8	1	CB303
1.0	2 x 2 x 1 x 2 3/8	1	CB304
2.0	2 x 2 x 1 1/4 x 2 3/8	1	CB305
2 x .1	1 3/4 x 1 x 7/8 x 2 1/8	2	CB306
2 x .25	2 x 1 3/4 x 7/8 x 2 3/8	2	CB307
2 x .5	2 x 2 x 1 x 2 3/8	2	CB308
3 x .1	1 3/4 x 1 1/4 x 7/8 x 2 1/8	2	CB309
3 x .25	2 x 2 x 1 x 2 3/8	2	CB310
3 x .5	2 x 2 x 1 1/8 x 2 3/8	2	CB311
4 x .1	2 x 1 3/4 x 7/8 x 2 3/8	3	CB312

Uncased Condensers

TYPE UB

Capacity	Size A x B x C	Catalog No.
1000 Volts DC		
1	4 3/8 x 1 7/8 x 3/4	UB362
2	4 3/8 x 2 1/8 x 1 3/16	UB363
800 Volts DC		
1	4 3/8 x 1 1/2 x 5/8	UB360
2	4 3/8 x 2 1/16 x 7/8	UB361
600 Volts DC		
.5	2 1/8 x 1 7/16 x 7/16	UB357
1	2 1/8 x 1 11/16 x 13/16	UB358
2	2 1/8 x 2 1/4 x 1 1/16	UB359
400 Volts DC		
1	2 1/8 x 1 9/16 x 9/16	UB354
2	2 1/8 x 1 13/16 x 7/8	UB355
4	4 3/8 x 1 9/16 x 13/16	UB356
200 Volts DC		
1	2 1/8 x 1 3/8 x 7/16	UB351
2	2 1/8 x 1 11/16 x 11/16	UB352
4	2 1/8 x 2 1/16 x 1 1/8	UB353

MALLORY CAPACITORS FOR AC MOTOR STARTING

Round Can Type

Cap. Rating New	Cap. Rating Old	AC Volts	Fig.	Size A	Size B	Size C	Type
26-30	25	110	R	1⅜	4¼	....	MSR860
26-30	25	110	R	1	2 5/16	....	MSR861
38-42	35	110	R	1⅜	4⅛	....	MSR862
53-60	50	110	R	1⅜	2¾	....	MSR863
53-60	50	110	R	1⅜	4¼	....	MSR864
53-60	50	110	R	2	4⅛	....	MSR865
53-60	50	110	R	2	5¼	....	MSR866
64-72	60	110	R	2	4⅛	....	MSR867*
70-78	65	110	R	2⅜	3⅛	....	MSR868
70-78	65	110	R	2	4⅛	....	MSR869
75-84	70	110	R	1⅜	3⅛	....	MSR870
75-84	70	110	R	2½	4⅛	....	MSR871
75-84	70	110	R	2	4⅛	....	MSR872*
86-96	80	110	R	2	4⅛	....	MSR873*
86-96	80	110	R	2½	4⅛	....	MSR874*
86-96	80	110	R	2½	5¼	....	MSR875
86-96	80	110	R	1⅛	3⅛	....	MSR876*
86-96	80	110	R	1⅜	4¼	....	MSR877
97-107	90	110	R	1⅜	3⅛	....	MSR878
108-120	100	110	R	1⅜	3⅛	....	MSR879*
108-120	100	110	R	2	4⅛	....	MSR880*
108-120	100	110	R	2½	4⅛	....	MSR881*
108-120	100	110	R	2½	5¼	....	MSR882
108-120	100	110	R	3	4⅛	....	MSR883
108-120	100	110	R	1⅜	4¼	....	MSR884
124-138	110	110	(a)	3	4⅛	....	MSR885*
124-138	115	110	R	2½	4⅛	....	MSR886*
124-138	115	110	R	2	5⅛	....	MSR887*
124-138	115	110	R	2	4⅛	....	MSR888*
124-138	115	110	R	1⅜	3⅛	....	MSR889*
124-138	115	110	R	3	4⅛	....	MSR890*
145-162	135	110	R	1⅜	4¼	....	MSR891
145-162	135	110	R	2½	4⅛	....	MSR892*
161-180	150	110	R	2	3¼	....	MSR893
161-180	150	110	R	2½	4⅛	....	MSR894*
161-180	150	110	R	2½	5¼	....	MSR895
161-180	150	110	R	1¾	3¼	....	MSR896
161-180	150	110	R	1⅜	4¼	....	MSR897
194-216	180	110	R	1¾	4¼	....	MSR898
216-240	200	110	R	2½	5¼	....	MSR899
216-240	200	110	R	2	3¼	....	MSR900
216-240	200	110	R	1¾	4¼	....	MSR901
216-240	200	110	R	3	5⅛	....	MSR902
270-300	250	110	R	3	4⅜	....	MSR903
324-360	300	110	R	2½	5¼	....	MSR904
378-420	350	110	†	2	4⅛	....	MSR905
378-420	350	110	R	2	5⅜	....	MSR906
485-540	450	110	R	3¼	5⅜	....	MSR907
108-120	100	125	R	1⅜	4¼	....	MSR908
14-15.5	13	220	R	2	7	....	MSR909
20-24	20	220	R	2½	5¼	....	MSR910
20-24	20	220	R	2	4⅛	....	MSR911
26-30	25	220	R	2½	5¼	....	MSR912
26-30	25	220	R	2½	4⅛	....	MSR913
32-36	29	220	R	2½	4⅛	....	MSR914
38-42	35	220	R	2½	4⅜	....	MSR915
43-48	40	220	R	2½	4⅛	....	MSR916
53-60	50	220	R	2¾	4¼	....	MSR917

(a) Has stud mounting.
†Has five studs.
*Represents items of most popular demand.

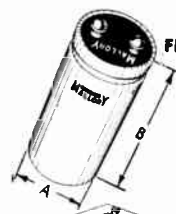


Fig. R

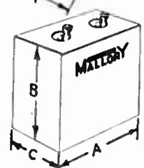


Fig. D

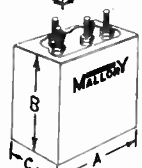


Fig. C

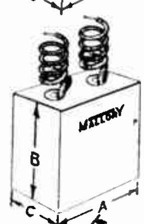


Fig. E

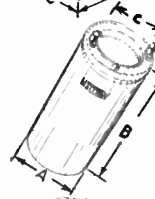


Fig. T

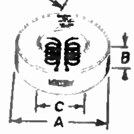


Fig. O

Rectangular Can Type

Cap. Rating New	Cap. Rating Old	AC Volts	Fig.	Size A	Size B	Size C	Type
81-90	75	110	D	4½	4½	1¼	MSD920
86-96	80	110	D	4½	4½	1¼	MSD921
86-96	80	110	D	3½	3½	2	MSD922*
86-96	80	110	E	4½	3½	1¼	MSE923
97-107	90	110	C	3½	3½	2	MSC924*
97-107	95	110	C	3½	4	2	MSC949*
108-120	100	110	C	3½	3½	2	MSC925*
108-120	100	110	C	4½	4½	1¼	MSC926
108-120	100	110	D	3½	3½	2	MSD927*
124-138	115	110	C	3½	3½	2	MSC928*
124-138	115	110	D	3½	3½	2	MSD929*
124-138	115	110	D	4½	4½	1¼	MSD930
124-138	115	110	E	3⅝	4⅛	2⅛	MSE931
161-180	150	110	D	4½	4½	1⅝	MSD932
161-180	150	110	E	3⅝	4⅛	2⅛	MSE933
161-180	150	110	E	5	4½	2	MSE934
161-180	150	110	C	3½	4⅛	2	MSC935
189-210	175	110	D	4½	4½	1⅞	MSD936
224-240	200	110	E	4¼	4¼	1½	MSE937
161-180	150	175	E	6	4½	3½	MSE938
10-12	10	220	E	4¼	4¼	1½	MSE939
20-24	20	220	E	4¼	4¼	1½	MSE940
26-30	25	220	E	4¼	4¼	1½	MSE941
26-30	25	200	C	3½	3½	2	MSC942
32-36	29	220	C	3½	3½	2	MSC943
32-36	29	220	E	4½	4½	1¼	MSE944
32-36	30	220	E	4¼	4¼	1½	MSE945
43-48	40	220	C	3½	4⅛	2⅛	MSC946
53-60	50	220	E	4¼	4¼	1½	MSE947
64-72	60	220	C	3½	4	2	MSC948

Toroidal Type

Cap. Rating New	Cap. Rating Old	AC Volts	Fig.	Size A	Size B	Size C	Type
86-96	80	110	T	2½	4½	1 7/16	MST970
108-120	100	110	T	2½	4½	1 7/16	MST971
124-138	115	110	T	2½	4½	1 7/16	MST972
189-210	175	110	T	3¼	5⅜	2 1/16	MST974
230-256	225	110	T	3¼	5⅜	2 1/16	MST975
243-270	225	110	T	3¼	6⅜	2 1/16	MST976
324-360	300	110	T	3¼	5⅜	2 1/16	MST977
324-360	300	110	T	3¼	6⅜	2 1/16	MST978
460-510	425	110	T	3¼	6⅜	2 1/16	MST980
540-600	500	110	T	3¼	6⅜	2 1/16	MST981

Ring Type

Cap. Rating New	Cap. Rating Old	AC Volts	Fig.	Size A	Size B	Size C	Type
161-180	150	110	O	7½	2	3¾	MSO982
270-300	250	110	O	7½	2	3¾	MSO983
324-360	300	110	O	9¼	2	4	MSO984
432-480	400	110	O	9¼	2	4	MSO985
432-480	400	110	O	10⅛	2	4	MSO986
540-600	500	110	O	9¼	2	4	MSO987
590-660	550	110	O	10⅛	2	4	MSO988
750-840	700	110	O	10⅛	2	4	MSO989

End Caps and Mounting Straps for Round Capacitors

	Size	Cat. No.		Size	Cat. No.
End Caps	1⅜"	115-1	Mounting Strap	2"	110-1
End Caps	2"	116-1	Mounting Strap	2½"	111-1
End Caps	2½"	117-1			

SECTION "C" VIBRATORS

THE PRACTICAL SERVICING AND TESTING OF VIBRATORS

The vibrator is literally the heart of every battery-operated radio receiver. The silent throbbing of this heart, whether in the air, on land, or at sea, furnishes the all-essential plate current necessary to give intelligence and life to an otherwise inanimate object. The endless entertainment of drama, music and news, pouring forth from the automobile and rural household radios, rely on its unfaltering rhythmic beat. Its dependable power has been the means of bringing aid to stricken, isolated communities during great emergencies. The protection of lives and property and the reduction of crime are being aided greatly in the ceaseless pulsations of the ever-vigilant police radio. Yes, the vibrator—like the heart—is all-essential.

Because of the importance of the vibrator in the modern battery-powered radio, servicemen should be thoroughly familiar with the functions of the DC power supply system. The millions of automobile and rural home radios which are in use, have given the serviceman a chance to expand and increase his income. In general the radio circuits of these receivers are much the same as other receivers, but here the similarity ends. The automobile radio must be compact, well shielded, and all leads must be well filtered to exclude the interference from the motor. The power pack is of extreme importance and a thorough understanding of its operation will make the servicing of these radios easier and much more profitable.

With the last year, many volumes relative to the Operating Principals of the Vibrator have been written. To gain a working knowledge of the vibrator circuits from these books, many hours of tedious reading and study are required. DC power supply systems, while extremely important, are in reality comparatively simple. A thorough explanation of their working functions can be completely covered in a few paragraphs. Since the DC power system is so closely related, the AC principles can be used very effectively to explain its operation.

AC ANALOGY

It is impossible to believe that there is a single successful radio service engineer who does not thoroughly understand the power circuit of the modern AC radio receiver. A typical circuit of this type is shown in Figure 1.

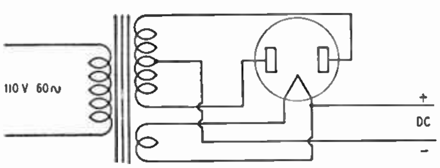


FIGURE 1

If an AC voltage is applied to the primary, in this circuit, there is a voltage developed in the secondary windings proportional to the turn ratio. The low voltage winding is used to light the "heater" of the rectifier tube. (A separate battery could be used just as effectively for this purpose.) The high voltage secondary is center-tapped and so connected that, through action of the rectifier tube, one-half of the secondary is delivering power on the first part of the cycle, and the other half is delivering power on the last part of the cycle. In this manner the alternating current is converted to unipotential or DC voltage. Although this voltage is unipotential, it is not constant so a filter system must be used to obtain a constant DC voltage. Since filter systems are more or less standard, and their action is common knowledge, no further reference to them will be made. So far we have explained only the simple action of the power supply system of an AC receiver, which is of course understood by every service engineer.

"ALTERNATING" DC VOLTAGE

If a DC voltage were applied to the primary of this transformer, there would be no flux change in the transformer core, and, therefore, no transformation of power from the primary to the secondary. However, if the circuit could be so arranged as to "alternate" this same DC voltage, first in one direction and then in the other direction through the primary, there would be essentially an alternating current (AC) flowing, and the transformer would again operate somewhat the same as it did on AC.

A theoretical circuit describing this method of "alternating" the DC is shown in Figure 2.

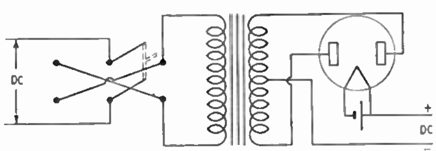


FIGURE 2

In this circuit, a double pole double throw switch is so connected in the primary circuit that, if the switch were rapidly thrown from one position to the other, the direct current would "alternate" in the primary winding of the transformer.

This type of switch could be made in the form of a vibrator but it would be far too complicated and critical for economical manufacturing or commercial use. In order to simplify this switching circuit a second primary, identical to the first, is wound on the transformer. This may be in the form of two separate windings or one continuous winding center-tapped. Figure 3 shows this revised circuit in which a simplified single pole double throw switch is substituted for the more complicated double pole double throw switch.

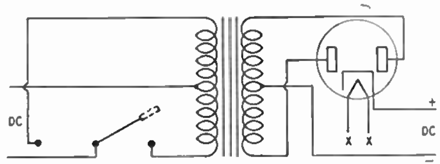


FIGURE 3

Now the switch connects the DC first through one primary and then through the other which produces essentially an "alternating current" which can be transformed and rectified, by the tube, into high voltage DC. With this form of switch, it now becomes possible to make it in the form of a vibrator that is economical to manufacture and reliable in operation.

INTERRUPTER (TUBE TYPE) VIBRATOR

The single pole double throw switch using the simplified switching circuit may be made in the form of a magnetically-driven switch or vibrator as shown in Figure 4.

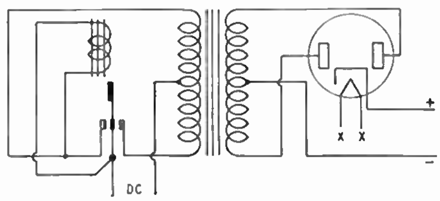


FIGURE 4

In this arrangement the coil is shunted across the contacts so that when current is applied to the vibrator, the coil is energized, pulling the armature toward the magnet. As the armature approaches the magnet, the contact points short the coil, destroying the magnetic force and the armature returns past its normal position and makes contact with the opposite contact point. This operation is rapidly repeated at 115 cycles per second. This method of energizing the vibrator reed is known as the shunt type driver system.

Figure 5 shows a different method of obtaining the magnetic force to energize the vibrator reed.

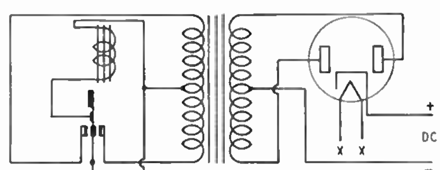


FIGURE 5

In this circuit the entire battery voltage is applied to the driver coil when the current is turned on causing the armature to be attracted toward the magnet and opening the extra set of driver contacts. The opening of the driver circuit destroys the magnetism in the coil. The reed has gained sufficient momentum at this point that it travels somewhat farther to make contact with one of the interrupter contact points but since the magnetism has been destroyed, it returns past its original position to make contact with the opposite contact point, thus completing the cycle. The operations are periodically repeated at fairly high frequency. This method of energizing the vibrator reed is known as the series driver system.

7

When the contacts connect and disconnect the DC from the primary of the transformer, there are certain power surges of current developed which must be "arrested" in order to prevent damage to the contact points. The "arresting" of these surges can be accomplished by connecting a condenser across the primary of the transformer, but since the capacity required to secure the same result drops rapidly with an increase in voltage applied, a comparatively small capacity high voltage condenser can be connected across the secondary to accomplish the same purpose. The capacity in the secondary circuit is reflected directly into the primary so that substantially the same results are obtained as with a large primary condenser.

Let us simplify this by stating that the secondary "buffer" condenser is used to control the surge voltages developed in the circuit.

A more detailed explanation of transformers and buffer condensers will be given later in this text.

Figure 6 shows the basic circuit in which the interrupter type vibrator "alternates" the DC in the primary of the transformer, the transformer steps up the alternated DC to high-voltage AC and the rectifier tube converts the AC to high-voltage unidirectional or direct current.

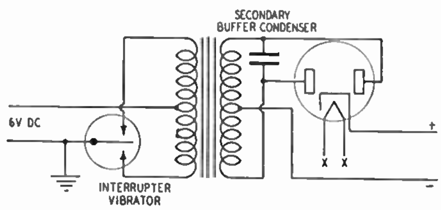


FIGURE 6

The basic operation of the interrupter type vibrator (commonly called tube type) is now clearly explained.

SYNCHRONOUS OR SELF-RECTIFYING TYPE VIBRATOR

The purpose of the rectifier as explained is to pass current only in one direction. It is so connected that during the first part of the cycle, one-half of the secondary is delivering current and during the second part of the cycle, the other half of the secondary is delivering current. In the tube rectifier this action is entirely automatic and is controlled by the electronic characteristics of the tube.

If the rectifier tube were replaced by a single pole double throw switch so constructed to operate simultaneously with the single pole double throw switch in the primary circuit, substantially the same rectifying action would take place. Figure 7 shows a theoretical circuit of such an arrangement.

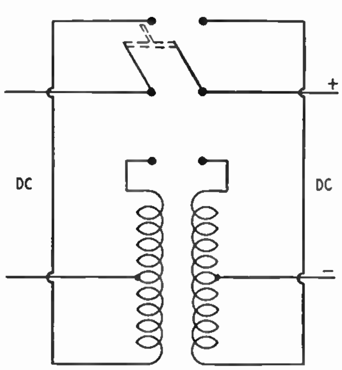


FIGURE 7

The polarity of the DC output, unlike the tube type, would depend on the polarity of the DC input. Correcting for polarity offers no problem, however, since the interchanging of the two secondary wires to the contacts of the "rectifier" section of the switch will give the desired polarity of output.

Since one side of the DC (6-volt battery) and B— are usually grounded, the circuit can be inverted and the polarity of the rectified current changed by reversing the primary wires to the vibrator. The "switch" could then be arranged so both "blades" are grounded or connected together as shown in Figure 8.

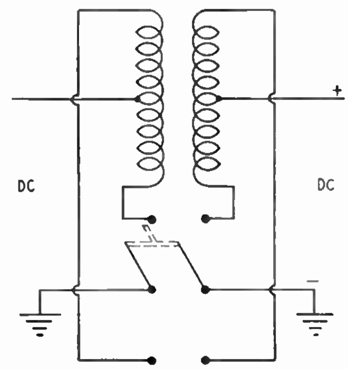


FIGURE 8

Now that both "blades" of this switch are grounded, they can be connected directly together or even made into one piece as in Figure 9.

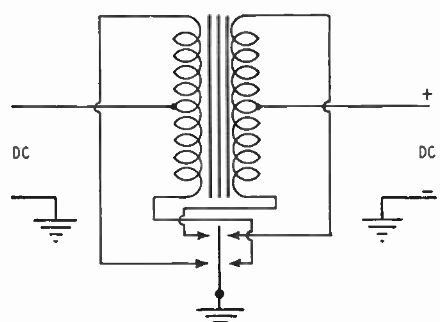


FIGURE 9

By using this arrangement all of the common interrupter and rectifier contacts may be installed on a single reed and thus made to operate synchronously. With this type of construction, a practical synchronous, or self-rectfying, vibrator may be made economically, incorporating long life and reliable operation. Synchronous vibrators eliminate the energy consumed by the rectifier tube, thereby increasing the overall efficiency of the system.

The basic synchronous rectifying type vibrator circuit is shown in Figure 10.

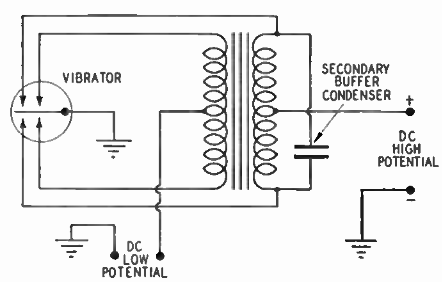


FIGURE 10

Two basic vibrator circuits have been shown. Figure 6 for interrupter type vibrators and Figure 10 for synchronous type vibrators.

Even with all the different lead and plug arrangements and all of the various sizes of containers that have been used, ONLY these TWO basic circuits have been used in the modern automobile and 6-volt household radio receivers since 1933. There is a slight variation of the synchronous type, as shown in Figure 8, where the reed is "split" into two parts which are mechanically (not electrically) connected together, but otherwise this is basically the same as Figure 10.

The foregoing explanation of vibrator power systems has given a picture of the operation of the vibrator, yet to give a complete story, it is in order to touch briefly on transformer and circuit design. Transformers and circuit components are, as a rule, carefully designed and matched by radio set engineers, in co-operation with vibrator engineers. Generally speaking, nothing can be gained by attempting to change these designs and values. Occasionally it is impossible to obtain a vibrator having the same frequency and time efficiency characteristics as the original or perhaps an unknown brand of radio might not be as carefully designed as it might have been. Under these conditions it is well for the service engineer to know how to properly adjust the timing capacity for trouble-free vibrator operation. In rare cases where it might be necessary to replace the transformer, a knowledge of transformer design will be of great help in selecting the most suitable design.

POWER SUPPLY DESIGN CONSIDERATIONS

In the design of vibrator-operated power supplies, engineers are faced with a considerably larger number of factors and problems that must be taken into account than are encountered in the design of an equivalent AC power supply. No one component in the supply can be divorced from the rest, since its function and design depends upon the design and operation of the other components. Therefore, the Vibrator, Transformer, Timing Capacity (commonly called the "buffer condenser"), Battery Voltage, "A" Lead Resistance, and the "A" Current of the Speaker Field and Heaters, all must be considered as a unit when the power supply is to be designed. Knowing the nominal battery voltage, i.e., 4, 6, 12, or 32 volts, the approximate lead, switch, fuse, and "A" choke resistances, the current drain of the tube heaters and speaker field, and the variation in battery voltage encountered in service because of charging and temperature, the problem resolves itself into correlating the three important items of the supply, namely the Vibrator, Transformer, and Timing Capacity.

In the design of AC power supplies the designer is considering mainly, Economy of Manufacture, Heating, Regulation, and Output. All of these factors must also be considered in the design of a vibrator-operated power supply, and in addition, size and primary current drain are of paramount importance. Size because of the fact that this type of supply is usually used for auto receivers and other applications where space is at a premium, and primary current drain because of the limitation of battery drain and also the more important factor of vibrator life which is largely determined by the loading applied to the contacts.

Since it is necessary to operate this type of power supply in a multitude of receiver designs having varying values of "A" lead resistance and "A" current, it is customary now to rate the power supply as furnishing the required output at an input voltage of 6.3 volts as measured from the center-tap of the transformer primary to the reed-terminal of the vibrator socket. When this is not done, it is necessary that the "center-tap" voltage be specified at which the required output is to be secured. Since it is also necessary to operate this power supply on a battery whose state of charge is variable, and whose rate of charge from an auto generator or "wind charger" varies from zero to thirty amperes or more, it is necessary to so design the power supply components that they will perform safely with applied voltages to the system varying between 5.75 and 9.0 volts at the battery in the case of a nominal 6-volt battery. Voltages at the center-tap will vary considerably depending upon whether a "starting" condition or a "running" condition is being considered; this voltage may range from 5.25 volts to 8.5 volts, or a 62% variation. This compares to the 24% maximum variation (105 to 130 volts) encountered in the design of AC power supplies. In addition, since heater-type tubes are now used for practically all applications involving vibrator-operated power supplies, a "no load" condition for the supply is present every time the receiver is turned on and this must be considered fully in the design since a vibrator is not only a mechanical device, but is limited by transient conditions arising from unusual operating circumstances.

VIBRATOR CHARACTERISTICS

Complete knowledge of the vibrator operating characteristics is the first necessity in starting a design of a power supply's electrical characteristics. These vary somewhat between various manufacturers, especially in those units manufactured prior to 1937-38. Prior to this time, modern full-wave vibrators were manufactured with frequencies of 85, 90, 100, 115, 135, and 165 cycles per second. Mallory has pioneered in establishing a frequency of 115 cycles per second, adopting this now generally-used frequency in 1935. In addition to the item of frequency variations, considerable variation also occurs in the mechanical "time efficiency" of the vibrator. Time efficiency refers to the percentage of the total time of one cycle that the power contacts are held in contact, although it is usually more important to determine this for each half of the cycle in order to measure the balance between the two swings of the vibrator reed mechanism. Values of time efficiency in the past have varied from 70% to 90%, but at the present time are mainly held within the range of 85% to 90% average.

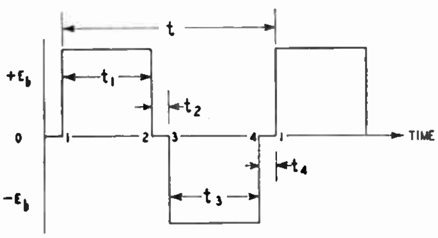


FIGURE A

Referring to Fig. A, time efficiency of the vibrator is illustrated as an electro-mechanical waveform trace plotted against time in seconds. At 1 on the diagram the power contacts are closing on one direction of swing of the reed, connecting the primary of the transformer, in effect, to the positive terminal of the battery. The contacts remain closed until point 2, this length of time being t_1, where the reed has started its return swing and has opened this pair of power contacts. The reed now requires a length of time t_2 to continue this return swing to the point where the opposite pair of power contacts close at 3 on the diagram, connecting the primary of the transformer, in effect, to the negative terminal of the battery. These contacts remain together for the length of time t_3, when the reed has reversed its direction of motion again and has continued its return swing (in same direction as at 1) far enough to open the second set of power contacts at 4. The reed then requires a length of time t_4 to travel between the second set of power contacts at 4 and the original set at 1 where the cycle ends and a new one begins. Current can only flow from the battery while the power contacts are touching, or during the time periods t_1 and t_3. Since this power, in effect, is reversed on each half-cycle, alternating voltage is applied to the primary of the waveform shown. The RMS value of this voltage is, of course, dependent upon the percentage of time the contacts remain closed during each cycle, or in other words, upon the time efficiency. Time efficiency is, therefore,

$$\frac{t_1 + t_3}{t_0} = \frac{t_1 + t_3}{t_1 + t_2 + t_3 + t_4}$$

THE TRANSFORMER

Knowing the characteristics of the type of vibrator to be used, the next step is the design of the transformer to be used with the vibrator to increase the primary alternating current voltage to a higher voltage of a sufficient magnitude such as to produce the desired rectified direct current. Since it can be shown that the value of timing capacity required in the primary circuit for correct matching of the vibrator and transformer depends directly upon the magnetizing current (maximum value) of the transformer required for the voltage of operation and upon the operating characteristics of the vibrator outlined in the preceding paragraph, it is of exceeding importance in the design of the transformer to consider first the range of flux density and also the maximum flux density to be encountered. This is because the magnetizing current-flux density relationship, commonly known as the magnetization or B-H curve, of the iron to be used in the transformer core is not a straight line, but is a curve which begins to deviate greatly from a straight line in most irons at a flux density of about 65,000 to 70,000 lines per square inch. Because it is necessary to operate the final design upon applied voltages covering a range of 6 to 9 volts, it would be desirable to limit the operating range of flux densities to the comparatively straight-line portion of the curve. However, this range is limited, and would be rather uneconomical except in the cases of some portable, or home receivers, where current drain is paramount. Therefore, it is usually satisfactory to set the upper limit (for maximum voltage) of 65,000 lines per square inch. Where the sacrifice of operating perfection and efficiency is required in order to secure economy, a maximum flux density of 75,000 lines per square inch is permissible. The following diagram, Figure B, illustrates the approximate characteristics of a grade of iron often used for vibrator transformers.

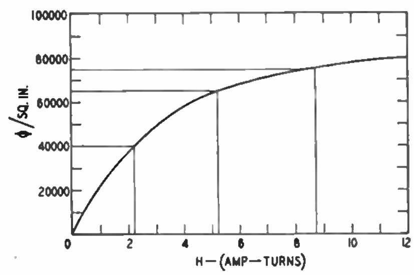


FIGURE B

This grade of iron is used, not only because of the low power lost as core losses, but because the variation between minimum and maximum limits of production runs of this grade are held to narrow limits. This enables a rather accurate determination in advance of the timing capacity necessary to give good vibrator performance. On those grades of iron with wide production limits, exceedingly variable results will be obtained in a production run of receivers using a supposedly identical transformer to the sample approved.

Knowing the limiting flux density, and the fixed vibrator constants, the design is now controlled by the balance between primary turns and the cross-section of iron in the center-leg of the shell-type of transformer usually used in this type of application. The biggest difference between the physical appearance of an AC transformer design and that of one for vibrator operation lies in the use of a dual primary on the vibrator transformer. As explained above, this is required to obtain the AC voltage effect. Also, on low battery voltages, such as 4, 6, and 12 volts, the wire size required for the primary is rather large, giving a rather inefficient winding space factor and almost always requiring that the primary be wound over the secondary. It is quite ordinary to find small power transformers for AC operation operating at a flux density of 90,000 to 100,000 lines per square inch as against the 65,000 to 75,000 lines per square inch for a vibrator transformer. Because of the need for the additional primary winding, the size of a vibrator transformer will always be considerably larger than for an AC transformer to furnish the same power output. The turns per volt are usually kept rather low for high output units, approximating 4 to 5. This is primarily done to reduce the leakage inductance of the transformer, although the combination of a medium size of lamination and large wire size works out best under this arrangement, the core being stacked thicker in order to adjust the flux density. Since the load currents must be increased or decreased through this leakage inductance, it acts as a burden on the contacts and therefore is more detrimental the higher this inductance is made. This leakage inductance burden has been demonstrated experimentally and in practice as being one of the biggest causes of rapid contact erosion, or wear. It is general practice to interleave the laminations 2X2, although 1X1 and 3X3 are often used. Interleaving 2X2 permits a lap joint between each lamination (as does 1X1 interleaving), whereas 3X3 or higher allows only a butt joint between all but the outside laminations in each group. Since the magnetic flux sprays from the core to a certain extent in all transformers, and this flux is modulated by any "hash" frequencies present in the electrical circuit, it is universally necessary to provide a comparatively heavy magnetic shield completely surrounding the transformer in order to provide a "hash"-free power supply. Of course, this is quite often enlarged to include the other components effectively.

TIMING CAPACITY (BUFFER CONDENSER)

With the transformer design arrived at, the magnetizing currents for the nominal and the maximum flux densities (corresponding to the nominal and maximum battery voltages), are calculated from the B-H curve and the length of magnetic path of the lamination used. These values of current are the average theoretical values used in determining the theoretical timing capacity required to give the proper voltage waveform for best vibrator operation. This is known as circuit matching. A timing capacity, or buffer condenser, is required in order to protect the circuit during the time that the reed is moving from one set of contacts to the other, in other words, t_2 and t_4 in Figure A. If no capacity were used, when the contacts opened at 2 in this same figure not only would the battery voltage present on the contacts need to be "broken," but an exceedingly high voltage of the opposite polarity would be induced in the transformer because of the collapse of the sustaining magnetizing current (and therefore flux) which would also have to be "broken." This would cause severe arcing and failure of the vibrator unless some other component suffered voltage breakdown first. Also, when the contacts closed at 3 the full battery voltage would be applied directly across the contacts, causing a spark to jump the gap just before the contacts closed, which is also detrimental to good contact life. By connecting a condenser across either of the windings of the transformer, and adjusting the capacity to the predetermined value, the oscillographic waveform trace illustrated in Figure A can be changed to that shown in Figure C following.

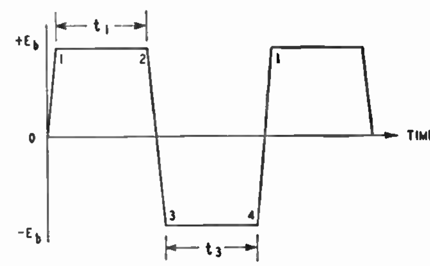


FIGURE C

We now notice that the "off contact" intervals of time, t_2 and t_4, are no longer horizontal lines but are sloping, closing the gaps between points 2 and 3 and points 4 and 1. This is the "ideal" waveform for an interrupter-type vibrator, or a self-rectifying type vibrator operating on no-load.

SELECTING PROPER TIMING CAPACITY

The condenser has become a "tank" in which we store energy during the "on contact" intervals t_1 and t_3, and which discharges into the transformer winding during the "off contact" intervals t_2 and t_4 to supply energy to the transformer. This discharge is in the form of a damped oscillation in the circuit formed by the transformer winding inductance and the condenser; however, the first one-quarter cycle is never completed before the next pair of contacts close. The "ideal" waveform shown in Figure C can be secured experimentally, but is not practical in production, because of the variations in the several components used in the circuit. Also, as a vibrator's contacts erode, or wear away, the spacing between those contacts increases, increasing in turn the "off contact" time intervals t_2 and t_4 during which the reed must move from one set of contacts to the other. Because of this fact, a larger timing capacity is theoretically required with an old vibrator than with a new, and the additional capacity that is required to prevent "overclosure" of the voltage waveform must be included in the original design. Therefore, the desirable oscillographic waveform for an average condition for a new vibrator would appear as in Figure D.

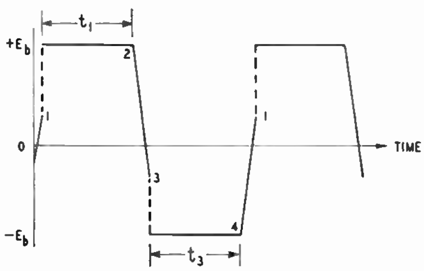


FIGURE D

With the circuit adjusted as described above, the "closure" of the waveform shown in Figure D is between 60% and 70%. That is, the distance vertically between the points where the contacts open and close, 2 and 3, is about 60% of the total distance between the two horizontal lines t_1 and t_2, with the same conditions holding true for the points 4 and 1. This would also hold true, again, for the self-rectifying-type of vibrator operating on no-load. "No-Load" does **not** mean the removal of the first filter condenser, also.

The waveform picture of a properly adjusted self-rectifying vibrator operating under load is shown in Figure E, following.

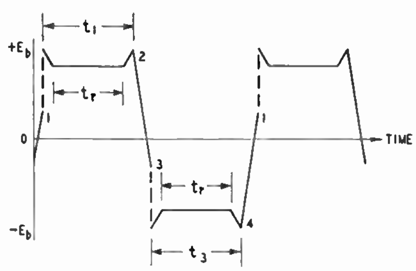


FIGURE E

The short, regular peaks shown at the start and finish of the time intervals t_1 and t_3 are proper and do not create "hash" or circuit difficulties if they appear approximately as shown. These peaks are caused by the increased voltage drop in all of the "A" circuit when the secondary, or "B" load is connected, since the vibrator is so adjusted that the interrupter contacts close before the rectifier contacts and open after the rectifier contacts. In other words, the rectifier contacts are spaced slightly wider than the interrupter contacts, the load thus being broken at high voltage and low current instead of at low voltage and high current.

IMPROPER TIMING CAPACITY

Correctly shaped waveforms have been pictured, but it is advisable to also illustrate a few of the more common mismatches found. It can readily be understood that should a modern 115-cycle vibrator with a time efficiency of 90% be used to replace an original equipment vibrator which originally was operating at 85 cycles and a time efficiency of 80%, a decided mismatch would occur. The new frequency being higher, the flux-density would be reduced by 26%, while because the new time efficiency is higher also, the flux density will in turn be increased by 13%. This is a net decrease of 13% in flux density, and correspondingly an even greater decrease in magnetizing current because of the curvature in the B-H curve of the iron. Because of the increase in time efficiency as well as in frequency, the "off contact" intervals t_2 and t_4 are considerably shorter (in seconds). Therefore, with less magnetizing current required by the transformer, and a shorter time interval in which to dissipate the stored energy, the timing capacity originally in the circuit is now too large, and the waveform pictured in Figure F results.

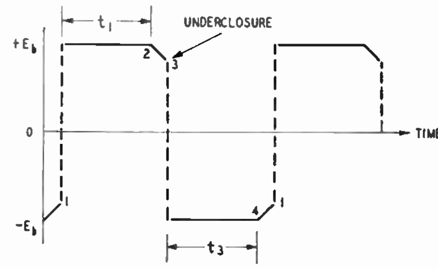


FIGURE F

Since the modern Mallory Replacement Vibrator would easily outperform the original under proper circuit matching, and because it is universally available, should this type of condition arise, it is advisable to replace the timing capacity incorporated in the receiver and install a Mallory Type OT condenser of a value which will approach the waveform shown in Figure D.

Should a mismatch occur in which the reverse, or partial reverse, of the above be found, or a condition be found in which the original capacity chosen was too small, waveform pictures such as shown in Figures G and H will result.

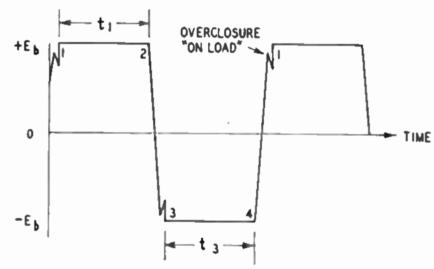


FIGURE G

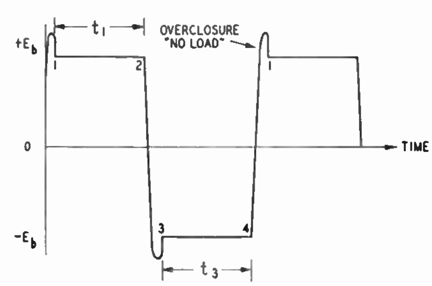


FIGURE H

Figure G illustrates a case of "overclosure" of the waveform with the load applied to the rectifier tube in an interrupter type power supply. This condition is not often noticed since it can be mistaken for bouncing of the contacts at the "make." However, if the load is removed, or the rectifier tube removed from its socket, the picture will change to that shown in Figure H, if overclosure is present. Naturally the cure for this condition will be the addition of more capacity to the original, or better still, to replace the original with a new Mallory Type OT of the correct capacity. Condensers age in much the same manner as springs, and it is frequently advisable to replace such hard-worked types as are used in vibrator power supplies every few years at least, or every 1000 hours of operation.

In the case of a self-rectifying vibrator, overclosure will evidence itself in much the same manner as in Figure H, except that very sharp and usually ragged peaks will result instead of the comparatively round ones illustrated. These are exceedingly dangerous and will undoubtedly cause the vibrator or other components to "break down," since the transient voltages are usually much higher than the value observed upon the oscillograph screen, and are multiplied by the transformer turn ratio when applied to the secondary or rectifier circuit. It should be noted that all of the above oscillographic pictures are to be observed with the vertical plates of the oscillograph connected across the entire primary of the transformer. The picture given in Figure A cannot be secured with a transformer, but can be illustrated by the use of a center-tapped resistor of 10 ohms total replacing the primary of the transformer. In this case a separate-driver type of vibrator should have the nominal battery voltage applied, but a shunt type of vibrator should have double this value applied.

All of these oscillograph waveform checks should be made **not only** at the **nominal** battery voltage of operation, but also at the **maximum** voltage under which the receiver may be called upon to operate. Since many automobiles are now being sold equipped with charging voltage-regulators which maintain a voltage at the ammeter of approximately 7.8 to 8 volts, it is essential that a check be made with 4 cells of battery in order to reach the required level of voltage. The higher the voltage applied, the greater the tendency for the waveform to "overclose."

A condition such as "single-footing," the operation of the vibrator mainly on one contact set only, is quite prevalent with old and even with some comparatively new vibrators, and a waveform illustrating this condition is shown in Figure I.

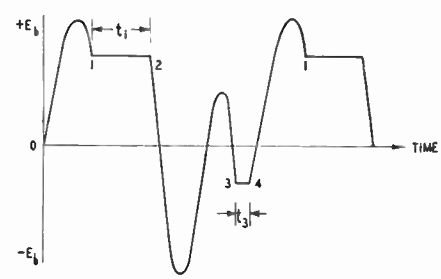


FIGURE I

Here is shown the condition where more than one cycle of the oscillatory discharge of the timing condenser has taken place before the one set of contacts closes at 3, whereas on the other set of contacts comparatively good operation is still secured although this will be found to have a short time interval t_1, since the reed amplitude will be low. This is usually overcome in slipshod engineering practice by use of additional timing capacity. However, this involves the acceptance of a waveform such as that in Figure F, which is not desirable.

EFFECTS OF BOUNCING CONTACTS

Bouncing or chatter of the vibrator contacts is illustrated in Figures J and K, where J illustrates this

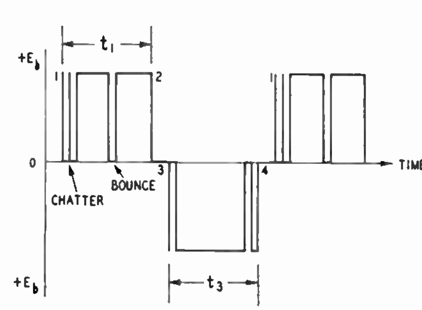


FIGURE J

condition when operating upon a center-tapped resistor, and K when operating upon a transformer-condenser set-up.

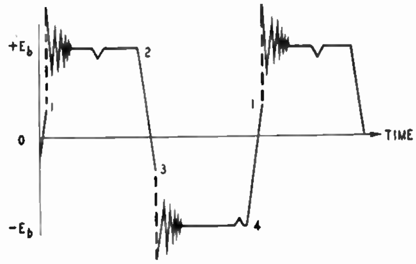


FIGURE K

"HASH" SUPPRESSION

Basic vibrator circuits have been clarified. Only one problem remains—that of radio frequency interference developed by the vibrator. This interference is commonly referred to as "hash." **Hash is caused by transient voltage surges, at radio frequency. These surges cannot be controlled by a "buffer" condenser. The only known methods of suppressing hash are:**

First—Shielding—Both magnetic and electrostatic.

Second—Proper grounds, and

Third—Proper RF filtering in the leads to and from the pack.

The amount of "hash suppression" depends mainly on:

First—The sensitivity of the receiver and

Second—the mechanical arrangement of the receiver.

Engineers do, as a rule, thoroughly design their receivers to have adequate shielding, proper grounds and a sufficient amount of RF filtering. They cannot be assured that screws holding the shielding, chassis, and case together will remain tight after hours of jolts and vibration in the automobile nor can they be assured of permanence of efficiency of the old style RF by-pass condensers under varying climatic conditions. Under these conditions it would seem that the only action that could be taken to eliminate hash in a troublesome receiver would be to tighten all the screws and to replace all the by-pass condensers thought to be defective. Figure 11 shows a typical interrupter-type circuit with its associate hash suppression filters.

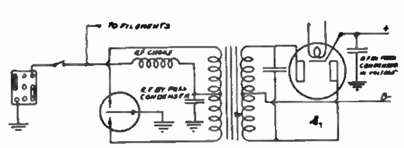


FIGURE 11

The circuit for synchronous vibrators is the same except the rectifier part of the vibrator replaces the tube rectifier as in Figure 10.

Through the combined efforts of the Mallory vibrator and condenser research engineers new types of RF condensers and RF chokes, which are far more efficient and permanent under widely varying climatic conditions have been perfected. It is now possible to do something about the hash caused by ineffective filtering.

On page 31 of the new Mallory-Yaxley General Catalog these condensers and chokes are listed.

Figure 12 shows the way they are to be used in the circuit.

The vibrator reed connection to ground, shown in dotted lines in Figure 12 should be removed, and connected to one of the double lugs on one end of the Mallory-Special low voltage RF By-Pass Condenser. The other double lug on the same end should be connected to ground as shown. The center tap of the transformer should be connected to one of the double lugs on the other end of the condenser and the RF choke connected to the other double lug on the same end of the condenser as shown in Figure 12. The original RF choke in the primary circuit should be replaced with one of the new Mallory high-efficiency, multiple pie-wound RF chokes. **In most cases of slight "hash"** the Mallory No. RF-481, .5 mfd. 50-volt condenser will be sufficient. **For other cases more pronounced,** the Mallory No. RF-482, 1.0 mfd., 50-volt condenser will be adequate. **When severe cases are encountered** it may be necessary to use either Mallory RF-582, 55 turn RF choke or the No. RF-581, 90 turn RF choke in addition to one of the two condensers mentioned above depending on the severity of the case. **For the greatest amount of "hash" suppression** Mallory No. RF-581, 90 turn RF choke and Mallory No. RF-482, 1.0 mfd. 50 volt RF condenser should be used in the primary circuit and a 200-300 turn RF choke in the B+ lead with a Mallory No. TP-418, .1 mfd. 600 volt by-pass condenser in the secondary circuit as shown in Figure 12.

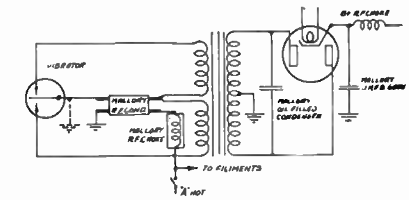


FIGURE 12

Exactly the same methods are used for synchronous type vibrator circuits. In these circuits the "rectifier" part of the synchronous vibrator replaces the tube and the center tap of transformer secondary becomes B+ instead of ground." For the sake of simplicity no conventional filter circuits are shown.

The 200-300 turn RF choke can be obtained from most parts distributors if not in the set. The Mallory No. RF-583 55 turn RF choke is wound with No. 12 wire and should be used with high output power packs where space will permit.

This method of "hash" suppression is by no means a "Cure-all." It will not suppress "hash" caused by inadequate shielding or improper grounds. If used intelligently, it will eliminate many cases of annoying chronic complaints.

These basic principles will prove to be a valuable aid in the successful servicing of vibrator-powered radio receivers. The problem of "hash" has been treated in a manner that it should no longer be a serious obstacle, yet **other common troubles are often encountered.**

CAUSES OF VIBRATOR TROUBLES

When vibrators were first introduced, servicemen regarded them with suspicion and uncertainty. They were inclined to attribute many auto radio troubles, such as unaccountable noises, low plate voltage, etc., to the vibrator, when actually its operation was perfectly normal. The unquestionable proof of this statement lies in the fact that until recently, more than one-half of all vibrators returned as defective, were perfectly good in every respect.

Vibrators can only be damaged by two causes:

1. Serious overloads from short circuits and/or
2. Defective buffer condensers.

Rarely if ever do power transformers give any trouble.

ELIMINATING TROUBLE

If vibrator servicing problems are to be simplified, specific troubles and the recommended remedy must be shown. A list of these troubles is given along with the best way of determining the exact trouble and the method of elimination.

NO "B" VOLTAGE

If the vibrator is operating and still there is no "B" voltage, first disconnect the lead from the B+ output of the filter. If the voltage becomes much higher than normal when this lead is disconnected, the trouble is in the radio receiver proper. The procedure for making receiver checks and repairs are outlined in other sections of the encyclopedia.

If, after disconnecting the B+ lead, there is still no voltage, the trouble is in the power pack circuit.

The following list shows the **probable defects, in the order of their importance:**

1. **Shorted Filter Condenser.**
2. **Shorted Buffer Condenser.**
3. **Shorted Rectifier Tube.**
4. **Shorted "B+" Bypass Condenser.**
5. **Grounded Filter Choke.**
6. **Shorted Transformer Secondary.**
7. **Ground in Wiring.**

If the vibrator does not operate, remove the vibrator and check for the following defects:

1. **Low Battery Voltage.**
2. **Blown Fuse.**
3. **Burned Switch.**
4. **Broken "A" Lead.**

All of these points may be quickly checked by measuring the voltage between the center tap of the transformer primary and the REED terminal of the vibrator socket. This voltage should read 5.5 volts or more.

If the check is satisfactory, the vibrator should be tested for proper operation either in a vibrator tester or by the substitution of a new Mallory Replacement vibrator. Sticking or shorted vibrators are usually caused by "projections" being built up on the contact points. These "projections" (contact transfer) are the result of an unbalanced condition in the circuit. A careful check of the "buffer" condenser should be made. If this condenser is open or the capacity not as specified, it should be replaced with a Mallory Oil Filled Condenser, Type VB or OT having the specified capacity. **NEVER CHANGE THE SPECIFIED CAPACITY OF THIS CONDENSER** unless specifically instructed to do so.

LOW "B" VOLTAGES

Check the points given below as the **cause for low "B" voltage.**

1. **Battery Voltage Low.**
2. **Corroded Fuse Clips.**
3. **High Switch Resistance.**
4. **Weak Rectifier Tube.**
5. **Defective Buffer Condenser.**
   (Caution: See preceding instruction on buffer condenser replacement).
6. **Defective Filter Condenser.**
7. **Worn Vibrator.**
   (Check in tester or substitute new Mallory Replacement Vibrator).
8. **Check for troubles in radio which will cause low voltage such as shorted cathode resistor, by-pass condenser, shorted transformer, defective tubes, etc.**

INTERMITTENT OPERATION

1. **Generally caused by troubles in the receiver, such as defective antenna insulation or connections, defective wiring, defective tubes, etc. Other sections of the encyclopedia specifically explain this method of servicing these troubles.**
2. **Intermittent vibrator operation usually caused by worn vibrator nearing the end of its life.**
3. **Loose connections in the power pack.**
4. **Defective Rectifier Tube.**

UNUSUAL MECHANICAL NOISE

Unusual mechanical noise from the vibrator may be caused by:

1. **Vibrator touching other parts and vibrating against them or causing other parts to vibrate. Correct this trouble with a cardboard pad around the vibrator.**
2. **An old vibrator nearing the end of its life.**
3. **Loose case screws, or loose parts in the radio set.**

ELECTRICAL HUM FROM SPEAKER

Hum from the speaker is usually caused by:

1. **Defective filter condensers** (low capacity).
2. **Microphonic Tubes.**
3. **Microphonic Condensers.** (Usually variable condenser).
4. **Loose chassis screws.**
5. **Poor Grounds in Radio.**

DON'TS

1. NEVER CHANGE THE SPECIFIED CAPACITY OF THE BUFFER CONDENSER (unless circuit matching is carefully checked with oscillograph).

2. NEVER attempt to repair a vibrator. Filing contacts or bending springs destroys the factory adjustment which has been carefully made with expensive instruments.

3. NEVER replace a vibrator until you are sure it is defective.

4. NEVER hesitate to write Mallory for specific information and help.

SELECTING UNLISTED REPLACEMENT VIBRATORS

If a Mallory replacement vibrator is needed for an unlisted set, refer to the "C" notes 6 or 8. These notes simplify the selection of the proper vibrator. Any Mallory-Yaxley distributor will gladly assist in this selection. If an authentic replacement is desired, have the distributor send the original vibrator together with the NAME and MODEL NUMBER of the receiver, to the Mallory Factory. The proper Mallory Replacement Vibrator will be promptly supplied.

The mystic veil has been torn from the vibrator type power pack and specific service helps have been listed. Servicemen should find that they can now work in an enlightened manner that will pay dividends in satisfied customers and extra profits.

A Practical Vibrator Test

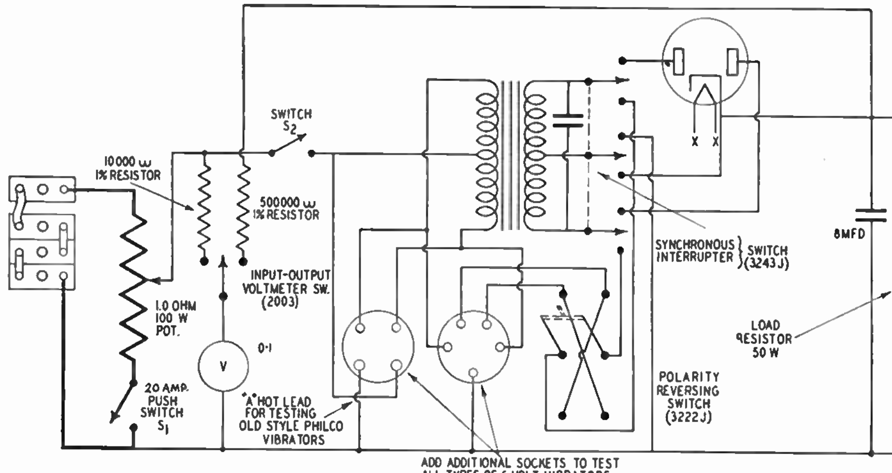


FIGURE 13

A practical vibrator test, which will give the service engineer as good an indication of the vibrator condition as the tube tester does of tubes, will probably be of extreme interest to many in the service profession. Many inquiries have been received for information, which would outline the proper method of using an oscillograph for testing a vibrator. The use of an oscillograph for testing vibrators is much less valuable than the dynamic characteristics or the mutual conductance method would be in testing tubes. The English reading emission tester has become by far the most popular method of testing tubes.

There are a good many vibrator testers available but a simplified test would enable the service engineer to find out easily and rapidly the very things he needs to know about a vibrator. Earlier this article pointed out that vibrators should never need replacement until the contacts are worn to such an extent that the output of the power supply is unsteady or the vibrator fails to start at about 5 1/2 volts.

The goodness of a vibrator may be tested by the value of the starting voltage the same as the goodness of a tube may be checked by the value of electronic emission from the cathode.

Phrasing a vibrator test into English reading indications, vibrators which will start at 5.2 volts or less are "good" vibrators and will give many more hours of satisfactory service. Vibrators that start between 5.2 and 5.6 volts are "doubtful" vibrators and may be expected to fail in the near future. Vibrators that only start above 5.6 volts are "bad" vibrators and may be expected to give immediate trouble, usually when the car battery is low and not being charged by the generator.

After the starting tests are made, the vibrator should be operated on 6 to 6 1/2 volts with a voltmeter connected in the output circuit. If the voltage fluctuates over a fairly wide range, the vibrator is definitely bad, but a fairly steady output voltage indicates a good vibrator. This test is equivalent to the "Short's test" of tube testers.

Vibrators which have been subjected to these two tests may be properly classified and the good ones used with confidence.

Figure 13 shows a typical circuit of a tester which will provide the above tests.

The vibrator is first placed in the proper socket. The voltage is then adjusted by the potentiometer, with Switch S_1 held in a closed position, to 5.2 volts. Switch S_2 is then closed. If the vibrator starts, the starting voltage is 5.2 volts or less, indicating a good vibrator. If it fails to start, open Switch$_2$ and readjust the potentiometer to 5.6 volts and again close Switch$_2$. By adjusting the voltage to various values and opening and closing Switch$_2$ the exact starting voltage of the vibrator and its corresponding condition may be obtained.

After the starting voltage of the vibrator has been obtained, adjust the potentiometer so that the voltage is between 6 and 6 1/2 volts, then observe the output meter for smooth flow of secondary power. The output meter can be calibrated in "good" and "bad" readings by using known good and bad vibrators.

Vibrator testers of this type will prove invaluable since the true condition of the vibrator may be quickly, easily and accurately determined.

Auto Radio Installation and Interference Elimination

The great majority of vibrators are used in automobile radio receivers. Therefore, a treatise on vibrators would scarcely be complete without some mention of Installation and Interference elimination. The proper installation of the radio in the automobile is all-important. Follow carefully the radio set manufacturer's installation instructions. Be sure to properly install the suppression equipment (condensers, suppressors, etc.) where specified. Above all, scrape the paint off of the metal around the holes used for mounting the set, to insure good grounds. If installations are made with this exacting care, it may require a few more minutes than a slip shod job, but it will repay you many times. Quite often many hours are spent in locating interference and when it is finally located, a good connection, a better ground, or a condenser in an out-of-the-way place, installed carefully according to the manufacturer's instructions, would have saved all the extra time. That lost time is worth money to you. Then, too, a slip shod job is seldom ever entirely satisfactory to the customer.

It is, therefore, to your advantage to make the best possible installation.

Usually, if the manufacturer's instructions are followed carefully, the operation of the radio will be entirely satisfactory. This is especially true on the later models of cars.

CHOOSING AND LOCATING THE ANTENNA

Before the all-steel top, the problem of antenna choice did not exist. There was, in most cases, from 6 to 16 feet of ideal antenna area available by simply tapping in to it.

An ideal antenna is one having the largest possible area and greatest separation between itself and ground. An auto radio must be very sensitive because in no case is the ideal from an antenna standpoint approached. The first introduction of antennas for the steel top cars were of the under-car type. Beneath the car is not the best place for an antenna as it satisfies nothing of the ideal and has several disadvantages. First, it is located near a number of sources of interference, such as wheel static, mechanical noise, etc. It represents a large capacity to chassis and is hard to keep well-insulated from it. It is difficult to keep in place, as ruts, stones and vibration all tend to tear it from its mountings.

The best antennas available today are those of the rod or strip type. Most customers do not object to a rod on top of the car or one located possibly on the door hinge. The higher the antenna is located, the better it will be as it is farther from interference and the car chassis. A single rod 4 or 5 feet in length on the top of the car is much better than an equal number of square feet located close to the ground.

INTERFERENCE

Occasionally, in new cars, and quite often in older cars, unusually troublesome cases of interference are encountered. When such troubles are encountered, it is best to just roll up your sleeves and go to work, for there are no hard and fast rules or cure-all methods of interference elimination. First determine the type of interference.

CHASSIS AND ANTENNA PICK-UP

Two classes of interference exist in auto radio, chassis (lead) pick-up and antenna pick-up. To determine which one exists, ground the antenna lead close to the receiver. If the interference is eliminated, it is antenna pick-up. If interference continues, it is chassis or lead pick-up.

CHASSIS PICK-UP

If interference is found to be chassis pick-up, be sure that all ground connections are clean and tight, all cables, tubes and pipes are grounded and are not rubbing against metal body parts or the receiver itself. If receiver has been properly installed according to the manufacturer's specifications, as to suppressors, condensers, filters, and the receiver wires have been kept out of the motor compartment or have been properly shielded, there should be no chassis noise.

TYPES OF ANTENNA PICK-UP

GENERATOR INTERFERENCE

Generator interference is due to the sparking between the brushes and the commutator and is radiated from the car wiring to the antenna. Usually a condenser installed at the generator, in accordance with the installation instructions, will eliminate this trouble. If the installation of the condenser is not sufficient to completely eliminate this interference, it will be necessary to clean the commutator and possibly install new brushes. Figure 14 shows the proper method of installing the generator condenser.

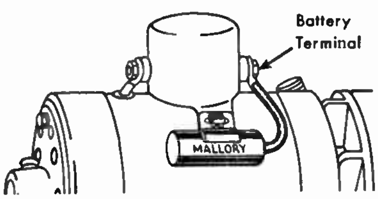


FIGURE 14

ADJUSTMENT OF GENERATOR AFTER INSTALLATION OF RADIO

Quite often it is necessary to "set-up"—or increase the generator output after installing the radio to take care of the increased current consumption. In many cases the service engineer has set the generator to a point where the armature is "burned up" after a short period of use.

Before setting up the generator it is advisable to consult the instruction book supplied with the car to ascertain its maximum output. **Never exceed this value.** If no instruction book is available, 20 amps. in winter and 15 amps. in summer should be considered maximum. If the generator does not keep the battery fully charged at this maximum setting, the customer should purchase one of the small home chargers which may be put on once or twice a week and left on overnight, thus assuring a good, hot battery at all times. One burned out armature will pay for the cost of the charger. The use of the charger will prevent overtaxing the generator and at the same time is useful, as a well-charged battery is necessary for starting, especially in the winter season.

HIGH TENSION IGNITION NOISE

This type interference is created between the coil and the spark plugs. Usually, with the newer cars and radios, a distributor suppressor is sufficient to reduce this type noise to an acceptable value. If the low tension leads are carried close to the high tension leads, it is advisable to reroute these leads so that they are as far apart as possible. Spark plug suppressors should not be used unless absolutely necessary. Quite often the condenser located at the distributor points will be found defective in which case it will be necessary to replace it. If the car has been in service for some time, inspect the gap between the rotor arm and points. If it is found that the contacts are too wide or burned, peen the rotor contact so that the gap is approximately .005 inches. Care should be taken not to crack the bakelite on the arm or peen it out so much that it will touch the points. Spark plug interference may be introduced into the radio through the oil pressure gauge tubes, windshield wiper, tube, etc. Tubes should be securely bonded to the bulkhead with a piece of heavy braid grounded securely. Keep the antenna lead as far from the high tension system as possible. Install the radio at a distance from the coil, so that it is not in the field of the secondary winding. In one make of radio, a mechanism is incorporated which introduces ignition noise 180° out of phase, which when adjusted properly, will eliminate a large portion of the interference. Never attach any condenser to the low voltage lead running from the coil to the distributor.

CAR BODY INTERFERENCE

While this type of interference is less frequent, it is by far the most baffling to locate and effect a cure. If the car has been in service for considerable time, it is advisable to go over the entire car, tightening all body bolts and screws which make contact with the metal parts of the car. One loose bolt, by making interrupted contact, may cause a noise which makes reception totally unsatisfactory while the car is in motion.

In automobiles using rubber-floated motors, a large portion of the noise may be eliminated by bonding the motor to the frame with a very heavy piece of flexible braid. Leave a little slack in the braid to prevent breaking from vibration. When bonding these parts, make sure all points are scraped clean and a good tight joint is made. Where there is a possibility of the muffler making contact with the frame from vibration, ground the exhaust pipe to the frame at the muffler.

WHEEL STATIC

Wheel static may be determined by allowing the radio to operate while the car is coasting (ignition off) over a dry concrete street. Cars that are equipped with wood wheels seem to be the worst offenders. To eliminate this interference, springs should be installed at the wheel hubs. Some of the modern cars have these installed so that there will be no trouble from this source. The brakes may also cause a noise similar to wheel static if they drag slightly, the noise stopping completely, or getting worse as the brakes are applied. In this case a heavy bond should be installed between the brake shoe and chassis. Wheel static may be carried to the radio through light wires, horn wires or accessory leads, in which case they should be by-passed with a .1 mfd. paper condenser. In some cases, it is very necessary that the hood make good contact with the frame. Small pieces of metal should be installed at the moulding which goes around the edge of the hood. In extreme cases of noise, radio frequency chokes such as the Mallory RF581, RF582, or RF583, may be necessary in addition to the condensers used.

INTERFERENCE FROM APPLIANCES

Cigar lighters, windshield defrosters, heater fans, etc., cause or may carry interference from an offending source to the radio. An ammeter condenser should be installed between one of the terminals and the chassis. Be sure to scrape all paint away from the chassis where the condenser is grounded. Ammeter type condensers will be satisfactory for any of these appliances when installed close to the source of interference. When using these by-pass condensers, make the leads as short as possible. Electric oil and temperature gauges may cause noise, in which case by-pass condensers should be installed at the controlling mechanism. This remedy also applies to electric gas gauges. Spark intensifiers should not be used.

DOME LIGHTS

In older cars the dome light is usually the greatest source of antenna pick-up interference. First check the dome light by disconnecting the dome light connection back of dash and grounding the wire. This should eliminate the interference. If so, install a Mallory dome light filter type DL445, as directed in the instruction sheet enclosed with each unit. Be sure this is installed as far up into the corner post of the automobile as possible. Make all grounds secure.

LOOSE CONNECTIONS

Loose connections are a frequent cause of interference. Be sure light bulbs are tight in their sockets, that all battery cable connections are tight and well grounded, that secondary leads at distributor and spark coil leads are making good tight contact.

PASSENGER BODY PICK-UP

In some older cars a person's body acts as a carrier of noise from the floor boards to the roof antenna. When this happens, shield the floor boards of the front seat by covering them with a copper screen and grounding it at several places to the frame.

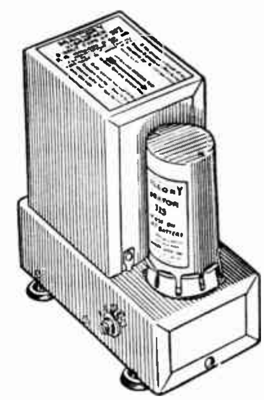
LOCAL INTERFERENCE

Interference picked up from powerlines and electrical equipment should not be confused with ignition noise. Electrical or outside interference will be heard whether car is running or not. Ignition noise should be checked in a location that is free of outside disturbances.

As explained at the beginning, there is no cure-all for interference and these suggestions have been given only as an aid in the elimination of motor car interference.

Read the "C" section of this Encyclopedia over again and again until you thoroughly understand the underlying principles of DC power circuits. The increased knowledge gained will pay you big dividends in more satisfied customers, served in less time.

VIBRATOR POWER SUPPLY UNITS



"Vibrapack," a copyright Mallory trade name identifies a group of Vibrator Power Supply units, designed for universal application with radio receivers, transmitters, automobile P.A. systems, as well as for other uses.

There are five types:

Cat. No.	Type	Nominal Output Voltage	Nominal Input Voltage
VP-551	Self-Rect.	125–150–175–200	6.3
VP-552	Self-Rect.	225–250–275–300	6.3
VP-553*	Tube Rect.	125–150–175–200	6.3
VP-554*	Tube Rect.	225–250–275–300	6.3
VP-G556	Self-Rect.	225–250–275–300	12.6

*Tube rectifier types required only for applications where B — cannot be at ground potential.

VP-G556 is similar in construction to VP-552 except that it is designed for use with a 12-volt storage battery and is thus especially adapted for use on airplanes, boats, and busses where a 12-volt electrical system is employed.

All Vibrapacks are equipped with a convenient tap switch so that a selection of four output voltages, in 25-volt steps can be made, as desired.

Vibrapacks are equipped with complete, built-in noise suppression equipment, but do not include high voltage filter. The high voltage filter requirements are similar to equivalent AC power packs, the design depending on the application.

Radio servicemen and amateurs have long recognized the advantages provided by Vibrator-type power supplies. As a means of obtaining "B" voltage from a storage battery, such supplies have no equal from the standpoint of efficiency, economy, dependability and compactness. It is these qualities that have lead to the universal adoption of Vibrator supply systems in automobile receivers.

Many experimenters have attempted to construct home-made vibrator power supplies, and have found to their sorrow that their units were most unsatisfactory. A "B" power unit for 100-volt AC operation can be constructed from parts selected at random. As long as the individual parts are capable of handling the desired power, satisfactory results will be secured.

However, a vibrator power supply cannot be built in this manner. Unless a perfect electrical match is maintained between the various components, the circuit conditions may be such that a high current exists at the vibrator contact points at the time when they are "making" or "breaking," and under such conditions vibrator life and efficiency may be disappointing.

There has always existed a real and active demand for a thoroughly reliable vibrator power supply; a power supply which would be flexible in application and which would maintain its efficiency and vibrator life under a wide range of load conditions. Laboratory research developed the Vibrapack for all electronic applications requiring DC voltages up to and including 300 volts at 100 milliamperes. Within their rated load limits, proper matching and synchronism of the components occur so that long vibrator life and economical operation is assured. Any amateur, radio service engineer or experimenter who can hook-up and apply a common AC power supply can install a Vibrapack.

WHICH TYPE OF VIBRAPACK TO USE

The choice between synchronous or self-rectifying Vibrapack types VP-551 or VP-552, and the tube rectifying types VP-553 or VP-554 should be made on the basis of circuit requirements. If the filter chokes may be in the positive (+) lead, and B — may be connected to one side of the filament circuit, use the smaller synchronous or self-rectifying Vibrapacks, types VP-551 or VP-552. On the other hand, if it is necessary for B — of the power supply to be above ground in potential—if a resistor or choke is incorporated in the negative circuit to provide bias voltage—a tube rectifier type Vibrapack, VP-553 or VP-554 should be used. There is no objection, of course, to using the larger Vibrapacks, types VP-553 or VP-554, with B — grounded.

In all applications, however, Vibrapacks will have satisfactory vibrator life, providing the maximum current rating is not constantly and continually exceeded.

INSTALLATION DATA

Location—The selection of the position for mounting the Vibrapack is important. Care should be exercised to locate this position at the maximum distance from the RF circuits of the receiver, or input to the amplifier, so as to eliminate as much as possible the introduction of "hash" radiation to poorly shielded high-gain circuits, and to minimize possibilities of magnetic coupling from the Vibrapack transformer.

In heavy-duty applications such as radio transmitters, public address systems where the Vibrapack will be worked close to its maximum rating, it is especially desirable to keep the wires between the battery and the Vibrapack as short as possible. In airplane installations, for example, it may be desirable to place the Vibrapack close to the storage battery, opening and closing the primary circuit with a relay. In most applications, however, the Vibrapack will be mounted directly on the amplifier, transmitter or receiver chassis in the same position that would be used for an equivalent AC power pack.

Mounting—Mounting is accomplished by drilling four 1/2" holes which line up with spade bolts attached to chassis of the Vibrapack. The rubber grommets furnished are inserted in these holes and the Vibrapack mounted thereon, with the cup washers placed on both sides of the grommets for distribution of the load, before the nut is placed on the spade bolt. This insulates the Vibrapack from the chassis both electrically and mechanically.

HOW TO CONNECT THE VIBRAPACK

The connections made to the Vibrapack are "A HOT," "A GROUND," "B+," and "B—." Provision is made for correct operation of all types of Vibrapacks on battery grounds of either positive or negative polarity. Special patented synchronous vibrators on types VP-551 and VP-552 are reversible. By determining the polarity of the grounded side of the battery and following label directions, the "B" voltage will be properly polarized. Special Vibrators on types VP-553 and VP-554 do not require polarization of output. On types VP-551, VP-552, and VP-G556, "A" ground and "B—" must be connected to the chassis itself, as they are common and at ground potential. On types VP-553 and VP-554, only "A" ground must be connected to the chassis, as "B—" may float if desired on these types.

Grounding of the Vibrapack chassis is best accomplished by soldering a heavy strip of stranded braid on the chassis and grounding the other end to the Vibrapack chassis at the screw located directly under the terminal board. The length of this lead must be kept at a minimum for best results.

Ground Only at One Point—The leads from the battery to the set and the Vibrapack must be as short and as large in cross-section as is conveniently possible. No. 14 wire is satisfactory if 10 feet total or less is used, but for longer leads, nothing smaller than No. 12 should be employed. It is preferable to use separate leads for the Vibrapack and the tube filaments or heaters. The efficiency and output of the Vibrapack depends upon the maintenance of a low voltage drop in the connecting leads. These leads to the battery should be twisted together and should be removed from the proximity of the antenna lead.

The off-on switch used for operating the Vibrapack must be of high current carrying capacity and low voltage drop characteristics. A high current toggle switch having a rating of at least 10 amps., is recommended. THE VIBRAPACK MUST BE PROTECTED WITH A 15-AMP. FUSE. While it is possible to successfully use an automotive type fuse, the standard screw type household fuse is recommended because of the low voltage drop.

Filter Requirements—The "B+" lead must be filtered for low frequency or audio hum. **The filter is not included with the Vibrapack.** This permits the components to be selected by the purchaser to meet the particular requirements of the installation. The filter must be of the capacitor input type and have about 8 mfd. in the first condenser. The capacity of the condenser may vary, depending upon the filtering desired, ranging from 4 to 24 mfd. with a 5 to 15 henry choke. The DC resistance of this choke should be as low as practical to secure maximum output voltage from the Vibrapack. For types VP-552, VP-554 and VP-G556 (high output units) 100 to 200 ohms is suggested. For types VP-551 and VP-553, not over 400 ohms should be used, depending upon the "B" current.

Use Capacitors having a rating of 450 working volts with Vibrapack types VP-552 and VP-554, or having a rating of either 450 or 250 working volts with Vibrapack types VP-551 and VP-553.

Sensitive radio receivers may require the use of a .5 or 1.0 mfd. RF condenser (Mallory types RF481 or RF482) connected from "A HOT" to ground in the radio receiver. It may also be necessary to use a .1 mfd. Mallory TP418 condenser connected between "B+" and Ground in the radio receiver. On installations using Vibrapack VP-553 and VP-554, it may be necessary to use a .25 mfd. Mallory type TP440 condenser connected between "B—" and Ground in the radio receiver.

If any difficulty is experienced with vibrator "hash" when using a Vibrapack to operate a regenerative, or super-regenerative short wave receiver, by-pass the "hot" sides of the filaments or heaters to the chassis, mounting the by-pass condensers close to the tube sockets. One-half mfd. 200-volt tubular paper by-pass condensers Mallory type RF481, are recommended.

These by-pass condensers are required to eliminate any remaining traces of RF (hash) interference that is subject to pick-up by receivers of unusual sensitivity.

Adjusting the Output—It is advisable that the Vibrapack be turned off when any adjustment is made on the voltage control switch. The lower output is obtained at position No. 1 and the voltage increased over the range in steps of 25 volts each to the highest output at position No. 4. Should a variation occur in the voltage of the battery, the output voltage will vary in direct proportion to the input voltage variations. Vibrapacks may be operated satisfactorily through a range of applied voltage from 5.5 to 8.0 volts. This range normally occurs in a 6-volt, 3-cell storage battery during the cycles of charge and discharge.

It must be remembered, however, that the maximum life from the vibrator, tube and other components will be secured when the voltage is near the rated value of 6.3 volts.

Special Precautions—Do not exceed 32.5 watts as total output from Vibrapacks VP-552 and VP-554, or 16.5 watts from Vibrapacks VP-551 and VP-553, when operating with 6.3 volts at the Vibrapack terminals.

Vibrators and tubes identical to the original supplied must be used for replacement. Do not attempt to use type 0Z4 tube with Vibrapack VP-553 in place of type 6X5 tube, unless "B" current of more than 40 ma. is to be drawn from this pack. For load currents below 35 ma. the 6ZY5G rectifier may be substituted for lower heater consumption than the 6X5 requires.

The VP-G556 Vibrapack should not be operated under conditions where the charging rate of the generator is such as to raise the potential of the battery above 15 volts.

"C" NOTES

C1—Use Mallory Replacement Vibrator Type 312T in early models and Type 292 in late models of this receiver. See Note C3.

C2—Use Mallory Replacement Vibrator Type F312 in early models and Type F221 in late models of this receiver. See Note C3.

C3—When unusual vibrator troubles are experienced a thorough check should be made of all of the power pack parts and the circuit. It is especially important that the secondary buffer condenser, connected across the secondary of the transformer be in good operating condition and within plus or minus 10% of the specified capacity. **Be Sure to Check Buffer Condenser.** In some instances this condenser may be two condensers with the common lead grounded. In certain sets resistors have been used in series with these condensers. If the replacement of a buffer condenser is necessary use the Mallory Oil Filled, high voltage condenser, Type "OT" or "VB" as required. NEVER SUBSTITUTE A DIFFERENT VALUE—USE ONLY THE SPECIFIED CAPACITY. The wrong buffer capacity may cause serious damage to the vibrator in a very short time. See Condenser listing for specified capacity.

C4—Use Mallory Replacement Vibrator Type 312T in early models and Type 225 in late models of this receiver. See Note C3.

C5—Use Mallory Replacement Vibrator Type 210-237 (210 Series) in both the "Standard" and the "Master" models. See Note C3.

C6—These sets use an interrupter type (tube type) vibrator; however the size and method of connection are unknown. **For an emergency selection of a replacement vibra-**

tor refer to the Vibrator Connection Charts, pages 232 to 234. Select an interrupter type vibrator which is approximately the same size and has identically the same connection arrangement as the original. For plug-in vibrators the pin-base must have the same arrangement and connections. For lead type vibrator the reed lead is red and the interrupter contact leads (two) will be yellow. Any Mallory-Yaxley Distributor will gladly assist in making this selection. **If an authentic replacement is desired, have your distributor send the original vibrator, together with the name and model of the receiver to the Mallory Factory. The proper Mallory replacement vibrator will be promptly supplied. See Note C3.**

C7—No information available on this vibrator circuit. See Notes C6 or C8.

C8—These sets use a synchronous (self-rectifying) type vibrator; however, the size and method of connection are unknown. **For the emergency selection of a replacement vibrator refer to the Vibrator Connection Charts, pages 232 to 234.** Select a synchronous type vibrator which is approximately the same size and has identically the same connection arrangement as the original. **If the original vibrator has condensers** connected from the rectifier springs to the reed BE SURE the selected replacement vibrator also has condensers. For plug-in type vibrators the pin-base must have the same arrangement and connections. For lead type vibrators refer to the Vibrator Connection Charts, pages 232 to 234, for the color of leads and connections. Any Mallory-Yaxley distributor will gladly assist in making this selection. **If an authentic replacement is desired, have the distributor send the original vibrator, together with the name and model of the receiver, to the Mallory Factory. The proper Mallory Replacement Vibrator will be promptly supplied.** See Note C3.

C9—See Note C6. Two Types of Power Packs are used: one with 25Z5 and the other an 84. Suggest Type F221, F292, F294, F297. See Note C3.

C10—Use Mallory Replacement Vibrator Type F221. See Note C3.

C11—Early type with vibrator mounted on the power transformer uses an F220C, late or plug-in type uses an F294.

C12—**The first series** of this receiver used a carbon point vibrator for which there is NO replacement. Obtain a new transformer (latest type for this set) from the manufacturer. (Wells-Gardner Co., Chicago, Ill.) After the new transformer has been installed use the Mallory Replacement Vibrator Type 292. A small amount of "hash," which cannot be eliminated, will be experienced with this receiver. See Note C3.

C13—This Mallory Replacement Vibrator used in early models. See Note C3.

C14—This Mallory Replacement Vibrator used in late models. See Note C3.

C15—Use Mallory Cup Adapter with Mallory Replacement Vibrator Type 273. See Note C3.

C16—12 Volt Receiver. See Note C3.

C17—Use Mallory Replacement Vibrator Type 285X for 1935 models. See Note C3.

C18—Use Mallory Replacement Vibrator Type 245 for early 1936 models. See Note C3.

C19—Use Mallory Replacement Vibrator Type 245A for late 1936 models. See Note C3.

C20—Use Mallory Replacement Vibrator Type 296 for six prong socket and Type 294 for four prong socket. See Note C3.

C22—A few early models of this receiver used Mallory Vibrator Type 75X as original equipment. Use the Mallory Replacement Vibrator Type 275XS in these early models. Use the Mallory Replacement Vibrator Type 285XS in all later models. See Note C3.

C23—Some production on this model used a plug-in type vibrator instead of the lead type. Select the proper Mallory Replacement Vibrator as outlined in C6. See Note C3.

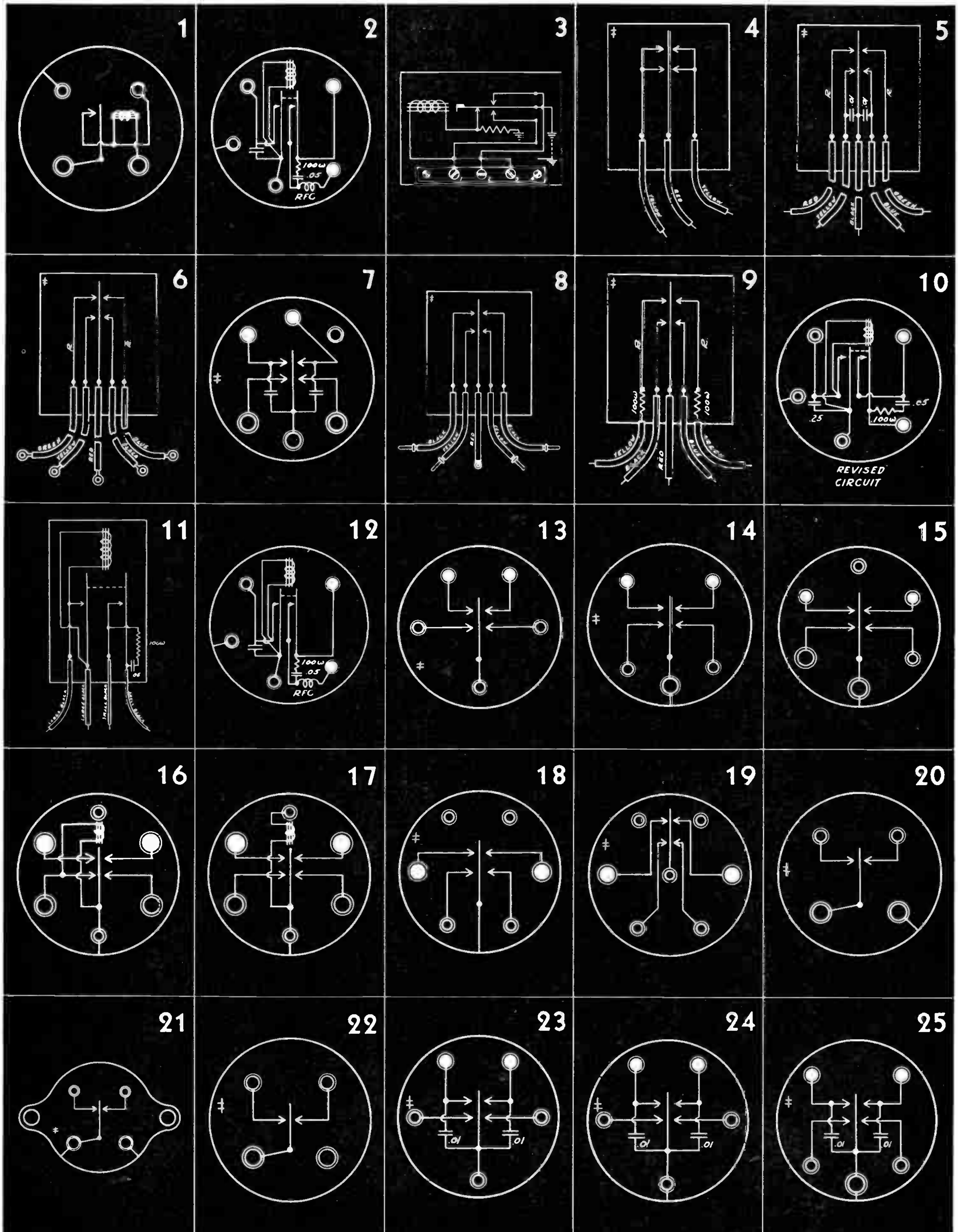
Chart Showing Automobile Antenna and Battery Grounds

Car	1931	1932	1933	1934	1935	1936	1937	1938
Auburn	P......No	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P.....Yes	....
Austin	P......No	P......No	P......No	P.....Yes	....	....	....	....
Buick	N......No	N......No	N.....Yes	N.....Yes	N.....Yes	N......No	N.....Yes	N.....Yes
Cadillac	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P......No	N.....Yes	P.....Yes
Chevrolet	N......No	N......No	N.....Yes	N.....Yes	N......**	N......No	N......No	N......No
Chrysler	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P....††No	P......No
Continental	....	....	N......No	N......No	....	....	....	....
Cord	P......No	P......No	P......No	....	....	P.....Yes	P.....Yes	....
Cunningham	N......No	N......No	N......No	N......No	....	....	....	....
DeSoto	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P......No	P......No
Dodge	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P......No	P......No
Duesenberg	N......No	N......No	N......No	N......No	N......No	N......No	....	....
Durant	N......No	N......No	....	....	....	....	....	....
Essex	N......No	N......No	N......No	....	....	....	....	....
Ford	P......No	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P......No	P......No
Franklin	P......No	P......No	P......No	P.....Yes	....	....	....	....
Graham	P......No	P......No	P......No	P.....Yes	P.....Yes	P......No	P........§	P......No
Hudson	N......No	N......No	N......No	P.....Yes	P.....Yes	P......No	P......No	P......No
Hupmobile	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P.....Yes	....	P......No
Lafayette	....	....	....	P.....Yes	P.....Yes	P......No	P......No	P......No
LaSalle	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P......No	N.....Yes	P.....Yes
Lincoln	N......No	N.....Yes	N.....Yes	N.....Yes	N.....Yes	N.....Yes	N.....Yes	N.....Yes
Marmon	P......No	P......No	P......No	P......No	....	....	....	....
*Nash	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P.....†No	P......No	P......No
Oldsmobile	N......No	N......No	N.....Yes	N.....Yes	N......No	N......No	N......No	N......No
Packard	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P.....Yes
Pierce-Arrow	P.........	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P.........	P......No
Plymouth	P......No	P......No	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P......No	P......No
Pontiac	N......No	N......No	N.....Yes	N.....Yes	N......No	N......No	N......No	N......No
Reo	N......No	N......No	N.....Yes	N......No	N.....Yes	N.....Yes	....	....
Rockne	....	P.....Yes	P.....Yes	....	....	....	....	....
Studebaker	P.........	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P.....Yes	P.....Yes
Stutz	N......No	N......No	N......No	N......No	N.........	N.........	N......No	....
Terraplane	....	....	....	P.....Yes	P.....Yes	P......No	P......No	P......No
Willys	N......No	N......No	N.....†No	....	N......No	N......No	N......No	N......No

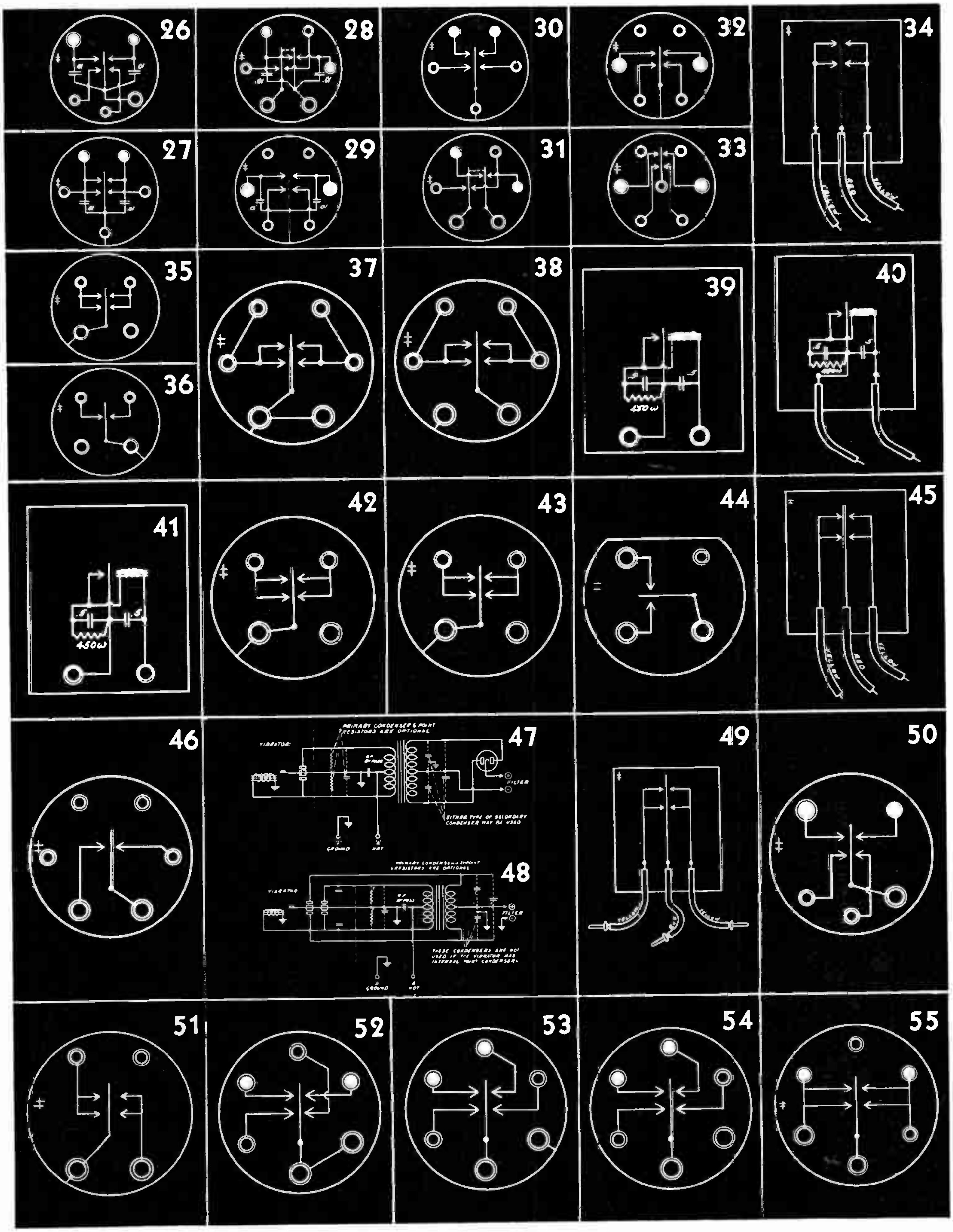
*Some models have N. ground **Standard, Yes; Master, No.
N—Negative battery terminal grounded to chassis.
P—Positive battery terminal grounded to chassis.

†Some models have built-in antenna.
Yes—Car equipped with built-in antenna.
No—Car not equipped with built-in antenna.

††Airflow, Yes.
§Small Models, No; Large Models, Yes.

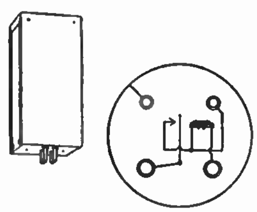


 ‡ Uses Shunt Type Driver Coils.



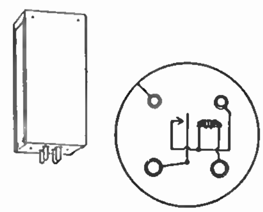
‡ Uses Shunt Type Driver Coils.

TYPE 201, 202, 203, 204 SERIES



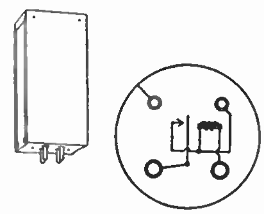
Half Wave......2 Contacts
Rectifier.........Tube (BR)
Size............2 11/16" x 2 7/8" x 5 5/8"
Prong Length....Standard
Operating Voltage....6

TYPE 205-206 SERIES



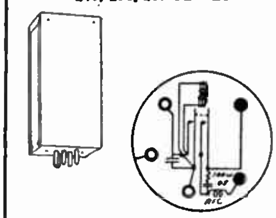
Half Wave......2 Contacts
Rectifier.........Tube (BR)
Size............2 11/16" x 2 7/8" x 5 5/8"
Prong Length....Standard
Operating Voltage....6

TYPE F204-F206 SERIES



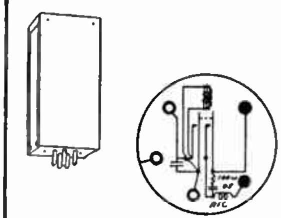
Half Wave......2 Contacts
Rectifier.........Tube (BR)
Size............2 11/16" x 2 7/8" x 5 5/8"
Prong Length....Standard
Operating Voltage....32

TYPE 210, 211, 212, 213, 214, 219, 236, 237 SERIES



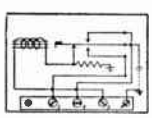
Half Wave......4 Contacts
Rectifier.........Synchronous
Size............2 7/16" x 2 1/4" x 5 5/16"
Prong Length....Standard
Operating Voltage....6

TYPE F211



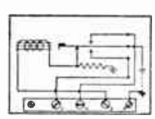
Half Wave......4 Contacts
Rectifier.........Synchronous
Size............2 7/16" x 2 1/4" x 5 5/16"
Prong Length....Standard
Operating Voltage....32

TYPE 220B.



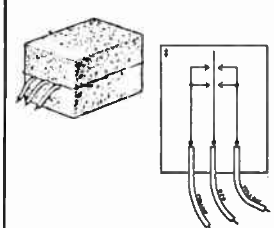
Full Wave......4 Power Contacts / 2 Driver Contacts
Rectifier.........Tube
Size............3 9/16" x 2" x 1"
Screw Terminal Connections
Operating Voltage....6

TYPE F220C



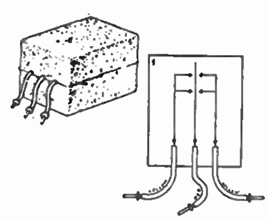
Full Wave......4 Power Contacts / 2 Driver Contacts
Rectifier.........Tube
Size............3 9/16" x 2" x 1"
Screw Terminal Connections
Operating Voltage....32

TYPE 221



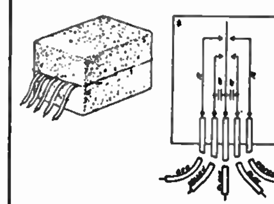
Full Wave......8 Contacts
Rectifier.........Tube
Size............4 1/2" x 1 3/16" x 1 9/16"
Lead Lengths...Red 4 1/2" / Yellow 3 1/2"
Operating Voltage....6

TYPE F221



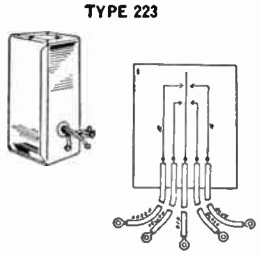
Full Wave......8 Contacts
Rectifier.........Tube
Size............4 1/2" x 1 3/16" x 1 9/16"
Lead Lengths....4 1/2"
Operating Voltage....32

TYPE 222



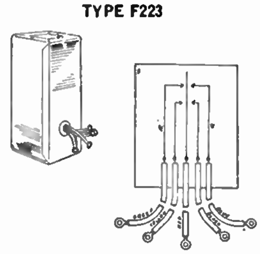
Full Wave........8 Contacts
Rectifier.........Synchronous
Size............4 1/2" x 1 7/8" x 1 13/16"
Lead Lengths...Blue 7 1/4" / Yellow 6 1/4" / Green and Red 3 1/2" / Black 2 1/2"
Operating Voltage....6

TYPE 223



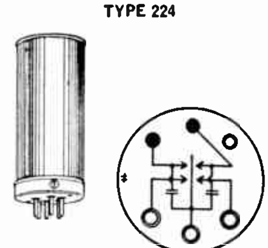
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............4 1/8" x 1 3/4" x 1 13/16"
Lead Lengths....7"
Operating Voltage....6

TYPE F223



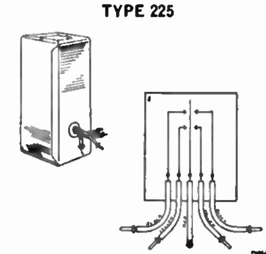
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............4 1/8" x 1 3/4" x 1 13/16"
Lead Lengths....7"
Operating Voltage....32

TYPE 224



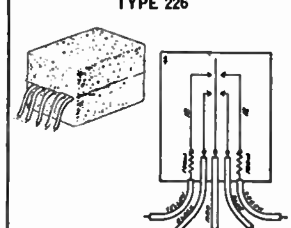
Full Wave......8 Contacts
Rectifier.........Synchronous
Size............2 3/8" dia. x 4 3/4"
Prong Length....Standard
Operating Voltage....6

TYPE 225



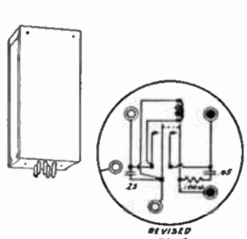
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............4 1/8" x 1 3/4" x 1 13/16"
Lead Length.....4"
Operating Voltage....6

TYPE 226



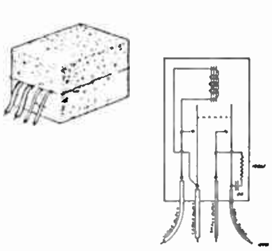
Full Wave......8 Contacts
Rectifier.........Synchronous
Size............4 1/2" x 1 9/16" x 1 9/16"
Lead Length...Blue and Black 4 1/2" / Red, Yellow and Green 3 1/2"
Operating Voltage....6

TYPE 230



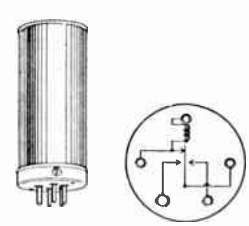
Half Wave......4 Contacts
Rectifier.........Synchronous
Size............2 7/16" x 2 1/4" x 5 5/16"
Prong Length....Standard
Operating Voltage....6

TYPE 231, 234, 235 SERIES



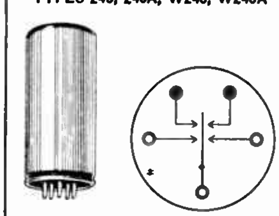
Half Wave......4 Contacts
Rectifier.........Synchronous
Size............2 7/16" x 2 1/8" x 5 5/16"
Lead Lengths....3"
Operating Voltage....6

TYPE H240



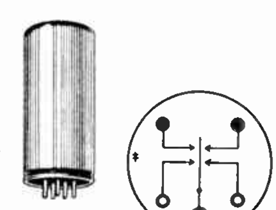
Full Wave......4 Power Contacts / 2 Driver Contacts
Rectifier.........Tube
Size............2 3/8" dia. x 4 3/4"
Prong Length....Standard
Operating Voltage....110

TYPES 245, 245A, W245, W245A



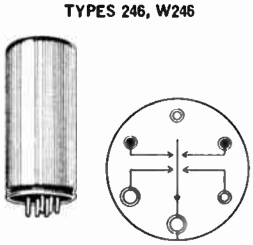
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size (245, W245) 1 1/2" dia. x 3 1/4"
Size(245A, W245A) 1 15/16 x 3 1/2"
Prong Length....Standard
Operating Voltage
(245, 245A).......6
(W245, W245A)....4

TYPE 245C



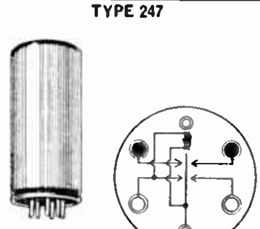
Full Wave......8 Contacts
Rectifier.........Synchronous
Size............1 1/2" dia. x 3 1/4"
Prong Length....Standard
Operating Voltage....6

TYPES 246, W246



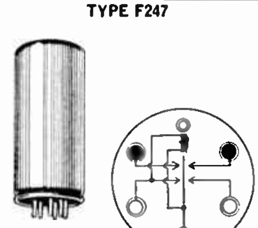
Full Wave......8 Contacts
Rectifier.........Synchronous
Size............1 1/2" dia. x 3 1/4"
Prong Length....Standard
Operating Voltage
(246)..........6
(W246).........4

TYPE 247



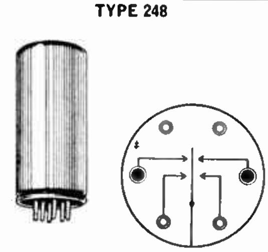
Full Wave......8 Contacts
Rectifier.........Synchronous
Size............1 1/2" dia. x 3 1/4"
Prong Length....Standard
Operating Voltage....6

TYPE F247



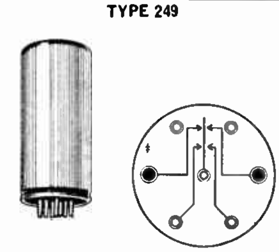
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............1 1/2" dia. x 3 1/4"
Prong Length....Standard
Operating Voltage....32

TYPE 248

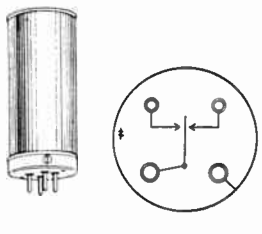


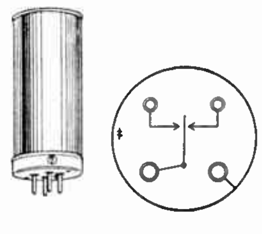
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............1 1/2" dia. x 3 1/4"
Prong Length...4 small standard / 2 large 11/16"
Operating Voltage....6

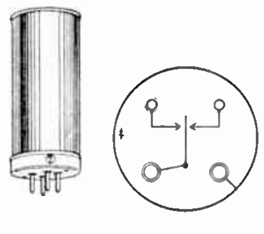
TYPE 249

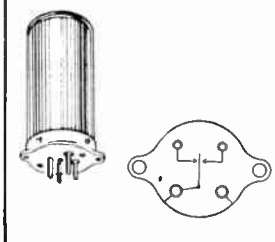


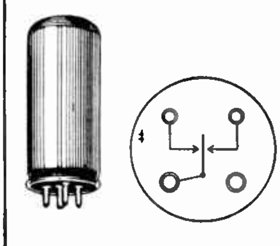
Full Wave......8 Contacts
Rectifier.........Synchronous
Size............1 1/2" dia. x 3 1/4"
Prong Length....Standard
Operating Voltage....6

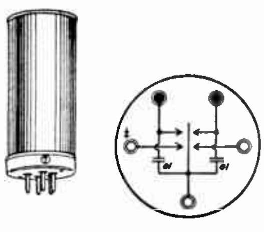
TYPE F251-F253 SERIES

Full Wave ... 4 Contacts
Rectifier ... Tube
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 32

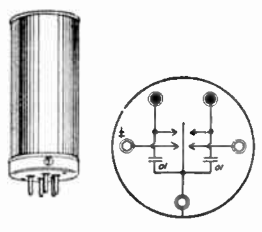
TYPE 253

Full Wave ... 4 Contacts
Rectifier ... Tube
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

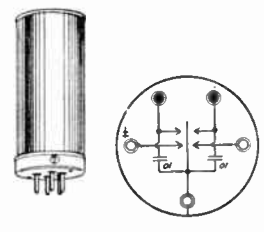
TYPE G253

Full Wave ... 4 Contacts
Rectifier ... Tube
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 12

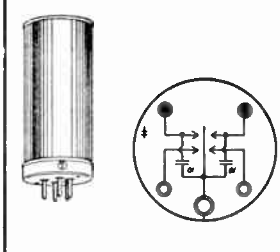
TYPE 253T

Full Wave ... 4 Contacts
Rectifier ... Tube
Size ... 2" dia. x 4½"
Prong Length ... 11/16"
Operating Voltage ... 6

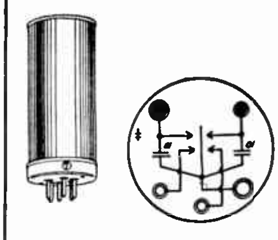
TYPE 253Y

Full Wave ... 4 Contacts
Rectifier ... Tube
Size ... 1¾" dia. x 4¼"
Prong Length ... Standard
Operating Voltage ... 6

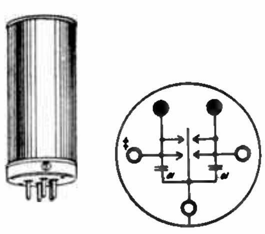
TYPE 270B

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

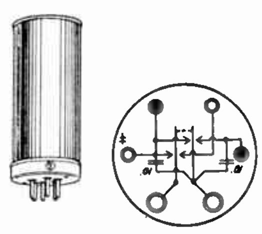
TYPE 271-273 SERIES

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

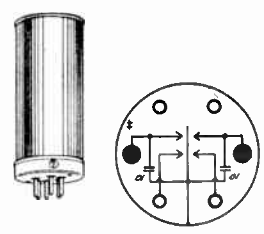
TYPE 271HD

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

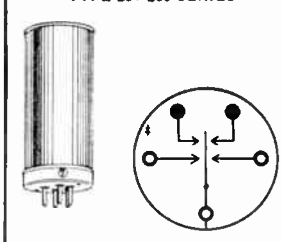
TYPE 273C

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

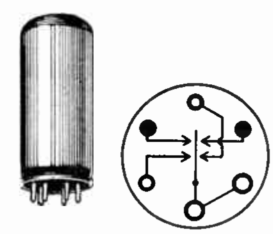
TYPE 273D

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

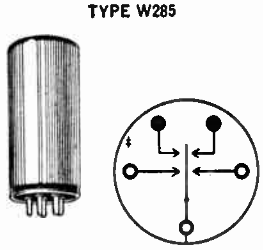
TYPE 275

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

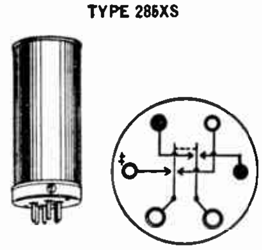
TYPE 275XS

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... 11/16"
Operating Voltage ... 8

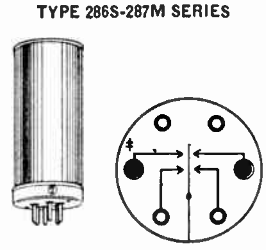
TYPE 277S

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

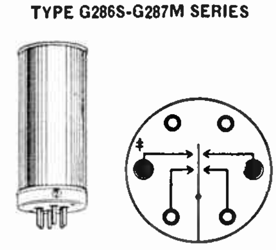
TYPE 281-285 SERIES

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

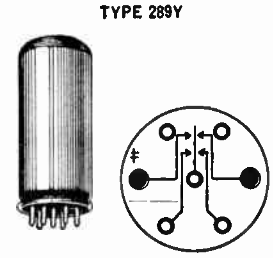
TYPE P285Y

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 1¾" dia. x 4¼"
Prong Length ... Standard
Operating Voltage ... 6

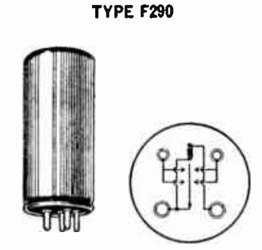
TYPE W285

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 1 15/16" x 3½"
Prong Length ... Standard
Operating Voltage ... 4

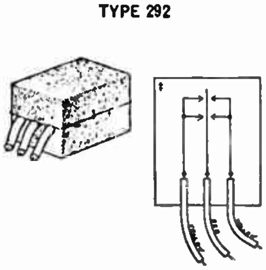
TYPE 286XS

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... 11/16"
Operating Voltage ... 6

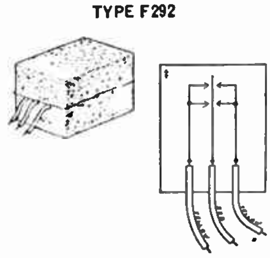
TYPE 286S-287M SERIES

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 6

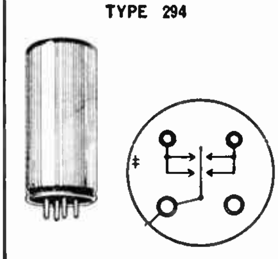
TYPE G286S-G287M SERIES

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 2" dia. x 4½"
Prong Length ... Standard
Operating Voltage ... 12

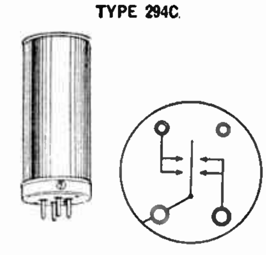
TYPE 289Y

Full Wave ... 8 Contacts
Rectifier ... Synchronous
Size ... 1¾" dia. x 4¼"
Prong Length ... Standard
Operating Voltage ... 6

TYPE F290

Full Wave ... 8 Contacts
Rectifier ... Tube
Size ... 1½" dia. x 3¼"
Prong Length ... Standard
Operating Voltage ... 32

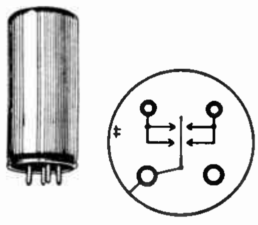
TYPE 292

Full Wave ... 8 Contacts
Rectifier ... Tube
Size ... 1½" x 1⅜" x 2 7/16"
Lead Lengths ... 3"
Operating Voltage ... 6

TYPE F292

Full Wave ... 8 Contacts
Rectifier ... Tube
Size ... 1½" x 1⅜" x 2 7/16"
Lead Lengths ... 3"
Operating Voltage ... 32

TYPE 294

Full Wave ... 8 Contacts
Rectifier ... Tube
Size ... 1½" dia. x 3¼"
Prong Length ... Standard
Operating Voltage ... 6

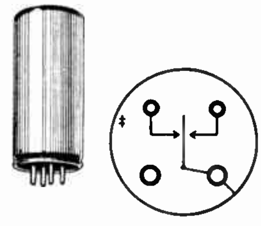
TYPE 294C

Full Wave ... 8 Contacts
Rectifier ... Tube
Size ... 1⅝" dia. x 3⅜"
Prong Length ... Standard
Operating Voltage ... 6

TYPE F294



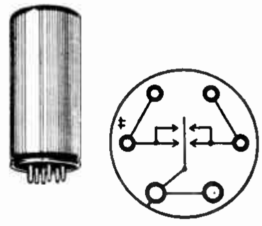
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 32

TYPE 294SW



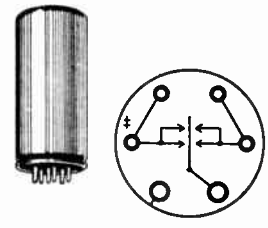
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 6

TYPE 296



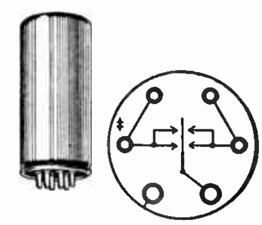
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 6

TYPE 297



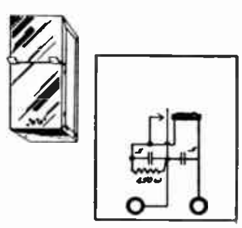
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 6

TYPE F297



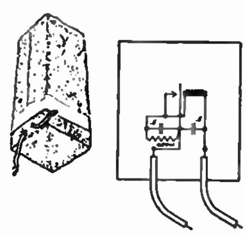
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 32

TYPE 302S, 303S, 312T Series



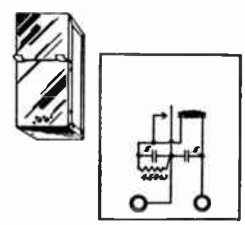
Half Wave....... 2 Contacts
Rectifier......... Tube (BR)
Size........... 2 15/16" x 2 15/16" x 6 5/16"
Prong Length.... Standard
Operating Voltage.... 6

TYPE 311S



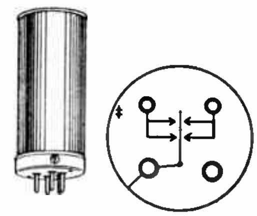
Half Wave....... 2 Contacts
Rectifier......... Tube (BR)
Size........... 2¾" x 2⅜" x 6⅛"
Lead Length..... 3"
Operating Voltage.... 6

TYPE F312



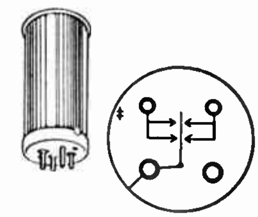
Half Wave....... 2 Contacts
Rectifier......... Tube (BR)
Size........... 2 15/16" x 2 15/16" x 6 5/16"
Prong Length.... Standard
Operating Voltage.... 32

TYPE 500P



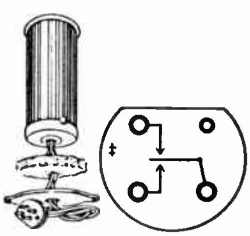
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 2⅜" dia. x 4¾"
Prong Length.... Standard
Operating Voltage.... 6

TYPES 501P, 505P



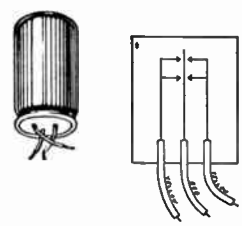
Full Wave....... 8 Contacts
Rectifier......... Tube
Size (501P)...... 1⅝" dia. x 3½"
Size (505P)...... 1 15/16" dia. x 3½"
Prong Length.... Standard
Operating Voltage.... 6

TYPE F502P



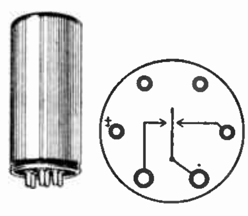
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1⅝" dia. x 3½"
Special Leads and Plug
Prongs.......... Standard
Operating Voltage.... 32

TYPE 503



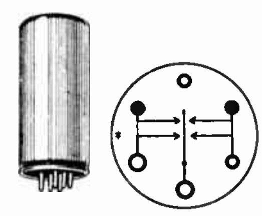
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1½" dia. x 3"
Lead Lengths.... 3"
Operating Voltage.... 6

TYPE 504



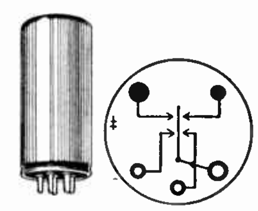
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 6

TYPE 506P



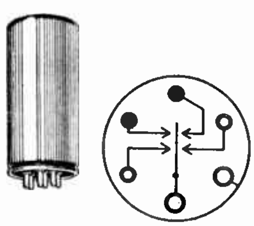
Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1 15/16" dia. x 3½"
Prong Length.... Standard
Operating Voltage.... 6

TYPES 514, 715



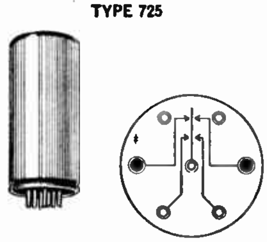
Full Wave....... 8 Contacts
Rectifier......... Synchronous
Size........... 1 15/16" dia. x 3½"
Prong Length.... Standard
Operating Voltage.... 6

TYPE 722A



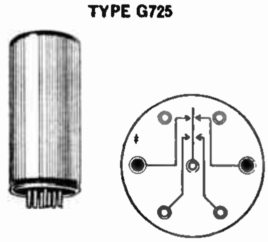
Full Wave....... 8 Contacts
Rectifier......... Synchronous
Size........... 1 15/16" dia. x 3½"
Prong Length.... Standard
Operating Voltage.... 6

TYPE 725



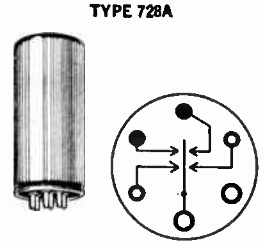
Full Wave....... 8 Contacts
Rectifier......... Synchronous
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 6

TYPE G725



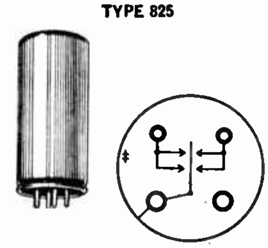
Full Wave....... 8 Contacts
Rectifier......... Synchronous
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 12

TYPE 728A

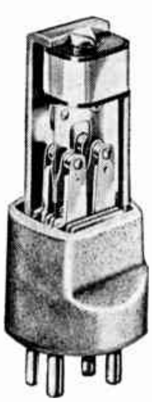


Full Wave....... 8 Contacts
Rectifier......... Synchronous
Size........... 1 15/16" dia. x 3½"
Prong Length.... Standard
Operating Voltage.... 6

TYPE 825



Full Wave....... 8 Contacts
Rectifier......... Tube
Size........... 1½" dia. x 3¼"
Prong Length.... Standard
Operating Voltage.... 6



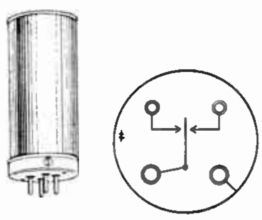
Avoid Grief—Insist on Mallory 8-Contact Replacement Vibrators

When you buy a Mallory 8-Contact Replacement Vibrator you are assured of these benefits: 1. Lowest cost per hour of actual use. 2. Trouble-free long life. 3. Positive starting. 4. Easy installation. 5. Freedom from lead breakage. 6. Freedom from failures due to lead corrosion. 7. Absolute freedom from broken reeds.

Mallory 8-Contact Replacement Vibrators are built by the most highly specialized group of technicians in the vibrator industry. The majority of these employees have been with Mallory since the beginning of the vibrator industry. Such a highly trained personnel can only assure the highest quality of workmanship possible. Mallory pioneered vibrators for automobile radios and has always led in all new developments in the vibrator industry.

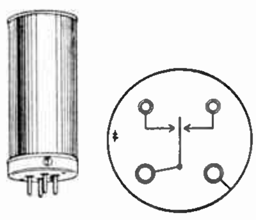
Because Mallory is the world's largest manufacturer of electrical contacts, you are assured the highest contact quality in vibrators. Outstanding quality construction features are: 1. Selected pure tungsten contacts. 2. Special high tensile reed. 3. The highest quality of insulation specially processed in the Mallory factory. 4. Sturdy construction. 5. Low loss of magnetic circuit. 6. Pure rubber insulated tubing. 7. Extra flexible tinned copper lead wires. 8. High contact pressure. 9. Sealed tamper-proof condensers.

TYPE F251-F253 SERIES



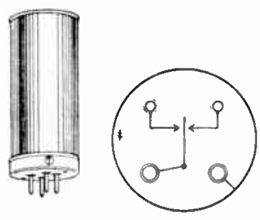
Full Wave....4 Contacts
Rectifier....Tube
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....32

TYPE 253



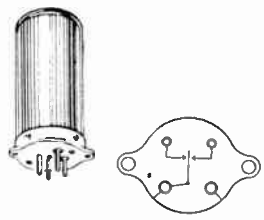
Full Wave....4 Contacts
Rectifier....Tube
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE G253



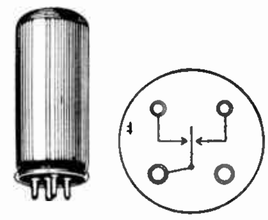
Full Wave....4 Contacts
Rectifier....Tube
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....12

TYPE 253T



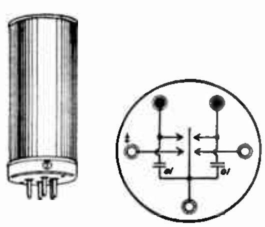
Full Wave....4 Contacts
Rectifier....Tube
Size....2" dia. x 4½"
Prong Length....11/16"
Operating Voltage....6

TYPE 253Y



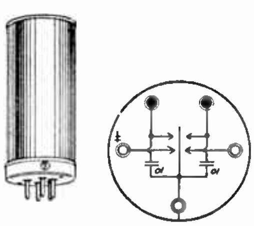
Full Wave....4 Contacts
Rectifier....Tube
Size....1¾" dia. x 4¼"
Prong Length....Standard
Operating Voltage....6

TYPE 270B



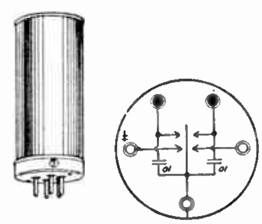
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE 271-273 SERIES



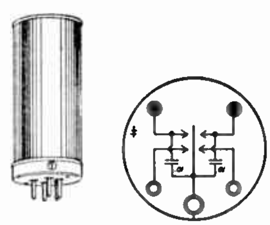
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE 271HD



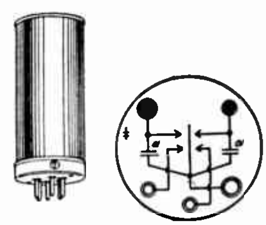
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE 273C



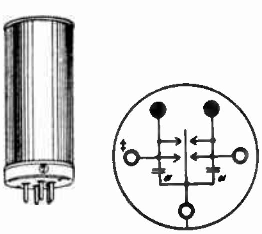
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE 273D



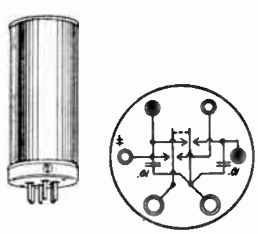
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE 275



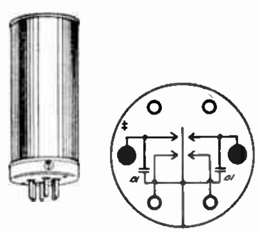
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE 275XS



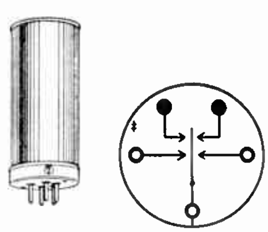
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....11/16"
Operating Voltage....6

TYPE 277S



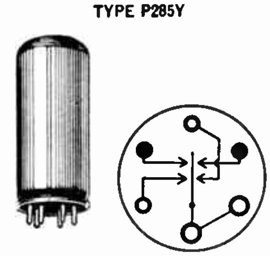
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE 281-285 SERIES



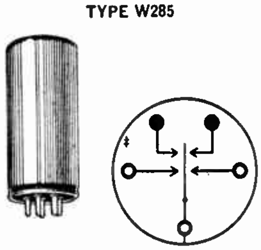
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE P285Y



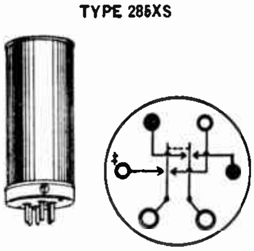
Full Wave....8 Contacts
Rectifier....Synchronous
Size....1¾" dia. x 4¼"
Prong Length....Standard
Operating Voltage....6

TYPE W285



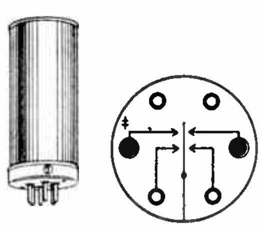
Full Wave....8 Contacts
Rectifier....Synchronous
Size....1 15/16" x 3½"
Prong Length....Standard
Operating Voltage....4

TYPE 285XS



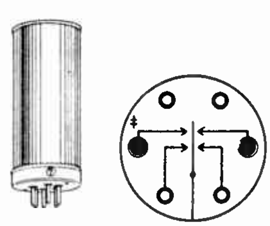
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....11/16"
Operating Voltage....6

TYPE 286S-287M SERIES



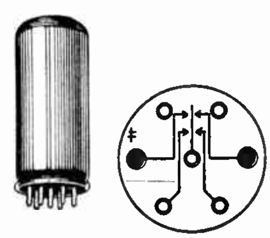
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....6

TYPE G286S-G287M SERIES



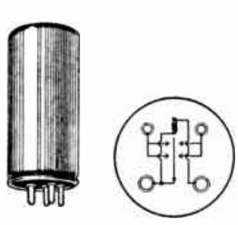
Full Wave....8 Contacts
Rectifier....Synchronous
Size....2" dia. x 4½"
Prong Length....Standard
Operating Voltage....12

TYPE 289Y



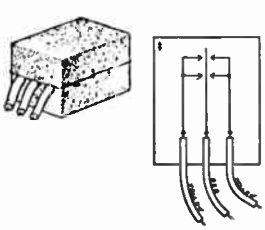
Full Wave....8 Contacts
Rectifier....Synchronous
Size....1¾" dia. x 4¼"
Prong Length....Standard
Operating Voltage....6

TYPE F290



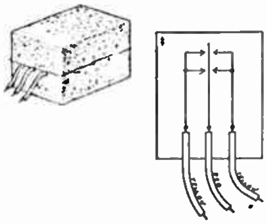
Full Wave....8 Contacts
Rectifier....Tube
Size....1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....32

TYPE 292



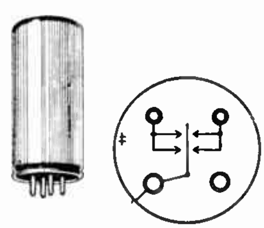
Full Wave....8 Contacts
Rectifier....Tube
Size....1½" x 1⅜" x 2 7/16"
Lead Lengths....3"
Operating Voltage....6

TYPE F292



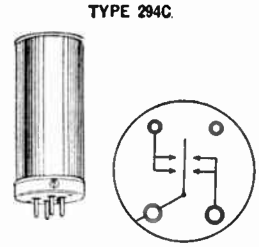
Full Wave....8 Contacts
Rectifier....Tube
Size....1½" x 1⅜" x 2 7/16"
Lead Lengths....3"
Operating Voltage....32

TYPE 294



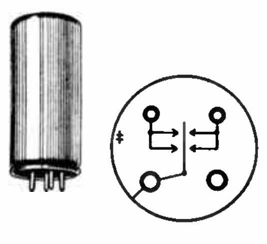
Full Wave....8 Contacts
Rectifier....Tube
Size....1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....6

TYPE 294C



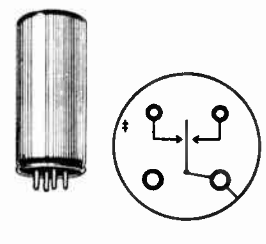
Full Wave....8 Contacts
Rectifier....Tube
Size....1⅝" dia. x 3⅝"
Prong Length....Standard
Operating Voltage....6

TYPE F294



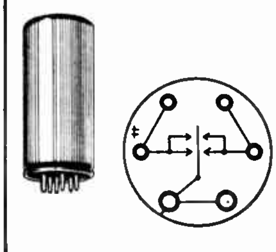
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....32

TYPE 294SW



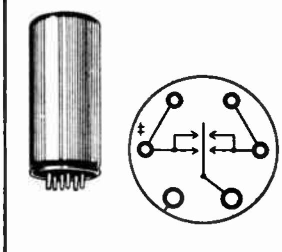
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....6

TYPE 296



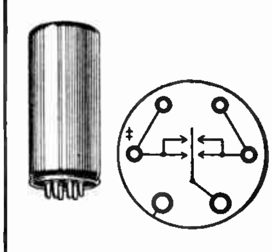
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....6

TYPE 297



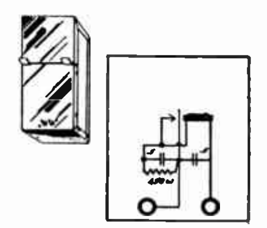
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....6

TYPE F297



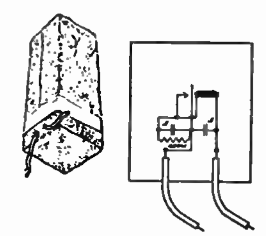
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....32

TYPE 302S, 303S, 312T Series



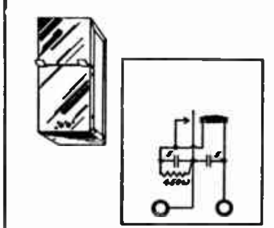
Half Wave......2 Contacts
Rectifier.........Tube (BR)
Size............2 15/16" x 2 13/16" x 6 5/16"
Prong Length....Standard
Operating Voltage....6

TYPE 311S



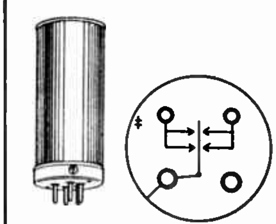
Half Wave......2 Contacts
Rectifier.........Tube (BR)
Size............2¾" x 2⅜" x 6⅛"
Lead Length.....3"
Operating Voltage....6

TYPE F312



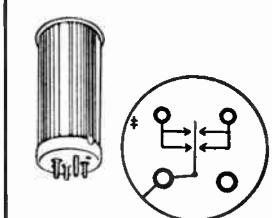
Half Wave......2 Contacts
Rectifier.........Tube (BR)
Size............2 15/16" x 2 15/16" x 6 5/16"
Prong Length....Standard
Operating Voltage....32

TYPE 500P



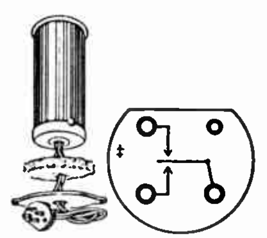
Full Wave.......8 Contacts
Rectifier.........Tube
Size............2⅜" dia. x 4¾"
Prong Length....Standard
Operating Voltage....6

TYPES 501P, 505P



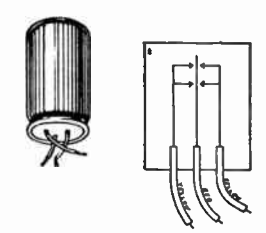
Full Wave.......8 Contacts
Rectifier.........Tube
Size (501P)......1⅝" dia. x 3½"
Size (505P)......1 15/16" dia. x 3½"
Prong Length....Standard
Operating Voltage....6

TYPE F502P



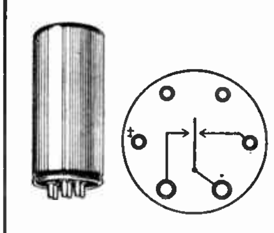
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1⅝" dia. x 3½"
Special Leads and Plug
Prongs..........Standard
Operating Voltage....32

TYPE 503



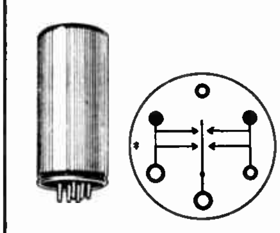
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1½" dia. x 3"
Lead Lengths....3"
Operating Voltage....6

TYPE 504



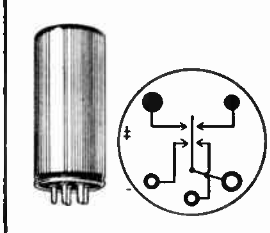
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....6

TYPE 506P



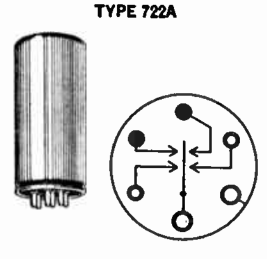
Full Wave.......8 Contacts
Rectifier.........Tube
Size............1 15/16" dia. x 3½"
Prong Length....Standard
Operating Voltage....6

TYPES 514, 715



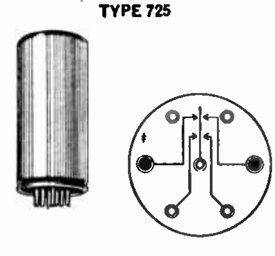
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............1 15/16" dia. x 3½"
Prong Length....Standard
Operating Voltage....6

TYPE 722A



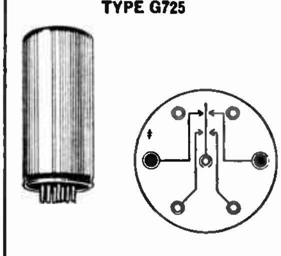
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............1 15/16" dia. x 3½"
Prong Length....Standard
Operating Voltage....6

TYPE 725



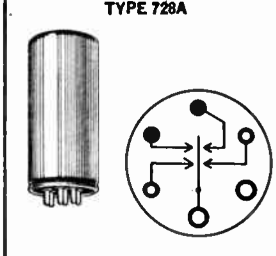
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....6

TYPE G725



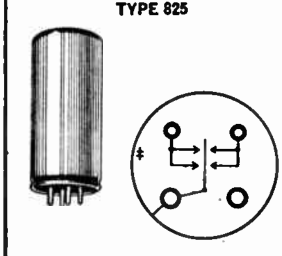
Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....12

TYPE 728A



Full Wave.......8 Contacts
Rectifier.........Synchronous
Size............1 15/16" dia. x 3½"
Prong Length....Standard
Operating Voltage....6

TYPE 825



Full Wave.......8 Contacts
Rectifier.........Tube
Size............1½" dia. x 3¼"
Prong Length....Standard
Operating Voltage....6

Avoid Grief—Insist on Mallory 8-Contact Replacement Vibrators

When you buy a Mallory 8-Contact Replacement Vibrator you are assured of these benefits: 1. Lowest cost per hour of actual use. 2. Trouble-free long life. 3. Positive starting. 4. Easy installation. 5. Freedom from lead breakage. 6. Freedom from failures due to lead corrosion. 7. Absolute freedom from broken reeds.

Mallory 8-Contact Replacement Vibrators are built by the most highly specialized group of technicians in the vibrator industry. The majority of these employees have been with Mallory since the beginning of the vibrator industry. Such a highly trained personnel can only assure the highest quality of workmanship possible. Mallory pioneered vibrators for automobile radios and has always led in all new developments in the vibrator industry.

Because Mallory is the world's largest manufacturer of electrical contacts, you are assured the highest contact quality in vibrators. Outstanding quality construction features are: 1. Selected pure tungsten contacts. 2. Special high tensile reed. 3. The highest quality of insulation specially processed in the Mallory factory. 4. Sturdy construction. 5. Low loss of magnetic circuit. 6. Pure rubber insulated tubing. 7. Extra flexible tinned copper lead wires. 8. High contact pressure. 9. Sealed tamper-proof condensers.

Mallory Vibrator Type Number Cross Reference Chart

In many instances original equipment Mallory Vibrators will be found to bear the Mallory number listed under the first column. Refer to third column for correct current Mallory Replacement Vibrator to employ.

Mallory Original Equipment Number	Original Mallory Replacement Number	Current Mallory Replacement Number	Type Construction
For 6 Volt Receivers			
1	201		
2	202	201 Series	Interrupter
3	203		
4	204		
5	205	205 Series	Interrupter
6	206		
10	210		
11	211		
12	212		
13	213	210 Series	Improved Dual Reed Synchronous
14	214		
19	219		
36	236		
37	237		
30	230	230	Improved Dual Reed Synchronous
31	231		
34	234	231 Series	Improved Dual Reed Synchronous
35	235		
		220B	Special Interrupter
		221	Interrupter
		222	Synchronous
		223	Synchronous
		224	Synchronous
		225	Synchronous
W45A		W245A Series	Synchronous
45		245	Synchronous
W45		W245	Synchronous
45C		245C	Synchronous
46		246	Synchronous
W46		W246	Synchronous
		247	Synchronous
48		248	Synchronous
49		249	Synchronous
50	250	500P	Interrupter
53		253	Interrupter
53T		253T	Interrupter
53Y		253Y	Interrupter
60 or 70B		270B	Synchronous
61 or 71	271		
63 or 73	273	271 Series	Synchronous
75	275		
71HD		271HD	Synchronous
		273C	Synchronous
		273D	Synchronous
75X		275XS	Split Reed Synch.
77S		277S	Synchronous
		280	Synchronous
81	281	281 Series	Synchronous
85	285		
85X		285XS	Split Reed Synch.
P85Y or P85XY		P285Y	Synchronous
W85		W245A Series	Synchrounos
86S	286S	286 Series	Synchronous
87M	287M		
89Y		289Y	Synchronous
92		292	Interrupter
94		294	Interrupter
		294C	Interrupter
		294SW	Interrupter

Mallory Original Equipment Number	Original Mallory Replacement Number	Current Mallory Replacement Number	Type Construction
For 6 Volt Receivers			
96		296	Interrupter
		297	Interrupter
S102	302S		
S103	303S	302S Series	Interrupter
112T	312T		
S111		311S	Interrupter
50	250	500P	Interrupter
		501P	Interrupter
		503	Interrupter
		504	Interrupter
		505P	Interrupter
		506P	Interrupter
514	514	715 Series	Synchronous
515	715		
522A		722A	Synchronous
528A		728A	Synchronous
For 12 Volt Receivers			
G53		G253	Interrupter
G86S	G286S	G286S Series	Synchronous
G87M	G287M		
For 32 Volt Receivers			
F4	F204	F204 Series	Interrupter
F6	F206		
F11		F211	Synchronous
		F220C	Special Interrupter
	F221	F292 Series	Interrupter
	F292		
		F223	Synchronous
F45		F245	Synchronous
		F247	Synchronous
F51	F251	F251 Series	Interrupter
F53	F253		
	F292	F292 Series	Interrupter
F94		F294	Interrupter
		F297	Interrupter
F112		F312	Interrupter
		F502P	Interrupter
For Vibrator Operated Inverters			
H40		H240	Interrupter
F90		F290	Interrupter
For Mallory Vibrapacks			
725		725	Synchronous
825		825	Interrupter
G725		G725	Synchronous

Transformers

THE design of a reliable power transformer, having high efficiency, requires fairly elaborate calculations, and to take into account the d.c. which flows in a transformer secondary when a half-wave rectifier is used, some interesting equations have been derived.

A simple approximate-design method will be given, for the construction of single-phase low-powered transformers up to 180 volt-amp., or 180 watts for approximately unity power factors. This design is especially suited to transformers which supply a full-wave rectifier and filament energy to an a.c. powered radio receiver, three factors making it possible to secure a satisfactory transformer without complicated design methods, these factors being:

1. There is no urgent need for high efficiency. An 80 per cent efficient transformer which takes 60 watts to supply 48 output watts is fairly satisfactory, if it can radiate the heat which it generates.

2. These transformers are operated at a fairly constant load. This improves the maintenance of the various output voltages as each secondary winding will have a constant *IR* drop.

3. The load on the transformer secondary is nearly of unity power factor. The filament power load is essentially a resistance load, with unity power factor. The current supplied to the filter has slightly less than unity power factor, but this can be disregarded in low-powered transformers. The indirect heated receiving tubes, such as the 227 requires less than half as much d.c. power in their plate and grid circuits, as that which is needed to heat their cathodes. This would mean a unity power-factor heater supply and (assuming a series voltage divider) less than half as many additional watts for plate and grid supply, at a lower power factor. It is true that a power tube, such as 250 at its maximum rating, uses slightly over three times the wattage in its $B + C$ circuit than in its filament. It is rare, however, to have more than two power tubes in a receiver, and the assumption that the power factor of the secondary is unity is usually not over 20 per cent off. This means that the wire of the high-voltage secondary and of the primary should be increased to allow for this added current.

Small Transformer Details—Economy in a transformer is secured when the winding encloses a maximum of core area with a minimum of wire, and the magnetic path should be as short as possible.

The core form of a small transformer can be of several shapes, but it is usual to use standard punchings shaped like capital letter E's. As a rule, two punchings are used, one having longer legs than the other so that the magnetic circuit "breaks joints" in stacking the iron. Another convention usually followed in small transformers is the use of a single-winding form, all secondaries and primary being on the middle leg of the E core.

The spool form is usually an insulating tube, and side pieces may be fitted on which terminals are placed, or, if the coil is to be machine wound with interwoven cotton, the side pieces can be omitted, and flexible leads provided.

Ten Steps in Designing a Small Power Transformer—1. *Determine the Volts and Amperes Needed for Each Secondary.*

a. Find the total maximum secondary watts $= W_s = E_1I_1 + E_2I_2 + \cdots$ (where $E \times I$ refers to the wattage in each secondary winding)

b. Find the total watts needed for primary (W_p)
Assuming 90 per cent efficiency $W_p = W_s/0.9$. Where W_s = Secondary watts.

c. Find primary amperes assuming 90 per cent power factor

$$I_p = \frac{W_p}{E_p \times 0.9} = \frac{W_s}{0.81E_p}$$

where E_p = 110 volts, $I_p = W_s/89.1$ amp.

2. *Size of Wire.* Knowing the current for each winding, the wire size is determined by the circular mils per ampere which it is desired to use. A safe rule is to use 1,000 cir. mils per ampere for transformers under 50 watts, and 1,500 cir. mils per ampere for higher powers—however, most commercial designs use 800 cir. mils per ampere.

3. *Core Considerations.* A curve showing core areas for different powers is Figure "A" which shows the area for 40 watts to be 1 sq. in., 70 watts, 1.5 sq. in., 120 watts, 2 sq. in. The area of the core is the same as the inside dimensions of the spool, making a 10 per cent allowance for stacking; for example, a spool 1 by 2 in. inside would enclose 2 sq. in., but, allowing for a 10 per cent loss, only 90 per cent or $0.9 \times 2 = 1.8$ sq. in. is the net core area. The core area is needed to determine the turns per volt.

4. *Core-Loss and Induction.* The flux density at which the core is to be worked determines the iron (core) loss. Figure "B" gives several curves of different core materials, watts per pound being plotted against flux densities in kilolines per square inch. Sixty-five kilolines per square inch is an average value of the induction. The making of a curve such as Figure "B" depends largely on experimental data, not directly on a theoretical basis. For this reason, no definite value of the core loss can be given; it depends on the quality of core material which is available. Standard core material generally has a power loss of .86 watts per pound. It should be noted that better and better core material is constantly being made, having lower loss per pound, so that the use of higher flux densities is becoming possible. Up to 15 kilolines is not uncommon, but unusual for this application. The core loss increases with frequency, a typical curve being Figure "C."

5. *Induced-voltage Equation, Turns per Volt.* The elementary definition, that 10^8 magnetic lines cut, per second, will induce one volt pressure, is the basis of the equation

$$E = \frac{BANf}{10^8} \times 4.44$$

where E is the voltage, A the area of the core, B the flux density in the same units as A, f the cycles per second, and N the number of turns. A more useful working equation for small power transformers is obtained by solving for N/E in turns per volt:

$$\frac{N}{E} = \frac{10^8}{BAf4.44}$$

Figure "D" is an alignment chart of this equation. The left column is B the flux density, in both kilolines per square inch and kilogausses (kilolines per square centimeter), the center column is the net core area in both square inches and square centimeters, the right column giving the turns per volt for both 25 and 60 cycles per second.

Using a flux density of 65 kilolines per square inch and the net core area mentioned in step 3 (1.8 sq. in.), the turns per volt for 60 cycles are found to be 3.1 turns per volt. Thus for each volt on the transformer, there must be 3.1 turns. It is customary to change the turns per volt to an even number so that the proper center taps can be made. In this case, by using 4 turns per volt, with the same core area, the induction will be lower, with a corresponding lower core loss. It is also quite possible, and sometimes advisable,

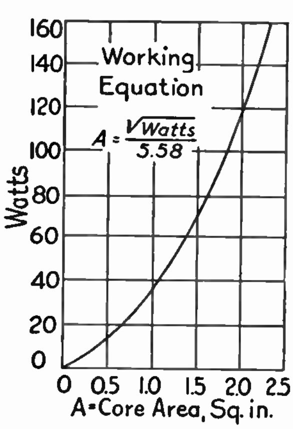


FIGURE A—*Small power transformer core area as a function of watts.*

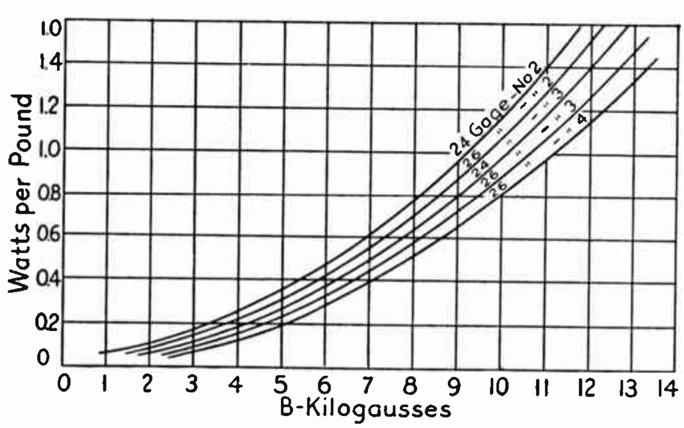


FIGURE B—*Core-loss curves Armco Radio grades* (*60 cycles*).

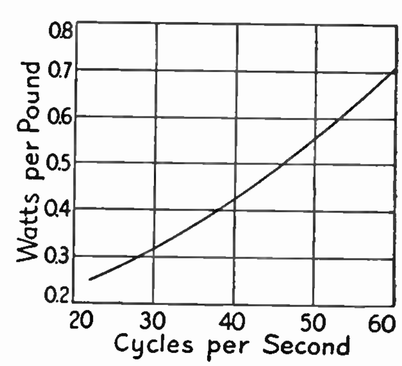


FIGURE C—*Core-loss* vs. *frequency* $B = 10{,}000$.

to change the core area so that an even number of turns per volt is given. For example, by increasing the core area to 2.8 sq. in. 2 turns per volt could be used, or decreased to 1.4 sq. in. so that 4 turns per volt would be used. The reason for desiring the even numbers of turns per volt is to supply the 1/2-volt steps for receiving tubes, such as 7 1/2 volts, which would require an integral number of turns when the turns per volt are used.

The voltage drop in the transformer winding should be mentioned here. For instance, the load voltage at a tube filament is lower than the no-load voltage by the amount of

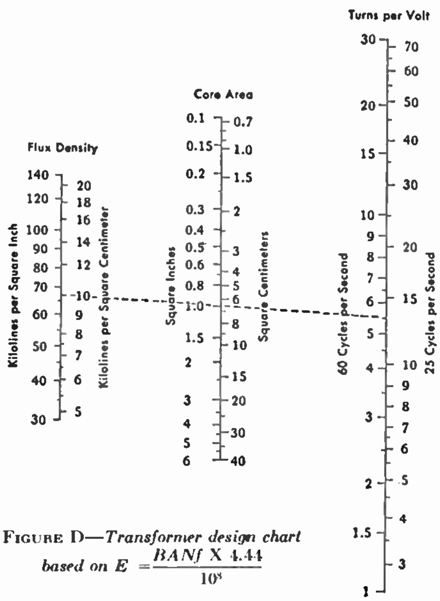


FIGURE D—*Transformer design chart based on* $E = \frac{BANf \times 4.44}{10^8}$

IR drop in the winding and the connecting wires to the tube. Thus, it may be that to secure 7 1/2 volts at the tube filament, the transformer no-load voltage will have to be 8. In this case, any integral number of turns per volt, either odd or even, will suit the design.

6. *Turns for Each Winding.* In step 1 the desired voltages were given, E_1, E_2, etc. Using the value of turns per volt in step 5, the total turns for each winding are found. For example, with 4 turns per volt, a 110-volt winding should have $4 \times 110 = 440$ turns.

7. *Winding Space Required.* From the total turns for each winding, and the wire size, the total area of winding space is calculated. Different wires and insulations have definite turns per square inch. The method of insulation, however, may have these values vary by factors of as much as three to one. That is, a 900-turn coil wound in layers with enamel wire may take up one square inch of cross-section area. By interleaving thin insulating paper between layers, only 600 turns can be wound in a square-inch area; and by using a certain size of cotton interwoven between turns, only 400 turns can be wound in a square inch. Thus, the space of winding depends to a large degree on the kind and thickness of insulation. Double cotton-covered wire takes up considerably more space than enameled wire. Yet, if the extra-needed insulating space for the interlayer protection is considered, the space ratio may not be so great.

After adding up the winding space of all the windings the area should be compared with that of the core. If the winding will go in the core space, this part of the design is finished.

If the wires will not go in the available space, the winding may be redesigned, or the core area increased. Using thinner coverings for wire, fewer secondaries or fewer circular mils per ampere will decrease the space needed for the wire. A larger iron size or a thicker stack of the same sized iron will increase the core area and allow a smaller number of turns per volt, thus decreasing the cross section of the winding.

8. *Copper Loss.*

a. Find the length of the mean (average) turns in feet.

b. Find the length of each winding in feet by multiplying the number of turns by the mean turn length.

c. From the following wire table find the ohms per 1,000 feet for the size wire used, and then from 8-*b* the actual ohms for this length.

d. Multiply the current squared for each winding by the ohms for that winding.

e. Add the I^2R's for each winding to get the copper loss L_1.

9. *Core Loss.* The core loss in watts L_2 is found from the weight of the core and flux density and kind of core used in step 4. A useful factor is that 4 per cent silicon steel weighs 0.27 lb. per cubic inch.

10. *The approximate percentage efficiency is*

$$\frac{W_s \times 100}{W_s + L_1 + L_2},$$

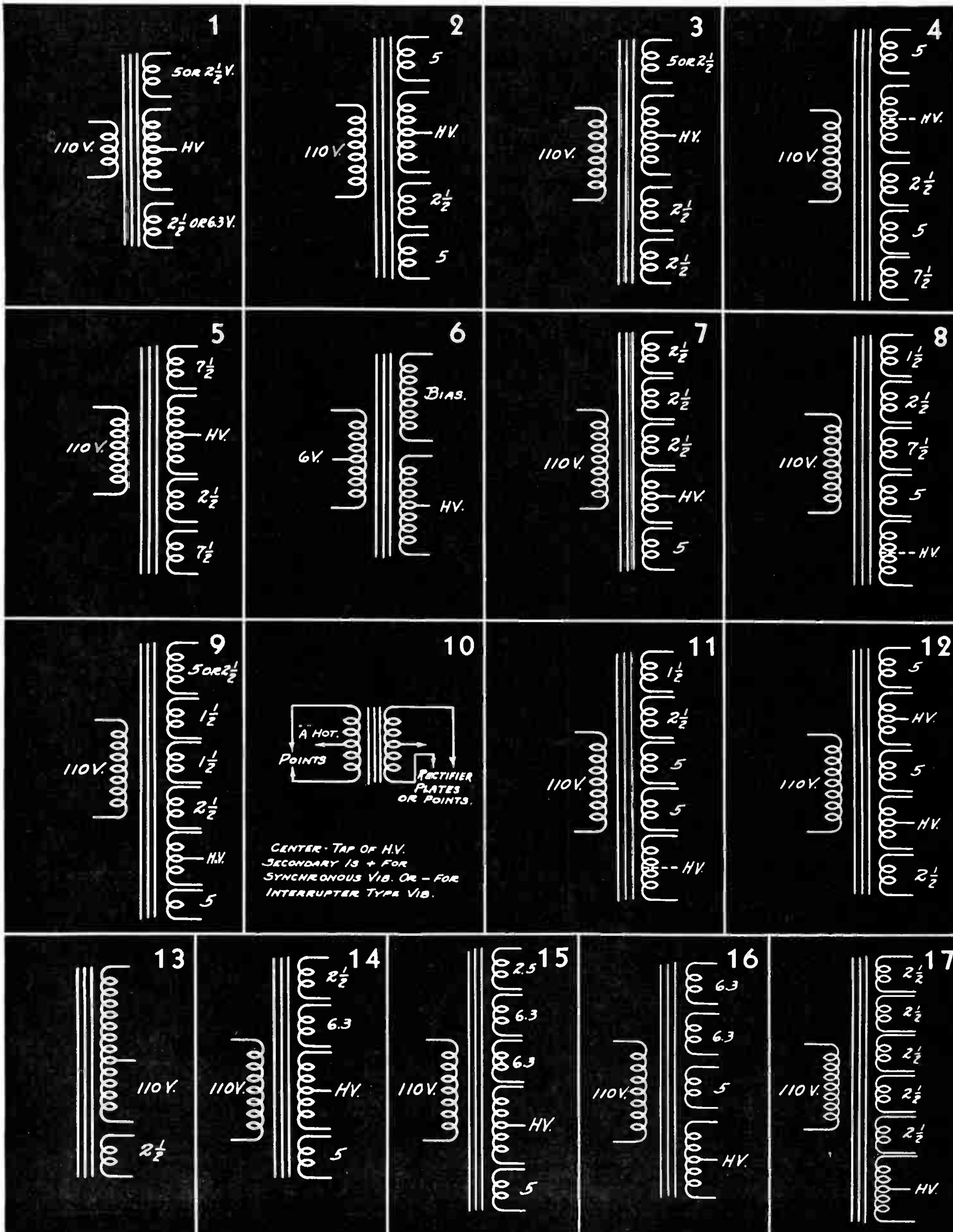
W_s being the secondary watts (see step 1).

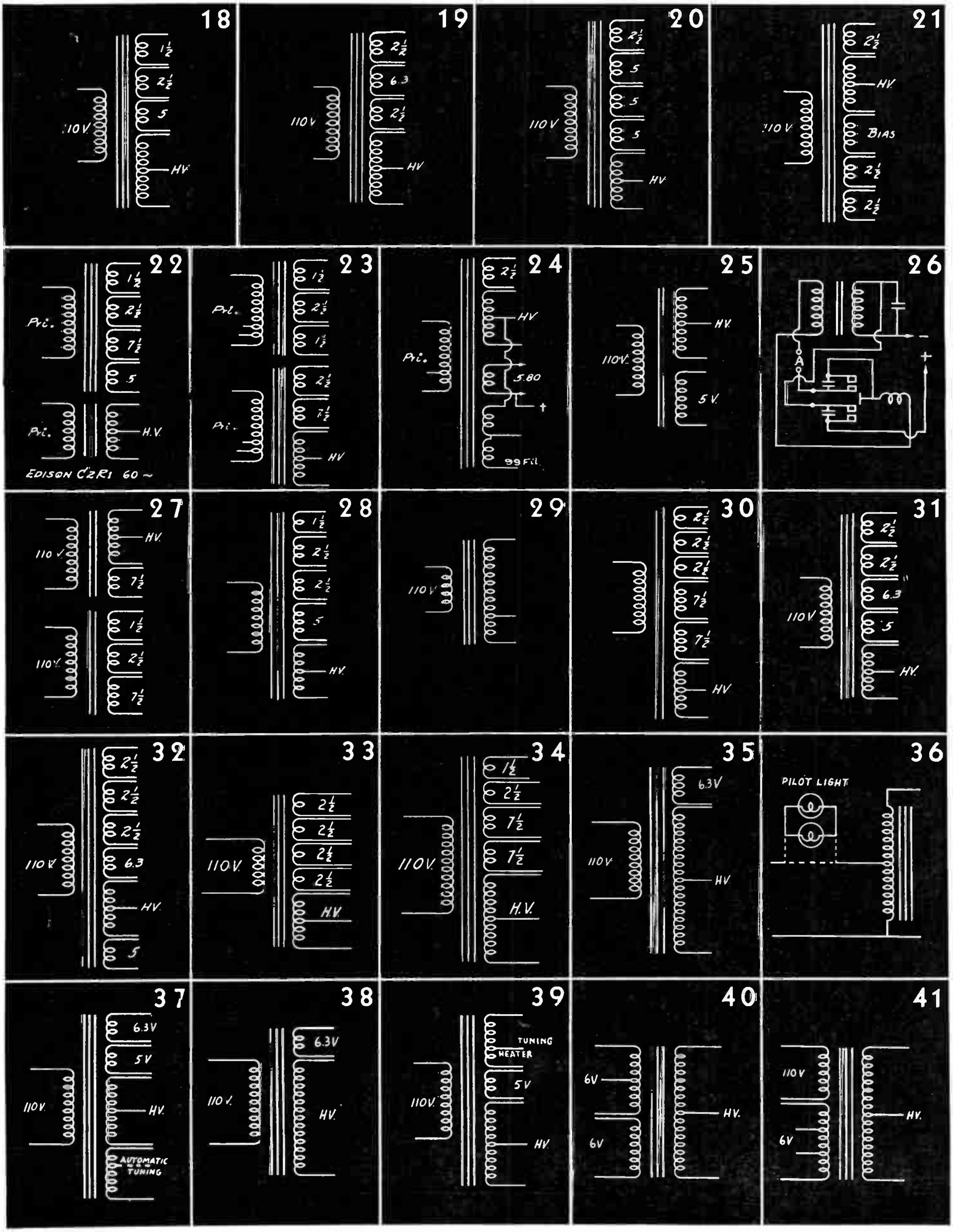
Note: If step 10 shows about 90 per cent efficiency, the design is complete. If much less than 90 per cent, step 1*a* must be modified, a new, larger value of *Ip* being used in finding a larger primary wire. This will not change the efficiency, but will prevent overloading the primary winding due to its carrying a greater current than that for which it was designed. It is desirable, as a rule, to keep the efficiency above 90 per cent, and this can be done by reducing L_1 and L_2, by using larger wires, or larger cores.

COPPER WIRE TABLE

Gauge No. B. & S.	Diam. in Mils[1]	Circular Mil Area	Turns per Linear Inch[2]				Turns per Square Inch[2]			Feet per Lb.		Ohms per 1000 ft. 250 C.	Correct Capacity at 1000 C.M. per Amp.[3]	Diam. in mm.
			Enamel	S.S.C.	D.S.C. or S.C.C.	D.C.C.	S.C.C.	Enamel	D.C.C.	Bare	D.C.C.			
1	289.3	82690	—	—	—	—	—	—	—	3.947	—	.1264	55.7	7.348
2	257.6	66370	—	—	—	—	—	—	—	4.977	—	.1593	44.1	6.544
3	229.4	52640	—	—	—	—	—	—	—	6.276	—	.2009	35.0	5.827
4	204.3	41740	—	—	—	—	—	—	—	7.914	—	.2533	27.7	5.189
5	181.9	33100	—	—	—	—	—	—	—	9.980	—	.3195	22.0	4.621
6	162.0	26250	—	—	—	—	—	—	—	12.58	—	.4028	17.5	4.115
7	144.3	20820	—	—	—	—	—	—	—	15.87	—	.5080	13.8	3.665
8	128.5	16510	7.6	—	7.4	7.1	—	—	—	20.01	19.6	.6405	11.0	3.264
9	114.4	13090	8.6	—	8.2	7.8	—	—	—	25.23	24.6	.8077	8.7	2.906
10	101.9	10380	9.6	—	9.3	8.9	87.5	84.8	80.0	31.82	30.9	1.018	6.9	2.588
11	90.74	8234	10.7	—	10.3	9.8	110	105	97.5	40.12	38.8	1.284	5.5	2.305
12	80.81	6530	12.0	—	11.5	10.9	136	131	121	50.59	48.9	1.619	4.4	2.053
13	71.96	5178	13.5	—	12.8	12.0	170	162	150	63.80	61.5	2.042	3.5	1.828
14	64.08	4107	15.0	—	14.2	13.8	211	198	183	80.44	77.3	2.575	2.7	1.628
15	57.07	3257	16.8	—	15.8	14.7	262	250	223	101.4	97.3	3.247	2.2	1.450
16	50.82	2583	18.9	18.9	17.9	16.4	321	306	271	127.9	119	4.094	1.7	1.291
17	45.26	2048	21.2	21.2	19.9	18.1	397	372	329	161.3	150	5.163	1.3	1.150
18	40.30	1624	23.6	23.6	22.0	19.8	493	454	399	203.4	188	6.510	1.1	1.024
19	35.89	1288	26.4	26.4	24.4	21.8	592	553	479	256.5	237	8.210	.86	.9116
20	31.96	1022	29.4	29.4	27.0	23.8	775	725	625	323.4	298	10.35	.68	.8118
21	28.46	810.1	33.1	32.7	29.8	26.0	940	895	754	407.8	370	13.05	.54	.7230
22	25.35	642.4	37.0	36.5	34.1	30.0	1150	1070	910	514.2	461	16.46	.43	.6438
23	22.57	509.5	41.3	40.6	37.6	31.6	1400	1300	1080	648.4	584	20.76	.34	.5733
24	20.10	404.0	46.3	45.3	41.5	35.6	1700	1570	1260	817.7	745	26.17	.27	.5106
25	17.90	320.4	51.7	50.4	45.6	38.6	2060	1910	1510	1031	903	33.00	.21	.4547
26	15.94	254.1	58.0	55.6	50.2	41.8	2500	2300	1750	1300	1118	41.62	.17	.4049
27	14.20	201.5	64.9	61.5	55.0	45.0	3030	2780	2020	1639	1422	52.48	.13	.3606
28	12.64	159.8	72.7	68.6	60.2	48.5	3670	3350	2310	2067	1759	66.17	.11	.3211
29	11.26	126.7	81.6	74.8	65.4	51.8	4300	3900	2700	2607	2207	83.44	.084	.2859
30	10.03	100.5	90.5	83.3	71.5	55.5	5040	4660	3020	3287	2534	105.2	.067	.2546
31	8.928	79.70	101.	92.0	77.5	59.2	5920	5280	—	4145	2768	132.7	.053	.2268
32	7.950	63.21	113.	101.	83.6	62.6	7060	6250	—	5227	3137	167.3	.042	.2019
33	7.080	50.13	127.	110.	90.3	66.3	8120	7360	—	6591	4697	211.0	.033	.1798
34	6.305	39.75	143.	120.	97.0	70.0	9600	8310	—	8310	6168	266.0	.026	.1601
35	5.615	31.52	158.	132.	104.	73.5	10900	8700	—	10480	6737	335.0	.021	.1426
36	5.000	25.00	175.	143.	111.	77.0	12200	10700	—	13210	7877	423.0	.017	.1270
37	4.453	19.83	198.	154.	118.	80.3	—	—	—	16660	9309	533.4	.013	.1131
38	3.965	15.72	224.	166.	126.	83.6	—	—	—	21010	10666	672.6	.010	.1007
39	3.531	12.47	248.	181.	133.	86.6	—	—	—	26500	11907	848.1	.008	.0897
40	3.145	9.88	282.	194.	140.	89.7	—	—	—	33410	14222	1069	.006	.0799

[1]A mil is 1/1000 (one thousandth) of an inch.
[2]The figures given are approximate only, since the thickness of the insulation varies with different manufacturers.
[3]The current-carrying capacity at 1000 C.M. per ampere is equal to the circular-mil area (Column 3) divided by 1000.


1
5 OR 2½ V.
110 V.
HV
2½ OR 6.3 V.
2
5
110 V.
HV.
2½
5
3
5 OR 2½
110 V.
HV.
2½
2½
4
5
110 V.
HV.
2½
5
7½
5
7½
110 V.
HV.
2½
7½
6
BIAS.
6V.
HV.
7
2½
2½
110 V.
2½
HV.
5
8
1½
2½
110 V.
7½
5
HV.
9
5 OR 2½
1½
110 V.
1½
2½
H.V.
5
10
"A" HOT.
POINTS
RECTIFIER
PLATES
OR POINTS.
CENTER-TAP OF H.V.
SECONDARY IS + FOR
SYNCHRONOUS VIB. OR – FOR
INTERRUPTER TYPE VIB.
11
1½
2½
110 V.
5
5
HV.
12
5
HV.
110 V.
5
HV.
2½
13
110 V.
2½
14
2½
6.3
110V.
HV.
5
15
2.5
6.3
6.3
110 V.
HV.
5
16
6.3
6.3
110V.
5
HV.
17
2½
2½
2½
110 V.
2½
2½
HV.


18
110 V.
1½
2½
5
HV
19
110 V
2½
6.3
2½
HV
20
110 V
2½
5
5
5
HV
21
110 V
2½
HV
BIAS
2½
2½
22
Pri.
1½
2½
7½
5
Pri.
H.V.
EDISON C2R1 60 ~
23
Pri.
1½
2½
1½
Pri.
2½
7½
HV
24
Pri.
2½
HV
5.80
+
99 Fil.
25
110V.
HV.
5 V.
26
A
–
+
27
110 V.
HV.
7½
110 V.
1½
2½
7½
28
1½
2½
2½
5
HV.
29
110 V
30
2½
2½
2½
7½
7½
HV
31
110 V
2½
2½
6.3
5
HV.
32
110 V.
2½
2½
2½
6.3
HV.
5
33
110 V.
2½
2½
2½
2½
HV
34
110 V.
1½
2½
7½
7½
H.V.
35
110 V
6.3 V
HV
36
PILOT LIGHT
37
110 V.
6.3 V
5 V
HV.
AUTOMATIC TUNING
38
110 V.
6.3 V
HV.
39
110 V.
TUNING
HEATER
5 V
HV
40
6V
6V
HV.
41
110 V
6V
HV.

Antenna Design

IF ONE were to really understand all the technical problems to be considered in producing an ideal antenna installation, intensive study of complete treatises on the subject would be necessary. Such a process is recommended if the individual desires the finest possible performance. However, since the number of locations where it is convenient to erect such an antenna would represent only a fraction of a percent of radio users, and also because it is possible to achieve quite acceptable results with the more common types of antennas, this discussion is purposely limited to the generally practical receiving types. A study of the advantages and disadvantages of each type is presented with no thought of prejudice against or promotional effort for any particular type which may be commercially available.

The frequency coverage of the all-wave receivers ranges from .55 megacycles to 15 megacycles. For purposes of antenna design requirements this wide coverage is roughly divided into two sections. The first section extends from .55 megacycles to 1.5 megacycles (the present broadcast band) and the second section from 1.5 megacycles to 15 megacycles (police, aircraft, amateur and foreign transmissions). The major requirements of these two sections as to physical location to obtain the largest possible signal energy, the most favorable signal to noise ratio, and the methods for conveying the signal energy to the receiver are very similar.

Probably the most common types of receiving antennas in use at the present time are still the "old faithful" single wire "T" and inverted "L" types, illustrated in Figure 1.

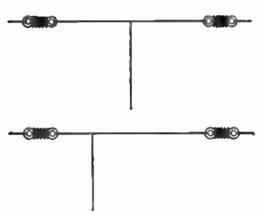


FIGURE 1

These antennas are used in the Marconi system, that is, installations employing ground as an essential part. The "T" and inverted "L" types are convenient to install and generally satisfactory in operation. No better testimonial need be given than the one usually included on the installation instructions of a newly purchased receiver. From an antenna standpoint the instructions read somewhat as follows: "satisfactory results may usually be obtained with an antenna of 25 to 75 feet in length, suspended as high as possible."

The directional characteristics of these antennas for broadcast band use are shown in Figure 2.

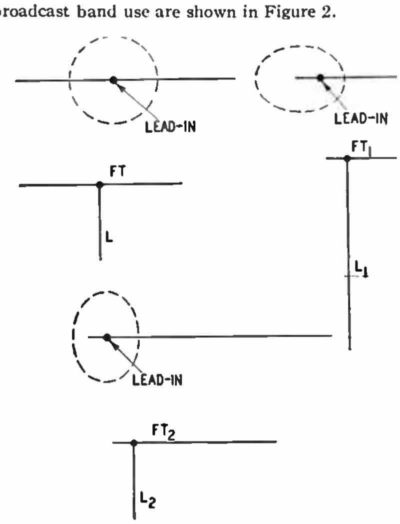


FIGURE 2

Two illustrations are given for the "L" type because the length of the flat top (FT) as compared to the length of the lead-in (L) has a bearing on the directional effect. If, as in Figure 2, the lead-in (L_1) has more length than the flat top (FT_1), the reception pattern is found to be almost uni-directional (equally effective in any direction). Figure 2 also shows the reception pattern when the lead-in (L_2) is shorter than the flat top (FT_2).

The directional effects noted are characteristic of an antenna erected over an open plain. In actual practice the pattern is greatly distorted by the presence of nearby metallic objects such as metal roofing, telephone and electric wires, gutters, down spouts, etc. In practical applications this means that if reception is poor from a desired direction, the situation can be improved by shifting one end of the antenna. Sometimes moving or rotating an antenna only a few feet will make a decided difference in its performance on the reception of more distant stations. The effects noted are more pronounced on the short wave bands.

A third type of antenna is one in which the wire is suspended in a vertical manner. This type antenna has a uni-directional reception pattern. When the average person thinks of a vertical antenna, he immediately visions large supporting masts, difficult installation, and prohibitive cost. However, this picture is not necessarily true. If the operation of the "T" antenna previously described is analyzed, it will be found that this system operates mainly on the ability of the lead-in wire to pick up the signal for the receiver. If the "T" type antenna has its lead-in attached at the electrical center, the two halves formed effectively counteract each other with the result that little or no signal is fed to the lead-in. It naturally follows that it is possible to erect a vertical antenna in much the same manner. However, if no masts are used, the only other logical way to support the vertical antenna is by fairly close mounting to a building or similar object. This, of course, destroys the antenna's uni-directional properties and much of its pick up efficiency since it is effectively shielded in one or more directions by the absorption qualities of the supporting object.

Before proceeding with a discussion of the noise reducing types, let us see just what improvements can be made by alterations in the designs previously described.

One of the most obvious methods of improving a short outside antenna (almost completely in the noise area created by household appliances and utilities) is by increasing its length in a direction so that a major part of it is in a comparatively noise free location as shown in Figure 3.

The same remedy may be applied to an indoor installation. While this method does not actually decrease the noise pickup, it increases the noise-free pickup and results in a more favorable signal to noise ratio. However, there is one factor to be considered, especially in the case of all-wave receivers, before installing a very large antenna.

Any wire has a certain amount of inductance. It also has a certain distributed capacity with relation to surrounding objects and to ground. As in the case of any tuned circuit, at some definite frequency the

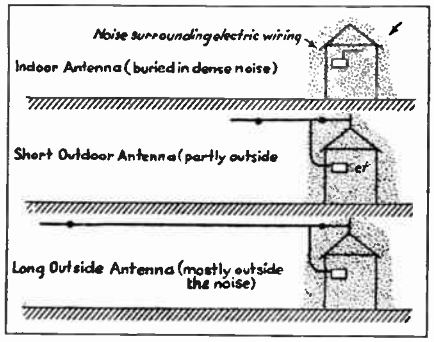


FIGURE 3—*Why a long outside antenna often increases signal-to-noise ratio.*

inductive and capacitive reactances will be equal and opposite, resonance will occur, and maximum efficiency realized. The larger the antenna, the larger the inductance and associated capacity, and the lower the frequency at which the antenna system is naturally resonant. The very large antenna tends to have its resonant point either in or near the broadcast band.

It should be remembered that the lead-in wire of the "T" and "L" types of antennas also functions as a pickup medium. When any calculations are made, the lead-in length should be included as an integral part of the antenna.

Since the ordinary lead-in wires are capable of intercepting signals, they are also capable of receiving noise impulses. Though the antenna itself may be located in a noise free area, the lead-in, forced to pass through the noise field to the receiver, may contribute heavily to the noise level. (See Figure 3.)

The fact that any vertical pickup medium is especially prone to intercept waves of vertical polarization makes conditions even worse, since most man-made interference is radiated in vertically polarized waves.

Several methods have been designed to eliminate the property of the lead-in to intercept either signal or noise impulses, and make it more suitable for its true purpose, that of conducting the energy accumulated by the antenna to the input circuit of the receiver.

One such method uses a completely shielded lead-in wire. Although it is possible to make this system perform in a fairly satisfactory manner on the broadcast band, it is practically useless for short wave reception unless a proper matching network is employed. The energy loss at broadcast frequencies due to the relatively high capacity between the lead-in and the shield is serious enough even considering the tremendous power of some of the popular broadcasting stations. Keeping in mind that this energy loss will increase with any increase in frequency it is easily understood why this method is not generally recommended. Most of the short wave stations are of relatively low power as compared to average broadcast band transmitting stations, and any appreciable loss in signal energy to be delivered to the receiver should be avoided. Figure 4 illustrates this point.

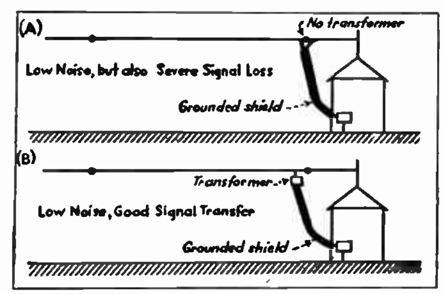


FIGURE 4—*Shielded lead-ins—poor (A); good (B).*

A second, and extremely popular method, is that of using a transmission line to transfer the signal energy from the antenna to the receiver with minimum signal pickup by the transmission line. Since this development has come about largely as a result of the demand for noise reduction on the short wave bands of commercial all-wave receivers, it would seem in order to discuss the basic antenna requirements of these all-wave receiving sets.

In the short wave spectrum a new condition arises in that the physical dimensions of a half wave length antenna are small enough (for given frequencies) that its length is within the restrictions of the practical installation. Antenna systems designed on this principle are capable of delivering a much stronger signal to the receiver in the frequency ranges for which they are designed.

The signal voltage that is generated in the antenna is due to the fact that the antenna is cut by magnetic lines of force created by the incoming signal. The value of the voltage generated in the antenna is somewhat proportional to the length of the antenna until this length approaches a half wave length with respect to the frequency of the signal under consideration. At this point the antenna becomes resonant. The voltage or power built up in the antenna itself at or near this frequency is much larger than it would be if the antenna length was not a half wave length or some multiple thereof.

This explanation may seem a bit involved and unnecessary but it should be understood that this basic action or principle is incorporated in the design of almost all of the commercially available all-wave antenna systems. These include such types as the doublet, double-doublet, "V" doublet, the staggered doublet (one having uneven flat top sections), the selective beam type, and the combination web types.

Up to this point it seems that the design for the standard broadcast range (.55 to 1.5 megacycles) has been somewhat neglected in the all-wave antenna design. This is true to a certain extent. In the first place both transmission and reception are more stable in the broadcast band frequency range. This band is not nearly as much affected by fading, skip distance, and unusual refraction properites peculiar to high frequency signals. Secondly, the power of the average broadcast band transmitter is much greater than a corresponding short wave station. As a result, if any compromise must be made in the antenna design, it should favor the short wave design so that the listener may have a performance on the higher frequency stations similar to the performance he expects and gets on the broadcast band.

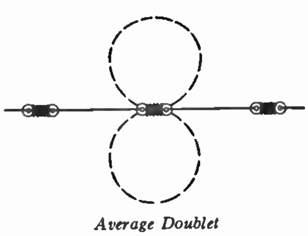
In the third place, manufacturers of all-wave antenna systems have made it possible either through ingenious design of the matching transformer at the set, or by a simple switching arrangement, to convert the antennas into the equivalent of an ordinary single wire antenna of equal length for broadcast band use.

DOUBLET ANTENNA DESIGN

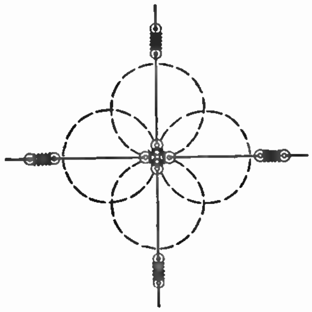
As previously pointed out, doublet antennas are usually designed to give maximum efficiency when used upon a certain predetermined frequency band or bands. It is well to remember that any section or combination of sections in the doublet systems can operate not only at the given frequency or frequencies but may also be operated quite efficiently at some harmonic of the fundamental design.

All of the doublet types use some form of a transmission line (either shielded, twisted, or transposed). This line under ordinary conditions will not have any tendency to pick up signal or noise impulses. Such a system provides the very useful advantage of allowing the antenna proper to be as much as several hundred feet from the receiver. In many cases this permits the antenna installation to be made in a noise free area. The addition of large amounts of like transmission line should produce little or no change in the impedance match at the transformer.

In the matter of locating the noise-reducing antenna types the following precautions should be observed.



Average Doublet



Beam Type Doublet

FIGURE 5

The prime need is of course to get the antenna as high as possible. Locate the antenna as far above and away from any noise radiating utility wires as is practical. At any cost stay away from elevator penthouses and any rotary electrical equipment.

In the matter of directional characteristics, the average double system has what is termed a broadside reception pattern. This means that the antenna is most effective when it is located at a right angle (90°) with relation to the desired direction. If two doublets are located at right angles to each other, the result is a uni-directional pattern inasmuch as one or the other section can always produce an essentially broadside effect to any desired signal. See Figure 5.

So far we have talked mostly about antennas which use a ground connection. Marconi first used such antennas; accordingly we call them Marconi antennas. Observe (Figure 1) that there is always more or less "up and down" to them. They start at the earth and go up. Sometimes they go horizontally also, but invariably they go up. In a moment we shall show why that is important.

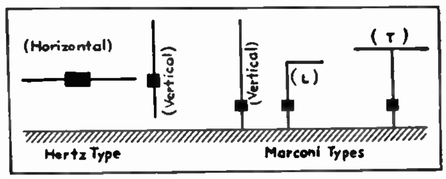


FIGURE 6—*Hertz (ungrounded) antenna types are becoming more and more popular for short wave work*

The Hertz antenna uses no ground connection whatever. Accordingly it need not run up and down at all; it is possible to make it a straight horizontal antenna if so desired. For the best short wave reception, this feature is very desirable.

VERTICAL OR HORIZONTAL

Near the radio transmitting station the waves are departing in the manner of Figure 7A. They are mainly vertical, and are best received by a vertical (or partly vertical) receiving antenna—an antenna that has some height. The Marconi antennas of Figure 6 will work best for such reception, as will the vertical Hertz type of Figure 6.

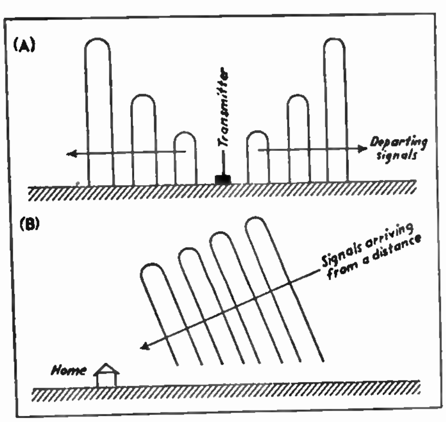


FIGURE 7—*Why vertical receiving antennas are best on locals, while horizontal types favor distance.*

At a great distance we have a different picture. We find that short waves arrive in the manner of Figure 7B. It is at once apparent that this leaning of the waves ("polarization toward the horizontal") gives the *horizontal* Hertz antenna a chance which it did not have on the nearby reception of 7A. For that reason the horizontal Hertz antenna is very useful in short wave long-range reception. Figure 8 shows the best theoretical and practical locations of antenna and receiver to keep the antenna out of the noise area and also to keep it from being shadowed by surrounding objects.

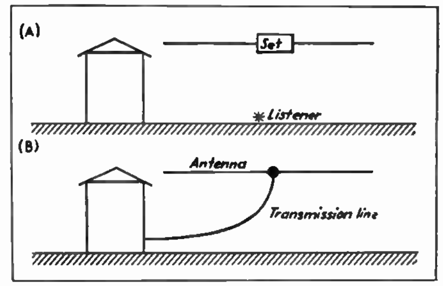


FIGURE 8—*The theoretical ideal (A) and the practical substitute (B).*

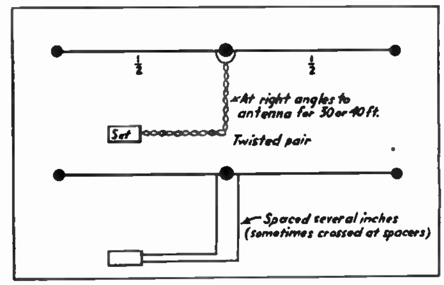


FIGURE 9—*Two efficient transmission line systems using Hertz collectors.*

One of the most popular forms of doublet antenna systems is shown in Figure 9. If we make the top about 70 or 75 feet long the best performance will appear in the 49 meter band, but at other wave lengths the line no longer acts as a pure line; the upper part participates in varying degree in the antenna action, and the losses vary materially with frequency. However, a theoretical shortcoming can often be tolerated commercially, and the extreme simplicity of this arrangement is evident. Its anti-noise action leaves little to be desired, it is easy to erect, the line can be of any convenient length upward of some 40 feet (be sure to use that much and coil up any you don't need inside the set cabinet), and strong wind does little damage.

The real shortcoming of this or *any other* horizontal Hertz type lies in the relative ineffectiveness of such an antenna near 500 kcs. To make the antenna long enough to get around this difficulty results in preposterous clumsiness. Accordingly one must accept reduced reception in the ordinary broadcast band for the sake of a more favorable signal to noise ratio in the short wave range.

The importance of a good RF ground cannot be over-emphasized. This statement may seem contradictory to the explanation of the doublet systems designed to operate with no ground. However, the purpose of the ground in such cases is to prevent chassis pickup and possible pickup from the light line. The ground in these cases has no function in the signal pickup design of the antenna system. A separate ground for the radio set other than water pipes, etc., is recommended for the best possible results. A good noise-filter in the 110-volt line which supplies power to the set may be of assistance when the noise condition is extremely bad.

Figure 10 shows the correct method of installing the lightning arrestors on a two-wire transmission line.

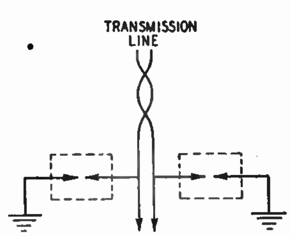


FIGURE 10

In Figure 11 we have a modification of the original doublet system. This design is sometimes known as the staggered doublet because its sections are unequal in length. The staggered system is used for the purpose of providing resonance properites on the higher frequencies.

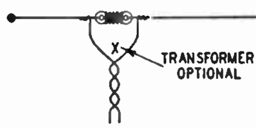


FIGURE 11

Figure 12 shows another type doublet known as the "V" doublet. In this system, the tapered "V" at the center has the property of effectively matching a relatively high impedance antenna to a low impedance line.

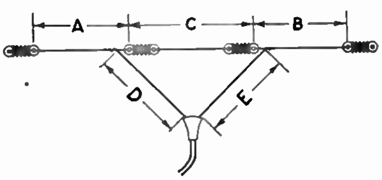


FIGURE 12

In the "V" doublet, Figure 12, the length of sections A and B are equal. Sections C, D and E should form an equilateral triangle.

The effect of systems employing two doublets mounted at right angles to each other has been previously discussed and is illustrated in Figure 5.

Another widely used design is shown in Figure 13. This particular design represents not only a combination of the resonance properties of its possible sections, but also has the additional factor of improvement where wave polarization is considered.

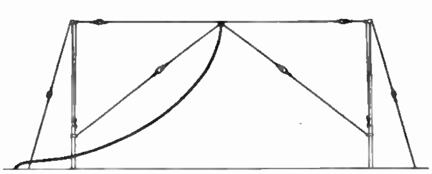


FIGURE 13

Figure 14 shows the web type of antenna. A thorough explanation of this somewhat complicated design would be very long. This system has roughly the same properties as the type shown in Figure 13.

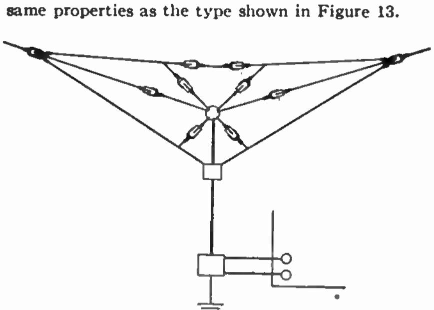
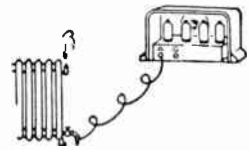


FIGURE 14

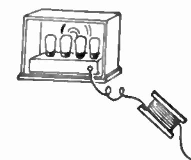
A final point to be considered lies in the choice of an antenna for a receiver of a given manufacturer. In every case it is well to follow the manufacturer's recommendations as to the type antenna to be used with his particular receiver, inasmuch as he specifies the one which has the best matching properites for his set design.

Choosing an Antenna

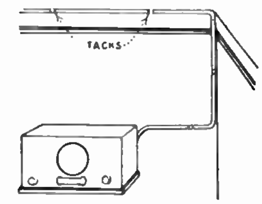
"No Radio Can Be Better Than Its Antenna"



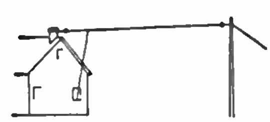
Ground as Antenna—Fair reception on local broadcast stations in some homes. Seldom satisfactory in suburban areas and useless for shortwaves. Use only where other systems cannot readily be installed, or for temporary service.



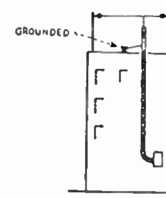
Built-In Wire—Good reception on local broadcast stations in all but extremely noisy buildings. Receives reasonably distant stations when used on upper floors in electrically quiet areas. Rarely effective on shortwaves and invariably noisy in large apartment houses.



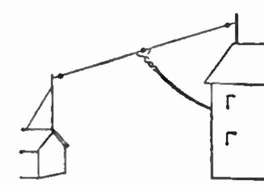
Moulding-Strip—Good reception on local broadcast stations in all but extremely noisy buildings. Receives reasonably distant stations when used on upper floors in electrically quiet areas. Rarely effective on shortwaves and invariably noisy in large apartment houses.



Ordinary Outdoor System—Excellent on both broadcast and shortwave bands when building and vicinity are electrically quiet. Recommended for homes away from trolley-lines, high-tension wires, motors and busy roads.



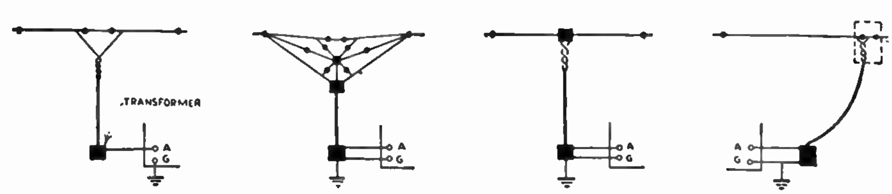
Shielded Lead-In—Reduces noise pickup by downlead where this wire must pass through electrically disturbed areas. Good reception on broadcast band but not recommended for shortwaves. In common with other noise-reducing types, must have antenna proper mounted out of noisy area for maximum benefit.



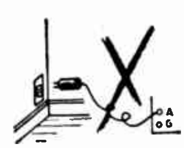
Simple Doublet—Reduces noise pickup by downlead where it must pass through noisy areas. Good reception on shortwave band and satisfactory for broadcast reception. Expecially efficient at certain frequencies, which may be those most often desired.

TYPICAL MODERN ALLWAVE MATCHED SETS

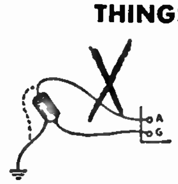
Matched to reduce losses in the transmission line between the antenna proper and the set and designed, also, to give good reception over the entire broadcast and shortwave range, or in those portions of the spectrum in which programs of major interest are found, these modern types and variations of them represent the last word in modern radio design.



THINGS TO AVOID

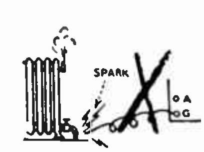


Electric Socket "Adapter"



Aerial "Eliminator"

Telephone Connection



Grounding AC-DC Sets

Show this **to your customer. It will convince him that a *good* antenna is a *good* investment.**

Alignment of Modern Radio Receivers

MANY VOLUMES have been written on this subject, both from a technical and a serviceman's viewpoint, and justly, because improper alignment is one of the most common ailments encountered in service work today, especially in receivers of the allwave type. Many servicemen are somewhat afraid to make adjustments on receivers, as long as the set plays at all, because they are not familiar with the various functions and workings of modern receivers. This article is intended to help clarify to the serviceman who wishes to learn the why of such adjustments, how the various radio frequency circuits of a radio receiver function, and how to make practical adjustments necessary in order to restore a set to its original factory performance and efficiency.

A vitally important part of a radio receiver is the small compensating condenser used to make adjustments of the various tuned circuits. These small adjustable condensers, usually called padders or trimmers, are constructed in various ways. They usually consist of two or more plates insulated from each other, one plate being made of spring material, so it will hold the adjustment or spacing given it by means of turning a screw or nut.

These condensers are used to obtain fine adjustment of the tuned circuits, so that they may be completely in resonance and perform at their highest efficiency. Since it is commercially impractical to construct coils or tuning condensers which would be accurate at every point on the dial, these trimmer condensers are placed across them so as to provide an accurate and easy means of making each circuit resonate at the proper dial position.

T. R. F. RECEIVERS

In a tuned radio frequency type of receiver the adjustments of these padders are usually made at the high frequency end of the dial using a signal generator or a station as a signal source, and adjusting the trimmers until maximum output is obtained. In some of the older type receivers, where the tuning coils were not properly impregnated, they absorbed moisture through exposure, which causes considerable losses or reduces their Q, and appreciably reduces the already none too abundant selectivity. Replacement or a baking and re-impregnating process is recommended for such cases before adjusting the trimmers.

In some of the older sets not using screen grid tubes, it is necessary to neutralize the circuits to prevent oscillations or howling, before the resonant circuit trimmer condensers are adjusted. Neutralization was usually accomplished by means of small trimmer type condensers, which served to compensate for the grid to plate energy transfer due to the grid to plate capacity of the triode tubes then used.

SUPERHETERODYNES

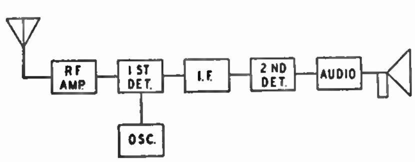


FIGURE 1

The modern superheterodyne is considerably more complicated than these older type receivers and a brief review of the elementary theory involved in this type of receiver is necessary, so that the importance of making accurate adjustments on these receivers may be more fully appreciated. In a superheterodyne, Figure 1, the incoming RF signal is usually impressed across the primary of an antenna coil, the secondary of which is tuned over the desired frequency range by a variable condenser. The signal usually goes from the first tuned circuit into the grid of the first RF amplifier tube. In many sets the RF stage is omitted in which case the signal is impressed on the grid of the first detector tube or the signal grid of a combination first detector and oscillator tube. In other designs the signal may be fed from one tuned circuit to another before going to the first tube. This arrangement is usually spoken of as a band pass filter type circuit. Some sets employ several stages of RF amplification before impressing the signal on the first detector grid, in order to obtain a more favorable signal to noise ratio and eliminate spurious responses.

In the first detector tube the incoming signal is mixed with an unmodulated signal generated by a local oscillator in the set, so as to produce a new frequency, namely the difference between the oscillator and RF signal frequencies. This frequency difference is commonly called the intermediate frequency of the set. The oscillator and RF circuits are so designed that the same frequency difference between the two signals is maintained throughout the tuning range of the receiver.

Commercial design uses an oscillator frequency higher than the incoming RF signal by an amount equal to the IF because it is more economical to build a set with less capacity and inductance (required to produce the higher oscillator frequency) than when it is lower, requiring more capacity and inductance. Capacity and inductance values when higher oscillator frequencies are employed, are much lower than would be required if the oscillator frequency were lower than the incoming frequency (RF). When a gang type tuning condenser is employed this requires that the capacity of the oscillator section be less than that of the RF sections. Commercially, this is done by either making all condenser sections alike and inserting a small padder type condenser in series with the oscillator section capacity across the oscillator coil, or by using a cut plate type oscillator section, which has the required reduced capacity. In either case, a small trimmer condenser is also connected across the oscillator condenser so as to correctly adjust the minimum capacity of the combination or adjust the highest frequency end of the oscillator range, the padding or series condenser being used to adjust for variations occurring towards the maximum capacity end of the range. In the case of the cut plate type condenser there is no adjustment other than plate bending for variations at the maximum capacity end of the oscillator section.

The signal resulting from the mixing of the incoming RF signal and the local oscillator is fed into the intermediate frequency amplifier. The first IF transformer serves to couple the output from the first detector into the grid circuit of the first IF amplifier tube. The signal is amplified by this tube and then passes through a second IF transformer, which may feed it into a second IF tube or the second detector tube, depending on the size of the set. In order to obtain maximum selectivity and sensitivity, both primary and secondary coils are tuned to the exact IF frequency of the set by means of trimmer condensers or by moving an RF iron core in or out of the coil so as to change its inductance.

The second detector serves to rectify or demodulate the IF signal, the audio components being fed to the succeeding audio amplifier stages, and so on to the speaker.

The advantages of this system are: that since it uses an amplifier designed for operation at one fixed low frequency, enormous gain and selectivity can be realized over that of an RF amplifier designed to operate at higher frequencies and over a wide frequency range.

ADJUSTING COMPENSATING CONDENSERS

Adjustment of these condensers should be made when the set lacks selectivity or sensitivity, or if the dial reads incorrectly, after other possible sources of trouble have been checked and eliminated; such as weak tubes, poor aerial, improper tube voltages, etc.

Adjustments should be made only after the set has been allowed to warm up for approximately a 30-minute period, so as to allow for capacity changes due to thermal effects.

I. F. ALIGNMENT

The IF trimmer condensers should be adjusted before the RF section is adjusted. This is best done by using a signal generator with an audio modulated signal tuned to the exact IF frequency of the set. The signal from the generator is fed into the grid of the first detector tube. In some cases it is desirable to "kill" the local set oscillator by placing a bypass condenser across the oscillator section of the tuning condenser to eliminate any erroneous beats which may be produced. An output meter should be connected from the plate of the last audio tube to ground or from plate to plate in case of push pull output.

If one owns a meter of sufficient sensitivity, it may be connected across the voice coil of the set. Sets using automatic volume control should be adjusted either **by reducing the signal output of the service oscillator** to a point where the **AVC does not function**, and using the output meter, or by inserting a milliameter in series with the plate voltage supply lead to the IF stages, or connecting a vacuum tube voltmeter across the AVC network, so as to read the AVC voltage developed.

If the set is provided with a resonance indicator such as the "Shadow Meter" or cathode ray "Magic Eye" this will provide an excellent indicator for adjustment purposes. After having made suitable provision for indicating resonance, the IF trimmer condensers should be adjusted for maximum output, or so as to tune the IF circuits to their exact resonant frequency.

A signal generator should always be used for aligning the IF transformers. If a station signal is used, one is apt to get the entire IF system "off" frequency, although it may be set for maximum output, thus causing poor tracking of the oscillator and RF circuits, producing dead spots on the dial and in many cases whistles and spurious responses. In high fidelity sets where the fidelity is variable, it is usually advisable to set the fidelity control to the low fidelity or sharp tuning position of the IF circuits, and adjust the IF trimmers for maximum output. The most accurate method and easiest of adjusting such high fidelity sets is to use a cathode ray tube in conjunction with a frequency modulated test oscillator, so as to reproduce the entire tuning curve of the IF system on the screen of the tube. The use of such equipment is explained in a following paragraph (page 248.) Sets which are equipped with automatic frequency control should be adjusted with the AFC control turned off. See article on AFC, page 248.

After these adjustments have been made, the IF system of the set will respond to a signal which is exactly equal to a frequency for which the circuit has been adjusted.

In many modern superheterodynes, a wave trap tuned to the IF frequency of the set, is provided in series with the antenna circuit, so as to prevent any unwanted signals of this frequency from entering the set and getting to the first detector and coming on through the IF system. The proper adjustment of such a wave trap is to connect the signal generator to the antenna post of the set and then adjust it to the IF frequency. Then turn the generator to maximum output. The trimmer condenser across the wave trap should be adjusted until minimum response is obtained in the output of the set.

R. F. ALIGNMENT

After the IF section of the set has been aligned to the proper frequency, the next job is to align the RF and oscillator sections.

DIAL ALIGNMENT

The setting of the receiver dial with respect to the condenser shaft position should be checked before making RF alignments. A number of receiver manufacturers have an index position at the low frequency dial position which corresponds to the maximum capacity condenser setting. In this case the condenser should be completely meshed and the dial set to the index position, and the set screws tightened, care being taken to prevent the dial or shaft from slipping, then tightening the set screws. In other cases no index position is provided so that it is usually necessary to determine a point, say 600 kc., at which the oscillator and RF sections are in resonance by the condenser rocking method and the dial set to correspond with the resonant set frequency at this point.

OSCILLATOR ADJUSTMENTS

Oscillator circuit adjustments are by far the most important, since the oscillator frequency determines whether the beat frequency between oscillator and incoming signal produced in the first detector is above, below, or exactly at the IF frequency. Improper oscillator adjustment affects the sensitivity, selectivity, and dial calibration considerably. The RF and first detector stage adjustments do not affect the performance as much, since their tuning is fairly broad in comparison to the sharp tuning of the IF system.

Ordinarily the oscillator trimmer condenser adjustment at the high frequency end of the band is made first. The signal generator is tuned to some frequency near the high end of the band, say 1500 kc., and the signal picked up on the set. If the set is far out of adjustment the signal will not be received at 1500 kc., but somewhere near on either side. The oscillator trimmer is readjusted then to make the signal come in at the 1500 kc. dial setting with maximum output. Following this adjustment the RF and first detector trimmer condensers should be adjusted until maximum output is obtained. Usually these trimmers are located on the tuning condenser gang. However, in many of the newer type sets they are located on the RF and oscillator coils instead. It is very helpful and time saving if a chart showing the locations of all trimmers is obtained before attempting any adjustments.

As the high frequency oscillator adjustment determines the tracking and performance at that end of the band so the low frequency padder determines the low frequency performance. Adjustment of the oscillator padder is usually done in a manner called "rocking." This adjustment is made by tuning the signal generator and the receiver to a point near the low frequency end of the band, say 600 kc. The signal may not be received at the 600 kc. calibration point on the dial. However, this is not of immediate interest. The set should be tuned so as to receive the 600 kc. signal with maximum output and the output reading noted. The gang condenser should then be turned slightly one way or the other and the oscillator padder condenser readjusted so as to again receive the signal with maximum output. If the output has increased, this procedure should be followed until it begins to fall off again; if it has diminished, the gang condenser should be turned slightly in the opposite direction from that first tried. In this manner the RF and first detector circuits can be made to tune exactly to the signal, and the oscillator to a frequency higher than the signal by an amount equal to the IF frequency. If the dial setting does not coincide with the signal frequency, the dial should be turned on the condenser shaft until it does. This adjustment is necessary because most receivers do not provide any means of adjusting the RF and first detector circuits at the low frequency portion of the band. On sets which do provide such adjustments, the dial should be pre-set to the index point with respect to the condenser setting as designated by the set manufacturer.

Usually after making the low frequency oscillator adjustment, it is necessary to slightly readjust the receiver at the high frequency portion of the band as previously explained.

ADJUSTMENTS OF R.F. CIRCUITS IN ALLWAVE RECEIVERS

Adjustment of allwave receivers is somewhat more involved than a broadcast band receiver due to the multiplicity of circuits involved and consequent increase in number of necessary adjustments. Before adjusting any allwave set, it is good practice to allow the set to warm up for approximately 30 minutes to allow for thermal expansion of the parts.

Each band of an allwave receiver must be adjusted separately in the same fashion as an ordinary broadcast receiver is adjusted; that is, connect the signal generator to the set's antenna and ground (usually doublet antenna-equipped sets should have the two antenna posts connected together), and adjust the generator to some frequency near the high frequency portion of the band. NOTE: In some cases it is extremely important that a dummy antenna be provided. Such an antenna usually consists of a 100 or 200 mfd. condenser or 400 ohm resistor connected in series with the high side of the generator, as directed by the set manufacturer for the particular band being adjusted.

Then the oscillator trimmer (shunt) condenser should be adjusted until the generator's signal comes in at the desired point on the dial. It is important that the oscillator trimmer be adjusted to the fundamental and not the image frequency. This can be assured by backing the trimmer screw entirely out, then slowly turning it in, until a maximum peak occurs. Turning the condenser slightly beyond this point will bring in another peak somewhat weaker than the first which is the image frequency. In some cases only one peak may be obtained because the trimmer's range is not large enough to reduce the oscillator frequency to the peak below the signal frequency.

Another check is to set the trimmer on the fundamental and leaving the generator at the same frequency, rotate the gang condenser to a lower frequency position until the image signal is heard. This signal should be lower in frequency than the generator frequency by twice the value of the set's IF frequency.

After the oscillator setting is made, the RF and first detector trimmer condensers should be adjusted so as to obtain maximum output at this end of the band.

Some of the first allwave receivers did not provide for any adjustment of the low frequency ends of their bands, either on the oscillator or RF coils. Most of the later receivers, however, provide an oscillator padder to make the tuning of the oscillator track with the dial; and some of the better receivers provide both RF and oscillator padders so that the circuits can be made to track exactly with the dial at all points.

Sets without series oscillator padders on the high frequency bands are of course not adjustable, except possibly by bending the oscillator gang condenser plates. However, this also changes the broadcast band adjustment. Usually it will be found that when the correct setting of the dial on the condenser shaft is obtained (as determined by rocking the condenser on the broadcast band), the other bands will track fairly closely with the dial calibrations.

Sets which provide for adjustment of the oscillator coils only, should first have the oscillator trimmer condenser adjusted at the high frequency end of the band as previously explained. Next the padding condenser should be adjusted to make a signal near the low frequency end of the band come in at the proper point on the dial.

Sets which provide RF and first detector adjustments for both ends of the bands should first be adjusted at the high frequency end of the band as explained previously, then the signal generator and the set tuned to some frequency near the low frequency portion of the band. The oscillator padding condenser should now be adjusted to make the signal come in at the correct dial calibration. Finally the RF and first detector padders should be adjusted until the signal is received with maximum amplitude.

In some allwave receivers there is an interlocking of adjustments from one band to another, in which case the alignment sequence as recommended by the manufacturer must be closely followed.

ADJUSTING THE SIGNAL GENERATOR

It is highly important that portable oscillators or signal generators used in radio service work be checked frequently for correct calibration.

Most generators have compensating condensers which can be adjusted to correct for any shifting of calibration that may have occurred. Their adjustment is simple, since it only involves:

First, tuning in a broadcast station near the high frequency portion of the generator's band.

Second, connecting the generator to the antenna of the set and beating it against the station.

Third, adjusting the generator's compensating condenser until the dial reading obtained on the generator at zero beat corresponds with the known station frequency.

Fourth, repeating the same process for some known station frequency near the low frequency end of the generator's dial and adjusting the series padder condenser until zero beat is obtained between the station and the generator, until the calibration of the generator corresponds to the known station frequency.

Some signal generators are not provided with a means of making their generated frequency track with the dial at the low frequency ends of the various bands. In such cases nearly perfect tracking can be effected by arranging a means of varying the inductance of the oscillator coil. If the inductance is too high, it can be lowered by moving a copper penny on a screw into the coil, or if it is too low by moving a piece of R.F. iron on a screw into the coil. There is probably nothing more time-wasting in adjusting a set, than attempting to correctly adjust it with a generator whose dial calibration is incorrect.

CHANGING THE I. F. FREQUENCY

In some parts of the country interference is experienced from nearby powerful code stations operating on a frequency near that of the I.F. peak of the receiver. The first remedy for this trouble is to install a wave trap in the antenna circuit tuned to the frequency of the unwanted signal. If this does not reduce the interference to a negligible amount it may be necessary to shift the I.F. frequency slightly until the unwanted interference is eliminated. Another cause of interference in the form of whistles and birdies, sometimes on every station received, is two powerful local stations whose frequencies are such that the beat between the two is nearly equal to the I.F. frequency of the set. For example, powerful locals broadcasting on 1400 kc. and 1230 kc. would produce a beat frequency of 170 kc., which is very close to 175 kc., a common I.F. frequency.Unless the set has an unusual amount of R.F. selectivity it will be full of unwanted whistles. This can usually be remedied by shifting the I.F. frequency up to approximately 200 kc., and retracking the oscillator to match the R.F. for maximum response over the band. It is also helpful in some extreme cases to install a wave trap in the antenna circuit tuned to one of the interfering signal frequencies.

ALIGNMENT WITH CATHODE RAY OSCILLOSCOPE

Through the development of frequency modulated signal generators or wobbulating devices, it has become possible to observe on the oscilloscope screen the radio frequency response curve of the individual IF stages or the entire radio frequency amplifier section of the receiver.

Numerous schemes of wobbulating an oscillator have been developed. The most common of these is the use of a motor driven condenser connected across the oscillator tuning condenser in order to periodically vary the oscillator frequency over approximately a 30 kc. band at a rate fast enough to make the image appear stationary on the screen.

In the past such curves were made manually by plotting output vs. frequency, output measurements being taken at several points either side of resonance. See Figure 2.

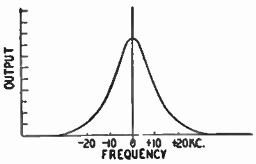


FIGURE 2

Service and factory adjustments were made with the view of obtaining maximum output at the resonant frequency, with little regard for band width.

It is common knowledge that in order to preserve the original fidelity of the transmitted program the receiver must be selective enough to reject interference from adjacent stations 10 kc. away on either side and must pass with equal gain signals 5 kc. either side of resonance, the ideal tuning curve being as illustrated in Figure 3 for 5,000 cycle audio fidelity.

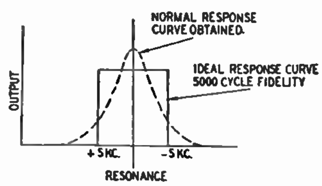


FIGURE 3

Unfortunately tuned circuits tend to produce more rounded and sharply peaked curves, illustrated by dotted lines in Figure 3. In order to produce tuning curves more nearly like the ideal, overcoupled and staggered tuned circuits are being used.

Figure 4, A-B-C-D-E-F-G, shows the result of changing the coupling between two IF coils; the coils being tuned to resonance with the input signal at the start of the test, this adjustment being unchanged throughout the test, and a constant input signal voltage being maintained across the primary of the IF transformer, and the overall tuning curve being shown on an oscillograph.

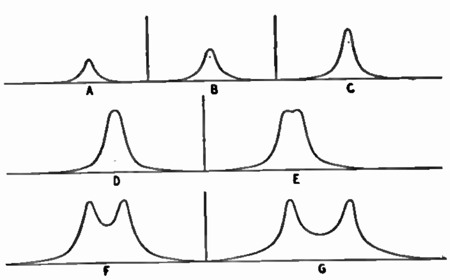


FIGURE 4

From Figure 3, A to D, it is seen that the band width does not change appreciably. However, increasing the coupling results in considerable increase in gain. Further increase of coupling produces a reaction between the primary and secondary tuned circuits causing a double hump to appear in the tuning curve, and a marked increase in band width. This curve more nearly approaches the ideal tuning characteristic. The reaction between the primary and secondary coils, due to close coupling, produces two peaks at different frequencies instead of one peak. This causes the tuning of the primary circuit to be definitely influenced by the secondary circuit tuning, making alignment using an ordinary output meter difficult and impractical.

Figure 5 illustrates the method of connecting an oscilloscope and associated equipment to visually observe the response curve of a receiver. If the overall tuning characteristic is desired, the frequency wobbulated signal generator is connected to the antenna; if the IF system alone is desired, it is connected to the grid of the IF tube.

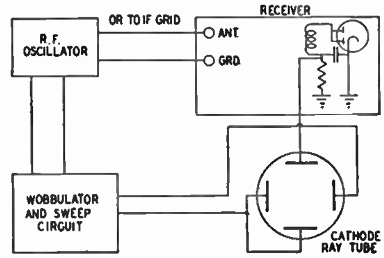


FIGURE 5

Assume the apparatus is connected as in Figure 5 and that an overall response curve on the broadcast band is desired. The signal generator would be set at say 1000 kc. and allowed to generate a 1000 kc. unmodulated signal. Since the signal is unmodulated there will be no audio output. Therefore, the vertical plates of the cathode ray tube must be connected across the plate load resistor of the second detector tube to measure the strength of the test signal as amplified by the receiver. A diode detector has been used as an illustration. Suppose the wobbulator is connected across the signal generator so that it will vary the frequency of the generator about 15 kc. each side of the 1000 kc. setting. This will in turn cause the voltage developed across the diode load resistor, and therefore, the voltage across the vertical plates of the oscilloscope, to vary in amplitude as the resonant voltage changes as the response of the receiver under test varies during the 15 kc. spread either side of resonance.

Then suppose the dial movement of the wobbulator or frequency vernier is translated into a voltage which is connected to the horizontal oscilloscope plates. Turning the frequency vernier or variable condenser will then cause the oscilloscope spot to trace out the picture of the selectivity curve of the receiver on the screen. If the vernier is caused to rotate at a steady speed of 15 or more times per second, the image will appear stationary on the screen, due to the persistence of vision of the eye. The advantages of such a system for set slignment is apparent, since the serviceman can instantly see the result of each little change made during the adjustment process.

ADJUSTING OLDER TYPE RECEIVERS FOR HIGH FIDELITY

It is possible to improve the tone quality of older type receivers having sharply tuned IF stages by realigning the IF transformers to provide a flat-topped resonance curve. This is accomplished by first peaking each IF transformer to exact resonance, then slightly readjusting each IF trimmer so that the resonance peaks will fall alternately on each side of the exact IF frequency. This process causes some loss in gain, but this is usually unimportant, compared with the improved tone quality obtained.

ADJUSTING RECEIVERS WITH VARIABLE FIDELITY

Perhaps the most practical solution to the entire problem of receiver fidelity vs. selectivity is found in a great number of recent receiver developments. These designs allow the customer to choose between fidelity and selectivity as his particular reception conditions dictate. Figure 6 illustrates the two conditions.

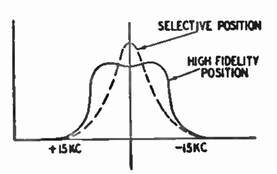


FIGURE 6

It is usually desirable to first adjust the set with the fidelity control turned to the selective position for maximum selectivity and gain, then readjust the last IF trimmers for wave symmetry with the selectivity control turned to the high fidelity position as shown in Figure 6.

USING OSCILLOSCOPE FOR 600 KC ALIGNMENT

One of the most difficult adjustments in the field is the aligning of the low frequency oscillator padding condenser. Rocking of the main tuning condenser is necessary while making the low frequency oscillator adjustment in order to bring the oscillator to the correct frequency when the RF and first detector circuits are exactly resonant with the incoming signal. The relations for ideal alignment are shown by Figure 7.

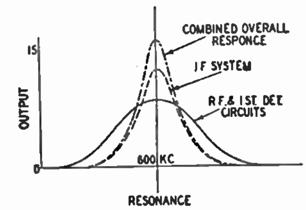


FIGURE 7

For example, if the RF and first detector circuits are tuned to 600 kc. and the IF frequency is 465 kc., the oscillator frequency must be 1065 kc. for correct alignment. Supposing, however, the RF circuits were tuned to 620 kc. when the oscillator was oscillating at 1065 kc., due to the resonant response of the IF system the 600 kc. signal would still be received. However, the overall set response would be poor due to the misalignment as illustrated in Figure 8.

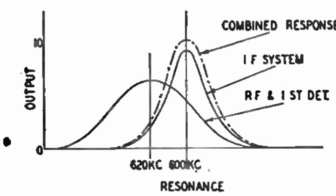


FIGURE 8

It would then be necessary to turn the gang condenser to bring the circuits to proper alignment. However, changing the gang condenser setting also changes the oscillator frequency so that it remains out of alignment. Proper adjustment, therefore, requires that the gang condenser be rocked continuously back and forth while the oscillator padding condenser is adjusted for maximum output. The receiver dial should then be set to coincide with this adjustment.

USING FREQUENCY MODULATED TEST OSCILLATOR AND OSCILLOSCOPE

The same results can be accomplished by setting the receiver to receive the 600 kc. signal, and instead of rocking the gang condenser while adjusting the padder, use the frequency modulator with the signal generator to automatically sweep the incoming signal over a 30 kc. band. The oscillator padder may now be set for maximum output or height of the tuning curve as seen on the oscilloscope screen. The image seen on the screen will be the resultant curve of the combined RF, first detector, and IF resonant characteristics; and their exact alignment will be indicated by maximum image amplitude.

Automatic Frequency Control

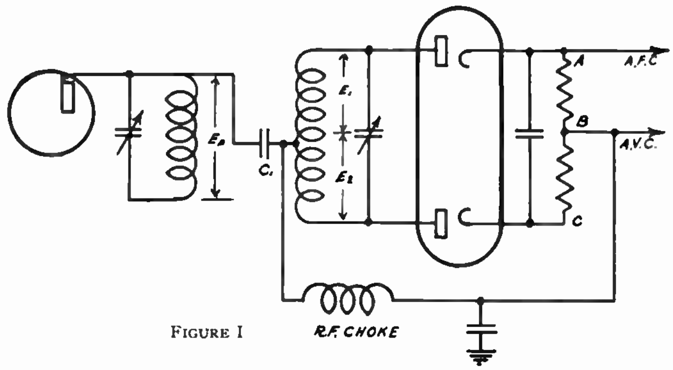


FIGURE I

THE purpose of AFC is to vary the frequency of the set oscillator (over a predetermined range) so that the frequency difference or beat between the set oscillator and signal frequencies is always equal to the IF of the set. This then takes care of improper tuning adjustment, oscillator drift, tracking inaccuracies, and makes commercially possible mechanical stop-dial type tuning.

In AFC circuits, two separate functions must be performed.

First, there is the discriminator. The purpose of the discriminator is to convert IF frequency changes into voltage variations. If the incoming IF frequency is higher than the resonant IF frequency of the set, the discriminator must produce a voltage varying in one direction. If the incoming IF frequency is lower than the resonant IF frequency of the set, the discriminator must produce a voltage varying in the opposite direction.

The second function is that of varying the frequency of the set oscillator. A separate tube known as the "Frequency Control" performs this task. The frequency control must be arranged so that voltage variations in one direction tend to increase the frequency of the set oscillator, and voltage variations in the other direction tend to decrease the frequency of the set oscillator.

DISCRIMINATOR

As previously mentioned, the purpose of the discriminator is to change frequency variations from the resonant IF frequency into DC voltage variations. Figure I shows the essential parts of the discriminator circuit. The discriminator transformer is similar to the other IF transformers in the set, except the secondary is center-tapped and the high side of the primary is coupled to the secondary center-tap by means of C_1 so that in addition to the usual magnetic coupling between coils, we have the primary voltage coupled to the center-tap of the secondary coil.

Supposing, in order to simplify the explanation of how this AFC transformer works, we consider for the moment that there is no magnetic coupling between the primary and secondary coils; therefore, there would be no induced voltage in the secondary coil and no current will flow in the tuned secondary circuit—see Figure II. However, the primary voltage is coupled to the secondary center-tap by C_1, which is large enough to have a negligible RF voltage drop across it, and both coils are tuned to the IF frequency of the set. If vacuum tube voltmeters were connected at points A and C to ground it would be found that the primary voltage E_p would appear at both points, and, when the incoming signal was varied above and below resonance the voltage would vary exactly as the primary voltage E_p, rising to a peak at resonance and falling off on both sides. In other words, the primary voltage E_p, transferred by C_1 would appear at points A and C.

Then, supposing we couple the coils magnetically so that the primary flux links with the secondary, inducing a voltage E_S in the secondary winding. This induced voltage will start a current flowing in the tuned secondary tank circuit. Since the same flux produces both the induced secondary voltage E_S and the induced primary voltage E_p, these voltages will be in exact time phase.

Also, it follows that, since at resonance the secondary circuit offers only resistance impedance, the circulating secondary current will be in phase with the induced secondary voltage E_S, or the primary coil voltage E_p will be in phase with the circulating secondary current.

Since the circulating current in the secondary coil induces a voltage in the coil, which at resonance is quite large compared to the induced voltage E_S, and this voltage E_{Sr} across the coil is necessarily 90 electrical degrees ahead of the current producing it, the resonant voltage E_{Sr} across the coil is 90 electrical degrees ahead of the primary voltage E_p. However, the secondary is center-tapped, so that the voltages developed across each half will be equal, but as seen from the center-tap will be 180° out of phase. This point is clarified when one reviews what happens in a push pull transformer or a full wave rectifier circuit. See Figure III.

Then, returning to Figure II again, and tracing the RF circuit from points A to ground or B+ (since B+ is practically ground to RF) and from point C to ground, it is apparent that whatever voltage appears across the upper half of the coil, plus the primary voltage will appear at point A, and whatever voltage appears across the bottom coil plus the primary voltage, will be found from point B to ground.

Then assuming that the primary voltage E_p is equal to the voltages appearing across each half of the secondary coil E_1 and E_2, we can draw the following vector diagrams to illustrate what happens at resonance. Since these voltages are not in phase they cannot be added directly but must be added vectorially as illustrated. See Figure IV.

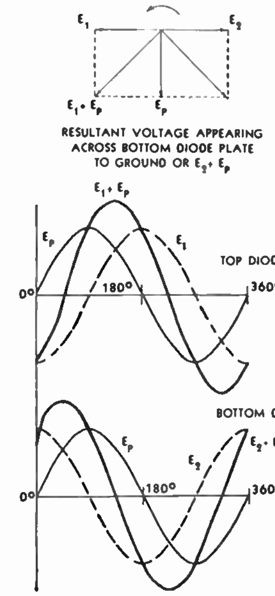


FIGURE IV

From these vector diagrams we see that equal RF voltages will appear at each diode plate with respect to ground at resonance. The heavy lines show the resultant voltage wave when E_p is added to E_1 and E_2.

Then it follows that if equal RF voltages appear at each diode plate to ground, equal DC voltages will appear across AB and BC at resonance, Figure I. However, A will be positive with respect to B, and C will be positive with respect to B, therefore, the total DC voltage from A to C will be zero, and we will have no AFC control voltage developed when the incoming IF signal is at the resonant frequency of the AFC transformer.

BELOW RESONANCE

Now, supposing the incoming IF signal impressed on the AFC transformer is LOWERED. The induced secondary voltage E_S will still be in phase with primary voltage E_p. However, the circulating current in the secondary tank circuit will no longer be in phase with it, but will begin to lead.

This follows, because at frequencies lower than resonance in a series tuned circuit, the capacitive reactance is large and the inductive reactance small, so that most of the voltage drop is across the condenser. The circulating current leads the applied voltage E_S, depending on the amount off resonance of the incoming signal. This, in turn, causes the induced voltage E_{Sr} to lead the primary voltage E_p by a like amount, or the voltages developed in each half secondary begin to shift as illustrated, with the result that the vector sum of the primary and each half secondary voltages becomes unequal, the top diode (Figure V) receiving a higher RF voltage than the bottom diode. For convenience, we have shown a phase shift of 30°.

Since the top diode receives more RF voltage than the bottom diode, the rectified DC voltage appearing across AB will be greater than that across BC. Also, since A will be positive with respect to B, the resulting DC voltage appearing across AC will be a positive AFC control voltage.

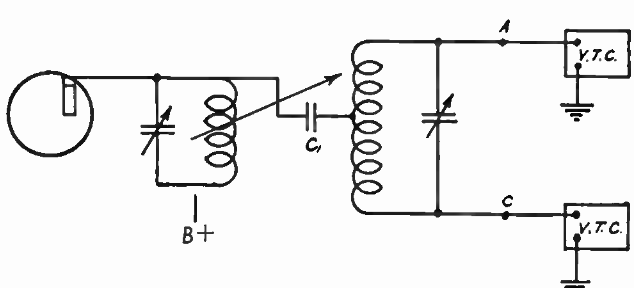


FIGURE II

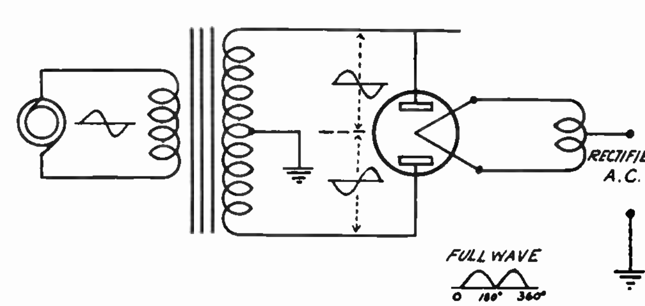


FIGURE III

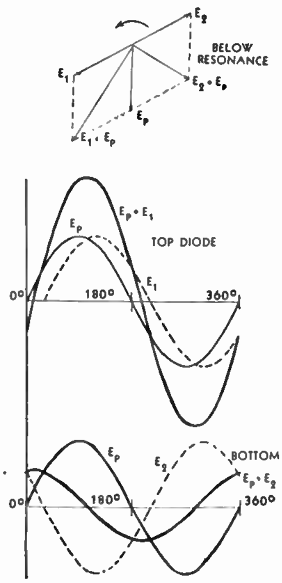


Figure V

ABOVE RESONANCE

Supposing now that the incoming IF signal frequency is higher than the resonant AFC frequency. The circulating secondary current will begin to lag the primary voltage, E_p.

This is because at higher frequencies, the inductive reactance is large and the capacitive reactance low, resulting in the circulating current lagging the induced secondary voltage E_S, or lagging the primary voltage E_p. This circulating current in turn induces the resonant voltage E_{Sr} in the coil, causing the secondary voltages E_1 and E_2 to lag the primary voltage E_p in our vector diagram, Figure VI, or to lag its original resonant position. For convenience a 30° phase shift is again shown.

From Figure VI, we see that the bottom diode receives more RF voltage when the incoming IF signal is above resonance; therefore, more voltage will be developed across the bottom diode resistor than across the top and since B will be negative with respect to ground or C, this negative voltage will overpower the voltage from the top diode resulting in a negative AFC control voltage.

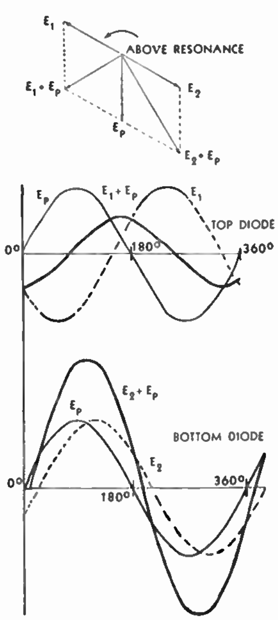


Figure VI

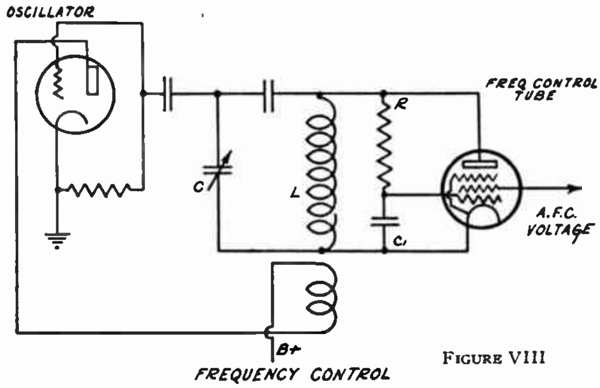


Figure VIII

This varying voltage is then fed to the grid of the frequency control tube. A typical resonance curve of an AFC transformer showing AFC control voltage developed, vs. kc. off resonance is shown in Figure VII.

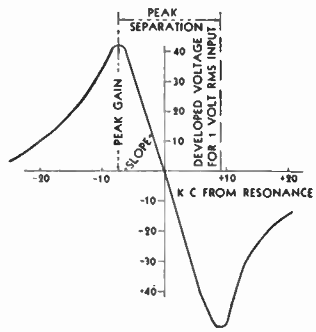


Figure VII

FREQUENCY CONTROL

Figure VIII shows the essential parts of the frequency control circuit.

To accomplish its purpose, that is, to provide some way of either increasing or decreasing the set oscillator frequency from normal, without changing the gang condenser position, we connect an imaginary inductance across the oscillator coil and provide a way of making this imaginary inductance either larger or smaller by means of the discriminator voltage. The imaginary inductance is the frequency control tube.

Reviewing elementary circuit theory, we find that the current in a condenser leads the voltage by 90°; also that the current in an inductance lags the voltage by 90°. We also find that when two inductances are connected in parallel, the resultant inductance is always less than that of the lowest of the two inductances.

WHY THE CONTROL TUBE ACTS AS AN INDUCTANCE

In order for the control tube to act as an imaginary inductance in shunt with the oscillator coil "L," it must cause a lagging current to flow through coil "L" (Figure VIII) with respect to the oscillator voltage already across coil "L" since this is exactly what would happen if an inductance coil were connected in shunt with coil "L."

Supposing the control tube was connected across coil "L," but without any AC excitation on its grid. In this case, it would shunt the coil "L" with a definite resistance or impedance, the magnitude of which would depend on the bias voltage applied to the tube. Therefore, the tube would draw current from the coil "L". However, this current would be in phase with the oscillator voltage since the tube acts as a resistance and increasing or decreasing the bias on the tube would not affect the oscillator frequency. However, the network RC is also connected across the oscillator coil "L" and the voltage across "C" is applied to the grid of the control tube. This causes the tube to act as an imaginary inductance, explanation as follows:

Looking at Figure VIII we find a resistance "R" and a capacity "C_1" connected in series across the oscillator coil "L." The values of "R" and "C_1" are so chosen that the resistance of "R" is greater than the reactance of "C_1," therefore, this combination has nearly unity power factor, or appears to the oscillator coil "L" or oscillator voltage source as a resistance load. The current through R and C_1, therefore, is nearly in phase with the oscillator voltage. Then, since the current through condenser "C_1" is nearly in phase with the oscillator voltage across the coil "L," it follows (from the statement above) that the voltage appearing across a condenser lags the current through it by 90°, that the voltage appearing across condenser "C_1" is lagging the oscillator coil voltage by nearly 90°.

This voltage is then applied to the grid of the control tube. If the control tube is properly biased, plate current will flow in phase with the grid voltage (peak plate current with peak grid voltage). This means that the plate current will lag the voltage across coil "L" or oscillatory circuit by nearly 90°, making the tube act as an imaginary inductance.

HOW CONTROL VOLTAGE AFFECTS INDUCTANCE

Since the plate current of the control tube draws a lagging current with respect to the oscillator voltage across "L" and since the plate current can be varied by varying the amount of bias on the tube, we have in effect a variable inductance in shunt with the oscillator coil, the amount of which inductance is directly controlled by the discriminator control voltages.

A COMPLETE CYCLE

Referring to Figure I again, when the local oscillator is generating the correct signal to produce an IF signal equal to the resonant IF frequency of the set, there is no need of any further adjustment. The differential voltage is zero across points A to C; Figure I, therefore, there is no effect upon the control tube and oscillator circuit.

However, on signals lower than the IF set frequencies, "A" becomes positive with respect to ground causing the "Frequency Control" tube to draw more plate current, or decreasing the effective inductance of the coil "L" causing the oscillator frequency to raise, therefore raising the IF frequency produced until it equals the resonant IF frequency. On signals higher than the IF frequency, "A" becomes negative with respect to ground, causing the "Frequency Control" tube to draw less plate current, and therefore increasing the oscillator coil's effective inductance and decreasing the oscillator frequency, until it is correct to produce the resonant IF frequency.

The action finally stops in either case, with about one volt as the differential voltage actually remaining. This action is quite rapid, taking place in less than 1 second of time. It is possible with this system to correct the IF to within 100 cycles of the IF peak, if the receiver is mistuned as much as 10 kc. off resonance.

COMMERCIAL AFC CIRCUITS

The previous discussion outlines in general the manner in which AFC circuits function, as commercially applied in receivers. However, there are several interesting variations, which are used to effect certain desired performances, that are well worth mentioning and explaining.

AFC IN TRIPLE DETECTION SUPERHETERODYNES

Figure IX is a block diagram which will serve to illustrate how this system functions.

For example, suppose a 1000 kc. signal is being received by the antenna. This signal is tuned and amplified by the RF amplifier circuits and is passed on to the first detector. In the first detector tube this 1000 kc. signal is mixed with a 1455 kc. oscillator frequency in order to produce a 455 kc. IF. A 6A8 tube serves as both the first detector and oscillator. The 455 kc. IF signal is passed on through an IF transformer into a second detector. At the second detector, the 455 kc. signal is mixed with a fixed 355 kc. oscillator frequency to produce a 100 kc. IF. This 100 kc. frequency is then amplified by a 100 kc. IF amplifier and is passed on to a third detector, which serves to rectify the signal. The audio components are passed on to the audio amplifier and then to the speaker. The second oscillator frequency (355 kc.) is chosen below the signal frequency of 455 kc. instead of above it, since a 555 kc. oscillator frequency, necessary to produce the 100 kc. IF, would fall in the lower limit of the broadcast band and tend to cause beat notes with broadcast signals. While it is true that the harmonics of the 355 kc. oscillator produce beat notes with broadcast signals, the effect is not as troublesome as in the case of a fixed oscillator frequency of 555 kc.

Referring again to Figure IX, we see that the oscillator control tube, 6J7, works only on the fixed 355 kc. oscillator. Any change in the frequency of the 355 kc. oscillator directly affects the second IF. For example, say a 1000 kc. signal is being received and the gang condenser is incorrectly tuned by 5 kc., or to 1005 kc. This will cause the IF produced by mixing the first oscillator and RF, to be 460 kc. instead of 455 kc. As a result the signal produced by the mixing of the second oscillator and second detector will be 105 kc. instead of 100 kc., which causes serious distortion of the signal. To compensate for this, the second oscillator must be changed in frequency by the control tube action, to 360 kc. This action in turn produces the 100 kc. IF and corrects for the original mistuning situation. The important thing about this is to note that the AFC is accomplished by varying the frequency of an oscillator which operates **near a fixed frequency.** In the previously described system the control tube must vary the frequency of an oscillator operating over extremely wide ranges. This gives rise to poor AFC action on the short wave ranges and varying action over the broadcast band; whereas in the triple detection system the control is equally effective on all frequency ranges, since it merely varies a fixed frequency oscillator. Any error caused by mistuning, drift in the RF section, or gang condenser tuned circuits, which might cause the signal going to the second detector to vary from 455 kc., would be compensated for by a change in the fixed 355 kc. oscillator frequency. In this manner the 100 kc. IF signal is accurately maintained.

Figure X illustrates the double superheterodyne and AFC circuits as employed in the chassis 1237-D, 12-tube Arvin receiver. This set was chosen as a typical example of the triple detection type receiver, as the design principles employed here are general.

Referring to Figure X, we note that the 100 kc. IF signal is fed into a limiter amplifier stage. This serves to amplify the 100 kc. signal before it goes into the discriminator, and also serves the important function of providing a nearly constant amount of signal to the discriminator. On weak signals the full gain of the amplifier is available to bring up the amount of signal going to the discriminator. On strong signals the grid current through the 1 megohm grid resistor increases the bias, thus decreasing the gain. This causes the output of the amplifier to level off, and provides uniform output to the discriminator regardless of signal intensity. In the Arvin receiver mentioned this amplified signal levels off when a 10 microvolt signal is applied to the antenna, and remains substantially constant for inputs beyond this value.

The discriminator circuit functions in the same manner as the one previously described and will not receive further attention here. The oscillator control tube, however, receives its 90° out of phase voltage in a manner that has not been previously explained. Referring to Figure X, we see that the control tube grid gets its RF voltage from the voltage drop across a 100 ohm resistor, which is in series with the oscillator tuned circuit, the low end of the 100 ohm resistor being grounded to RF by the .05 mfd. condenser. Since the reactance of the 100 ohm resistor is low in comparison to that of the oscillator coil, the current through the resistor is substantially in phase with the coil current. However, the voltage across the coil, or the oscillator voltage, is 90° ahead of the coil current. The voltage across the resistor is in phase with the current. Therefore, the voltage across the resistor lags the coil voltage by 90° and in turn causes the control tube to act as an inductance in shunt with the oscillator coil; the value of the inductance varying with the polarity and magnitude of the control voltage received from the discriminator.

ALIGNMENT OF AFC-EQUIPPED SETS

First, the IF transformers of the set should be carefully aligned according to the standard practice as recommended by the manufacturer. (Usually it is a good practice to allow the set to warm up thoroughly before making any adjustments, so as to allow for inductance or capacity changes due to thermal expansion.) Then the test oscillator should be connected to the first detector or first IF stage and tuned to the exact IF frequency of the set, as determined by peak on an output meter. A vacuum tube voltmeter should be connected across the discriminator control voltage, points "A" and "C," Figure I. Usually one diode cathode connects to ground or chassis, so it is only necessary to connect the vacuum tube voltmeter to the chassis, and the other diode cathode.

Then the secondary trimming condenser of the AFC transformer should be backed out with alignment tool until it is nearly open.

This is done in order to insure ease of aligning the primary trimmer. Practically no change would result if the secondary happened to be set for zero discriminator voltage, regardless of the amount of adjusting that was given the primary trimmer. Thus an inaccurate setting would result. Adjust the primary trimmer condenser for maximum discriminator voltage, either positive or negative.

Then adjust the secondary trimmer for exactly zero voltage across the discriminator network points "A" and "C," Figure 1.

The adjustment of the secondary trimmer is critical in most AFC-equipped sets and must not be attempted without proper equipment. Usually there are three points at which zero discriminator voltage is obtained; namely, when the trimmer is all out; in about the middle; and when it is completely closed. The correct point is the center adjustment, or where a very slight change in adjustment causes a rapid change in discriminator voltage. After the zero voltage setting is made, the test oscillator frequency should be varied until the maximum positive and maximum negative discriminator voltages are developed, and the meter readings noted. The readings should be closely the same. A wide discrepancy in readings indicate misalignment of the primary trimmer or a defective discriminator transformer. In such case the primary trimmer should be readjusted slightly until equal readings are obtained. Do not readjust the secondary trimmer to make them equal, since this would cause the zero voltage to be developed at some frequency other than the resonant IF, and cause the set to mistune every station when the AFC is functioning.

A quick check of the functioning of the AFC circuit can be made as follows: Tune in a local station with the AFC switch off. Then detune the set a measured amount off resonance, say 8 kc. Then turn the AFC control on. The AFC should lock in and tune the set to resonance. Then repeat the same test 8 kc. the opposite side of resonance and see if the AFC again locks in, tuning the set to resonance. The AFC should control an equal amount from either side of resonance when properly aligned. Also when the set is tuned to resonance on a weak signal with the AFC control off, turning the AFC control on should not cause the set to be mistuned. If it does, the AFC control adjustments are not properly aligned.

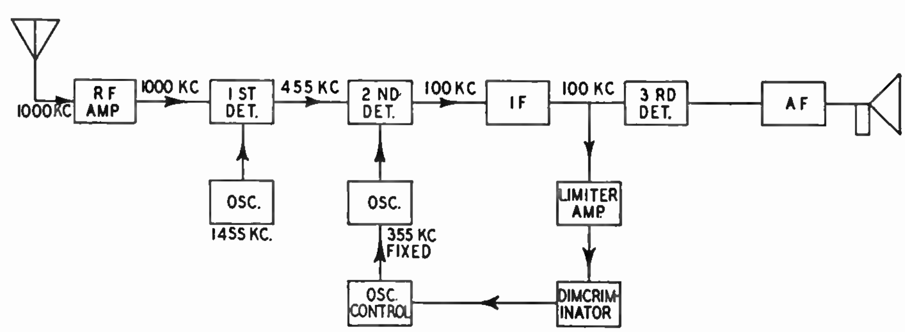


FIGURE IX

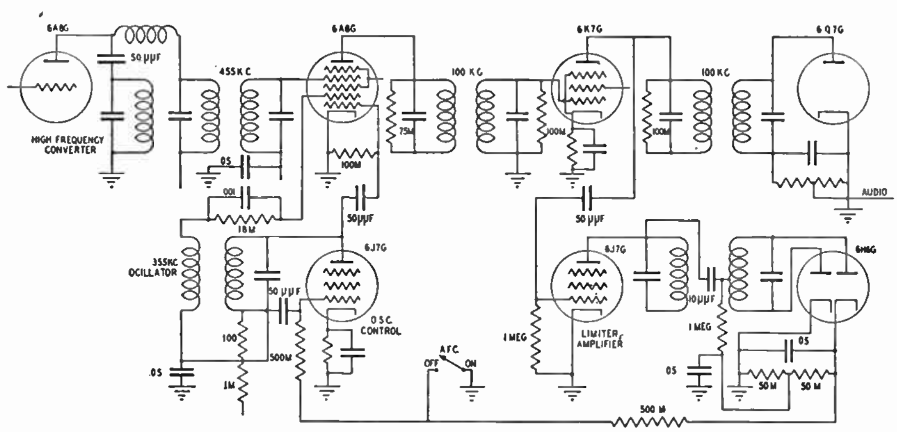


FIGURE X

AUTOMATIC TUNING

THE past radio season has witnessed the widespread adoption of automatic tuning systems by practically every radio receiver manufacturer. The appeal of this feature to the public has been fostered by intensive sales promotion and advertising campaigns which have established it as a necessary adjunct to a modern receiver. It presents to the radio service engineer a unique opportunity for the establishment of closer customer contact since the original setup of selected stations as well as the maintenance of continued satisfactory automatic operation is a function which he alone is technically capable of rendering.

As everyone acquainted with radio receiver details will realize, automatic station selection is not a new development but rather a refinement and perfection of principles which have been in use for the past eight years. It is interesting to note that the continued progress towards the ideal of simplification of the tuning requirements of radio receivers has been the result of a series of cycles in which improvements in mechanical design have in every case followed and been initiated by the introduction of new radio circuits. In the present case the development of automatic frequency control of superheterodyne oscillators, stabilization of drifts due to temperature and humidity and the expansion of IF amplifier circuits have simplified the design of automatic tuning devices by allowing considerable latitude in the mechanical and electrical precision of selectors.

The present article presents a descriptive review of the various methods of accomplishing automatic tuning. The subject at first glance appears to be bewilderingly complex. Upon closer study it is found that the various systems used are inter-related and that it is possible to classify them. Certain devices and circuit elements have been found to be common between the various systems and their description will be presented by the use of sections devoted to them. In general automatic tuning systems may be divided into three main groups:

I. Mechanically Operated Manual Types
II. Motor Operated Types
III. Tuned Circuit Substitution Types

These main headings may be further subdivided into individual variations. To classify the receivers and explain the many details of automatic station selection employed, a system has been adopted similar to that used elsewhere in this manual for the listing of service components. This system of manufacturer listing followed by individual detail sections allows the presentation of an immense amount of material in condensed form and has been found extremely helpful. Careful study of the automatic tuning classification outline which follows together with the manufacturer model listings under general types will make the use of this system apparent.

CLASSIFICATION OUTLINE

I. MECHANICALLY OPERATED MANUAL TYPES

The tuning condenser is turned to the desired station reception position by direct mechanical effort of the person operating the receiver. Four general divisions of this type have appeared:

A—Linear (Typewriter key motion).
B—Rotary (Telephone dial motion).
C—Indent (Spot tuning).
D—Flash (Light indicator tuning).

A. Linear (Typewriter Key Motion)
Straight line motion of a key in a direction parallel to the tuning panel rotates the gang condenser by means of cams or levers whose position is pre-set to the desired station. Examples: Belmont (Belmonitor), Crowe (Cromatic).

B. Rotary (Telephone Dial Motion)
This type of mechanism which appeared in late 1935 and in 1936 receivers has found widespread use and has been subject to many mechanical refinements. Gearing between dial mechanism and tuning condenser is arranged to allow almost 360° of dial movement.

1. Button or Indexing Adjustment.
   a. By splines or serrations on plunger co-operating with similar shaped grooves in an opening on a die-cast dial plate. Examples: Colonial, Emerson, Fairbanks-Morse, Philco.
   b. By locking nut on threaded plunger shaft.
      (1) Rotary adjustment of location of pin on radius about center of equally spaced buttons. Example: Wilcox-Gay, G. H. U.
      (2) Sliding adjustment in annular slot or series of overlapping slots around periphery of dial. Examples: Erla (Sentinel), Trav-ler, Philco (Cone-centric), G. H. U. (Teledial).
2. Stop or "lock-in" device.
   a. Latch Gate—A spring operated double gate allows depressed station pin to enter from either side but immediately locks after the pin enters to prevent rotation in either direction. Examples: Colonial, Fairbanks-Morse, G H. U., Philco (Magnetic tuning).
   Note: In most instances the latch gate operates switching of AFC and audio silencing circuits. The latch gate principle is also employed in some motor-tuned systems. See II-C1 under "Motor Operated Types."
   b. Slot in metal plate co-operating with depressed pin. Example: Wilcox-Gay.
   c. Floating Vane Stop—Vane is moved sideways by the depressed pin until it strikes fixed stops. Pin centers at same position when moved from either direction. Examples: Emerson, Trav-ler.

C. Indent (Spot Tuning)
Hardened steel ball is pressed into threaded groove in soft brass cylinder to provide indents to assist manual tune. Example: Galvin (Motorola Spot Tuning).

D. Flash (Light Indicator Tuning)
As set is tuned manually, with audio system silenced, a light flashes to indicate when tune to the desired station has been accomplished. Receiver "muting" is removed as station tune point is reached.

1. Operated by latch gate switching. Example: Stromberg-Carlson (Flash Tuning).
2. Operated by sliding contacts on dial and "muting" relay. Example: Noblitt-Sparks and Erla.

II. MOTOR OPERATED TYPES

See Pages 250-251

The rotation of the variable gang tuning condenser to a position corresponding to a desired station tuning point is accomplished by means of an electric motor. The system usually includes: an electric tuning motor, a station selector switch or group of selector buttons, a selecting commutator or other device for stopping the motor at the desired point, an audio silencing and AFC release circuit operating during the tuning cycle and a transfer device to change from manual to automatic tune. Each of these functions will be covered more completely under individual headings. Motor tuning methods may be broadly divided into three main groups:

A—Motor drive by scanning switch.
B—Electrical push button switch with selecting commutator.
C—Mechanically interlocked station plunger and selecting mechanism.

A. Motor Drive by Scanning Switch.
A scanning or motor reversing switch is operated by a knob concentric with the manual tuning knob. The operation of the motor brings the tuning condenser position close to the desired point after which the tuning operation is completed manually. Examples: Crosley and Zenith.

B. Electrical Push Button Switch with Selecting Commutator.
The selecting commutator or stop device is mechanically connected to the gang condenser and electrically connected to the station selector switch and motor. Examples: Crosley, Detrola, General Electric, Gilfillan, Galvin (Motor car set), Midwest, Packard Bell, Pacific Radio, Radio Products, Stromberg-Carlson.

C. Mechanically Interlocked Station Plunger and Selecting Mechanism.
The selecting buttons and the stop device are combined in one unit with some type of mechanical latching at the instant of stop. This type may be pre-set for stations from the front of the receiver since the stop devices are part of the dial mechanism.

1. Circular arrangement of fixed buttons which lock rotation by latching. Examples: Galvin (Motorola household sets), United American Bosch, Westinghouse.
2. Straight line arrangement of fixed buttons with mechanical interlock to disc or cam selectors. Examples: Stewart-Warner, Wells-Gardner.

III. TUNED CIRCUIT SUBSTITUTION TYPES

See Page 252

A latching or ladder type push button switch selects pre-calibrated tuned circuits which are substituted for the usual variable condenser tuned input and oscillator circuits. In general two types of pre-set circuits are used:

A—Trimmer condenser tuning.
B—Iron core tuning.

A transfer switching means to change from manual tuning is used in all cases except in those models which operate on selected broadcast stations only and do not have a gang tuning condenser.

A. Trimmer Condenser Tuning.

1. Ground side switching with push button switch. The low potential or ground side of the trimmers are connected to the switch.
   a. Two trimmer circuits (no RF stage). Examples: Garod, Howard, Pacific Radio (Chicago), Wilcox-Gay.
   b. Three trimmer circuits (RF stage, detector input and oscillator). Examples: Noblitt-Sparks, Sparks-Withington.
2. High side switching with push button switch. The push button switch is connected on the high potential or grid side of the RF circuit. This allows transfer switching to gang tuning by one button of the switch.
   a. With transfer switching by other means than selector switch. Examples: Pacific Radio (Los Angeles), Stromberg-Carlson
   b. With transfer switching on push button station selector switch. Examples: Air King, Erla, General Electric, Warwick.
3. No gang condenser—selected broadcast only. Examples: Howard, Sparton, Wilcox-Gay.
4. Rotary type station selector switch. Examples: Fada, Radio Products (Motor Car Touch-O-Matic).

B. Iron Core Tuning.
Screw adjusted iron core varies the inductance of pre-set coil units. This type of tuning is used in the oscillator circuit of some receivers due to less frequency drift with temperature. Examples: Automatic Electric, R.C.A.

I. MECHANICALLY OPERATED MANUAL TYPES

As briefly covered in the classification outline this method of automatic tuning includes all of the devices

TABLE I—MECHANICALLY OPERATED MANUAL TYPES

MANUFACTURER AND MODEL	Name of Automatic Feature	No. of Selected Stations	Type See Page 249	Button Indexing Adjustment See Section A Page 253		Stop or Lock-In Mechanism See Section B Page 256		Transfer Device Manual to Auto. See Section C Page 257		Audio Silencing Circuit See Section D Page 261		AFC Circuit Release See Section E Page 264	
				Type	Note	Type	Note	Type	Note	Type	Note	Type	Note
BELMONT													
582	Belmonitor	6	IA	(See descr	iption	of mechani	sm on	page 271.)					
860	Belmonitor	8	IA	(See descr	iption	of mechani	sm on	page 271.)			D2		
1175	Belmonitor	8	IA	(See descr	iption	of mechani	sm on	page 271.)			D2		
COLONIAL "Sears-Roebuck"													
4666, 4686, 4786, 4791, 4792	Automatic Tuning Dial	11	IB	Serrated	A1	Latch Gate	B1				D1		
4687, 4787	Automatic Tuning Dial	11	IB	Serrated	A1	Latch Gate	B1	Separate Switch	C1	Dial Conts.	D1	Latch Gate	E1
ERLA													
11-Tube—3-Band	Automatic Flash Tuning	12	ID	Slot and Screw Lock	A4	Latch Gate		Band S'tch	C2	Dial Conts.	D4	Switch Bias to Cutoff	E2
	Automatic Tune Wheel Dial	10	IB	Screw Lock	A3	Latch Gate		Band S'tch	C2	Dial Conts.	D4		E2
	Push Button Dial	10	IB	Screw Lock	A3	Latch Gate		Band S'tch	C2	Dial Conts.	D4		E2
EMERSON													
AT170, AT172, AT181	Automatic Dial	10	IB	Serrated	A1	Vane	B4						
FAIRBANKS-MORSE													
9AC4, 9AC5		15	IB	Serrated	A1	Latch Gate	B1			Dial Conts.	D1	Latch Gate	E1
12AC6		15	IB	Serrated		Latch Gate				Dial Conts.	D1	Latch Gate	
GALVIN													
2 Motor Car Models	Spot Tuning	Any Number	IC	Thread	A6								
GENERAL HOUSEHOLD UTILITIES													
1291, 1293	Teledial	15	IB	Serrated	A1	Latch Gate	B1			Dial Conts.	D1	Latch Gate	E1
1081, 1091, 1181, 1183, 1185	Super-Teledial	16	IB	Serrated	A1	Latch Gate	B1			Dial Conts.	D1	Latch Gate	E1
589, 623, 585, 663, 1067	Teledial	10	IB	Serrated	A3	Latch Gate	B1			Dial Conts.	D1	Latch Gate	E1
588, 622, 624, 632	Teledial	8	IB	Serrated	A3	Latch Gate	B1			Dial Conts.	D1	Latch Gate	E1
NOBLITT-SPARKS													
818AT, 828AT, 838AT	Phantom Tuning	10	ID		A4			Sep. Switch	C1	Relay	D5		
PHILCO													
38-116 (121), 38-116 (125), 38-1 (121), 38-2 (121), 38-3 (121)	Automatic Dial Tuning System		IB	Serrated	A1	Latch Gate	B1	Sep. Switch	C1	Dial Conts.	D1	Latch Gate	E1
38-4 (121), 38-7 (121), 38-7 (124)	Cone-centric		IB	Screw Lock	A3		B4			Dial Conts.	D1		
STROMBERG-CARLSON													
255L, 260L, 260P	Flash Tuning	7	ID	Disc and Clamp Nut	A5	Latch Gate	B2	Sep. Switch	C1	Latch Gate	D6	Latch Gate	E1
TRAV-LER		12	IB	Screw Lock	A3	Vane	B4						
WELLS-GARDNER													
A1, A2, A3, A4, and A5	Telephone Dial	17	IB	Serrated	A1	Latch Gate	B1			Dial Conts.	D1		
WILCOX-GAY													
A33, A35, A37, A40, A42	Automatic Telephone Dial	10	IB	Lock Nut	A2	Slot	B5			Dial Conts.	D1		

(Notes given on pages 253 to 271)

which permit the gang tuning condenser to be directly adjusted to tune on the desired station by mechanical effort of the person tuning the receiver. The column of the following listing headed "Type" refers to the main subdivisions of the foregoing outline. With the exception of the linear type listed as IA, all of the details of a given receiver may be determined by reference to the section notes under the various section headings.

The linear or typewriter key motion type of mechanism is separately described on page 271.

II. MOTOR OPERATED TYPES

As indicated in the main outline, motor tuned systems in general include:

1. An electric tuning motor.
2. A selecting commutator.
3. An audio silencing and AFC release device.

A typically motor tuned system is illustrated pictorially in Figure 1, with its corresponding schematic wiring diagram in Figure 2. A description of this system will serve to familiarize the reader with motor tuned operation. Variations from this typical system will be covered in the notes listed in Table II.

The tuning motor drives the variable gang condenser through a train of gears to which the motor is mechanically coupled by a quick-acting clutch.

When the motor is not energized the armature is positioned slightly out of the center of the magnetic field. It is held in this position by a flat phosphor-bronze spring which also acts as part of a jack spring switch assembly. When the windings of the motor are energized the rotor is drawn into the magnetic field, closing the separated parts of the clutch and actuating the jack spring switch. The clutch performs a dual function in that it relieves the driving system of the load of the motor during manual tuning and it allows the motor to coast to a stop, permitting instant cessation of gang condenser rotation when the selecting commutator opens the motor circuit. The selecting commutator is directly coupled to an extension of the variable gang condenser shaft by means of a universal coupling. In the case illustrated it consists of a series of metal discs which are electrically connected to the shaft and are driven by means of cupped friction washers. In the periphery of each disc is a short insulated section which serves to open a circuit when the disc has revolved to such a point that a contacting finger is resting upon the insulation. These discs may be rotated with respect to their drive shaft to allow them to be set to positions corresponding to desired station tuning points. This is done by locking the disc against rotation with an indexing pin while the station is tuned in manually. Since this single circuit disc cannot select the direction of rotation of the tuning motor, a motor reversing switch is attached to the commutator shaft and serves to reverse the motor at the end of gang condenser rotation in the event that the desired station tuning point has not been reached before this occurs.

Selection of the desired station is accomplished by depressing a button of the station selector switch. A single circuit switch is actuated by each button respectively wired to the contactor fingers of the station selecting commutator aforementioned. Since the push button plungers engage a common latch bar (as described in section G) a circuit will be held closed until released by the choice of another button. The circuit is completed from ground through a commutator disc and its respective push button switch, the motor, reversing switch and motor supply winding on the power transformer. Thus when a station selector button is pressed the motor will continue to run until the station selecting disc opens the circuit at the correct station tuning point. During the time that the motor is running the jack spring switch on the motor clutch has silenced the audio system of the receiver and released the automatic frequency control from operation. The necessity of these two functions will be described in greater detail in sections D and E.

Several variations of this basic system exist which are not readily described in the listing. These will be described separately.

TABLE II—MOTOR OPERATED TYPES

MANUFACTURER AND MODEL	Name of Automatic Feature	No. of Selected Stations	Type See Page 249	See Section A Page 253 Button or Indexing Adjustment See Note	See Section B Page 256 Stop or Lock-In Mechanism See Note	See Section C Page 257 Transfer Device Manual to Automatic See Note	See Section D Page 261 Audio Silencing Circuit See Note	See Section E Page 264 AFC Release During Tune See Note	See Section F Page 264 Tuning Motor See Note	See Section G Page 266 Push Button Station Selector Switch See Note	See Section H Page 270 Station Selecting Commutator Device See Note
CROSLEY 617, 1127	Dynatrol Drive		IIA						F6	G4	
1137	Prestotune	8	IIB				D7		F6	G1	H4
DETROLA 175, 183, 185	Electric Automatic Tuning	8	IIB				D7		F2	G1	H3
191, 192, 193	Electric Automatic Tuning	10	IIB				D7		F2	G1	H3
GALVIN 10Y1, 12Y, 12Y1	Electric Automatic Radio	19	IIC1	A2	B7	C3	D7	E2	F3	G3	
Motor Car Models 8-60, 8-80	Press Button Tuning	6	IIB		B9		D5		F4	G1	
GENERAL ELECTRIC F107, F109, F137	Touch-Tuning	13	IIB	(See Special Description, page 271.)		C4	D5	E3	F1	G2	H2
GILFILLAN BROS. 13C8-E	Automatic Electric Motor Tuning	8	IIB			C1	D8		F2	G2	H3
HERBERT H. HORN IIA		8	IIB			C4	D8	E4	F2	G2	H3
HOWARD RADIO CO. 400A and 425A	Motor Automatic	8	IIB			C4	D8		F2	G2	H3
MIDWEST VT16, VT18, VT20	Motorized Automatic	8	IIB			C6	D3		F4	G1	H3
PACKARD-BELL 160	Automatic Tuning	8	IIB			C5	D8		F2	G2	H3
R.C.A. 811K, 812K, 813K, 816K	Electric Tuning	8	IIB			C1	D8	E4	F3	G2	H1
RADIO PRODUCTS 930-16R, 925-16R, 935-11S, 940-11S	Touch-O-Matic	8	IIB			C4	D8	E4	F2	G2	H3
STEWART-WARNER R184, R185, R186	Magic Keyboard	15	IIC2	(See Special Description, page 272.)							
STROMBERG-CARLSON 70, 72, 74	Te-Lek-Tor	8	IIB			C7	D8		F2	G1	H3
UNITED AMERICAN BOSCH 850, 860	Automatic Electric Tuning	14	IIC1	A2	B8	C1	D6		F4	G3	
WELLS-GARDNER A1, A2, A3	Electric Drive	8	IIC2	(See Special Description, page 273.)							
ZENITH S905 (7 models), 1204 (7 models), 1501 (6 models)	Electric Automatic Tuning, Robot Dial		IIA						F5	G4	

(Notes given on pages 253 to 271)

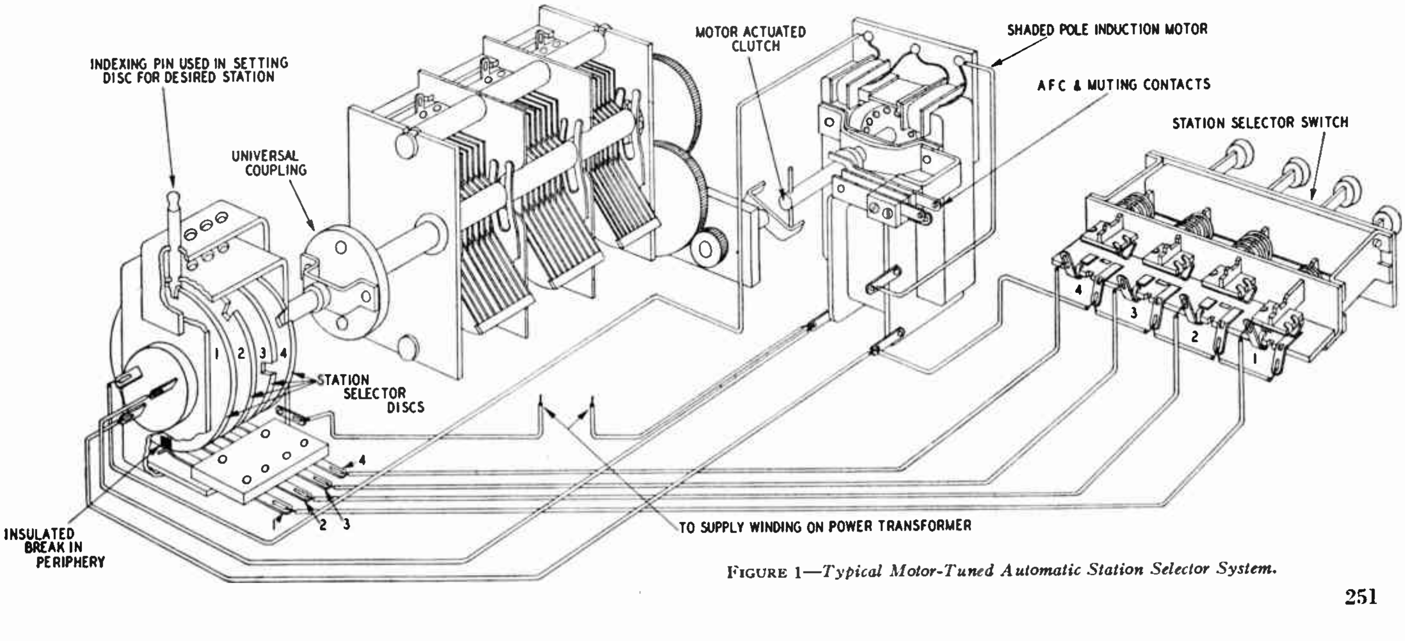


FIGURE 1—*Typical Motor-Tuned Automatic Station Selector System.*

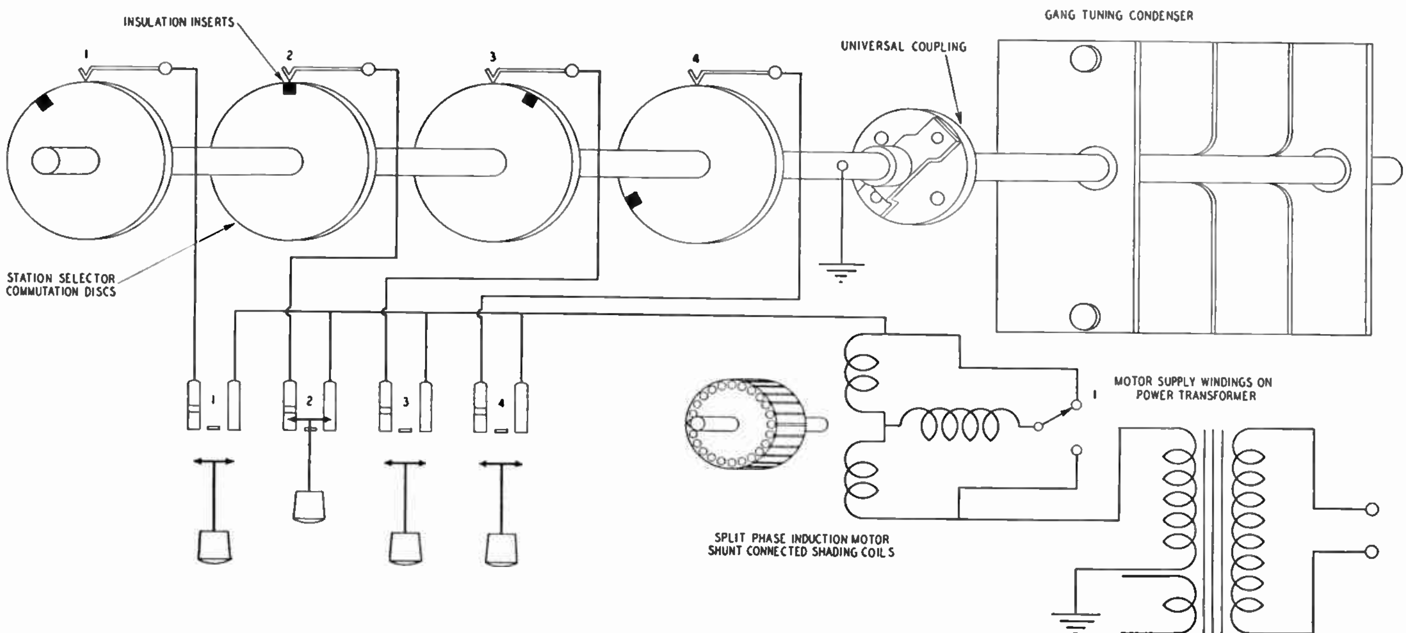


FIGURE 2—*Schematic Diagram of Typical Motor-Tuned System.*

TABLE III—TUNED CIRCUIT SUBSTITUTION TYPES

MANUFACTURER and MODEL	Name of Automatic Feature	No. of Selected Stations	Type See Page 249	See Section C Page 257 Transfer Device Manual to Automatic See Note	See Section G Page 266 Push Button Station Selector Switch See Note
AIR KING					
910		5 and T*	IIIA2b	C4	G2
911		5 and T	IIIA2b	C4	G2
AUTOMATIC ELECTRIC 855, 892		6	IIIB	C2	G2
ERLA 107AE		5 and T*	IIIA2b	C4	G2
FADA 368	Flashomatic	6	IIIA4	C2	G5
GAROD 782, 782-1	Prestomatic	6	IIIA1a	C2	G2
GENERAL ELECTRIC F96	Touch-Tuning	6 and T*	IIIA2b	C4	G2
GILFILLAN BROS. 5T8	Automatic Touch Tuning	6 and T*	IIIA2b	C4	G2
HOWARD 240, 240-2	Automatic Tuning	8	IIIA3		G2
210 Adapter, 211 Converter		8 and T*	IIA1	Spec. note	G2
NOBLITT-SPARKS 1237, 1247, 1247A	Phantom Tuning	6	IIIA1b	C2	G2
1427		10	IIIA1b	C2	G2
PACIFIC (CHICAGO) Converter Unit	Selectro-Matic	6 and T	IIIA1a	C4	G2
PACIFIC (LOS ANGELES) 37, 37A		6 and T*	IIIA2	C4	G2
R.C.A. 87K1, 87T2	Automatic Electric Tuning	6	IIIB	C2	G2
RADIO PRODUCTS Motor Car Conversion Unit	Touch-O-Matic	5 and T	IIIA4		G1
SPARKS-WITHINGTON 1068, 1268, 1288, 1568	Selectronne	6	IIIA1b	C1	G2
738		6	IIIA3		G2
STROMBERG-CARLSON 235, 245	Electrical Flash Tuning	6	IIIA2a	C1	G2
WARWICK 645		5 and T*	IIIA2b	C4	G2
WILCOX-GAY A48, 7S5		6	IIIA3		G2

*When gang is tuned to desired station the transfer button (T) becomes an additional selected station.
(Notes given on pages 253 to 271)

III. TUNED CIRCUIT SUBSTITUTION TYPES

These types, of which the Sparton "Selectronne" was the first to be introduced in this country, function by substituting pre-set tuned circuits for the usual variable condenser tuning circuits. Control is shifted from the variable condenser to pre-set trimmer condensers (or iron core tuned circuits) mounted adjacent to the switch terminal of a push button selector switch. The transfer may be accomplished in a variety of ways described in detail in section C. One outstanding advantage of this type of system is its instantaneous action. Response to a desired station occurs immediately upon depressing the station button.

DESCRIPTION OF CONDENSER TUNED SYSTEM

A typical condenser substitution system is shown in pictorial fashion in Figure 3, with the schematic diagram of the rear wave switch section shown in Figure 4. The various parts are separated in these illustrations in such a manner as to show the operation to advantage and do not necessarily represent the actual placement of the parts in a receiver.

The circuit illustrated is that of a two-band receiver with both push button and continuous tuning on the broadcast band. The wave change switch has been given an extra or extreme counter clockwise position to transfer the circuit connections from manual to automatic tuning. In this position the switch terminal connected to the gang condenser stator is open and the grid, broadcast secondary and push button selected trimmer condenser are all connected in parallel. The upper bank of condensers serve to tune the oscillator grid circuit, while the lower bank of condensers are used to tune the detector input circuit. The circuit illustrates ground side switching with the high potential side of the trimmer condensers connected in parallel. In this case the shoe holders of the sliding contact shoes on the push button switch are made of metal and serve to connect the low potential sides of the selected condensers to frame or ground as shown in the schematic diagram of Figure 4.

DESCRIPTION OF IRON CORE TUNED SYSTEM

The use of adjustable iron cores as a means of presetting tuned circuits was described briefly in the general outline.

In Figure 5 is shown the schematic wiring diagram of one of the recent models employing compression tuned (trimmer) input circuits and iron core tuned

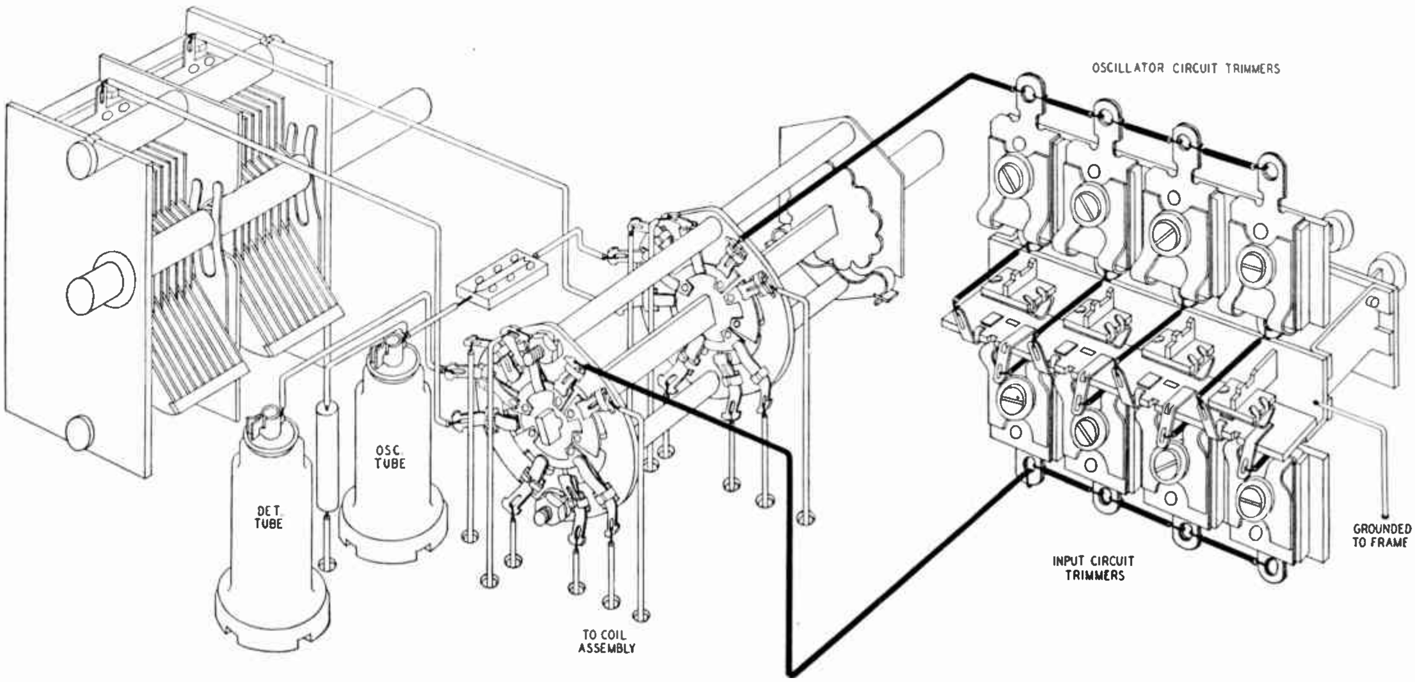


FIGURE 3—*Typical Condenser Substitution Tuning System.*

oscillator circuits. Figure 5A shows an "under-chassis" view of this receiver. As in the previous diagram a position of the wave change switch has been used to transfer from manual to automatic operation. The portions of the circuit used in automatic tuning have been shown by darker lines than the remainder of the diagram. The iron core trimmed coils are individually connected in parallel with an auxiliary secondary coil coupled to the broadcast oscillator plate winding. This coil tuned by condenser C is resonant to a frequency below the broadcast band so that when it is paralleled by the iron core winding the frequency is increased to the desired point in the band. The condenser is of special construction and utilizes a ceramic dielectric which has a negative temperature coefficient to compensate the positive temperature drift of coil and tube.

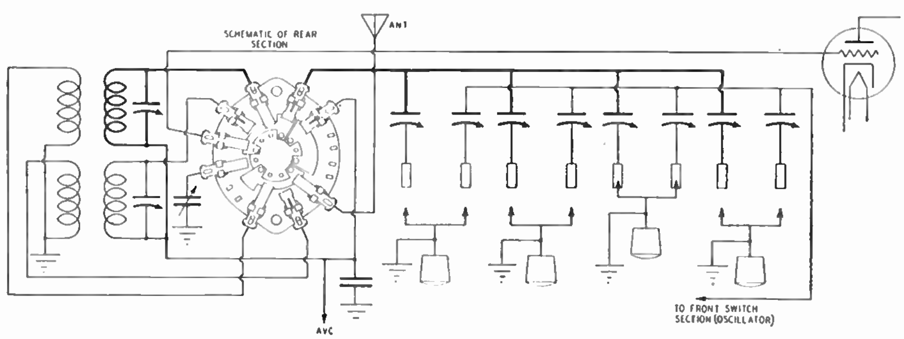


FIGURE 4—*Schematic Diagram of Rear Switch Section of Figure 3.*

SECTION A—MECHANICAL STATION BUTTON OR INDEXING ADJUSTMENT

In all of the mechanically operated manual types and a few of the motor driven types the station selecting button itself provides the adjustment of the indexing pin which arrests rotation of the gang condenser at the proper point for station tune. In most models the pin or lever is attached to the opposite end of the push button plunger and is held away from the dial mechanism by a coiled or flat spring. The series of button plungers are usually attached to a dial plate which in turn drives the gang condenser through a gear train so proportioned as to allow almost 360° of dial plate rotation. This constitutes the familiar "telephone" dial type of drive mechanism. As the plunger is depressed and the dial rotated in the same operation the indexing pin moves forward and is arrested in its rotary motion by some type of stop or lock-in device (See Section B). The precise position at which the condenser rotation stops is adjustable, by one of the following methods described, to allow set-up of the receiver to a group of desired stations after which the adjustment is locked in place.

Note A1

The splined, serrated or straight knurl type of indexing adjustment has probably been employed in more of the manually tuned sets than any other type. Its action can be understood from a study of Figures 6, 7, and 8. The grooves on the plunger slide freely

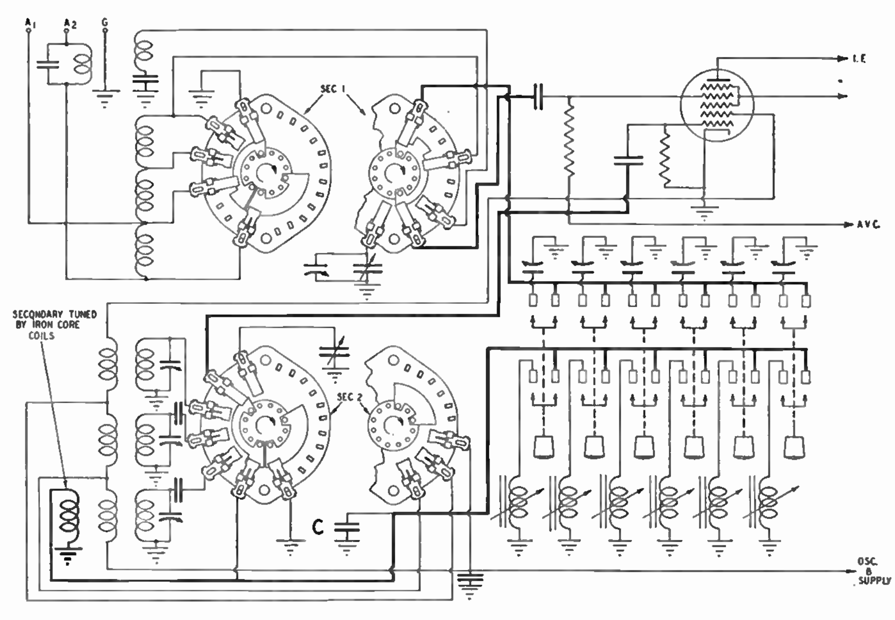


FIGURE 5—*Iron Core Tuned System (R.C.A.).*

in co-operating grooves in the dial plate so that the plunger may be readily pushed into the opening in the dial plate but may not be rotated unless unlocked in some manner for adjustment.

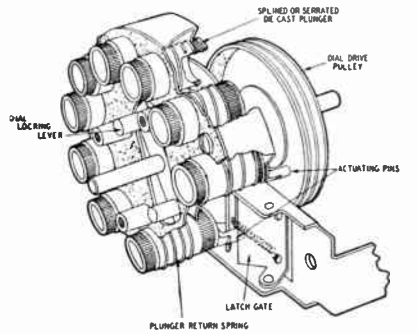


FIGURE 6—*Colonial Indexing Adjustment.*

COLONIAL—Figure 6 shows by means of a line drawing cutaway view the action of the Colonial indexing adjustment. The dial locking lever when rotated a few degrees toward the left unlocks the mechanism and allows the die cast plungers to be pushed in until the serrated portion clears the grooves in the aperture of the dial plate. When this is done the plungers may be rotated so that the actuating pin can be correctly located for station tune. A reverse rotation of the locking lever prevents subsequent motion of the plunger beyond the serrations.

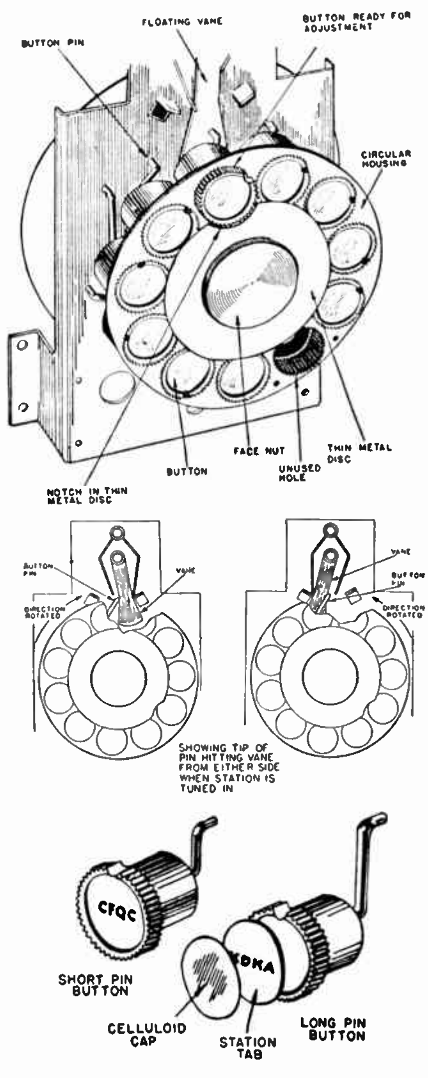


FIGURE 7—*Emerson Indexing Adjustment.*

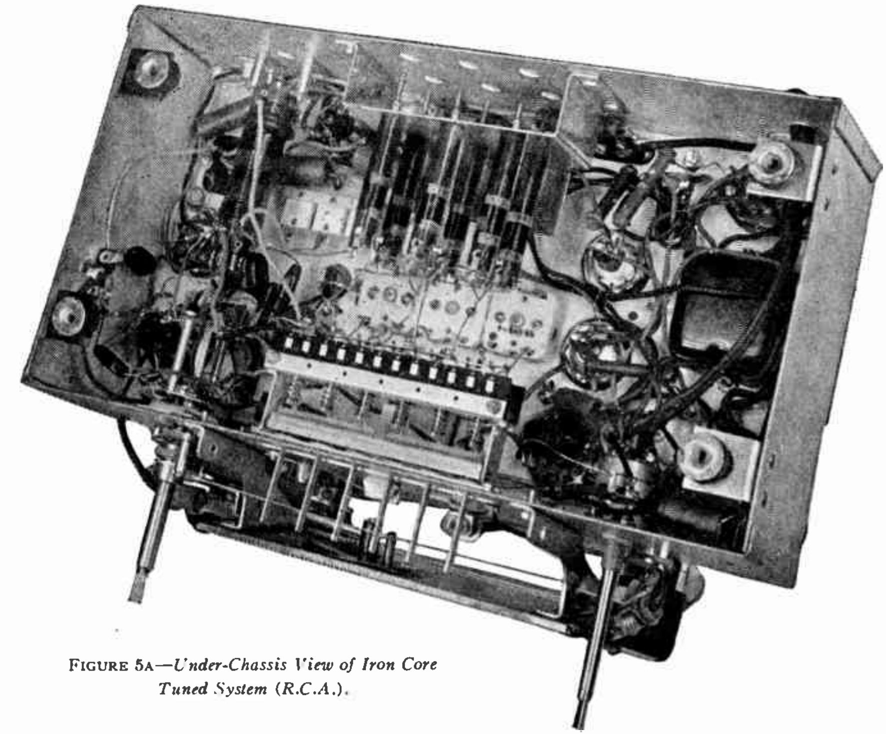


FIGURE 5A—*Under-Chassis View of Iron Core Tuned System (R.C.A.).*

EMERSON—Figure 7 shows a similar serrated type of adjustment. In this case the outer ornamental dial plate is removed during setup operations. Its place is taken by a thin metal disc held in place by the knurled face nut. This disc has a single semi-circular notch in its periphery which may be adjusted to allow any one button to be moved forward while holding the rest of the buttons in place. Thus a button under the action of its spring will move forward sufficiently to allow its serration to clear those of the housing after which it may be rotated so that the button pin is in the correct position for station tune.

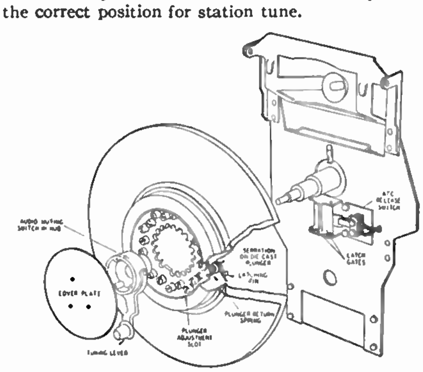


FIGURE 8—*Philco Automatic Dial.*

PHILCO—Figure 8 shows a line drawing of the details of the Philco Automatic Dial. A diecast plunger similar to those previously described operates in grooves in the rear of the housing. The method of adjustment differs from the foregoing in that the plunger may readily be moved from one groove to another after the front plate has been removed by depressing it against the action of its spring until the serrations clear the opening in the rear of the housing. This may be done with a screw driver since the head of the plunger has a slot to receive the screw driver.

Similar mechanisms employing serrated plungers may be found in the mechanical models of Fairbanks-Morse, General Household Utilities, and Wells-Gardner.

Note A2

An alternate method of locking the station selecting button is by means of threaded lock nuts on the plunger shaft.

WILCOX-GAY—Figure 9 shows one of the simplest of automatic dial assemblies. The station buttons are located at the ends of radial flat spring members which are so shaped as to hold the button away from contact

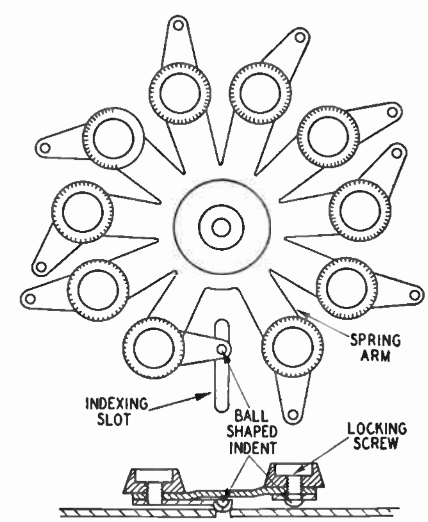


FIGURE 9—*Wilcox-Gay Automatic Dial Assembly.*

with a slotted plate on the front of the receiver. These radial members are attached to the dial drive shaft. Each of the buttons carries a cam at whose end is a ball-shaped depression which engages a fixed slot in a stationary plate attached to the chassis. The cam may be unlocked and allowed to rotate around the button center by unscrewing the button itself which acts as a lock nut.

The Galvin Household, United American Bosch, and Westinghouse motor-driven systems employ the lock nut principle of adjusting station plungers.

Note A3

This method of pre-setting the position of the station button plungers employs the screw locking principle of Note A2 in combination with annular shaped slots in the dial plate concentric with the dial center.

ERLA—The Erla "Push Button Dial" and "Automatic Tune Wheel" dial have the station plungers and tabs locked in a slot around the outer rim of the dial as shown in Figures 10 and 11 by means of a lock nut sliding within the dial rail.

PHILCO — The "Cone-centric" tuning system employs small metal cones which are locked in place in a circular slot as shown in line drawing 12. Two small holes near the apex of the cone allow the insertion of a special tool through the hollow center of the tuning knob. This permits the cones to be loosened, moved along the slot and tightened in the desired position in a single operation as the dial is adjusted to tune on a desired station. Subsequent selection of the station is accomplished with accuracy by centering the conical depression of the tuning arm over the desired station cone.

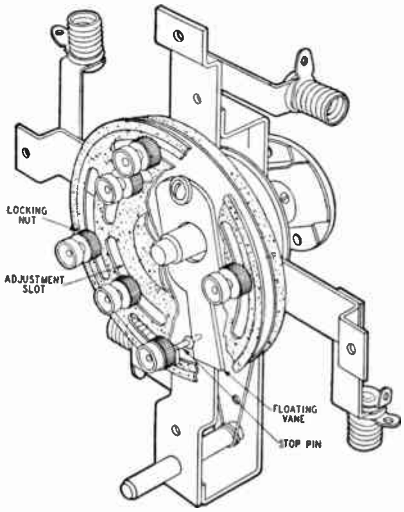


FIGURE 13—*Trav-ler Annular Slot and Lock-Nut System.*

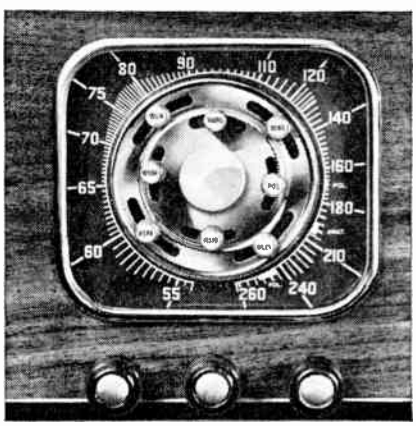


FIGURE 13A—*Trav-ler Dial.*

TRAV-LER—Figures 13 and 13A illustrate the simple use of the annular slot and lock nut for setting of button positions. In this case stations may be set even on adjacent channels since the buttons are arranged on two radii with an overlap of range.

Note A4

In the flash tuning systems of Erla and Noblitt-Sparks the station indicator adjustments operate in annular slots in a fixed member or plate while an electrical contactor is carried by the moving dial mechanism causing an indicator light to flash as each of the desired stations are successively tuned in. Audio silencing which is operative between stations is removed as the contacts are made. Audio silencing details of these systems are covered more fully in Section D.

NOBLITT-SPARKS—Figures 14 and 14A show rear and front views of the "Phantom" tuning dial of the Arvin models which employ the flash tuning principle. Contacts are movable along the annular slots shown and as the station positions are successively passed in manually tuning the receiver the lights in panels along either side of the dial indicate the station to which the receiver is tuned. Adjustment of position of the contactors is accomplished by unlocking them by means of their screw thread and subsequently relocking them in the required positions.

ERLA—The Erla Flash Tuning dial employs a similar system except that station tabs are employed which are set along a circular guide rail at the edge of the dial. Rapid and Flash tuning are accomplished by a lever which operates independently from the conventional rotary vernier tuning knob.

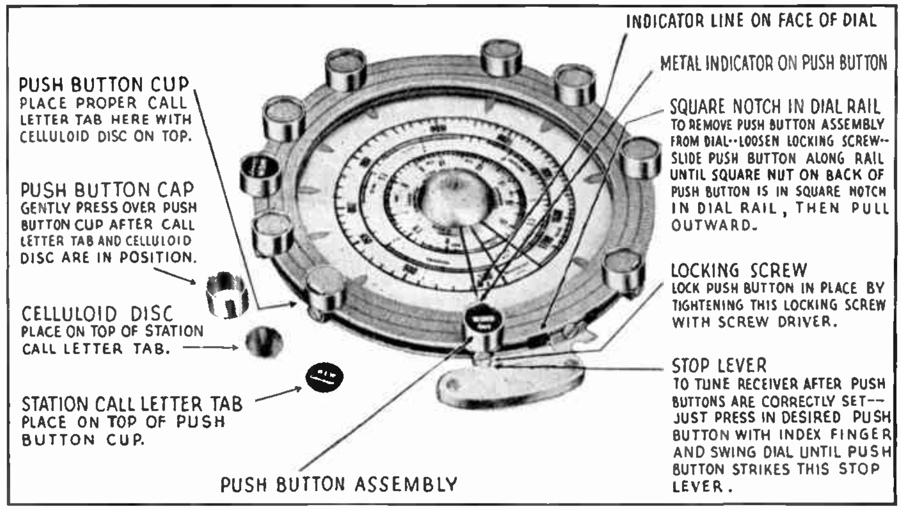


FIGURE 10—*Erla-Sentinel Push-Button Dial.*

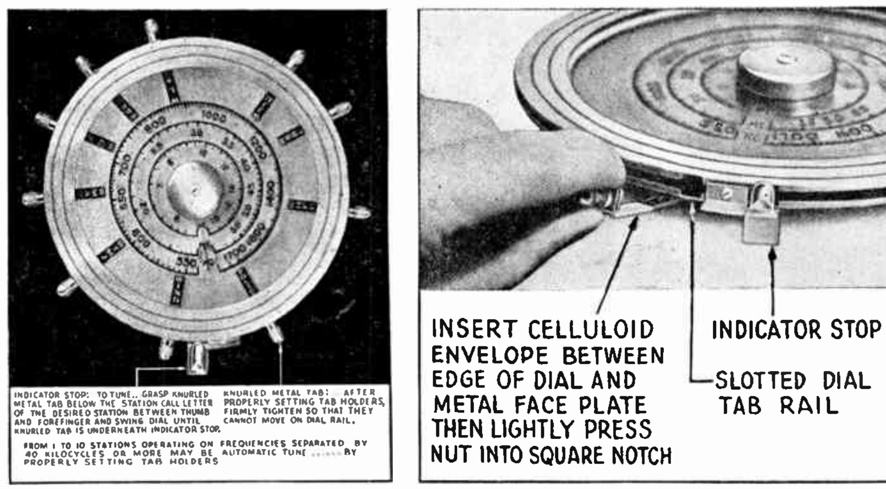


FIGURE 11—*Erla-Sentinel "Automatic Tune Wheel" Dial.*

Note A5

An alternative system of "Flash" tuning of novel design is that offered by Stromberg-Carlson. This system employs a series of thin discs or contactors which operate in conjunction with an electrical gate as shown in Figures 15 and 15A. When the large knurled clamping nut is released, a contactor disc may be located in the center of the electrical gate while a station is tuned manually. The knurled nut is then tightened while the contactor clamping frame is held rigidly to prevent accidental rotation of either the gang condenser or the contactor disc. The contactor discs are insulated from the frame and individually connected to station indicator lamps one of which is illuminated as each contactor disc centers in the electrical gate. Audio silencing and AFC release functions are performed by contacts in the electrical gate (see Sections D and E).

Note A6

A unique application of mechanical automatic station selection to motor car receivers has been made available in several Motorola models. This device, known as "Spot Tuning," is illustrated in Figures 16 and 16A. It consists of a compact mechanism in a cylindrical housing attached to the exterior of the motor car receiver by means of the mounting plate. It constitutes a link in the driving system between the flexible shaft from the control head and the gang condenser driving gear system. Since it is connected directly adjacent to the gang condenser it is not subject to back-lash difficulties. Its operation is as follows: A soft brass cylinder carries a double V thread and is surrounded by a spring steel sleeve of cylindrical form having a longitudinal slot. This slot serves as a guide to retain a hardened steel ball in one of the threads. As the flexible shaft is rotated in tuning the receiver the steel ball is caused to "walk" along the thread. If

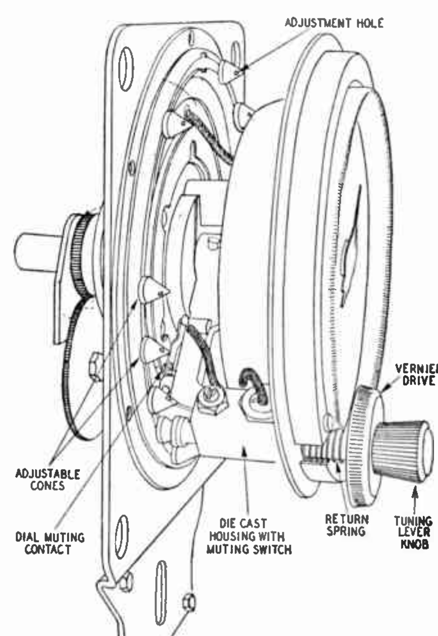


FIGURE 12—*Philco "Cone-centric" Tuning Mechanism.*

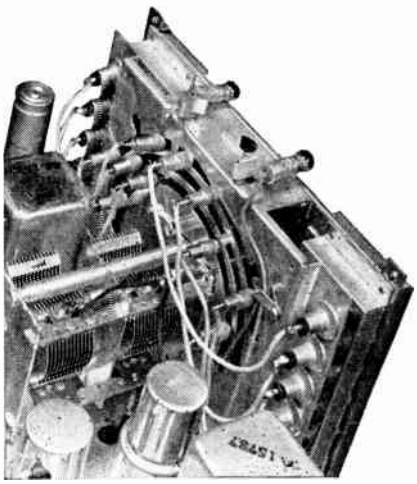


FIGURE 14—*Noblitt-Sparks (Arvin) "Phantom Tuning"—Rear View.*

FIGURE 14A—*Noblitt-Sparks (Arvin) "Phantom Tuning"—Front of Dial.*

after a station is accurately tuned to resonance, pressure is applied to the steel ball and sleeve at points AA (see Figure 16) with a pair of gas-pliers, an indent is produced in the brass cylinder which subsequently will act as a mechanical indexing point for automatic tuning. In this manner all of the desired automatic station points are set up in turn. In the event that an error is made in the location of one of these points, use can be made of the other thread in the double-threaded cylinder by rotating the tuning condenser to the end of this range at which point the steel ball will drop into the next thread channel and present a new, clear groove for station set-up. Alternatively the double thread may be employed for two separate sets of automatic station selections as in two separate localities between which the car owner frequently travels.

SECTION B—MECHANICAL STOP OR LOCK-IN MECHANISM

All of the indexing pin arrangements described in Section A operate in conjunction with some type of stop or latch mechanism. As the dial is rotated with an indexing pin extended a fixed stop must be provided to arrest the motion of the pin at the desired tune point. In many cases this stop also functions to remove the automatic frequency control bias momentarily and thus allow control to be regained on the desired station. Stop mechanisms are employed on all of the mechanically operated manual types and also on a few of the motor driven types in which case they replace the electrical commutation device normally used.

Note B1

One of the most popular types of lock-in mechanisms is the latch gate, illustrated in Figures 6 and 8. This consists of a pair of hinged gates normally held closed by a spring mechanism. As the extended plunger pin approaches the gate it strikes one of the pair of plates causing it to move inward until the pin passes the edge of the plate. As soon as the pin has passed the edge of the plate, the latter returns to its closed position. At this point the pin strikes the edge of the opposite open plate and is thus locked from rotation in either direction. Figure 6 shows one of the plungers with its pin engaged in the latch gate.

Examples of use of the latch gate are: Colonial, Fairbanks-Morse, G. H. U., Philco, and Wells-Gardner.

Note B2

In the Stromberg-Carlson "Flash Tuning" receiver the latch gate, whose contactor mechanism was described in Note A5, the gate mechanism does not latch the end of the contactor disc against further rotation but merely arrests motion by interposing additional friction as shown in Figure 15. This detent principle which indicates the point of tune without preventing further rotation is also employed in the Motorola "Spot Tuning" as described in Note A6.

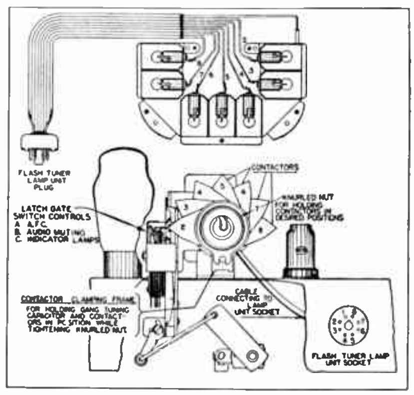


FIGURE 15—*Stromberg-Carlson "Flash-Tuning" System.*

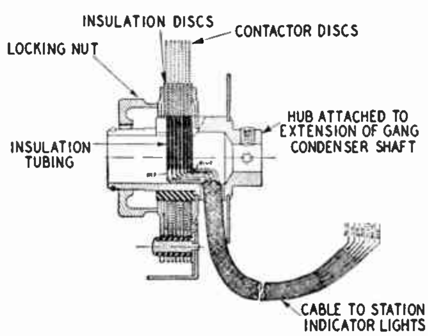


FIGURE 15A—*Stromberg-Carlson "Flash-Tuning" System.*

Note B3

The Philco "Cone-centric" latching principle is a novel method of assuring accuracy of location of the tuning drive. The approximate location of desired local stations are printed upon the dial (a separate dial scale is available for each of the principal sales centers of the country). By means of the station indication the dial is quickly turned to the approximate location of the station. Upon depressing the tuning lever it will be found that a conical shaped end of the lever will center itself over the cone which has been accurately located by the dealer or service engineer as indicated in Note A3 and Figure 12.

Note B4

A method of station stop which permits of very simple construction employs a floating vane operating between fixed stops.

EMERSON—The Automatic Dial mechanism illustrated in Figure 7 clearly delineates the action of the floating vane stop. The stop is so shaped that the center of the pin will be located on a line drawn vertically through the center of the dial when the pin pushes the vane against either stop. In other words the shape of the vane and its thickness are such that independent of the position of the pin it will be centrally located when approaching the stop from either direction. Note—In using this type of mechanism the operator should be instructed to withdraw the finger from the button directly and thus prevent motion of the dial away from the stop since the vane arrests motion in one direction only.

TRAV-LER—The Trav-ler mechanism is similar to the Emerson type previously described with the exception that the stop occurs on the tuning hub rather than on two symmetrically spaced stops as in the former mechanism. This will be evident from an inspection of Figure 13.

Note B5

A simple positive lock-in mechanism is employed in the Wilcox-Gay receiver whose button adjustment has been described in Note A2 and illustrated in Figure 9. The end of the cams attached to the button have a hemispherical detent which drops into a vertical slot when the dial is rotated toward the index or bottom position. When this occurs, further motion in either direction is not possible. Upon removing the finger from the button, the spring arm to which the button and cam are attached withdraws the detent from the notch.

Note B7

The Motorola "Electric Automatic Tuner" of the motor-driven type, shown in Figure 17, employs a method of locking a depressed station button which is very similar to that used in some of the ladder type push button switches. The button plunger has a groove and shoulder running around its circumference. This serves to lock a button "in," when it is pressed. The button is held by a locking plate which drops behind this shoulder. The locking mechanism consists of three flat plates, the center of which is the locking plate. The three plates have a series of round holes through which the button plungers extend. The center or locking plate is under spring tension with respect to the other two which tends to keep the holes out of line. When a button is pressed the shoulder on the plunger forces the holes into alignment which releases any previously held button and locks the button selected into place. A rotating mechanism carrying a slotted latch gate, locks upon the stop arm of the button, forming a mechanical stop. At the same time the electrical circuits of the motor are opened by jack spring contacts within the slotted latch gate.

Note B8

In the United American Bosch and Westinghouse receivers the latch gate is carried on a rotating member driven by the tuning dial. This latch locks upon the end of the tuning lever of a depressed button in a manner similar to that described in Note B7.

Note B9

The Motorola "Press-Button Tuning" magnetic latch differs in so many respects from other latching

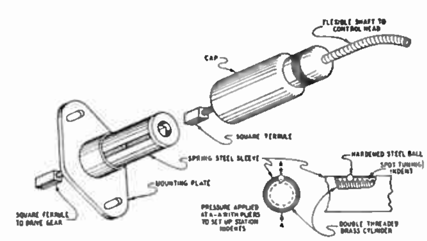


FIGURE 16—*Galvin (Motorola) "Spot Tuning" Mechanism.*

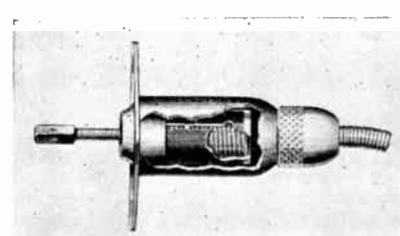


FIGURE 16A—*Galvin (Motorola) "Spot Tuning"—Exterior.*

systems as to merit special consideration. Its operation is illustrated in Figures 18 and 19, and circuit diagram 20. In Figure 18 is shown a cutaway drawing

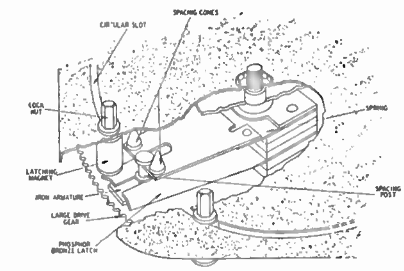


FIGURE 18—*Galvin (Motorola) "Press Button Tuning" System*

of the magnetic latching system as used in the Motorola motor-tuned motor car receivers. A moving latch system attached to a large drive gear is caused to stop and lock at desired station tune positions by selectively energized magnets. The magnets are mounted by means of threaded studs in a circular slot with their pole faces directly above the path of an iron armature. A phosphor bronze member, fashioned as a two-prong fork is interposed between the armature and the magnet pole face. The spacing of this bronze latch and the armature from the pole faces of the magnets is accurately held by means of the spacing post and spacing cones shown in Figure 18. Reference to the sequence diagram shown in Figure 19 and the schematic circuit of Figure 20 will assist in clarifying

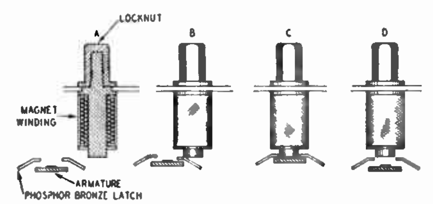


FIGURE 19—*Galvin (Motorola) "Press Button Tuning"—Action Diagram.*

the operation of the device. "A" of Figure 19 shows a cross-section view of the magnet, locknut, armature and bronze latch gate. This view represents the condition before the tuning cycle is initiated. Pressing a desired station button (see Figure 20) closes the switch by first connecting a desired latching magnet to the plus A supply followed by the completion of the A supply through the reversing switch and tuning motor. As the motor starts driving the large gear which carries the armature and latch bar, the armature approaches the position of the desired station locking magnet as shown in "B" of Figure 19. The magnet attracts the armature. As the armature carries with it the latching spring, this is depressed and drops over the pole face of the magnet. "C" of Figure 19 shows the condition which exists as the armature is held against the magnet pole face with two sides of the fork firmly pressed against the pole face and preventing further rotation of the armature and consequently of the gang condenser. When the operator's finger is withdrawn from the push button the motor contacts break, thus preventing further rotation of the gang condenser. Then the magnet supply circuit is broken, allowing both the armature and latch spring to be pulled away from the magnet as shown in "D" of Figure 19. This leaves the system clear and ready to move, on the next station-selecting impulse. Details of motor reversal and audio muting relay action will be covered more completely in their respective sections.

SECTION C— TRANSFER DEVICES AND CIRCUITS FROM MANUAL TO AUTOMATIC TUNING

The circuits, switches, and mechanical devices employed to transfer operation from manual or continuous tuning to automatic tuning display more variation and are inter-related with more diverse circuit functions than any of the other elements of automatic tuning. The transfer operation in some receivers is handled by a separate switch, in others by a separate position on the wave band switch and in still another group by the use of one of the switches of the push button selector switch. In many receivers a number of functions are performed by the transfer switch such as the removal of automatic frequency control operation when in the manual position, addition of transfer to phonograph operation, or removal of audio muting. The circuit diagrams used in illustrations of transfer switching will in some cases also serve to illustrate details to be covered under the headings of push button station selector switches, audio silencing and AFC release.

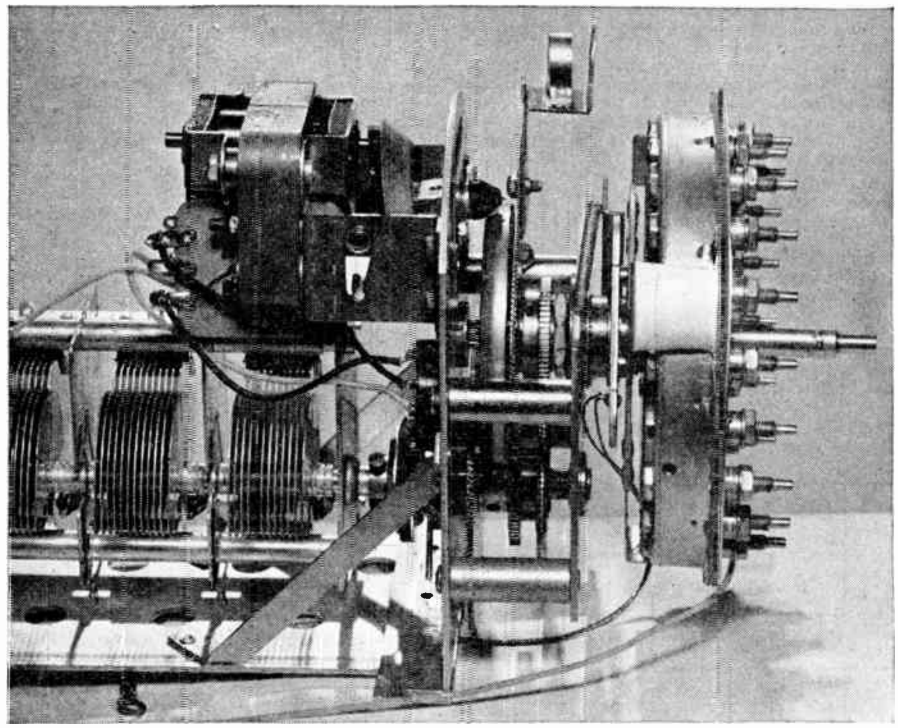


FIGURE 17—*Galvin (Motorola) Electric Automatic Tuner.*

Note C1

The use of a separate transfer switch for changing from manual to automatic tuning is found in receivers of all three classifications of automatic tuning. The transfer switch is found to handle RF, AF, motor or dial lighting circuits and in many cases, combinations of these circuits.

COLONIAL—Figure 21 shows the interconnection between three separate switching groups employed in some of the Colonial (Sears-Silvertone) receivers. The three-point switch shown at the right in Figure 21 provides for normal or manual tuning in its first position, automatic tuning in its second position and phonograph operation in its third position. It consists of three separate sections. The upper group serve to connect the audio grid to either the detector or the phonograph pick-up. The middle group interconnects with the wave band and dial switches to provide the release of AFC and audio muting when in the broadcast manual position, using these functions in the automatic position and the short circuit of the detector output when in phonograph operation. The lower switch serves to connect an indicator lamp while in the automatic tuning position. The wave band switch carries contacts which disconnect the AFC system on both of the short wave positions as well as rendering the audio muting circuits inoperative in short wave positions.

GILFILLAN BROS.—This model (circuit diagram shown in Figure 22) combines the operation of transfer with that of selectivity control. The three-position switch when in its counter-clockwise position provides for automatic tuning by completing the motor supply circuit and at the same time operates on the coupling of the IF transformer to broaden its response. In the center position the receiver is used for manual tuning with the IF coupling adjusted for sharp response, the motor circuit open and the sensitivity of RF amplifier and converter altered by change in bias. The third

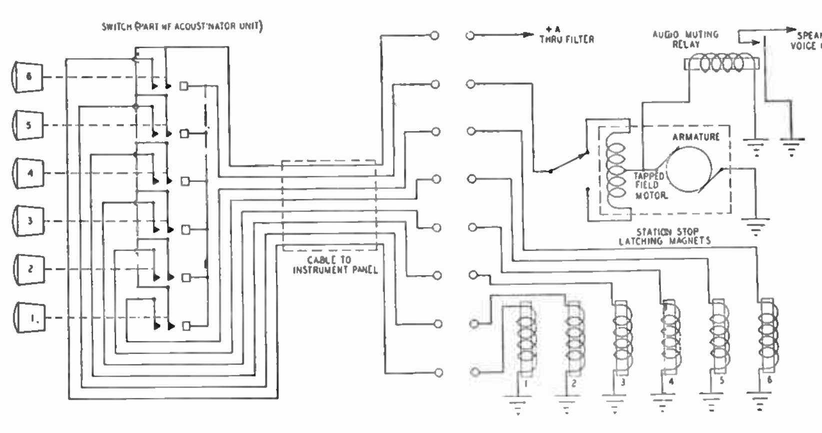


FIGURE 20—*Galvin (Motorola) "Press Button Tuning"—Circuit Diagram.*

or clockwise position provides for manual operation with broad response of the IF amplifier. In this position the bias has been returned to the same condition as in position one but the motor circuit is open to prevent the use of the automatic tuning function. An additional interconnection of the motor circuit through the broadcast position of the band switch prevents the use of automatic tuning when the switch is in either of the short wave positions.

NOBLITT-SPARKS—Figure 23 shows the use of the transfer switch in connection with a band-widening circuit and a relay controlled muting circuit. This latter circuit is covered in greater detail in section D. When on the manual tuning psoition, both intermediate frequency stages are in the narrow or sharp position and the muting relay is held open. In automatic tuning both IF stages have increased coupling for broad response and audio muting is controlled by station contacts on the dial. The use of broad response in the automatic tuning position obviates the necessity of automatic frequency control.

Note—the change from sharp to broad tuning when in the automatic position is used in a number of makes of receivers on the theory that automatic selection is used for high level or local programs only. In this case it is not only desirable to have high fidelity response but also broad tuning to cover slight inaccuracies incidental to automatic tuning.

PHILCO—In Philco models employing the "automatic dial tuning system" transfer from automatic to manual tuning is accomplished by a two-pole switch which grounds both AFC discriminator cathodes when in manual tuning to render the automatic frequency control system inoperative.

R.C.A.—In R.C.A. receivers of the motor-tuned type the transfer switch serves the additional function of selecting either automatic operation at the receiver or at a remote point. Indicator lights for manual or electric tuning are selected by the transfer switch as is also the removal of AFC control while on the manual position (see Figure 24).

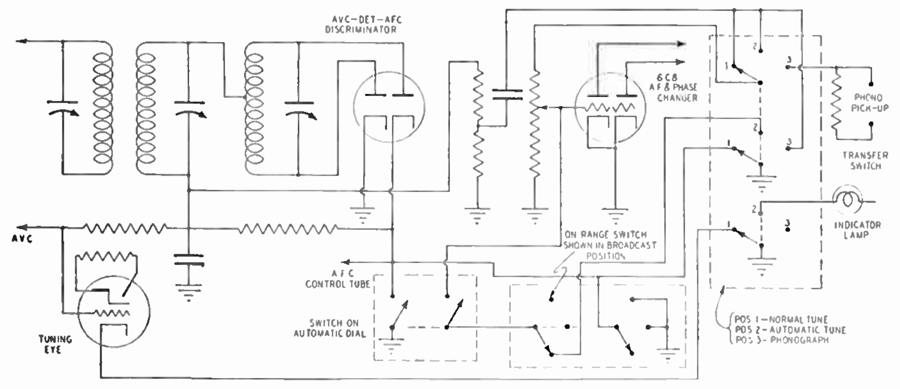


FIGURE 21—*Colonial (Sears-Silvertone) Transfer Switching Diagram.*

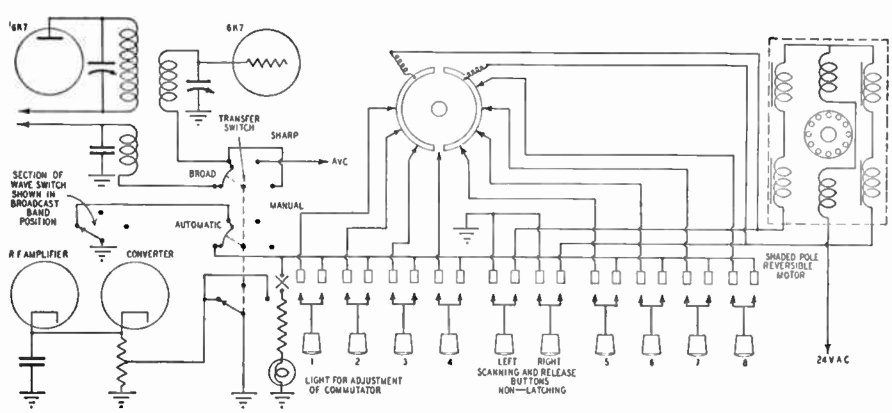


FIGURE 22—*Gilfillan Bros.—Transfer Switching and Selectivity Control.*

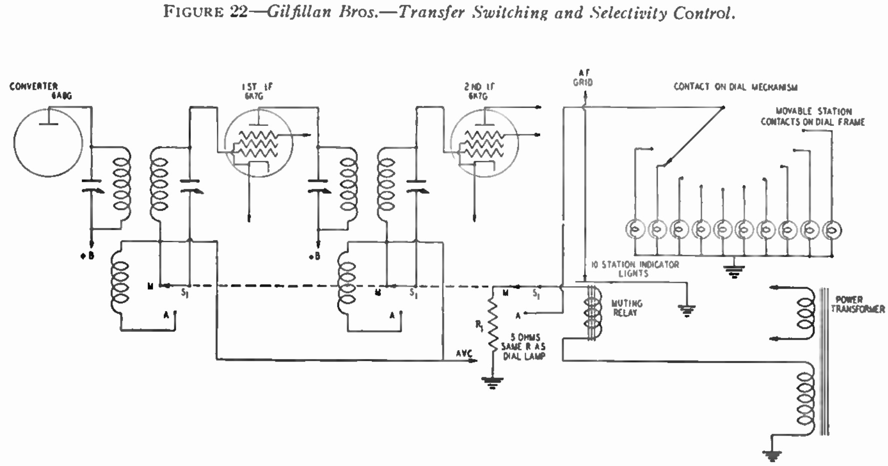


FIGURE 23—*Noblitt-Sparks (Arvin) "Phantom Tuning"—Circuit Diagram.*

SPARKS-WITHINGTON—The transfer switch of the Sparton "Selectronne" is of a very novel construction since it makes use of axial movement of the wave band switch shaft. This is accomplished by mounting the individual switch sections of the wave band switch to partitions of a subassembly in such a manner that the rotor staff of the switch can be moved longitudinally to operate a series of five single-pole double-throw switches. This transfer switch assembly is shown pictorially in Figure 25 with the schematic wiring diagram in Figure 26.

The three switch sections mounted adjacent to the wave band sections are used to transfer the grids of the RF, detector, and oscillator tubes to either the gang condenser for manual tuning or to their respective sections of the push button capacitor group for automatic tuning. The two switches shown on the front plate of the unit are used to operate the AFC and dial light circuits. An advantage of this type of switch lies in the low capacitance of the transfer switches to ground and their close promixity to the desired switching points.

STROMBERG-CARLSON—The "Electric Flash Tuning" models employ a transfer switch of unique design which embodies some of the functions usually associated with wave band switches. In fact the switch is constructed with wave band or rotary selector type terminals although it is of sliding construction as shown in Figure 27. Because of its construction it has been termed a "shuttlecock" switch. Circuit diagram Figure 28 shows that the switch is not only used to change from the gang tuning condenser to preselected trimmer units but also to drop the RF amplifier stage when on the push button position. The switch is mounted directly on the side of the gang condenser thereby assuring short interconnecting leads and a minimum of capacitance to ground due to the relatively great separation of the switch terminals from each other and ground.

The functions of dial light switching and release of automatic frequency control on manual positions are additional functions handled by the switch. The switch is moved between its two positions by a mechanical link connecting a knob on the tuning panel with the stud in the moving member. Coils L1 and L2 reduce the effective inductance of input and oscillator tuning coils when on the push button position to accommodate the high minimum capacitance of the push button bank and allow tune to the high frequency and police stations. Note—The inclusion of what would normally be considered wave band switching functions on the transfer switch are an indication of the trend toward push button wave band switching.

Note C2

Transfer from manual to automatic tuning is often accomplished by providing an extra position on the wave band switch. This method is frequently found in receivers of Table III (Tuned Circuit Substitution Types). It provides a ready means of removing the minimum capacitance of the push button condenser group when on the manual or continuous tuning position. In some of the motor tuned types the use of additional contacts on the wave change switch provides the function of limiting automatic operation to the broadcast band by breaking the motor supply circuit when the band switch is in any of the short wave positions. The use of the band switch for transfer has been briefly indicated in the description of typical substitution tuned systems on page 252 and illustrated in Figures 3, 4, and 5, page 253.

AUTOMATIC RADIO—In several of the Automatic Radio models an unusual switching sequence is provided to change from a conventional variable condenser-tuned circuit to a combination of trimmer and iron core tuning on the automatic position. Figure 29 shows the use of a three-position wave change switch consisting of six single-pole three-position units. When in the automatic tuning position the detector input is transferred to a separate antenna coupling coil tuned by individual trimmer units. On this same position a novel oscillator circuit is in use employing a separate tube (type 76) connected as a Colpitts or capacitance feedback type. The Colpitts is ideally adapted to iron core trimmed circuits since it does not require the use of feedback coupling coils and allows the switching of the iron trimmed coil units by a simple single-pole grounded switch.

ERLA (SENTINEL)—The Erla "Flash Tuning" and "Automatic Tune Wheel Dial" models employ circuits on the band switch to control the lamp circuit, audio silencing and AFC release as shown in circuit diagram Figure 30. Audio silencing and AFC details are unusual in that a bias change of the RF and IF amplifiers are used (see Sections D and E.)

FADA—Figure 31 shows the use of a wave band switch for the dual functions of transfer to automatic tune and IF band widening when on the automatic position. An auxiliary switch is provided to narrow the IF band width during the alignment of the pre-set station trimmers. This precaution assures accuracy of adjustment and compensation for slight drift of tune in use since the receiver is always set for wide band reception when in the automatic tuning position.

GAROD—A simple switching sequence is used on the wave band switch of the Garod "Prestomatic" receivers to connect the circuits for pre-set trimmer tuning as shown in the schematic wiring diagram of Figure 32.

NOBLITT-SPARKS—Several models of the Arvin line employ wave band transfer switching to trimmer tuned circuits. The first or counterclockwise position of the band switch is used to connect the broadcast coils to the pre-set trimmer units by a switching arrangement similar to that shown in Figure 4, page 253.

R.C.A.—The schematic diagram of an "Automatic Electric Tuning" model with iron core trimmed oscillator circuits is illustrated in Figure 5, page 253. In this diagram the wave band switch which consists of two sections has been shown pictorially to clarify the various switching positions. It is shown in position No. 1, or automatic tune, with the circuits in use shown in heavy lines. It will be noted that in the next position of the switch the units of the gang condenser will be connected and the input trimmer condensers and iron core oscillator units disconnected.

Note C3

In the Motorola electric automatic tuner whose latching system was described in Note B7, transfer to manual tune is assigned to one of the push buttons known as a release button. This release button operates a series of jack spring contacts which open the motor circuit, release or cut-out the AFC and open the audio muting. Thus when this button is depressed any of the latch buttons are released and circuits set up for manual tuning. This circuit is shown in Figure 33.

Note C4

A popular method of transfer from manual to automatic tuning in both the motor and tuned circuit substitution types is the utilization of one of the buttons of the push button station selector switch. This type of switch will be covered in greater detail in section G. In the majority of cases the switch is of the latching or ladder type. The latch locks a button in place and releases any previously selected button. When the transfer switch is part of such a unit the receiver will be held in the manual tune position until it is desired to operate it automatically. In this case the selection of a particular station button transfers operation by the single motion of depressing the button rather than by two operations as would be necessary in all of the transfer devices previously described with the exception of Note C3, which may be regarded as similar to the type under discussion.

In the receivers listed in Table III, push button switch contacts are connected directly to the trimmer condensers and are part of the radio frequency circuits of the receiver. Two methods have been used for transfer as illustrated in Figures 34A and 34B. In Figure 34A a group of L-shaped terminals are used to produce a series switching sequence. When button one is depressed the grid and coil circuit is connected to gang condenser "G." When any other button is selected the gang condenser is disconnected and a pre-set trimmer condenser "T" tunes the coil. Figure 34B shows a similar type of transfer switching with the exception that the trimmers are connected to a common bus when a station button is depressed. Figures 35 and 35A illustrate the use of both of the above switching circuits in the same receiver.

Receivers introduced by Air King, Erla, Pacific (Los Angeles), and Warwick employ transfer switching of this type.

The manual button of this class of receivers may be regarded as an additional selected station button since the gang condenser may be set to a desired station other than those of the selected push button group.

GENERAL ELECTRIC—The General Electric "Touch-Tuning" Model F96, features a push button switch in which the manual tune or transfer button combines a group of functions. Reference to schematic diagram Figure 36 shows a similar switching sequence to that described in Note C1 and Figure 28. Four separate units are actuated by the manual plunger which in common with the switches attached to the other plungers employ wave band type terminals. S1 and S2 serve to transfer the antenna circuit from

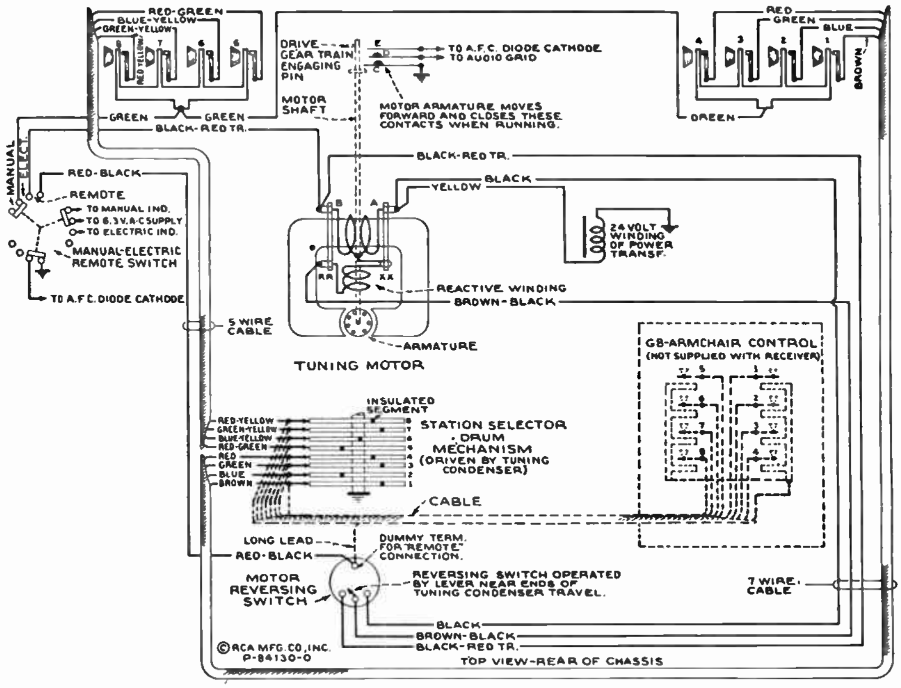


FIGURE 24—*R.C.A. Motor-Tuning System—Wiring Diagram.*

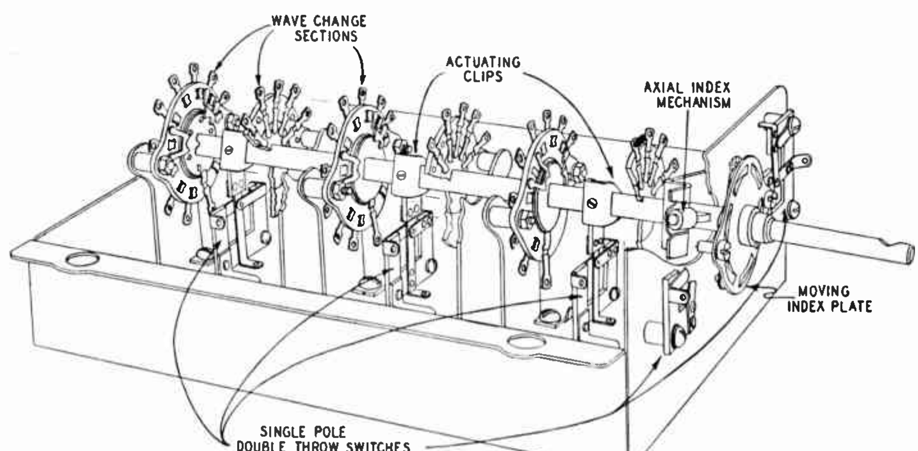


FIGURE 25—*Sparton "Selectronne"—Transfer Switch Assembly.*

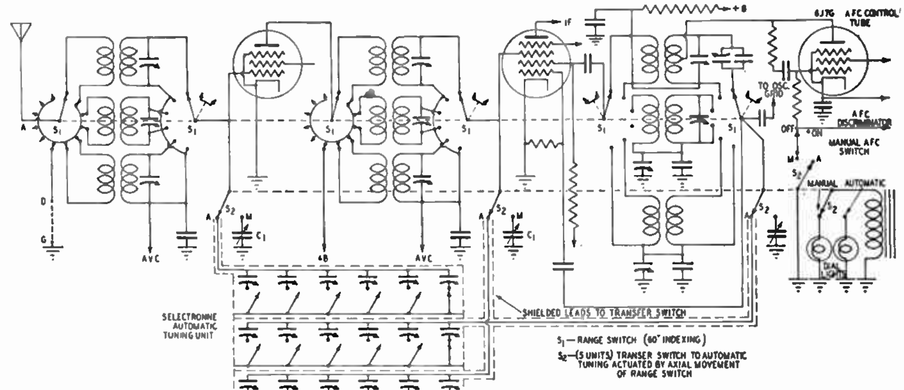


FIGURE 26—*Sparton "Selectronne"—Schematic Wiring Diagram.*

the RF tube to the converter when on the push button position. At the same time the pre-selected trimmer is substituted for the gang condenser unit. This operation drops the RF stage when on push button tuning. Switch S3 serves the dual function of grounding the interconnecting link between switches S1 and S2 when the RF stage is operative on manual tuning and changing the receiver sensitivity by grounding a tap on the bias resistor of an IF tube when on the push button position. Switch S4 transfers the oscillator grid circuit from gang condenser to pre-set trimmer condensers.

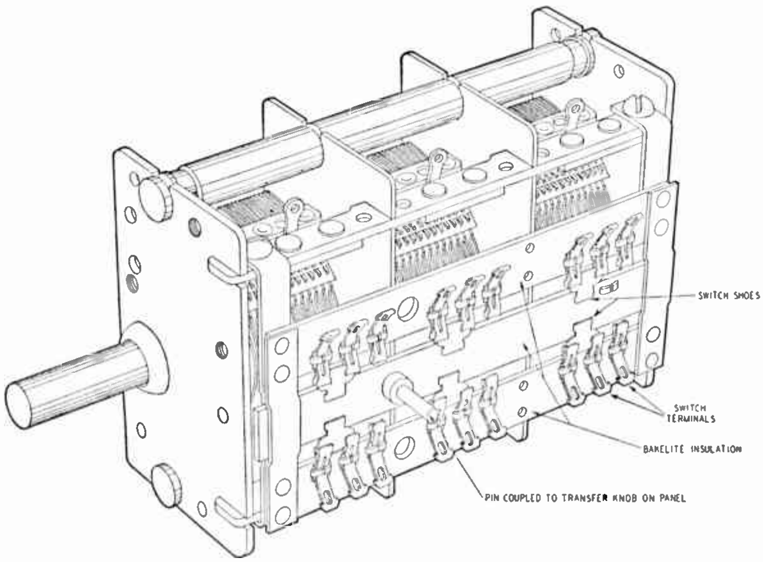


FIGURE 27—*Stromberg-Carlson "Electric Flash Tuning"—Shuttlecock Transfer Switch Assembly.*

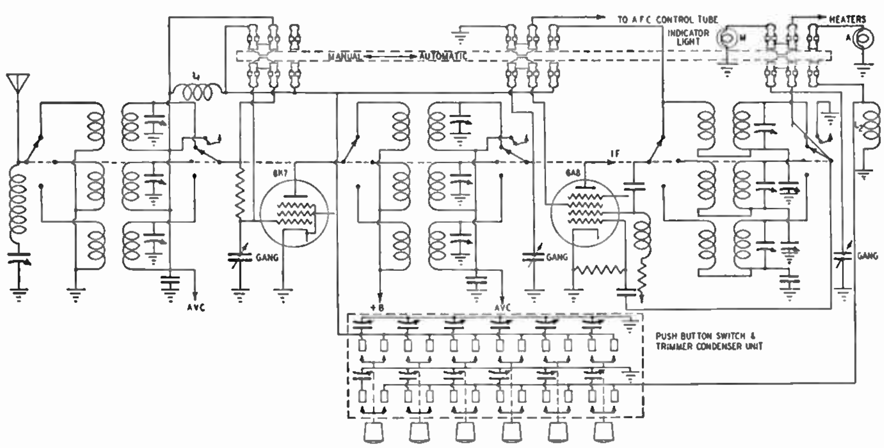


FIGURE 28—*Stromberg-Carlson "Electric Flash Tuning"—Circuit Diagram.*

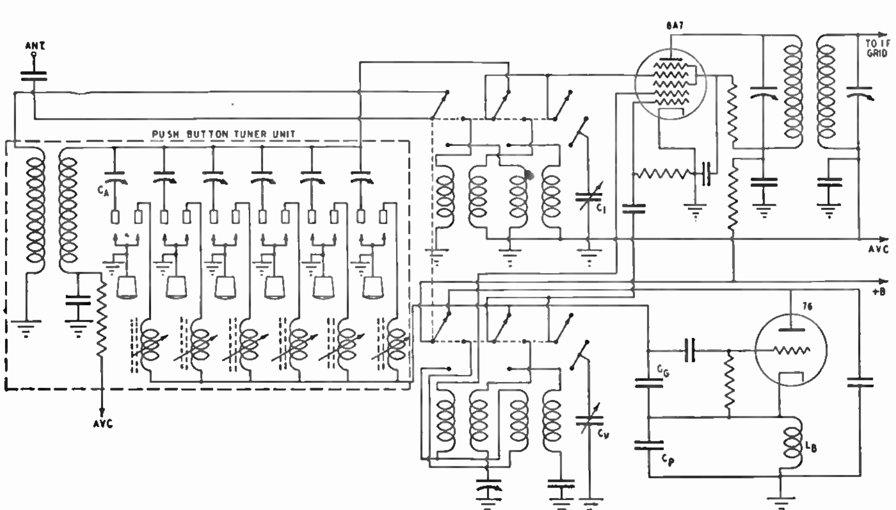


FIGURE 29—*Automatic Radio Iron Core System—Circuit Diagram.*

GILFILLAN BROS.—The Automatic "Touch-Tuning" Model 5T8 selects the gang condenser as the first position of the push button switch in the same manner in which the trimmer condensers are selected. This is possible since the receiver is designed to operate on the broadcast band only.

HOWARD—Howard Radio models employing trimmer type station selection make use of a separate converter tube for the automatic tuning input and oscillator circuits. This allows the complete automatic unit to be plugged into receptacles on the chassis so that a model may be available with or without automatic tuning with no other change. It also permits the selector switch to have grounded contactor shoes since transfer switching may be accomplished in the B supply circuit as shown in Figure 37. Other versions of this type of unit convert older type receivers to automatic tuning and employ a transfer switch which operates in the cathode circuit.

PACIFIC (Chicago)—The Pacific "Selectro-matic" conversion unit is so designed that its input and oscillator trimmer units may be connected in parallel with the respective gang condenser sections. The gang condenser is set at its minimum capacitance during automatic operation. Transfer to manual tuning is accomplished by the simple expedient of opening the common bus to each of the trimmer banks by a double-pole single-throw switch controlled by the transfer button.

Several motor-driven models listed in Table II use transfer switching buttons in the push button group. Examples are: General Electric, Herbert Horn, Howard Radio, and Radio Products.

GENERAL ELECTRIC—The General Electric motor-driven "Touch-Tuning" models make use of a latching type push button switch with jack spring type contacts. Because of the rather involved switching a description of this system has been reserved for special consideration on page 271. The schematic wiring diagram showing the manual transfer wiring is illustrated in Figure 41, page 263.

HOWARD—The Howard "Motor Automatic" models 400A and 425A provide manual tuning transfer by the simple expedient of opening the motor circuit with an off button which interrupts the series connected switching sequence.

RADIO PRODUCTS—The Admiral "Touch-O-Matic" circuit, Figure 38, combines several circuit operations on its transfer button shown on the left hand end of the group and labeled OFF. In the released or automatic tuning position the grounded contactor shoe connects the motor supply circuit to ground and allows automatic operations by depressing any one of the eight series-connected push button circuits. In the actuated position this transfer button removes AFC by grounding the discriminator cathode and also connects the motor circuit to a lower voltage through an indicator light whose function will be described in section II. When this off button is pressed it will unlatch any station button thereby breaking the series circuit to the motor. The Tiffany Tone Model IIA manufactured by Herbert H. Horn employs a similar transfer and motor circuit.

Note C5

In Packard-Bell motor-tuned receivers two of the buttons of the push button bank are made non-latching. The shape of the cams on the plungers are such that the latch bar is released when they are depressed thus unlocking any previously selected button. The circuit connections of these plungers are such as to allow their use for "scanning" or motor operation for

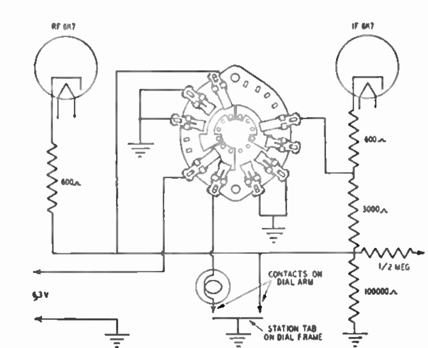


FIGURE 30—*Erla-Sentinel Muting and AFC Release Circuit Diagram.*

continuous tuning. A secondary use is that of releasing the push button control when manual tuning is desired.

Note C6

The Midwest "Motorized Automatic" circuit diagram shown in Figure 39, makes use of the tone control switch for the combined functions of tone control, transfer to manual tuning and release of AFC while in the manual tuning position. It is an eight-position switch. The first four positions provide for motor tuning with four selections of audio tone control, including volume expansion on one of the positions, and audio muting on all positions. The next four positions open the audio muting and motor supply circuits and provide for the same four tone control selections with the tuning controlled manually.

Note C7

Stromberg-Carlson "Te-Lek-Tor" remote control systems as employed in the 70 series receivers make use of a mechanical clutch for shifting control from manual to automatic operation. The entire motor drive unit with its controlling commutator is declutched from an extension of the gang tuning condenser shaft by axial movement of the fidelity control knob. In manual tuning the mechanical drag of the motor drive system is removed by this clutching system.

SECTION D— AUDIO SILENCING DURING THE AUTOMATIC TUNING CYCLE

In practically all of the mechanical and motor-tuned systems provision is made for silencing or muting the audio system of the receiver as the tuning mechanism is being changed from one station selection to another. This is necessary since, if it were not done, a bedlam of annoying sounds would issue from the receiver as tuning progressively passed intervening broadcast channels. The methods employed from a circuit or electrical operation standpoint may be divided generally into six types:

1. Short circuiting the moving coil of the dynamic speaker or the output transformer primary.
2. Short circuiting the output of the audio diode detector to ground.
3. Grounding to chassis frame of an audio grid whose circuit is normally returned to ground.
4. Grounding the uninverted grid of a phase inverter driving system.
5. Biasing an audio tube to cut off by the application of high negative bias.
6. Applying high negative bias to the RF converter and IF amplifier tubes to reduce the receiver sensitivity.

The methods of accomplishing the muting operation have been varied and will be covered in detail in the following notes.

Note D1

In the manually operated mechanical dials of the rotary or "telephone" type muting of the audio system is usually accomplished by the use of a metal ring of annular shape insulated from frame ground and connected to the point in the audio system which it is desired to ground. When the plungers are depressed in station selection a flange or other portion of the plunger strikes this ring and holds the ring grounded until the plunger returns to its normal position as the operator's finger is removed from it. Examples of this type of mechanism are to be found in the Fairbanks-Morse, G. H. U., Wells-Gardner and Wilcox-Gay receivers.

Similar types of dial operated muting devices with detail variations are to be found in the Colonial and Philco "Automatic Tuning Dials."

PHILCO "AUTOMATIC DIAL"—An audio silencing switch is housed within the hub of the automatic station tuning lever. This switch is normally held open by the spring which returns the lever to its unoperated position. In making a station selection the switch closes as the lever is pressed downward upon the desired plunger (see Figure 8, page 251).

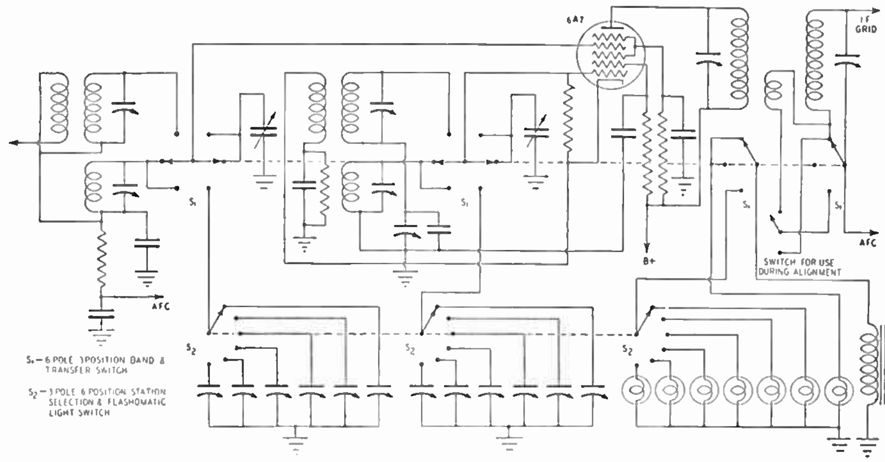


FIGURE 31—*Fada Automatic Tuning—Schematic Wiring Diagram.*

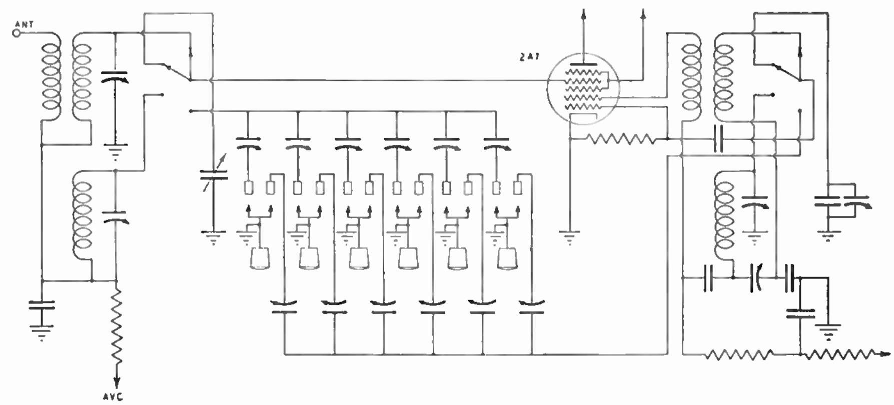


FIGURE 32—*Garod "Prestomatic"—Schematic Wiring Diagram.*

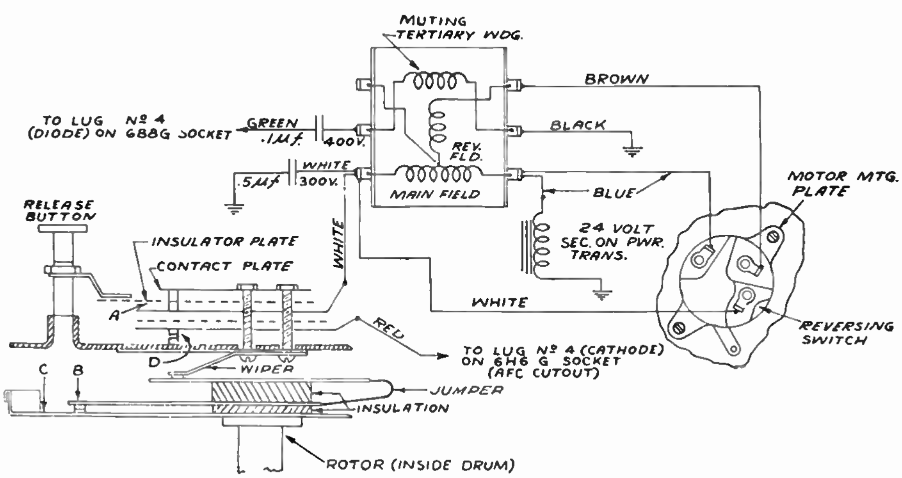


FIGURE 33—*Galvin (Motorola) Electric Automatic Tuning—Wiring Diagram.*

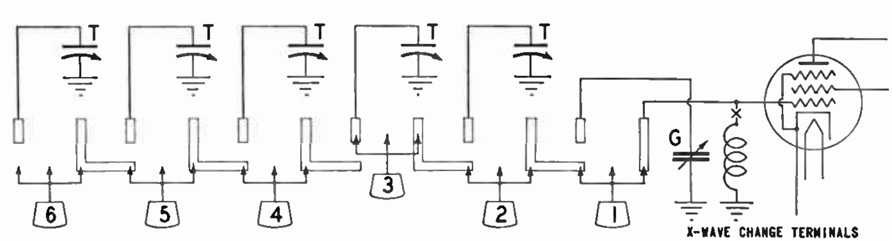


FIGURE 34A—*"L"-shaped Terminals Used to Produce Series Switching Sequence.*

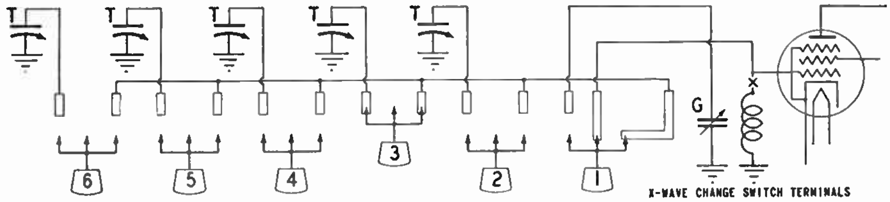


FIGURE 34B—*Transfer Switching with Trimmers Connected to a Common Bus Bar When a Station Button is Depressed.*

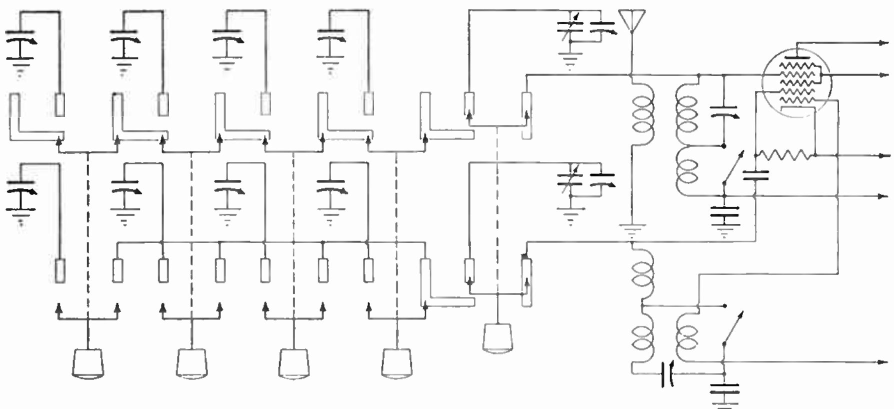


FIGURE 35—*Warwick Transfer Switching as Illustrated in Figures 34A and 34B.*

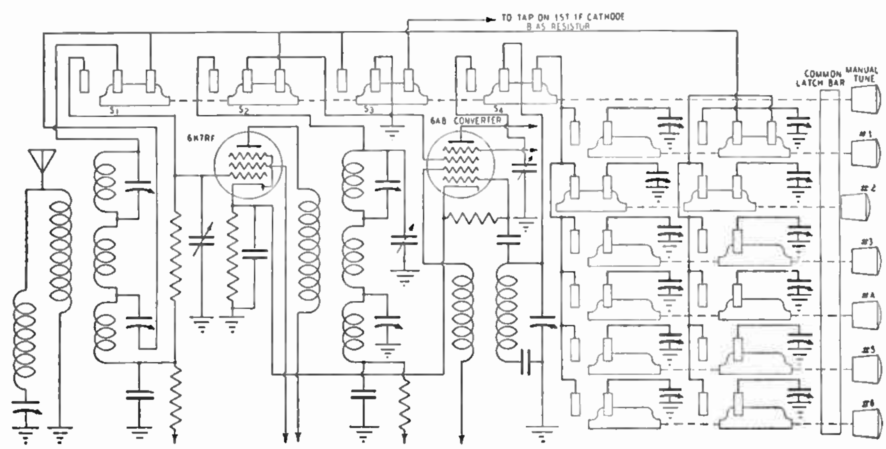


FIGURE 36—*General Electric "Touch-Tuning"—Circuit Diagram.*

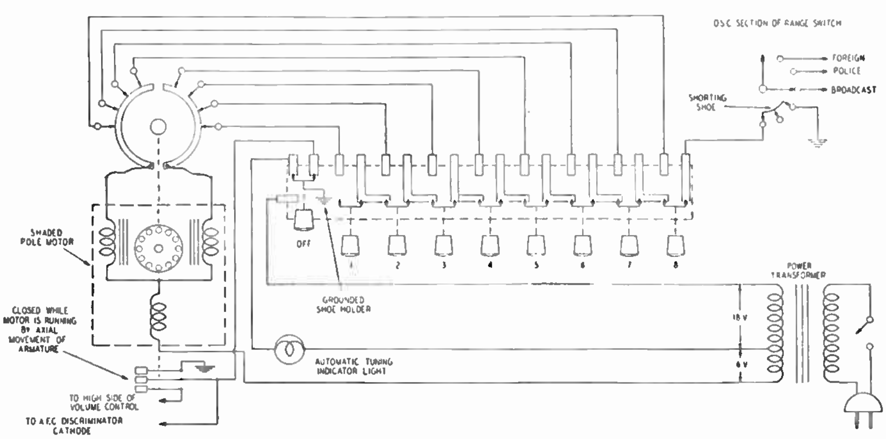


FIGURE 38—*Admiral "Touch-O-Matic" Circuit Diagram.*

PHILCO "CONE-CENTRIC"—Two muting circuits are connected in series to provide for manual tuning without muting and automatic selection with audio muting by selected position of the tuning lever handle. Within the diecast housing (see Figure 12, page 255), is an insulated switch operated by axial position of the knob. This switch is connected in series with the contact on the dial disc. If either of these switches are open the receiver audio system is operative. In the manual tuning position of the knob the switch in the housing is open. In the automatic tuning position both switches are closed until the tuning lever is pressed upon the desired cone. As this is done a lever is operated which lifts the contactor from the dial segment.

Note D2

The Belmont lever actuated system (see page 271), accomplishes audio silencing during tune by short

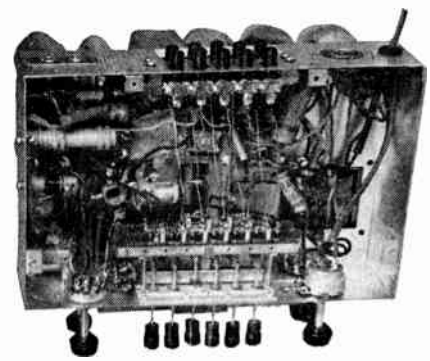


FIGURE 35A—*Warwick Under-Chassis View.*

circuit of the speaker moving coil by means of contacts actuated by the tuning levers (Figure 40).

Note D3

The Midwest "Motorized Automatic" models in which the motor drive system is controlled by momentary contact push buttons without the latching feature are silenced during tune by a pair of contacts on each button which grounds the uninverted driver grids during the tuning cycle as shown in schematic drawing Figure 39.

Note D4

The Erla "Flash Tuning Dial" carries a pair of contacts on a moving dial arm which light an indicator

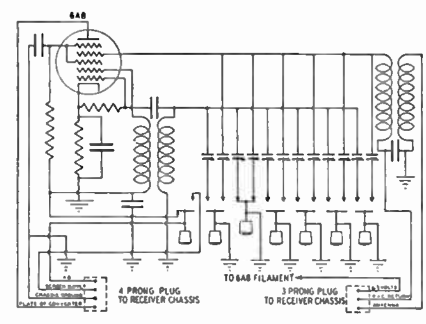


FIGURE 37—
Howard Automatic Tuning Circuit Diagram.

light and at the same time return the bias of the RF and IF amplifiers to normal. During the tuning cycle these amplifiers have been subjected to high negative bias which renders them inoperative (Figure 30).

Note D5

In a number of receivers the audio silencing or muting is accomplished by the use of a magnetic relay. This is of advantage from a design standpoint when it is desired to perform the muting at a remote point as in automobile receivers or when muting is removed as a pair of contacts or circuits close rather than open. Receivers of Galvin, Noblitt-Sparks and General Electric employ muting relays.

GALVIN MOTOROLA "PRESS BUTTON TUNING"—Figure 20 shows the use of a relay whose contacts are connected in parallel with the speaker moving coil. The contacts are closed whenever the tuning motor is running since the relay is operated by a voltage drop across the motor armature. This circuit eliminates the necessity of extra wires in the cable between the receiver and the push button switch.

NOBLITT-SPARKS—The Noblitt-Sparks schematic diagram Figure 23 illustrates the use of a closed circuit to hold a muting relay circuit open. When using the automatic tuning feature, with the transfer switch on position "A," a circuit is established through the muting relay, and the selected station dial light when the movable contact on the dial (see Figure 14) reaches the desired fixed contact. When this occurs the muting relay opens the circuit which has been silencing the audio system. With the transfer switch in position "M" for manual tune a circuit is established through the contacts of the switch and a resistor of the same value as one of the indicator lamps. This circuit continues to hold the muting relay open as long as the receiver is being used for conventional manual tuning.

GENERAL ELECTRIC—In the General Electric "Touch Tuning" motor-driven models a relay is made to serve as a control element for a number of functions. One of these is the release of audio muting as shown in Figure 41. The details of this circuit are described on page 271.

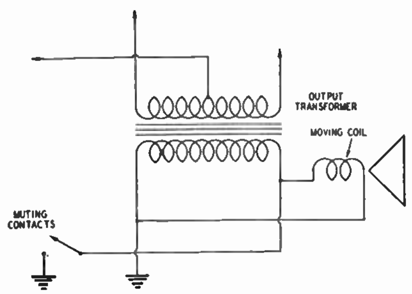


FIGURE 40—*Belmont "Belmonitor" Audio Silencing Unit—Circuit.*

Note D6

In Bosch and Westinghouse models employing motor-driven electric tuning, muting is accomplished by a pair of contacts associated with a moving latch which locks on a station plunger pin. The circuit is unusual in that muting is secured by biasing the converter tube to a condition of non-operation. Muting is removed by shorting the resistor whose drop is furnishing this bias. The Stromberg-Carlson "Flash Tuning" models also employ muting contacts operating within the latch gate. (See Figure 28.)

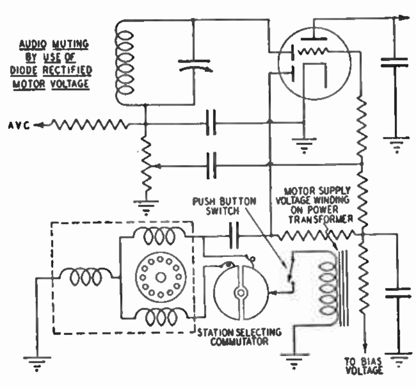


FIGURE 42—*Detrola Audio Silencing Unit—Circuit Diagram.*

Note D7

An effective and ingenious method of securing audio silencing in receivers employing low voltage AC tuning motors is by the rectification of the motor voltage to furnish a DC bias voltage with which to cut off the plate current of an audio tube. The voltage drop across the motor winding or across an auxiliary winding coupled to the motor field is applied to a diode plate and the resulting rectified voltage drop fed to a tube in the audio system through an appropriate resistor network. In this manner as long as the motor

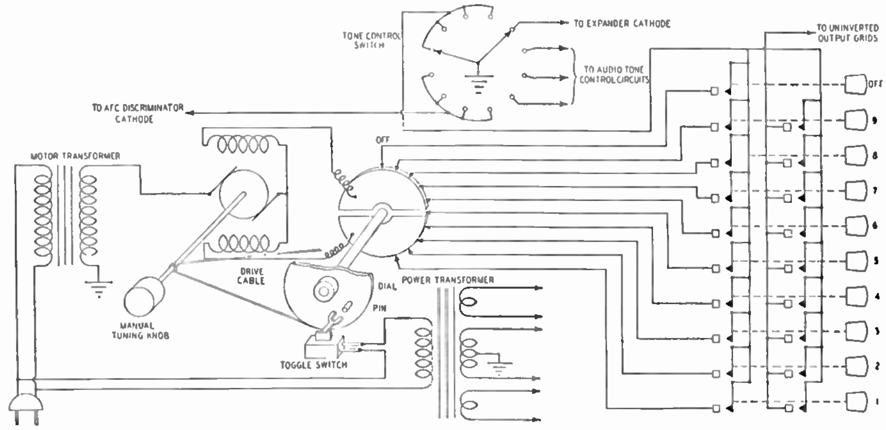


FIGURE 39—*Midwest "Motorized Automatic" Circuit Diagram.*

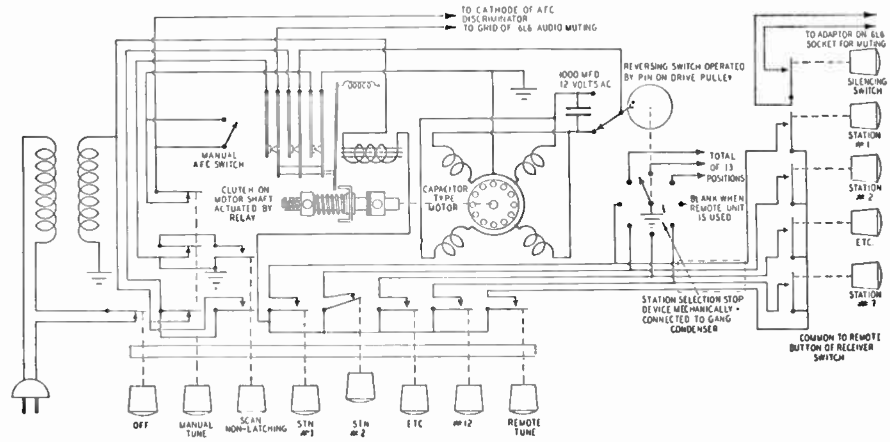


FIGURE 41—*General Electric Motor-Driven "Touch-Tuning"—Circuit Diagram.*

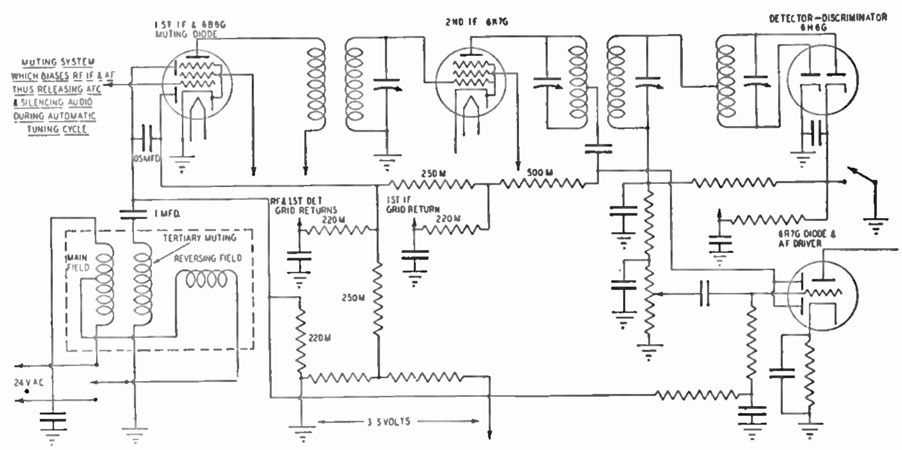


FIGURE 43—*Galvin (Motorola) Audio Silencing—Circuit Diagram.*

is running the receiver output will be silenced. The instant that the motor stops, as controlled by the selecting commutator, the audio bias returns to normal and the receiver is once more operative. Examples of the use of this circuit are to be found in the receivers of Crosley, Detrola, and Galvin. Typical circuits are found in schematic diagrams, Figures 42 and 43. The former illustrates the use of what would normally be an unused diode plate to furnish a voltage with which to bias to cut-off the grid section of a high mu diode-triode. Figure 43 shows a further extension of the use of rectified motor voltage since in this case the RF and IF amplifier is rendered inoperative by high bias as well as the audio system. Thus during the tuning cycle the automatic frequency control system does not function due to absence of signal and is allowed to regain control when the amplifier once more becomes sensitive as the bias returns to normal.

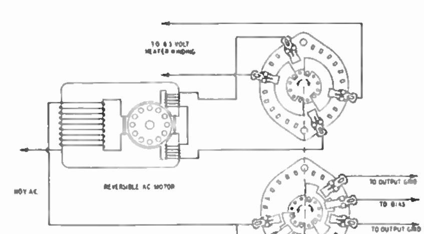


FIGURE 44—*Zenith Electric Automatic Tuning Wiring Diagram.*

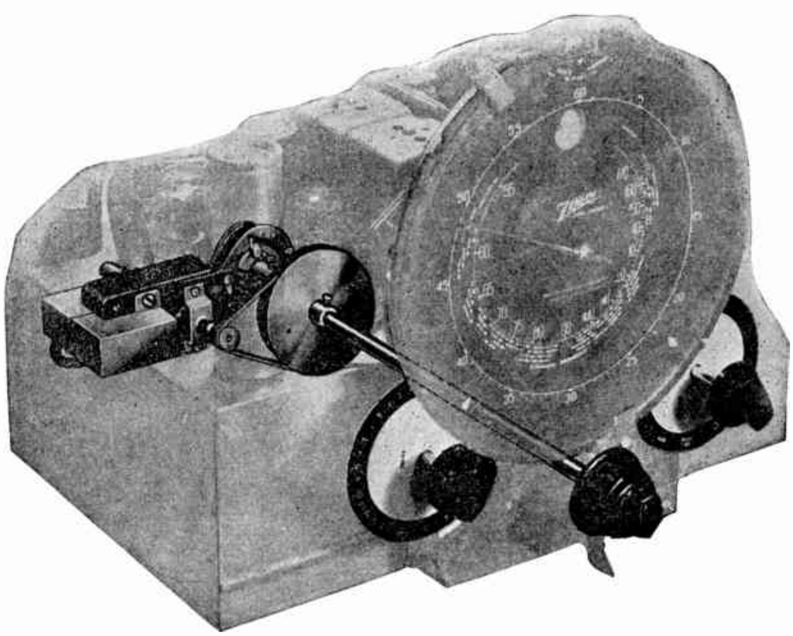


FIGURE 45—*Zenith Motor Drive—Phantom View.*

Note D8

One of the earliest methods of silencing the audio system of motor-driven sets was the use of jack spring switches operated by axial movement of the motor shaft. This action has been explained in the short description of the operation of a typical motor-driven system on page 250, and will be illustrated in the section on motors. Figures 1, 24, and 38, pages 251, 259, and 262, illustrate the action of this type of switch.

Note D9

The scanning system of rapid tuning employing electric motor drive to be found in Zenith "Electric Automatic Tuning" models is accompanied by the silencing of the audio system with a group of contacts on the center return spring switch which controls the motor. These contacts short the input to the audio grids during the tuning cycle as shown in Figures 44 and 45.

SECTION E—AUTOMATIC FREQUENCY CONTROL RELEASE DURING TUNE

As has been frequently mentioned in preceding sections practically all automatic tuning systems employ the automatic frequency control principle. It has been the use of this principle which has made selected station automatic control possible. A description of the operation of automatic frequency control will be found on pages 246 to 248 of this encyclopedia. The necessity for providing some means of rendering the AFC system inoperative during the automatic tuning cycle is obvious from a consideration of its action as the tuning knob is moved. Depending on the width of control as determined by the design of the discriminator system a strong local station will continue to hold the AFC for a few channels beyond its point of tune, thus preventing the system to "lock" on the stations of any of the intervening channels. This makes it necessary either to remove AFC action during the automatic tuning cycle or to remove it for an instant as tune is established on a desired station. It is also desirable to render the AFC system inoperative during manual tuning for the same reason. In general four methods have been applied to accomplish AFC release.

Note E1

In the mechanically operated manual types and in a few of the motor-driven types, which make use of the latch gate principle of stopping the motion by locking, on a plunger controlled pin, use has been made of this latch gate to control a switch whose function is to short to ground the AFC voltage for an instant before the pin locks in the gate. This type of action is possible since the sides of the gate move inward under the pressure of the pin and return to their normal positions to constitute a lock when the pin has passed the edge of the gate. Figures 8 and 15, pages 254 and 256 will serve to illustrate this action. This switch attached to the latch gate is often connected in parallel with contacts on the transfer switch so that AFC action may be removed when manual control of tuning is desired. Such a connection is shown in Figures 21 and 33, pages 258 and 261. In the Stromberg-Carlson "Flash Tuning" models removal of AFC is accomplished by a mechanical link of the transfer control to the latch gate switch as shown in Figure 15, page 256.

Note E2

The use of high negative bias on amplifier tubes to render the receiver insensitive during the automatic tuning cycle is described in Notes D4 and D7. This accomplishes the desired result since the signal voltage at the discriminator is below the threshold of action even for strong local signals. Bias is returned to normal at the completion of the tuning cycle. Figure 30, page 260, and Figure 43, page 263, illustrate this action.

Note E3

Relay contacts control the AFC circuits in the General Electric motor-driven "Touch Tuning" receivers. See description, page 271.

Note E4

AFC circuit control by movement of the motor drive shaft has been mentioned in the description of the motor-driven system on page 250 as well as in Note D8. Illustrations of such a switch are found in Figure 1, page 251, Figure 24, page 259, and Figure 38, page 262.

SECTION F—ELECTRIC TUNING MOTORS

An analysis of the motors in use for the control of automatic tuned radio receivers discloses three main types which in turn have several sub-classes.

1. Induction motors
   - A. Split phase
     1. Phase splitting by the use of a capacitor.
     2. Phase splitting by difference in inductance or impedance of windings.
   - B. Shaded pole
     1. Pole shading coils in parallel with main field winding.
     2. Pole shading coils in series with main field winding.
2. Series wound commutator type or "Universal."
3. Impulse type.

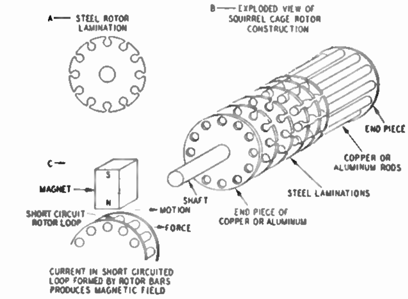


FIGURE 46A-B-C—*"Squirrel Cage" Rotor Assembly.*

1. INDUCTANCE MOTORS

Since induction motors use the same type of rotor assembly known as "squirrel cage" and operate by means of a rotating magnetic field, it seems advisable to start by an explanation of the manner in which a "squirrel cage" rotor follows a rotating magnetic field.

The "squirrel cage" rotor consists of a stack of round laminations stamped from thin sheets of a similar grade of iron as that found in power and audio transformers. These laminations have a central hole to fit the rotor shaft and a series of equally spaced holes around their periphery as shown in Figure 46A. Round copper rods are inserted in each of these outer holes and extend beyond the cylindrical stack. Copper laminations are placed over the ends and the rods staked and soldered to them so that each bar or rod is short circuited to all of the others at each end. An exploded view of such a rotor assembly is shown in Figure 46B. While for the sake of simplicity the rods have been shown parallel to the shaft in Figure 46, in many designs they will be found to be "skewed" or at an angle to the shaft. When this rotor assembly is threaded by a changing magnetic field the current generated in the short circuited loops will produce a magnetic field of its own which will magnetize the portion of the stack of laminations lying within the short circuited loop.

For a simple explanation of the manner in which such a rotor assembly will follow a moving magnetic field refer to Figure 46C. As the magnet is moved, its magnetic flux cuts the shorted loop and gives rise to an induced current by transformer action. Reference to Lenz's law of the direction of induced electric currents in any standard text will amplify this explanation. The current in the shorted loop causes a magnetic field which reacts on the field from the moving magnet so as to tend to force the loop to follow the magnet. The shorted loop can never attain the speed of the moving magnet, for if it were to do this there would be no relative motion between the two and therefore no cutting of flux to produce current. The loop current would become zero and no torque would be developed which would immediately result in the loop speed dropping to below that of the magnet. The velocity of rotation of the magnetic fields of all of the tuning motors in use is 3600 revolutions per minute. The speed of the rotor depends upon the load or amount of work which the magnetic field is called upon to perform and may be as high as 3000 revolutions per minute although it is usually much less than that.

In the motors under discussion, the effect of the moving magnet previously discussed is produced by the movement of magnetic flux across the pole faces of a field structure. The field consists of a stack of laminations with pole faces extending toward the rotor and encircling it. The poles are so spaced that when they are alternately energized by the alternating current flowing through their windings the effect of a rotating magnetic field is produced.

The split phase motor shown in Figure 47 produces a rotating field of the time-phase type. Considering opposite windings 1 and 3 which are directly connected to the AC supply as reaching maximum magnetic flux at a given time, it can readily be seen that windings 2 and 4 whose current flows through the impedance "Z" must reach their maximum flux at some other time. The impedance "Z" may be a resistance, inductance or capacitance. If it is an inductance

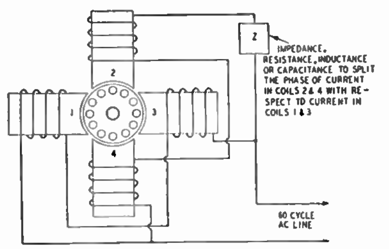


FIGURE 47—*Split Phase Motor Wiring Diagram.*

or capacitance the phase angle may approach 90°. In this case the magnetic flux at pole 1 would be passing through zero as the magnetic flux at pole 2 is reaching its maximum. This sequence continues to follow around from pole 2 to pole 3 and thus a rotating magnetic field is produced. The rotor will follow this field with a slip or time lag depending upon the load. Such a motor possesses its maximum torque as the phase relations between the two field systems approaches 90°. It can be made very close to this ideal in the capacitor type motor. An example of the ca-

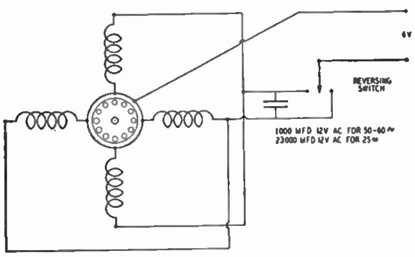


FIGURE 48—*General Electric Capacitor Motor—Wiring Diagram.*

pacitor type motor is shown in schematic Figure 48 and Figure 49. This motor manufactured by the General Electric Company is used in their "Touch Tuning" models described on page 271. Reversal of direction is obtained by shifting the phase splitting capacitor from one set of field windings to the other. Its characteristics are identical for either direction of rotation.

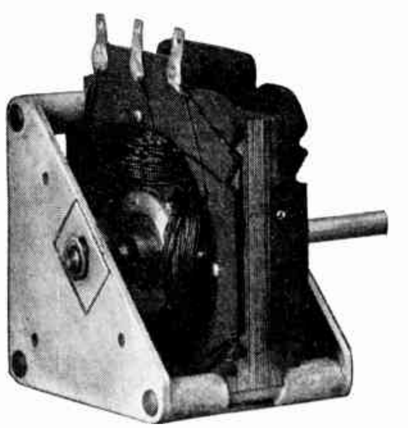


FIGURE 49—*General Electric Capacitor Split-Phase Motor.*

Another method of producing a rotating magnetic field is by means of pole shading. Figure 50 illustrates this principle in diagram A. It will be seen that the tip of each field pole is notched and carries an additional winding. The windings on either pole may be alternately short circuited as in Figure 50B. When the main field pole is building up in flux density some of the lines of force cut the shorted turns of the shading winding and cause current to flow in them. This current produces a magnetic field which tends to oppose the action of being generated and therefore does not allow the tip of the pole to become magnetized as quickly as the main pole of which it is a part. On the diminishing part of the half cycle these shorted turns are again being threaded by the collapsing flux and consequently oppose this action also with the result that the magnetism does not die out in the shaded tip at the same time that it does in the main field but lasts a short time longer. This difference in time between the main field flux and the tip causes a rotating field across the face of the pole which in turn causes the rotor to move. The direction of rotation depends upon which tip of the main field is being shaded. The direction of rotation is always from the main field pole towards the shaded portion since the flux in the shaded portion always lags the main flux. Motors produced by Alliance and Barber-Coleman are of this type.

If the pole tip windings are connected to the same source of alternating current as the field, a rotating magnetic field is produced in practically the same manner as that described for the split phase motor. In this case the phase displacement to produce the time shift of magnetic flux is due to the difference in impedance of the pole tip winding which usually is

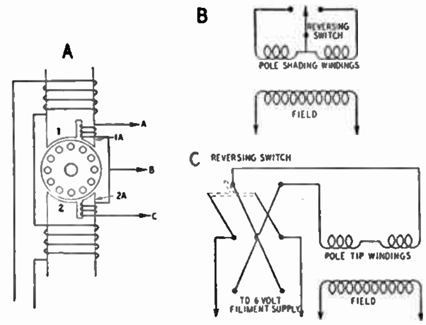


FIGURE 50—*Pole Shading Operation.*

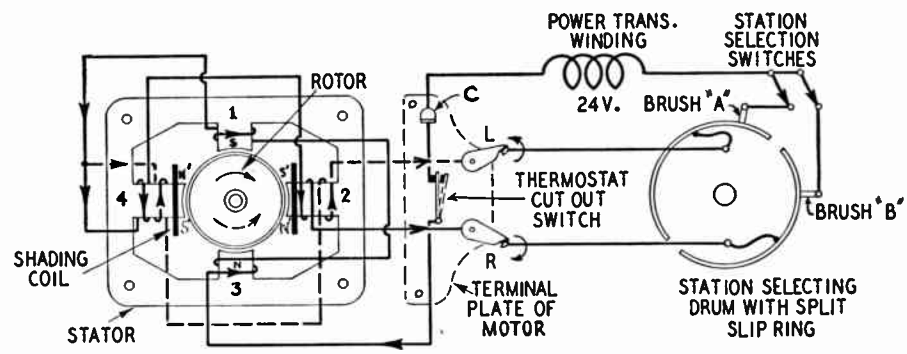


FIGURE 51—*Shaded Pole Induction Motor (Utah)—Wiring Diagram.*

wound with a far different number of turns and hence a different inductance. The torque produced by this type of connection is greater than for the pole shading type since windings on both poles are active in producing rotation.

Another version of the split phase type which depends for its operation on the difference of impedance of simultaneously operating coils energizes its reactive winding by connecting it from a center tap on the field winding across either half of the field depending upon the direction of rotation desired. Examples of this type of induction motor are to be found in models offered by Delco, Robbins-Meyer and Speedway. See schematic Figures 24, 33, and 43.

A type of shaded pole induction motor developed by the Utah Products Company is illustrated in diagram Figures 51 and 52. This motor is furnished complete with built-in integral automatic clutch permitting instant stop of driven load when power is cut off; a built-in thermostatic cut-out switch for protection if operated continuously on overload and an AFC-muting switch operated by end thrust of the rotor shaft. Speed reduction gearing with approximately 35:1 ratio is furnished as shown in Figure 52 so that the drive system of the receiver may operate by belt connection to the pulley shown on the large shaft with the shaft itself acting as the manual drive. In using this for manual drive the clutch is automatically disengaged relieving the load of the motor.

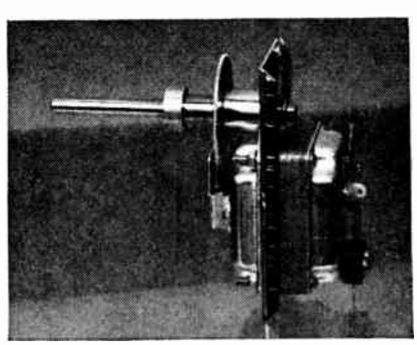


FIGURE 52—*Exterior View—Utah Shaded Pole Induction Motor.*

In this motor the wiring and placement of shaded poles makes possible reversal of direction by means of a single-pole double-throw switch. Unlike the pole shading types previously described which used only two poles with shaded tips, this motor places the shaded sections on two additional poles midway between the unshaded sections as indicated in the figure. The pole shading is accomplished by the use of heavy copper shading "coils" which are in reality large single short circuited turns. The shading poles each have two separate sets of magnetizing coils of opposite polarity which are alternately connected with the winding on the unshaded poles by a "T" circuit. Thus either set of windings on the shaded sections may be used in series with the unshaded section.

To explain the operation of reversing this motor, assume that the external circuit is closed so as to apply current to the common terminal "C" and the directional terminal "R" (right). At a given instant assume the current to flow in the direction shown by the arrows. The current passing through coils 1 and 3 will make the corresponding unshaded pole section have polarities "S" and "N," respectively. Continuing through the windings on pole sections 2 and 4 as indicated by solid lines, magnetic polarities "S¹" and "N¹," respectively are produced, which due to the shading rings of solid copper reach maximum intensity after unshaded sections 1 and 3.

Thus the maximum flux of polarity "S" occurs first at pole section 1 and then later at pole section 2. The "N" flux simultaneously shifts from pole section 3 to 4. This causes the rotor to turn in a clockwise direction as indicated by the solid curved arrow on the rotor.

To run the motor in the other direction, the electrical connection is made to terminal "L" (left) instead of "R" (right). At a given instant, pole sections 1 and 3 will be "S" and "N" polarity as before but by following the dotted line windings now used on pole sections 2 and 3 it will be seen that their polarities are now reversed, being "N¹" and "S¹" respectively, as shown in the dotted letters. The maximum flux now shifts from pole section 1 to 4, turning the rotor counterclockwise, as shown by the dotted curved arrow.

The motor is rated for continuous operation at 12 volts although it may be safely overloaded several hundred percent for the short intervals of time involved in tuning a radio receiver since it is protected by the thermostatic cut-out. Its performance characteristic at various percentages of rated load are shown in the graph of Figure 53.

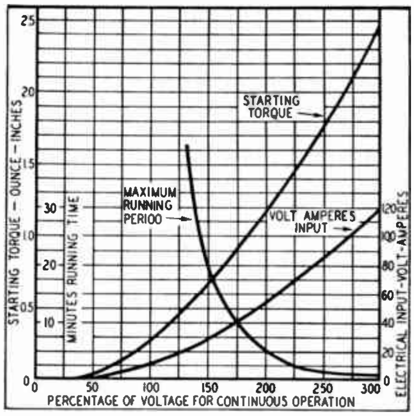


FIGURE 53—*Performance Characteristics of Utah Shaded Pole Induction Motor.*

2. SERIES WOUND COMMUTATOR TYPE OR "UNIVERSAL"

The wound armature series connected universal motor is such a well known device as to require no detailed explanation. This type of motor ordinarily requires a double-pole double-throw switch for reversal of direction. In the types developed for the present requirements of automatic tuning a change in construction and wiring has permitted a simpler type of reversal switching. Figure 54 shows the Delco Products 3-wire construction whose wiring diagram is shown in Figure

understood by reference to Figure 56, a line drawing of the Crosley "Dynatrol." On the motor shaft are two drums around which are wrapped flexible belts having cork friction surfaces cemented to that portion of the belt which surrounds the drum. One end of the belt is connected to the armature and the other end to an adjustable screw supported by a rubber grommet. The action of the belt in producing rotation is as follows: First, as the armature is attracted towards the magnet the belt becomes tightened and the cork friction surface wraps tightly on the smooth surface of the drum. Second, the further motion of the armature causes the belt to move a short distance until the rubber grommet and stretch of the belt prevent further motion. This slight motion advances the drum a fraction of a revolution. This entire action has occurred during the first quarter cycle of the sixty cycle alternating current. As the armature leaves the pole face under the action of its restoring spring during the decay of voltage the relieved pressure on the belt releases the cork friction surface from the drum. The inertia of the moving drum and friction of the system prevents reverse rotation as the belt tension is released. During the second half cycle this sequence of "grab, turn, and release" is repeated and so on at a rate of one hundred and twenty times per second. In this manner due to the frequency of operation the drum appears to move continuously as long as an alternating voltage is impressed on the coil. A duplicate system is used for operation in the reverse direction. The two operate independently of one another since no friction exists between the cork surface and the drum except when the magnet is energized. Close adjustment of armature motion and tension are required. This type of motor develops a surprising amount of torque due to the short motion of each cycle of operation acting through the lever arm of the radius of the drum.

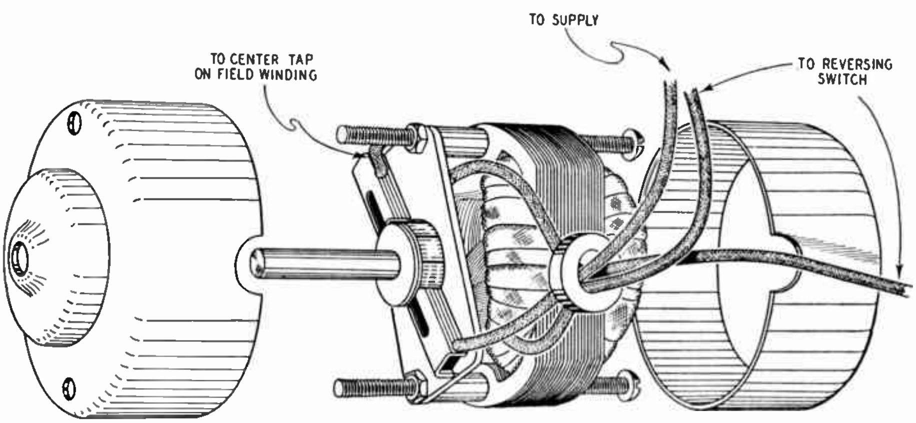


FIGURE 54—*Delco Universal Tuning Motor—Assembly.*

55. By dividing the field winding into two parts the direction of the magnetic field of the armature with respect to the field may be reversed by the use of a single-pole double-throw switch.

This type of motor is adaptable to either the operation of AC household receivers or 6-volt DC motor car sets. Schematic diagrams of receivers employing this type of motor are shown in Figures 20 and 39.

3. IMPULSE TYPE MOTORS

In this type of motor the rotation is not continuous but is intermittent as determined by a series of pulses. An electro-magnet operating on low voltage alternating current is used to obtain rectilinear motion from a hinged pole shoe normally held away from the magnet by a spring. The operation of such a motor can be

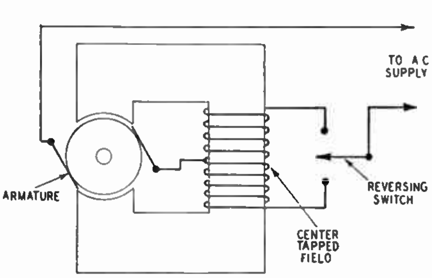


FIGURE 55—*Delco Motor Wiring Diagram.*

Note F1

Capacitor type split phase, see description under split phase motors.

Note F2

Series connected shaded pole types, see description of shaded pole motors.

Note F3

Split phase with reactive winding in parallel with part of field, see description of split phase and shaded pole motors.

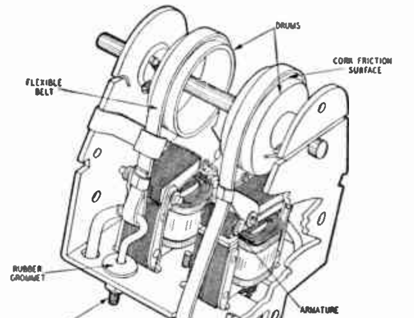


FIGURE 56—*Crosley "Dynatrol" Tuning Motor.*

Note F4

Series wound commutator type with tapped field, see description and Figures 54 and 55.

Note F5

Pole tip windings on separate supply, see Figure 44 and description in text.

Note F6

Impulse type motor, see description Crosley "Dynatrol" motor, Figure 56.

SECTION G— STATION SELECTOR SWITCHES

Station selection switches are used as a method of accomplishing desired station tune in all of the receivers listed in Table III (Tuned Circuit Substitution Types), and in all but a few of the receivers listed in Table II (Motor Operated Types). In general the push button type of switch has met with widest acceptance although a few models employ rotary selector switches of the familiar wave band type. The push button idea has also been used in combination with the stop mechanism in a few receivers (see Notes B7, B8, and G3.)

Push button switches may be classified into two main groups: (Momentary) in which the button does not lock down but is held down by the operator until the tuning cycle has been completed and, (Latching) in which the button locks in position and remains locked until released by the act of depressing another button.

Note G1

The momentary type of push button selector switch is employed in many receivers because of the facility with which it lends itself to remote control operation. Since buttons are not locked in place, the contacts of the remote switch may be connected in parallel with those of the switch at the receiver without any conflict of operation or the necessity of unlocking the switch at the receiver before making a remote selection. The necessity of holding the button depressed until the tuning cycle has been completed, a seeming disadvantage of this type of switching, has been rendered less objectionable by speeding up the duration of the tuning cycle to the point that action is almost instantaneous.

CROSLEY—The Crosley "Prestotune" models use two switch groups of four units each. One is shown in Figure 57. The switch is similar in construction to that shown in Figure 66, but with the latch bar removed to make each unit independent and non-latching.

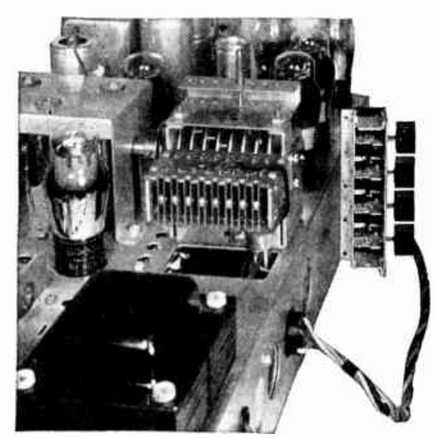


FIGURE 57—*Crosley "Prestotune" Showing Station Selecting Commutator and Push Button Switch.*

DETROLA—The Detrola "Electric Automatic Tuning" models use the momentary type single circuit push button switch. A split ring commutation device directs the motor as covered in Section H. Certain models have provision for remote control by parallel connection of an additional switch of the same type.

GALVIN—The "Press Button" motor car radio control system, whose latching system was described in Notes B9 and D5, employs a momentary type switch as an integral part of the "Acoustinator" unit. This unit may be mounted below the instrument panel or on the steering column. Illustrated in Figure 58 is the push button "Acoustinator" unit with its six illuminated station buttons. The unit is equipped with an extension cord to which is attached a twelve pin plug for connection to the radio receiver. The wiring of the push button circuits is shown in Figure 20. Each button actuates three contacts which are connected together in the sequence described in Note B9. The contacts themselves are of silver riveted to phosphor bronze springs. The motor circuit contacts are of generous size to break the current of the stalled motor (approximately 10 amperes).

FIGURE 58—*Galvin (Motorola) Combined Push Button Switch and "Acoustinator."*

MIDWEST—The Midwest "Motorized Automatic" receivers are controlled by a push button switch of the momentary type which also operates the audio silencing circuit. The circuit connections of this switch are shown in Figure 39. The switch is mounted on the top of the cabinet and is connected to the receiver by cables and plugs as shown in Figure 59. The momentary type push button switch shown behind the receiver has ten buttons of which nine are used for station selection and the tenth to turn the receiver off. Pressing any station button turns the receiver on by means of an AC line switch mounted in such a fashion that a pin on the dial engages the actuator of the switch as the tuning motor starts rotating the dial. A "keep alive" motor transformer is connected to the AC line at all times and draws a small no-load exciting current. This transformer allows the push button switch to be used for complete control since the motor is at all times ready to receive an impulse which will select a desired station and turn the receiver on in the same operation. The "off" button turns the condenser to one end, thus tripping the line switch and turning the receiver off.

FIGURE 59—*Midwest "Motorized Automatic" Showing Push Button and Selector Commutator Details.*

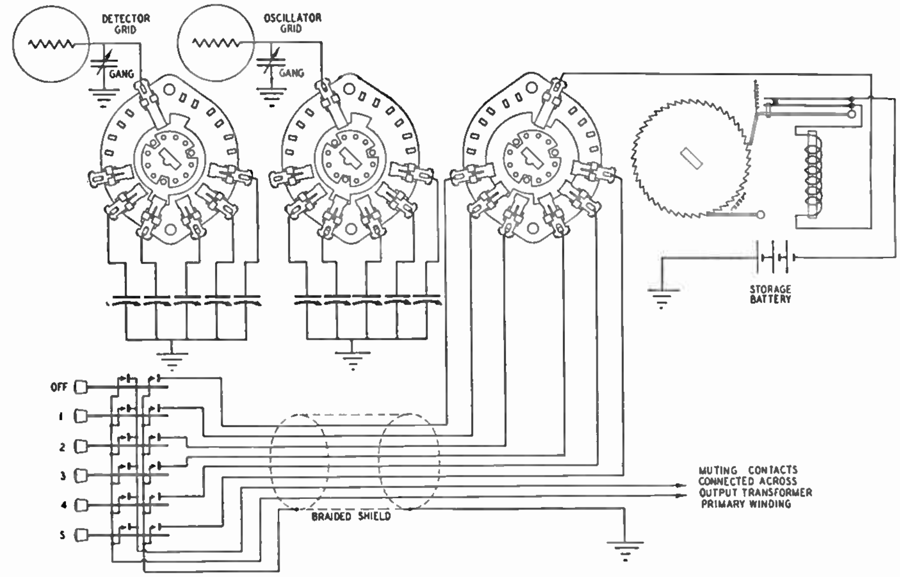


FIGURE 60—*Admiral "Touch-O-Matic" Motor Car Conversion Unit—Circuit Diagram.*

RADIO PRODUCTS CO.—The Admiral "Touch-O-Matic" conversion unit for motor car radio receivers employs a momentary type push button switch in combination with a stepping system for the remote selection of tuned circuit elements. This unit shown in schematic diagram Figure 60 may be attached to any two gang motor car radio receiver and allow the selection of five favorite stations by means of a push button box attached to the steering column and connected to the unit at the receiver by means of a shielded cable. The push button box as shown in the diagram contains six switch units. The first of these units is used for the purpose of transfer to the normal manual control. Each button serves to close two circuits when depressed. The first of these circuits shorts the moving coil of the loud speaker or the output transformer primary winding thus silencing the receiver during the tuning cycle. The second switch selects a circuit for one of the desired station selections. The operation of the conversion unit follows: A multi-section wave change switch is rotated by a stepping device in which a toothed wheel is advanced by a magnetic armature with breaker points similar in action to an electric door bell. As long as the circuit is complete through this device it will continue to vibrate and move the toothed wheel one notch or tooth at each vibration. The first section of the switch is used to stop this motion at the desired points. How this is accomplished will be obvious from an inspection of the circuit shown in Figure 60. It will be noticed that two circuit opening notches diametrically opposite one another as well as two rotor projections on each of the trimmer selector switches corresponding with the notches on the circuit opening section make it unnecessary for the rotor to revolve more than one hundred and eighty degrees to select any station. The two trimmer selector switches are connected in parallel with the oscillator and input sections of the gang condenser respectively. The gang condenser is turned to its minimum stop when using the automatic station buttons. Thus the "off" button accomplishes transfer by opening these two circuits.

STROMBERG-CARLSON—The 70 series "Te-Lek-Tor" remote control "key" box contains twenty momentary type push buttons for complete control of the receiver. In addition to the selection of eight preset stations, the unit has push button control of on and off functions, the increase or decrease of volume, scanning or continuous tune to higher or lower channels, automatic operation of the automatic record-playing phonograph and selection of four speakers. These operations are accomplished by the use of separate motors for the tuning and volume control operations and relays for the control of off-on and radio-to-phonograph switching.

Note G2

Under this note number are classed all of the latching or ladder type push button switches. Most recent

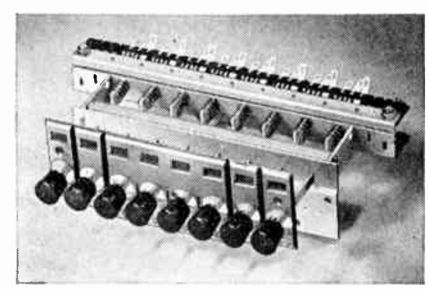


FIGURE 61—*Mallory-Yaxley Multiple Push Button Latching Type Switch.*

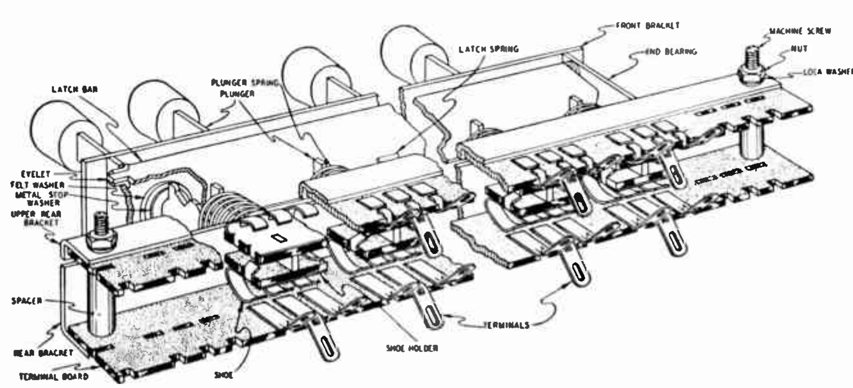


FIGURE 62—*Mallory-Yaxley Multiple Push Button Latching Type Switch—Sectional View.*

receivers have employed this type of switch. Design trends seem to indicate its use will shortly be extended to include other control operations in addition to the original application of station selection. Before describing the circuit applications of push button type selector switches it is believed that a short description of the constructional details of typical switches of the latching type will be of interest. Figure 61 shows the front view of such a switch together with its escutcheon plate with openings for station call letter cards. The switch illustrated is an eight-button unit with a double terminal row allowing each plunger to actuate two isolated circuits. Figure 62 is a sectionalized view of the same type of switch as viewed from the rear. The rear terminal board and latch bar have been cut away to show the construction and inter-relation of parts. Figure 63 is a side view of one of the plungers with the side bracket removed. The operation of the switch can readily be understood from a study of this view. It will be seen that the plunger has two notches and as it is pushed forward the latch bar is lifted and then dropped into the second notch. The latch bar is held firmly against the plunger by means of the phosphor bronze latch bar spring. The plunger spring forces the holding notch against the edge of the latch bar which locks the plunger in place. Upon pressing another plunger the latch bar will rise sufficiently to allow the plunger spring of the previously latched plunger to return to its normal position. In this manner any plunger that is depressed completes a new circuit and opens previously held circuits.

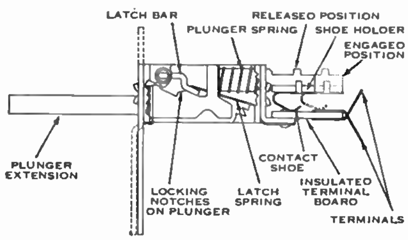


FIGURE 63—*Side View of Actuating Mechanism—Mallory-Yaxley Switch.*

The plungers carry contactor shoe holders which may be of bakelite thus insulating the shoe from the frame; or of metal if it is desired to connect the sliding shoe to the frame. This particular switch which has proved to be very popular with radio receiver designers can accommodate a maximum of three terminals on one side of the terminal strip or six terminals if the double row construction shown in Figures 61 and 62 are employed. Several combinations of these terminals are possible, as shown in Figure 64.

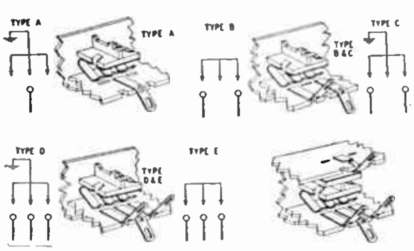


FIGURE 64—*Terminal Combinations of Mallory-Yaxley Switch.*

A terminal arrangement frequently used in which the connection proceeds in series from one end of the switch is shown in Figures 65A and 65B. The L-shaped terminals bridge adjacent shoes in such a manner that when any plunger is in its released position connection is made to the switch on the adjacent plunger. This type of switching is of advantage in the motor-driven type of receiver in that if "A" represents the supply terminal, and if two plungers are pushed in simultaneously the plunger closest to terminal "A" will determine the station selected and the system will not run continuously as it would if the two selected circuits were connected in parallel as in a switch having a common bus bridging all units.

This series operation principle also finds application in some of the tuned circuit substitution types as explained in Note C4 and illustrated in Figure 34.

Several structural variations of the latching type switch are in use. The switch described above and

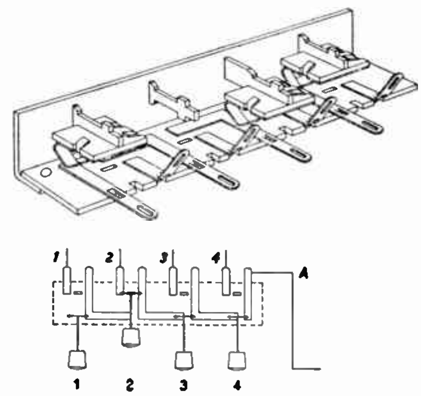


FIGURE 65A-B—*Series Operation Principle in Mallory-Yaxley Switch.*

illustrated in Figures 61, 62, 63, 64 and 65, is known as the Mallory Yaxley Type 3S and has been widely used in receivers of both the motor drive and tuned circuit substitution types.

Another latching type switch, known as Mallory Yaxley Type 3SJ is shown in Figure 66. It was developed in response to the request for a switch for motor-driven receivers which would occupy less depth than the Type S3. Its total depth, beyond terminals, is slightly over one inch.

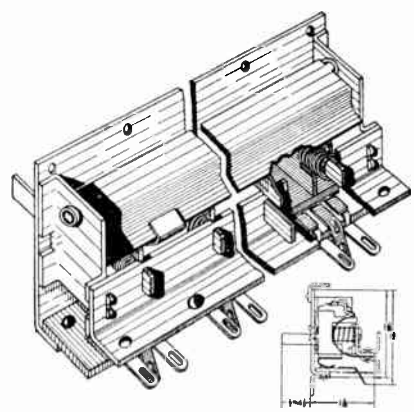


FIGURE 66—*Mallory-Yaxley Junior Type Multiple Push Button Switch.*

Several of the tuned circuit substitution type receivers employ a switch in which the trimmer condensers are an integral part of the switch design. The switch structure is arranged to provide shielding between the circuits. An example of the use of such a switch is that employed in the Sparton "Selectronne," illustrated in Figure 26. A shielding box with partitions as indicated by dotted lines separates the individual groups of trimmers. Shielded cables of a low capacity type connect these trimmer groups to the input, detector, and oscillator transfer switches as described in Note C1.

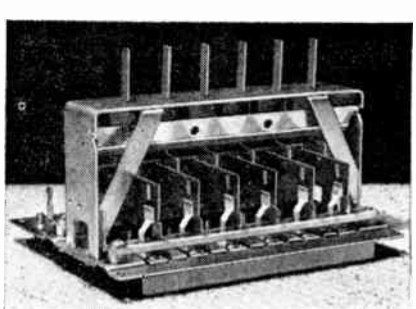


FIGURE 67—*Sprague Switch and Trimmer Condenser Bank—Front View.*

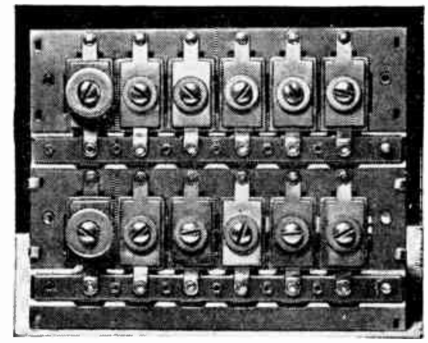


FIGURE 68—*Sprague Switch and Trimmer Condenser Bank—Rear View.*

Figures 67 and 68 show the front and rear views of the Sprague combination latching type switch and trimmer condenser bank. The unit illustrated is adapted for rear adjustment of the trimmers which are mounted directly on a metal back plate. Since the connection of a desired pair of trimmers is accomplished on the grid or high side of the circuit, this back plate constitutes a common ground for all the trimmer circuits and therefore one set of the trimmer plates may be riveted directly to the metal support plate. A common comb shown in Figure 67 is connected to the desired trimmer as the plunger is depressed by sliding a small metal contact shoe carried by a bakelite strip between a terminal on the comb and a terminal connected to the high side of the trimmer. In the unit illustrated, the trimmers of two circuits are selected in this manner. Similar type switches are in use with the trimmer units mounted on the front of the assembly for adjustment through holes in the escutcheon plate. Another variation of this unit provides for three rows of back-adjusted trimmers.

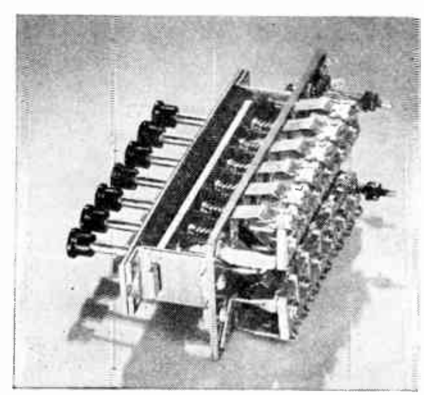


FIGURE 69A—*Pacific "Selectromatic" Unit—View from Top.*

A somewhat different latch assembly is a feature of the "Selectromatic" unit shown in Figures 69A and 69B. This unit which is intended for use in converting existing two gang receivers to push button operation

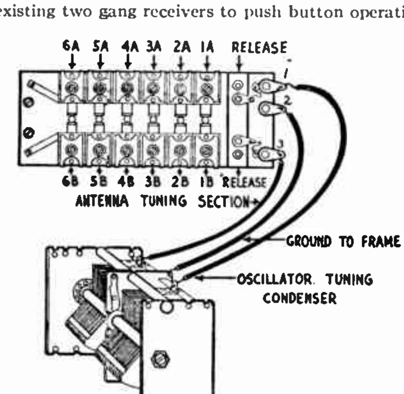


FIGURE 69B—*Pacific "Selectromatic" Unit—Wiring Diagram.*

employs a side acting bar for holding and releasing the plungers. This design is similar to the one in use in apartment house telephone systems. The plungers are turned from round rod stock and have cone-shaped locking grooves which co-operate with round holes in the latch bar. The latch bar is forced to one side by a spring which causes its hole to overlap the edge of the cone, thus preventing the cone from returning to its released position. When a plunger is depressed, its cone aligns the hole in the latch bar causing the latch bar to move sideways. As the cone moves through the hole in the bar, the bar is in such a position that any previously held plunger cone will pass through it thereby releasing the previously selected circuit. In use the individual sections of this switch are paralleled across units of the gang condenser. When the release button is pressed these circuits are opened allowing the receiver to be tuned manually by the gang condenser. When using the automatic unit the gang condenser is turned to its minimum capacity stop.

The Howard push button switch is used as shown in Figure 70 in a separate conversion unit as described in Note C4 and Figure 37 A feature of this switch is the use of silver-plated setel wire loops for terminals These loops are connected to ground by the actuated plunger which itself is silver-plated. Since the unit contains its own converter tube it constitutes the entire pre-amplifier oscillator and detector of a superheterodyne The addition of a rectifier and filter makes possible in the type 211 converter a unit which may be used for remote control purposes with the radio receiver to which it is attached tuned to a frequency below the broadcast band (540 kc) and acting as an IF amplifier.

AIR KING—Trimmer condenser switching is employed with the series or "L" terminal. This allows one of the push button positions to be used for the selection of the gang condenser. See Figure 34A and Note C4.

AUTOMATIC ELECTRIC—Iron core tuning is employed in the oscillator circuit of several models with switching accomplished on the ground side of the circuit. Note C2 and Figure 29 cover the details of circuit connections.

ERLA—The series operating or "L" terminal circuit is used as illustrated in Figure 34A. Transfer switching to gang condenser is accomplished on the push button switch. A feature of this circuit is the use of fixed condensers having a negative drift of capacitance with temperature to compensate for the positive drift tendency of the trimmers, coil, and tubes.

GAROD—The Garod "Prestomatic" receivers employ ground side switching for the connection of dual trimmers. See Figure 32.

GENERAL ELECTRIC—General Electric receivers employ two distinct types of latching switches in touch tuning models of the motor-driven and capacitor substitution varieties. The motor-driven model actuates "jack spring pile-up" switching as described on page 271. The trimmer condenser models use a latching type switch as shown in Figure 36. This switch employs wave band type terminals with contactor shoes carried by strips of thin bakelite. Connection is made to the high potential side of the circuit. Further details of the switching as regards the transfer button are described in Note C4, page 259.

GILFILLAN BROS.—Models of this company employ latching switches in both motor driven and trimmer substitution types. The motor-driven model incorporates a novel feature in the push button switch as shown in Figure 22. This comprises the use of two buttons at the center of the switch which are non-latching but which have a release cam so that the act of depressing either of them releases any previously latched plunger. These buttons are used for continuous scanning in either direction as shown and are employed when it is desired to rapidly tune across the broadcast band for the purpose of selecting a desired type of program. One of the buttons is connected to run the motor in the clockwise direction and the other to run it in the opposite or counterclockwise direction. Skillful manipulation of these plungers enables them to be used in lieu of the manual tuning knob.

In the automatic "Touch Tuning" models, condenser substitution is employed with transfer switching in one of the push button units as described in Note C4.

HERBERT HORN—Herbert Horn motor-driven models employ a circuit similar to that shown in Figure 38.

HOWARD—The motor-driven models use a latching type push button switch with series connection (see Figures 65 and 34). The transfer switch opens this series circuit to prevent operation of the motor while on manual tuning.

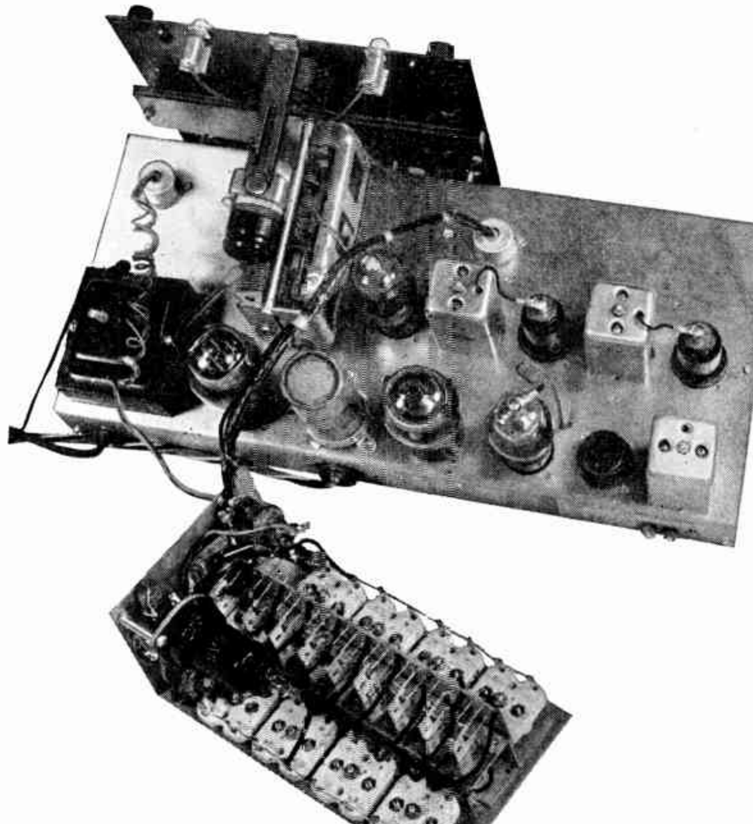


FIGURE 70—*Howard Radio Eight Station Tuning Unit.*

Tuned circuit substitution models employ a separate converter tube as described and illustrated in Figures 37 and 70.

NOBLITT-SPARKS—In these receivers a double row construction switch similar to that illustrated in Figures 61 and 62 is employed to connect three sets of trimmer condensers. A shield is interposed between the switch terminals to prevent couplings between circuits which might result in instability. The method of mounting the trimmer condensers and connecting them to the switch terminals is shown in Figures 71, 71A, 72, and 72A. In this switch the sliding contactor shoe is grounded and switching is performed between the low or rotor side of the trimmers and the frame or ground. Transfer from manual to automatic tuning is performed by the wave change switch whose counter clockwise position transfers coil circuits to trimmer tuning as described in Note C2.

PACIFIC RADIO (Chicago)—The "Selectromatic" tuning unit has been described in the introduction.

PACIFIC (Los Angeles)—Several models employ condenser substitution with the push button switch in the high side of the circuit. The first or gang tuning position connects the gang condenser in the same manner in which the other positions select trimmers. A transfer position to manual tuning is used on the wave band switch.

PACKARD-BELL—The Packard-Bell "Automatic Tuning" motor-driven model uses a series connected switch with two non-latching buttons for scanning operation as discussed above.

R.C.A.—"Electric Tuning" motor-driven models make use of a latching type switch. The circuit connections are shown in Figure 24. An optional feature of the system is the use of a switch similar to that incorporated in the receiver as a remote tuning unit. Shift to remote operation is controlled by a transfer switch as shown in the circuit.

The "Automatic Electric Tuning" models use condenser tuned input circuits and iron core trimmed oscillator circuits as shown in Figure 5, page 253. The switch, of double row construction, is of the high side connection type.

RADIO PRODUCTS — "Touch-O-Matic" tuning models of the Admiral line use a series-connected "L" terminal switch whose wiring is shown in Figure 38. Operation of the "off" or transfer button is described in Note C4.

SPARKS-WITHINGTON — The Sparton "Selectronne" switching unit serves to ground three independent sets of trimmers as shown in Figure 26, and described in the introduction to this section.

WARWICK—The Warwick push button switch com-

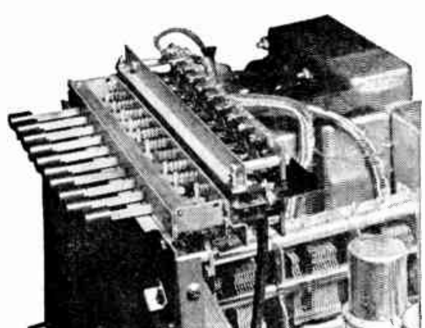


FIGURE 71—*Noblitt-Sparks (Arvin) Ten-Station Selector Switch—Top View.*

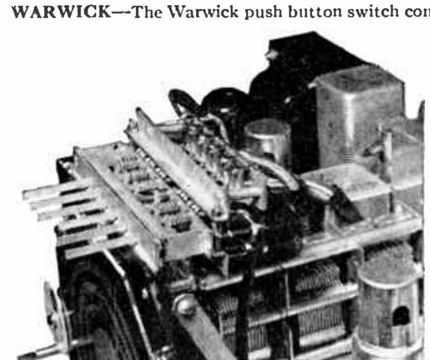


FIGURE 71A—*Noblitt-Sparks (Arvin) Six-Station Selector Switch—Top View.*

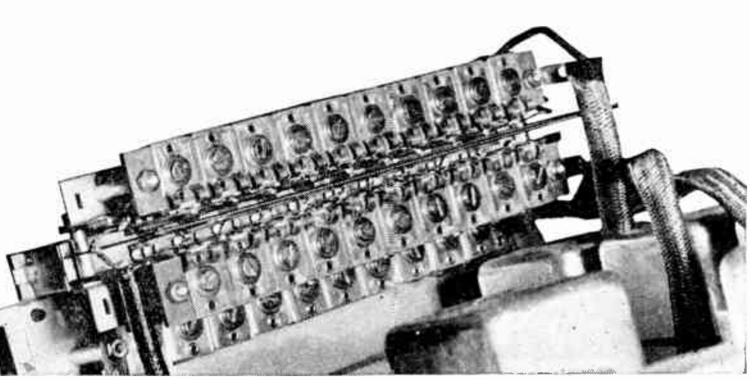


FIGURE 72—*Noblitt-Sparks (Arvin) Ten-Station Selector Switch—Rear View.*

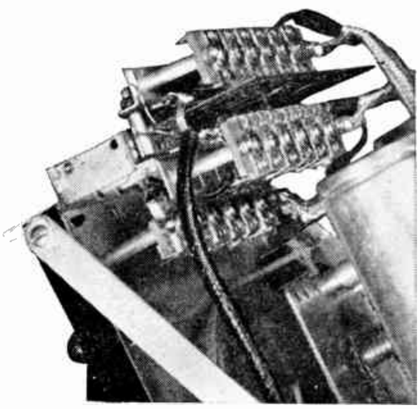


FIGURE 72A—*Noblitt-Sparks (Arvin) Six-Station Selector Switch—Rear View.*

bines series and parallel connections on separate sides on the same unit as shown in Figure 35.

WILCOX-GAY—Models A48 and 7S5 which feature the choice of six selected stations without gang condenser tuning, use an insulated shoe construction in which the contact arm connects three terminals together. One of these terminals is the grid, another the coil and a third the selected trimmer. By using a tap on the coil it is possible to restrict the range of the trimmers without restricting frequency coverage of the receiver. In a particular locality in which it might be desired to have more than the usual number of selected stations toward one end of the broadcast band, a simple shift of these coil connections could be made by the service engineer.

Note G3

As noted in the introduction a few of the motor-driven receivers employ electro-mechanical latching of a station button which also acts as a station stop position. These buttons are latched in place in a fashion similar to that described under Note G2 although they are not strictly push button switches.

GALVIN—"Electric Automatic Radio" models described in Note B7 and illustrated in Figure 17, combine the functions of a latching push button with an electrical station stop.

UNITED AMERICAN BOSCH—Several automatic tuning models employ a button latching principle in connection with the station stop mechanism.

Note G4

Certain Crosley and Zenith receivers use a motor drive to assist manual tune and rapidly turn the tuning mechanism to the desired station reception point. The tuning operation is then completed with the manual tuning knob. The switch controlling the motor in this case has its shaft concentric with that of the manual tuning shaft and the switch is of the center spring return type. Rotation of the switch knob toward the right causes the motor to turn in that direction. Conversely the motion of the knob to the left produces motor rotation in the opposite direction. Figures 44 and 45 illustrate this method of control.

Note G5

In the Fada "Flashomatic" models a rotary selector switch is used as shown in Figure 31 to connect pre-set trimmer condensers and indicate the station tuned by lighting an individual dial lamp.

SECTION H—STATION SELECTING COMMUTATOR DEVICES

The motor-driven models which make use of electrical push button switches all have some type of selective device driven by the gang condenser for the purpose of stopping the motor system at the correct point for station tune. With the exception of General Electric "Touch Tuning" these devices open the motor circuit to stop the tuning operation. The General Electric system is different in this regard since a contact is made rather than broken to cause the system to stop. This is described on page 271.

In general these electrical station stop devices may be divided in two classes: 1. A single-pole type which does not select direction of rotation of the motor and may therefore run to one end of the tuning range and throw a reversing switch before stopping on the desired station. 2. A single-pole double-throw type which by its position determines the correct direction of rotation of the tuning motor and therefore requires no reversing switch. Several mechanical designs of widely different appearance have been developed, of which the most common is the split ring type although the multiple disc type as described in the introduction in connection with a typical motor-tuned system has been used in the receivers of some of the larger manufacturers.

Note H1

The single grounded disc selecting device is shown in Figures 1, 24, and 73. As previously described this commutator is set by locking the disc against rotation by means of the selector adjusting key while the receiver is manually tuned to the desired station. Friction washers between the discs allow the commutator to rotate while the disc remains locked. After the adjusting pin is withdrawn the disc will remain in correct relative position to the shaft by which it is driven through the friction discs.

Note H2

As previously mentioned the General Electric commutating device reverses the usual procedure and makes contact of a moving grounded arm to movable insulated points for station selection. See description of G.E. "Touch Tuning" system, page 271.

Note H3

The split disc commutator may be considered as a single-pole double-throw switch. The single pole is the selected contact point which can rest upon either one of two rings or discs or upon an insulated break between them. The motor will start to run in such a direction as to move the disc or ring towards the break. Figures 22, 38, 39, and 59, illustrate this principle. An interesting phenomenon occurs in some of these sets as the break reaches the selected contact: inertia of the system may cause over-drive past the insulated break so that contact is established with the other disc or ring. This causes the motor to start in the opposite direction and several oscillations of motion may occur about the position of the insulated break. The accuracy of this type of commutator depends upon the width of the break, speed of the system and shape of the contact.

An interesting feature has been added to a number of the receivers employing this type of commutator in the form of an indicating light for assistance of correct station set-up. The Detrola, Gilfillan and Radio Products receivers employ this light. Since the circuit connections for the operation of this light differ slightly in the models of these companies an individual brief description follows.

DETROLA—The Detrola tuning system employs a selector drum type of mechanism in which the two rings mentioned take the form of half cylinders and the contacts are pins which may be shifted around the periphery of these cylinders in two parallel slots. This arrangement allows two stations on adjacent channels to be selected by using pins on the separate slots for the desired stations. A lamp is connected between ground and a flexible lead which may be held upon the selector pin being adjusted. While it is so held the station is accurately tuned manually and the pin moved until the light is extinguished. This indicates that the pin is resting on the insulated section of the commutator which is the correct point for automatic operation when selecting that station.

GILFILLAN BROS.—Reference to Figure 22, page 258, will illustrate the operation of the adjustment light in connection with the commutator setting. A

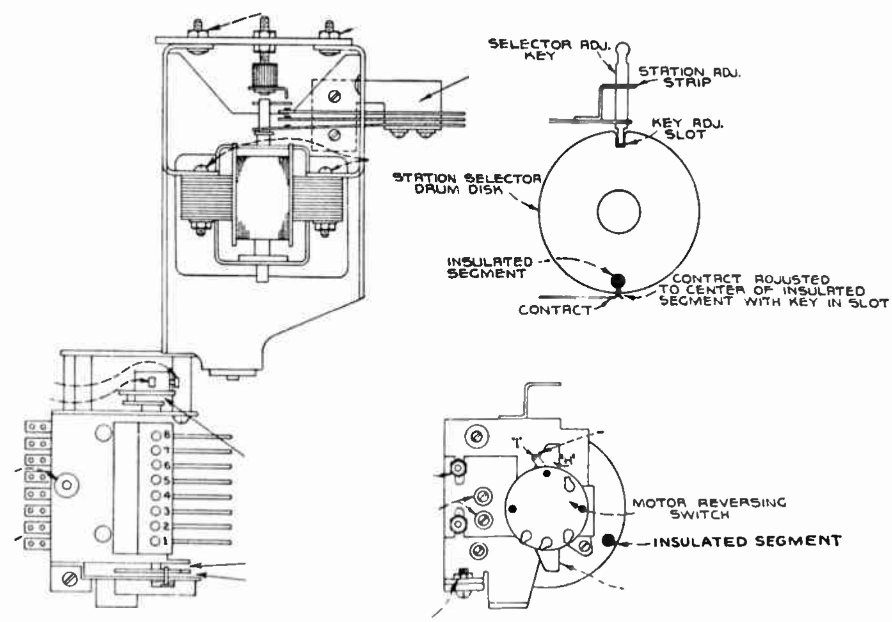


FIGURE 73—*R.C.A. Motor and Commutator Details.*

switch at the point marked X is provided to connect the light with its protective resistor between the common bus and the frame. With the transfer switch in the manual-sharp position, a station is tuned in by means of the usual manual tuning drive. The contactor point closest to the break is chosen for this station and with the indicator light switch closed and the station selector switch button latched in place, this selector point is moved until the light is extinguished. Suppose that the station desired was placed on button number 4 (Figure 22). It will be noted that when number 4 button is locked in place, the circuit from the 24-volt source, tuning motor, commutator, and resistor light to ground is broken at the commutator. The resistor and light reduces the current sufficiently so that there is no tendency of the motor to rotate while this adjustment is being made.

RADIO PRODUCTS—In adjusting the Radio Products Admiral "Touch-O-Matic" system illustrated in Figure 38, the following sequence is observed: The "off" button and the desired station button are simultaneously locked in. Under these conditions the automatic tuning indicator light is connected in series with the voltage supply to the motor from a 6-volt tap on the 24-volt supply winding. The voltage supply to the motor through the indicator light is insufficient to permit rotation of the motor, and the receiver may be controlled manually. If, when adjusted for exact resonance with the desired station, the indicator lamp is extinguished this indicates that the required contactor is resting on the insulated break of the station selecting commutator. If this is not the case and the light still glows, adjustment of the position of the contact point on the commutator can readily be made. A check of the correctness of commutator setting can be obtained at any time by locking in the required button and the "off" button. During the adjustment cycle described above the automatic frequency control system has been rendered inoperative by contacts controlled by the "off" button.

Note H4

The Crosley "Prestotune" household receivers and Chevrolet motor car radio sets employ a combination of disc and toggle switch action as illustrated in Figures 57, 74, and 75. Referring to Figure 74 it will be noted that the discs are similar as regards station set-up to the type described in Note H1. It will be noted, however, that instead of an insulated break, the disc itself carries no electrical connection, but has a pin fastened to its periphery which engages a toggle. This toggle throws a single-pole double-throw switch in one direction or the other, depending on the direction of motion of the disc. As the station is selected and the discs all start to rotate the pins of the unwanted station discs will throw their respective toggles as they pass them, in such a direction that when they are subsequently chosen the switches will have been thrown in the proper manner to start rotation towards the desired station. It will be noted that adjustment screws are provided to limit the throw of the toggle switch. Careful adjustment of these screws makes it possible for the spacing of contacts to compensate for back-lash of the driving system. In the Chevrolet commutator shown in Figure 75 the contact arm and toggle are combined in one "T"-shaped piece. A screw at each position permits adjustment of the angular width of the break.

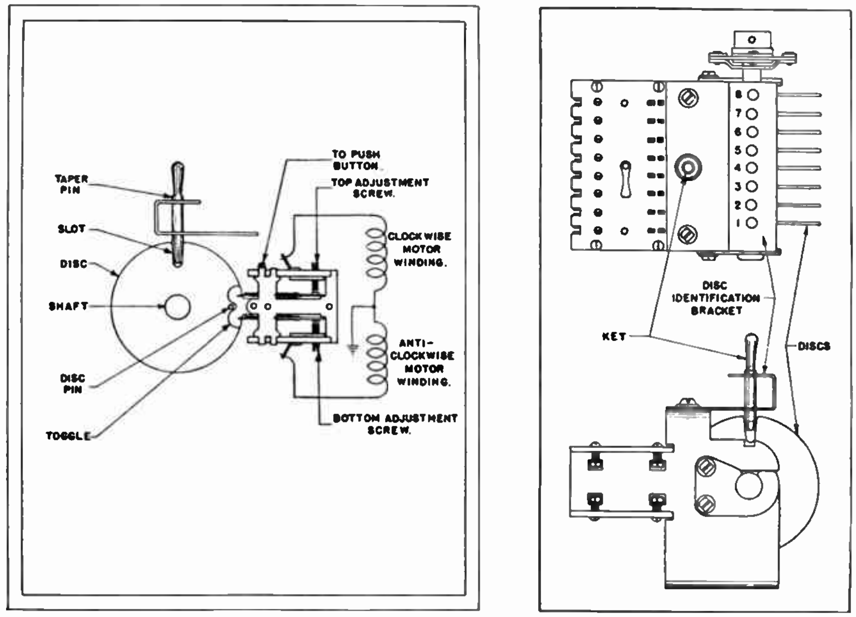


FIGURE 74—*Crosley "Prestotune" Commutator Details.*

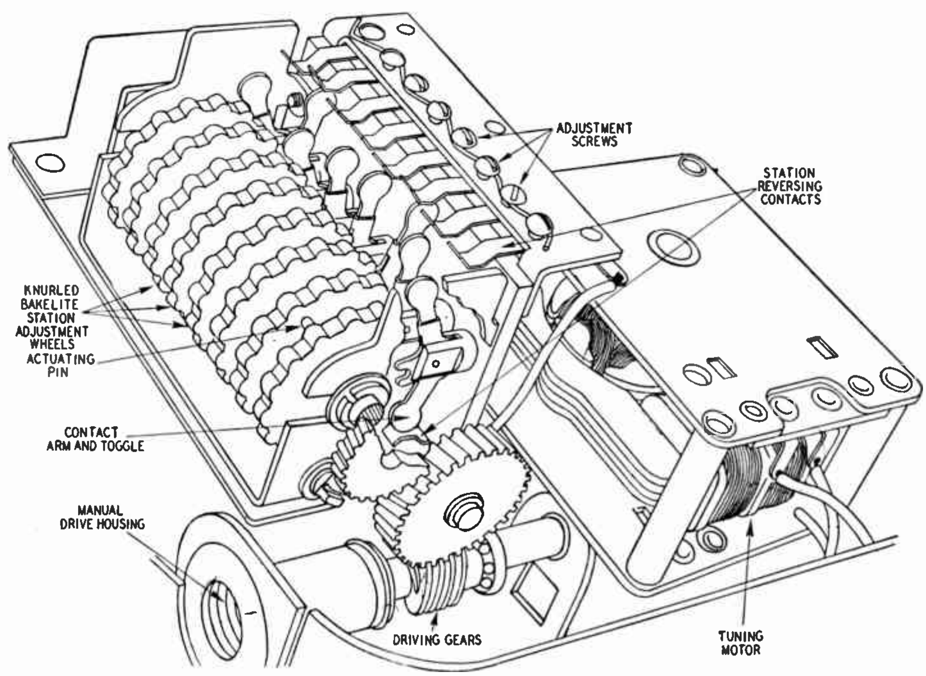


FIGURE 75—*Chevrolet Station Selecting Commutator.*

SPECIAL DESCRIPTION OF RECEIVERS NOT INCLUDED IN GENERAL OUTLINE

Certain receivers differ in so many respects from those listed and described in the various preceding sections that it appeared advisable to describe their operation separately. These include the Belmont "Belmonitor" which employs the "linear" or "typewriter" type of direct control of the gang condenser; the General Electric motor-driven "Touch Tuning" system, the Stewart-Warner "Magic Keyboard," and the Wells-Gardner "Electric Drive."

BELMONT "BELMONITOR"

This device consists of a series of "heart-shaped" cams stacked on a shaft attached directly to the gang condenser. These cams are individually adjustable since they can be unlocked from the drive shaft by a tapered expansion sleeve which is controlled by a screw. Figure 76 shows a front view of the tuning system. The levers shown at the front of the unit move through a distance of approximately 1 1/4 inches and in doing this turn the cams until the two lobes of the cam are aligned against the lever. This is the position corresponding to station tune. To set-up stations the screw at the end of the shaft is loosened, the button depressed to the end of its travel and while holding it down the station is accurately tuned in manually. This operation is repeated for each of the desired stations on separate levers. The screw is re-tightened after this procedure.

Figure 77 shows the appearance of this type of mechanical tuner from the front of the cabinet.

Note—Devices of this type controlled by push button type motion as well as the lever action described, are currently attracting the attention of receiver designers. It seems likely that several variations of the direct mechanical tuner will appear in receivers in the near future.

GENERAL ELECTRIC MOTOR OPERATED "TOUCH TUNER"

The General Electric "Touch Tuning" system involves the application of so many features not found in the other receivers described that a complete explanation of the operation of the system has been reserved for special consideration. Some of the individual components have been mentioned briefly in the sections devoted to them with reference to this note.

Sixteen push buttons in a latching type switch control the operation with provision for an eight-button remote unit as an additional accessory if desired.

Of these sixteen buttons, thirteen are used for station selection, one for scanning, one for transfer to manual operation, and the last to turn the receiver off.

Referring to schematic diagram 41 it will be noted that the off button controls an AC line switch. This turns the receiver on whenever any of the other buttons of the switch are pressed since the line switch is in its "on" position when its plunger is released or out. To turn the receiver off it is merely necessary to press this button.

The heart of the control system is a combination relay and mechanical stop. This is shown at the center of the diagram. The armature of this relay engages a

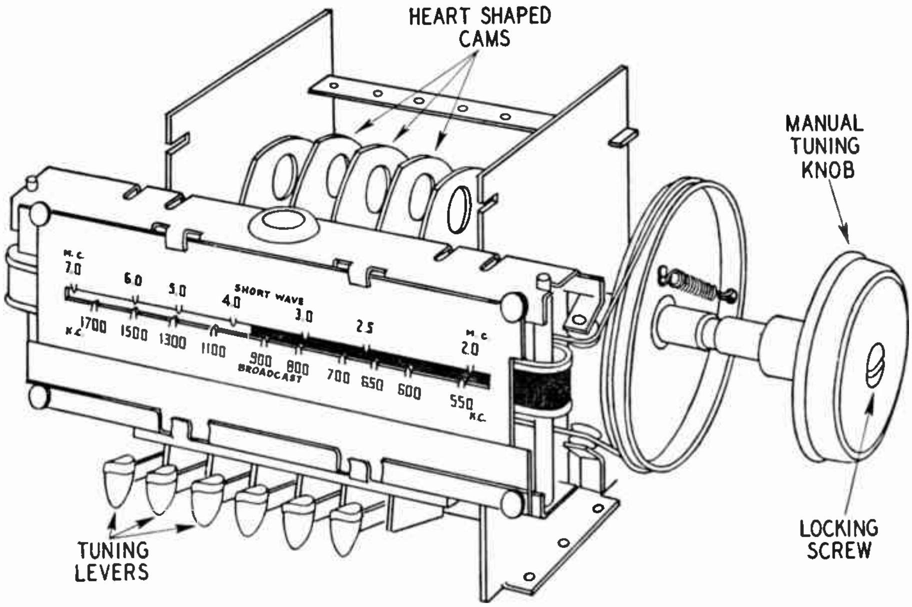


FIGURE 76—*Belmont "Belmonitor" Tuning System—Front View.*

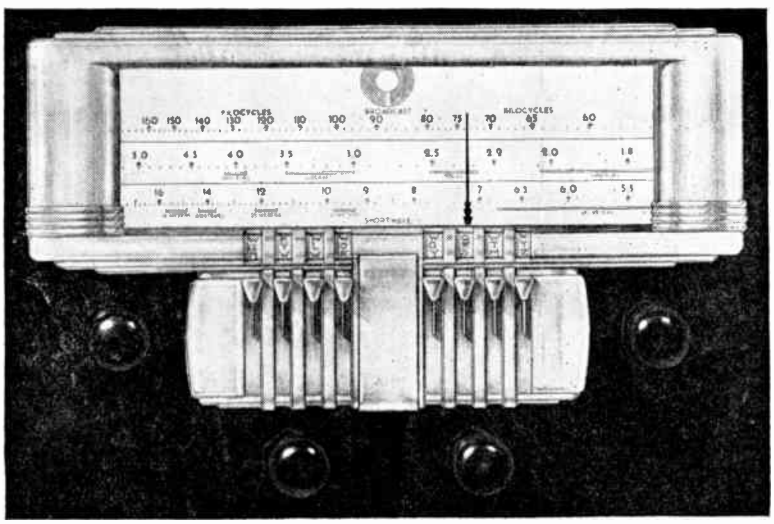


FIGURE 77—*Belmont "Belmonitor" Tuner—Front of Cabinet.*

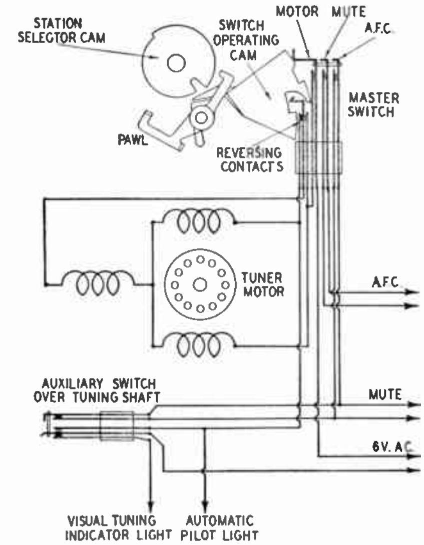


FIGURE 79—*Stewart-Warner "Magic Keyboard"—Wiring Diagram.*

two-fingered friction clutch which acts as the connecting link between the split phase capacitor type motor and the gang condenser driving system. When the relay closes the end of the armature causes an instant stop of the drive system in addition to opening three circuits by means of contacts on six jack springs as shown.

The first pair of contacts control the release of automatic frequency control, the second pair of contacts control the motor current and the remaining pair of contacts control the audio silencing circuit.

The relay winding is energized when the station commutator on the gang condenser shaft makes contact with the adjustable contact pin to which the desired station button is connected.

Pressing the manual button releases any depressed button. Thus the relay coil circuit is opened and the relay field coil cannot be energized. When the manual button is locked in, the motor circuit is open, and the grounding of output grids and AFC circuit removed. This allows a separate manual AFC switch to be used at will when the manual button is in.

With the receiver set for manual operation depression of the scan button closes the motor circuit by shunting the open motor contacts of the manual switch allowing continuous motor operation and dial travel. As the motor drives to the limits of the dial on either end, the reversing switch operating at the end of travel is automatically thrown, causing reversal of motor rotation. Since the scan button is non-latching, it does not unlock the manual tune button as it is depressed. The audio system is silenced by a pair of contacts on the scan button which avoids reception of unwanted stations or inter-station noise when this button is used.

Since the system stops on contact, the connection of the remote control unit is somewhat different than in systems of the open circuit type. One of the receiver station selector buttons is chosen as the remote tune transfer button. The remote tune switch is connected with the lead which would normally run from this button to the commutator now serving the purpose of a common connection in the remote switch. In this way the remote button serves to connect the remote switches to the relay coil and allow parallel operation of seven positions at the remote point with any seven selections at the receiver. The eighth button at the remote point is used to silence the receiver whenever desired for such occasions as answering the phone.

STEWART-WARNER "MAGIC KEYBOARD"

This mechanism combines mechanical and electrical features to produce a system requiring no transfer means to change from manual to automatic tuning other than the act of turning the tuning knob for manual operation or depressing a button for automatic operation. An additional feature not found in other systems is the dual use of the tuning knob for mechanically unlocking the station set-up cams.

Figure 78 is a photograph of the "Magic Keyboard" unit. Figures 79 and 80 show electrical details of the master and auxiliary switches.

The keyboard itself consists of fifteen station-selecting plungers arranged in two rows. These plungers serve to engage pawls with the surface of cams. Each cam has a high and low side separated by a tapered notch. When a station plunger is depressed, it causes its corresponding pawl to drop on the high or low side of the station cam depending upon the position of the tuning condenser at the time it is pressed. The position of the pawl controls the master switch operating cam shown in Figure 79.

If the pawl is resting on the high side of a cam the switch contacts will be in the position shown in Figure 80A. It will be noted that all contacts of the master switch are closed thereby actuating the motor, muting the receiver and releasing the AFC circuit. The motor reversal switch is closed in such a direction as to cause the motor to drive the station selector cam in the shortest direction for the extension on the pawl to drop into the notch.

FIGURE 78—*Stewart-Warner "Magic Keyboard."*

If the pawl is resting on the low side of a cam when the station plunger is depressed the sequence of Figure 80B will occur which is identical with that described except that the reversing switch is thrown in the opposite direction to cause a reversed direction of motor operation. This means that the motor must run in the opposite direction for the tip of the pawl to drop into the notch.

When the notch is reached the switch operating cam changes position to that of Figure 80C which stops the motor, releases audio silencing and renders the AFC system operative.

The mechanism whereby these station selector cams are set in the proper physical relation to the gang condenser for station selection is as follows: The tuning knob shown in Figure 78 is removed by pulling it directly off the shaft. When removed, an auxiliary knob will be found which can be used to unlock a clamp holding the station selector cams in relation to their shaft. After unlocking the cams any one of them may be held firmly in position by depressing a station button while the receiver is tuned manually. After the entire group of cams are set up in this way, they are locked in place with the knob mentioned, the tuning knob replaced, leaving the receiver ready for automatic station selection.

Transfer to manual tuning is accomplished by a kickout arm and spring which interconnects the latch bar of the plunger group with a star wheel on the manual tuning shaft. As the manual tuning shaft is turned in either direction the star wheel will kick out the latch bar, releasing any latched station plunger and operate the auxiliary switch over the tuning shaft. This switch then changes the indicator lights from automatic to manual and removes AFC control. Depressing an automatic selection button reverses the sequence of operation by resetting the side switch over the tuning shaft, changing the indicator light and removing the AFC short circuit.

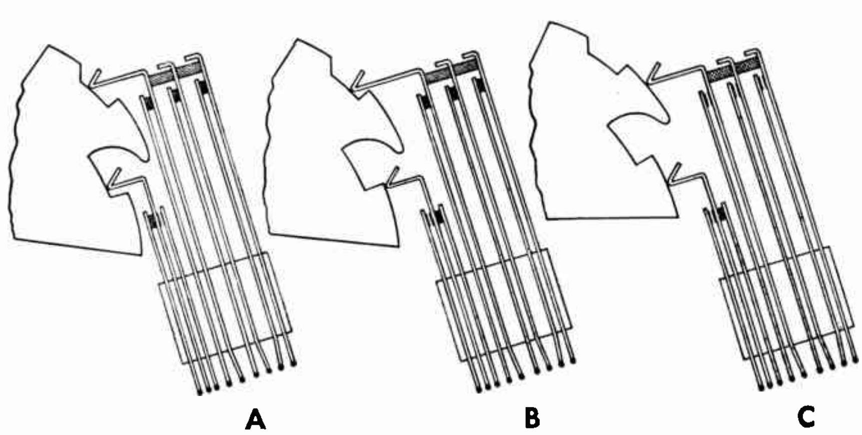


FIGURE 80—*Stewart-Warner "Magic Keyboard"—Position of Switch Contacts.*

WELLS-GARDNER "ELECTRIC DRIVE"

The Wells-Gardner "Electric Drive" is a combination of mechanical and electrical interlocks which allows station "set-up" from the front of the receiver. The station stop mechanism consists of a series of discs which are geared to the condenser drive system and are encircled by brake shoes having notches which co-operate with stop levers as shown in the sequence of drawings of Figure 81.

Above each station tuning button is a setting button used only when it is desired to change the pre-set tuning choice. The station tuning buttons are interlocked by means of a side-acting latch in such a manner that the act of depressing a station button will move the latch and release any previously held button. This side-acting latch or locking plate is also actuated by the manual-electric transfer control.

Figure 81A shows the system of rocker arms and stops in position corresponding to a released plunger. It will be seen that all parts of the stop system are clear of the brake shoe and will allow its free rotation. Figure 81B shows the tuning button depressed with the stop lever bearing against the outer periphery of the brake shoe. The ball on the end of the switch lever is depressing the switch plunger causing the motor to run. The motor will run the system until the stop lever drops into the notch and allows the switch lever ball to leave the switch, thus stopping the motor with the setting disc firmly locked in place, as shown in Figure 81C.

Figure 82D shows the manner in which the setting disc is released from the brake drum to allow it to be set at the correct point for station tune. The station is tuned in manually with the system as shown in Figure 81D. The brake drum turns freely within the setting disc until it is clamped in place by the cams on the drum release and auxiliary lever, as the setting button is withdrawn. Study of the position of the various parts as shown in Figure 81 will disclose the sequence of operation.

Audio silencing is obtained by a switch operated by axial movement of the motor shaft.

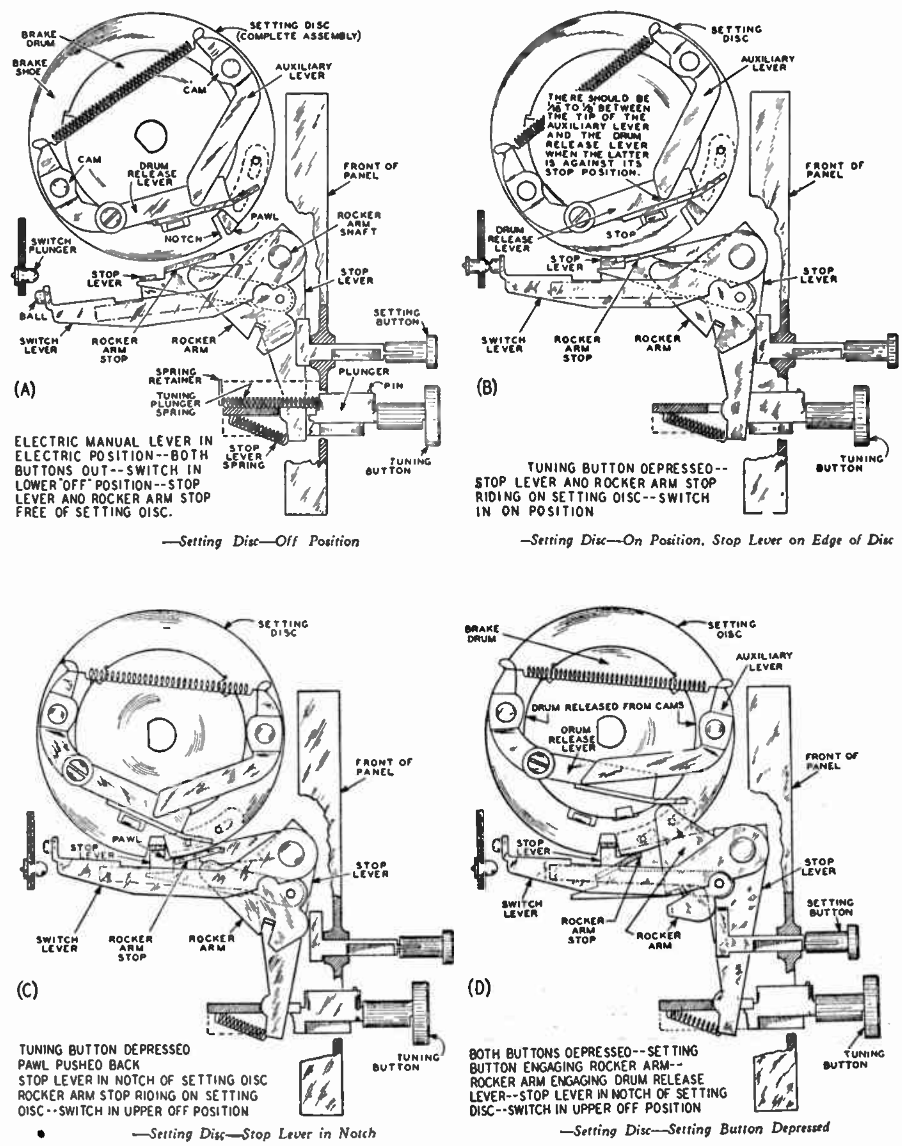


FIGURE 81—*Wells-Gardner "Electric Drive" Details.*

SUGGESTIONS FOR SERVICING AUTOMATIC TUNED RECEIVERS

The purpose of this presentation of the subject of automatic tuning has been to give the service engineer a broad and comprehensive review of the various systems in use and their inter-relation.

Several general suggestions are offered as applicable to all makes of receivers and worthy of consideration:

1. Make certain that the alignment of IF and RF circuits is precise since quality of reception and satisfactory signal to noise ratio are dependent on precision of resonance. This is especially true in models which are not equipped with automatic frequency control.

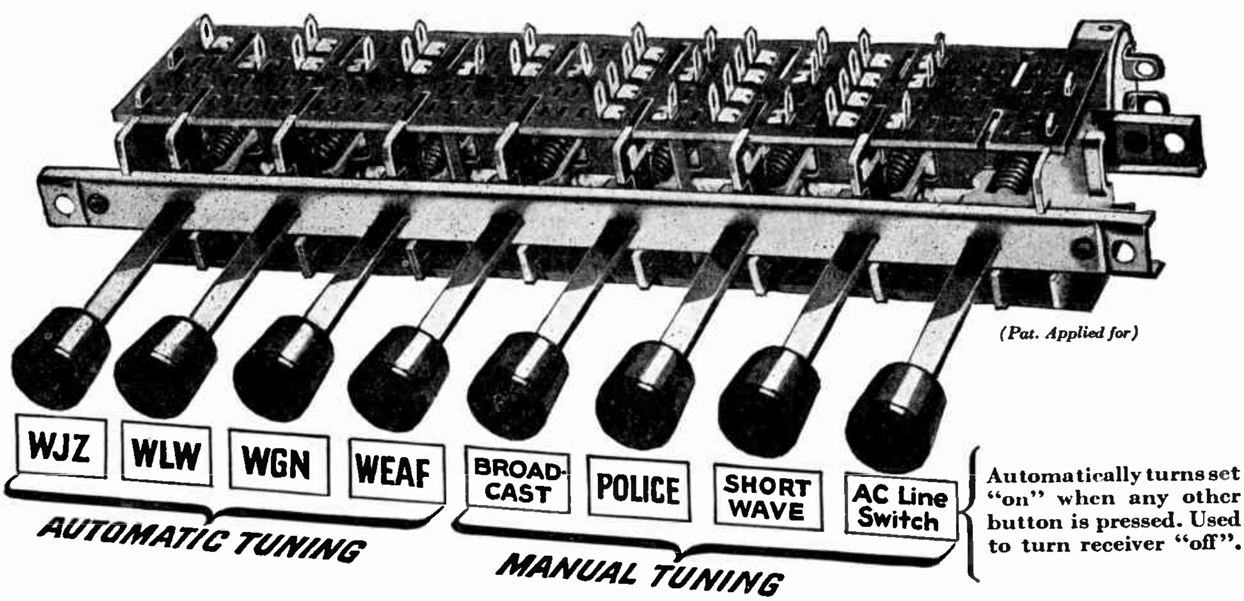
If band widening circuits are employed in the IF amplifier it is highly desirable to use visual means of alignment. Some receivers have band widening on the automatic position and not on the manual position. In these it is highly desirable to observe whether the band widens without shifting of the center of tune when changing from manual to automatic positions by the transfer means. The electric tuning eye of the receiver is not always an accurate indication of this condition since the sensitivity of the amplifier may be changed by the band widening circuits. A cathode ray oscilloscope alignment method should be used whenever possible.

Although at first thought it might not seem strictly necessary to have the radio frequency circuits accurately tracked when employing AFC, a moment's consideration will show that the operation is impaired by mistracking. The AFC control of the oscillator only assures that the IF signal is of proper frequency. If the RF amplifier is off tune very seriously, the quality, sensitivity, and signal-to-noise ratio will be impaired. Adjacent channel interference may be objectionally high with a mistuned RF system in an AFC set.

2. In making a choice of the stations to be pretuned it is important to select only those which are sufficiently above the noise level as to furnish satisfactory entertainment at all times. An interesting bit of owner psychology is involved in the consequences of improper choice of stations. The purchaser of a new automatic tuned radio receiver is not acquainted with the phenomena of drift of tune due to temperature, mechanical aging of parts, humidity drift, frequency drift due to voltage instability, etc. Nor is he apt to be sympathetic with the vagaries of fading signals and adjacent channel "monkey chatter." When his new receiver fails to produce pure and unadulterated music as every automatic push button is pressed, he feels that he is not receiving his money's worth of radio performance or that the receiver has been improperly adjusted. Even a demonstration that no better reception of the particular station is possible by manual tune is apt to be too late to be convincing.

3. Allow the receiver to operate for at least fifteen minutes before making the station selector adjustments. This will allow the radio chassis to assume normal operating temperature with voltages at their final values. During this period the oscillator frequency gradually drifts as tuned circuit elements and tubes warm up, and their component parts expand. This precaution is particularly true with respect to the tuned circuit substitution types of receivers not equipped with AFC. As mentioned previously, certain parts of the receiver cause the oscillator to have a positive drift of frequency with increasing temperature and other parts cause the frequency to decrease with increasing temperature. These two effects unfortunately are not balanced. In some of the recent receivers as well as the band spread types, compensation is provided. In spite of this feature, it is wise to allow a reasonable warm-up time to elapse before making final adjustments.

4. Make a check-up trip to the customer after a few days have elapsed to correct any drift tendencies which may have made themselves evident due to mechanical and long-time aging effects. After this second adjustment most receivers will have reached a final condition of operation which will continue to give satisfactory performance. By providing a periodic check-up service, the customer will learn that he can expect continued satisfaction from his automatic-tuned radio receiver.



AS THIS goes to press, Mallory-Yaxley announces a new type of push-button, station-selection and wave-change switch. The editors feel fortunate in having the opportunity to present a brief description and illustration of this switch.

As indicated in Section C, pages 257-261, of the preceding article on automatic tuning, a trend toward the employment of other than station-selection functions on the push-button switch seemed evident. By the inclusion of band switching, station-selection and AC line switch circuits on the push-button switch itself, a simplified completely interlocked system is possible.

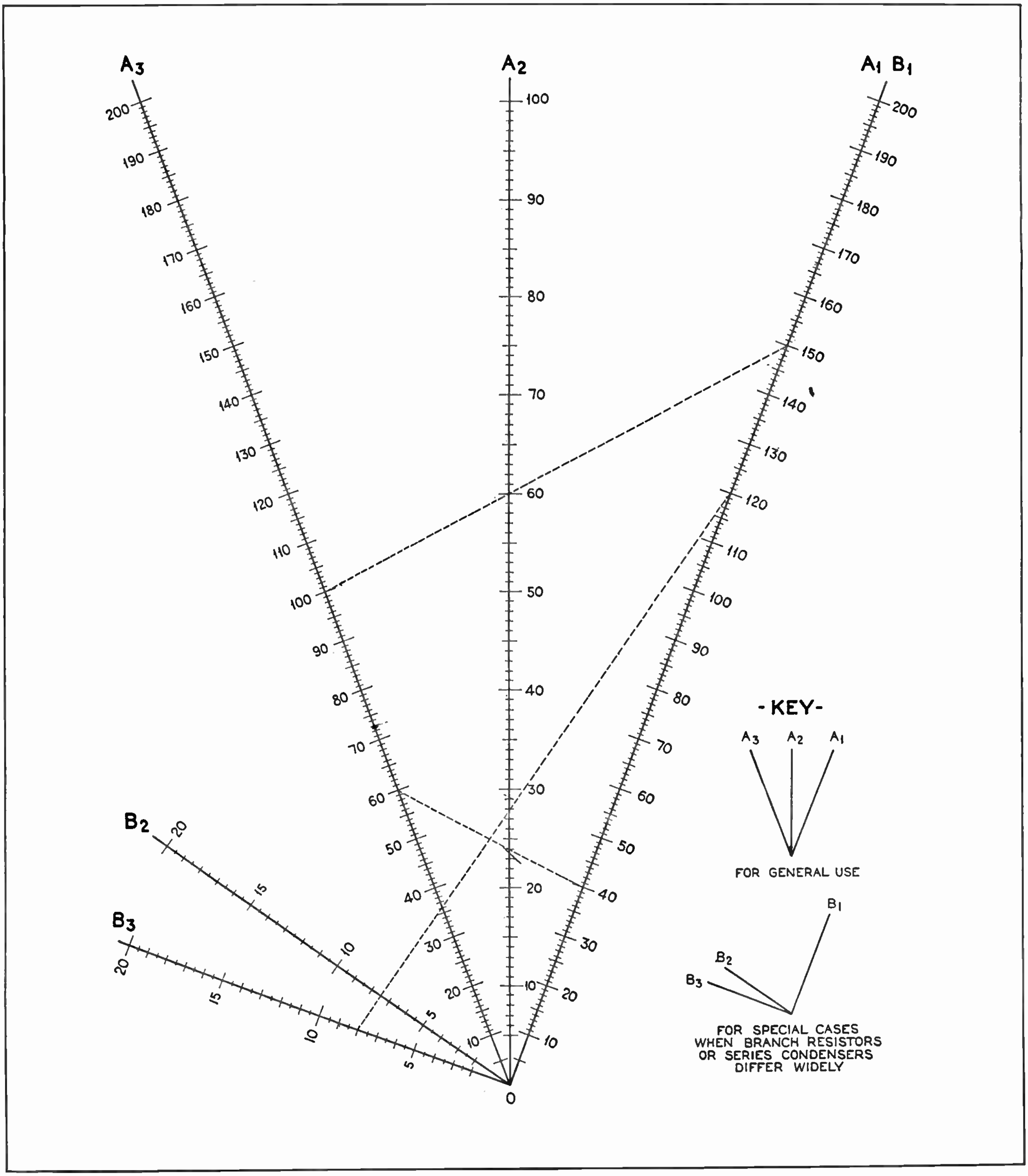
The AC line switch is actuated by the first plunger and is so coupled to the plunger that the receiver is turned "on" whenever this plunger is in its released position; thus the receiver may be turned off and any previously depressed button released merely by pushing the AC line switch button. If any other button is depressed such as a wave-change switch or selected station, the return of the AC line switch plunger to its released position will automatically turn the receiver on as wave-band or station is selected.

To accomplish this type of switching, it became necessary to develop a push-button switch more nearly resembling a wave-change switch in flexibility of circuit combinations than the switches described on pages 266-270. The basic design as shown in illustration, Figure 82, consists of two spaced bakelite terminal boards on either side of the plungers carrying double rows of terminals. These terminals contact movable shoes attached to sliding bakelite members which in turn are driven by the plunger. Each terminal board has four rows of terminals disposed on either side of the sliding member, thus eight terminals are provided for each plunger on both sides of the switch, or a total of sixteen possible terminals per plunger. Switching combinations may use any or all of these terminals, or any terminal may be omitted when not required. The design is such as to keep the capacitance between terminals, and of the terminals to the frame, at a minimum, thus reducing RF losses and allowing the switch to be used for wave-band switching functions.

The sliding shoes are available in four different shapes and allow terminals to be connected together either on the same side or on opposite sides of the sliding bakelite piece. Switching combinations up to 4-pole double-throw plus 2-pole single-throw per plunger are possible. The sliding contact shoes may be of either the shorting type, which maintain contact between successive terminals during operation, or of the non-shorting type which open the circuit before making contact with the succeeding terminal. The shorting type switch is commonly used in radio circuit applications in which an open circuit during switching might produce a transient noise, and the non-shorting type is required in meter or instrument switching.

Series Condenser—Parallel Resistors Chart

This chart enables you to find the equivalent resistance of two resistors in parallel and also the capacity of two condensers in series. Draw a straight line through the divisions on scale A_1 and A_3 representing the resistance in the two branches, and you will find the resultant resistance on scale A_2. To find the resistance of one branch when the other branch and the total resistance are known, draw lines through the corresponding points on A_1 and A_2 and find the answer on A_3. When the resistance of the two branches is widely different, use the chart consisting of scales B_1, B_2 and B_3. B_1 and B_3 are for the unequal branches and the result is on B_2.



Mallory Vitreous Enameled Fixed Resistors

Conservatively rated, rugged and dependable, Mallory Fixed Vitreous Resistors, type HJ, provide a standard unit for all receivers, amplifier, transmitter, and industrial applications. The small-sized resistors 1HJ (10-watt) and 2HJ (20-watt) are furnished with pig tails and lugs for mounting or connection. The larger resistors, 5HJ (50-watt), 10HJ (100-watt), and 20HJ (200-watt) have connecting lugs only, and are supplied with convenient mounting brackets. Mallory Vitreous Enameled Resistors can be depended on to provide long, uninterrupted service.

†10 Watt Rating

(†On Values to 10,000 Ohms) Size: 5/16 x 1 3/4 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
1	3150	3	1HJ1
2	2200	4.5	1HJ2
3	1800	5.5	1HJ3
5	1400	7	1HJ5
7.5	1150	8.5	1HJ7.5
10	1000	10	1HJ10
15	812	12	1HJ15
20	707	14	1HJ20
25	630	16	1HJ25
35	530	19	1HJ35
50	447	22	1HJ50
75	360	27	1HJ75
100	315	31	1HJ100
125	280	35	1HJ125
150	260	39	1HJ150
200	220	44	1HJ200
250	200	50	1HJ250
300	180	55	1HJ300
400	158	63	1HJ400
500	141	70	1HJ500
600	130	77	1HJ600
750	115	85	1HJ750
1000	100	100	1HJ1000
1250	89	111	1HJ1250
1500	81	122	1HJ1500
2000	70	141	1HJ2000
2500	63	158	1HJ2500
3000	56	173	1HJ3000
3500	53	185	1HJ3500
4000	50	200	1HJ4000
4500	47	212	1HJ4500
5000	45	224	1HJ5000
6000	40	240	1HJ6000
7500	36	270	1HJ7500
10000	32	316	1HJ10000
12000*	17	204	1HJ12000
15000*	15	225	1HJ15000
20000*	13	260	1HJ20000
25000*	12	300	1HJ25000
30000*	11	330	1HJ30000
40000*	9	360	1HJ40000
50000*	8	400	1HJ50000

†20 Watt Rating

(†On Values to 12,500 Ohms) Size: 1/2 x 2 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
5	2000	10	2HJ5
10	1415	14	2HJ10
25	895	22	2HJ25
50	633	31	2HJ50
75	517	38	2HJ75
100	447	44	2HJ100
150	365	54	2HJ150
200	316	63	2HJ200
300	258	77	2HJ300
400	224	90	2HJ400
500	200	100	2HJ500
750	163	122	2HJ750
1000	141	141	2HJ1000
1250	126	157	2HJ1250
1500	115	173	2HJ1500
1750	107	187	2HJ1750
2000	100	200	2HJ2000
2250	94	211	2HJ2250
2500	89	222	2HJ2500
2750	85	235	2HJ2750
3000	81	243	2HJ3000
3500	75	262	2HJ3500
4000	71	284	2HJ4000
4500	66	300	2HJ4500
5000	63	315	2HJ5000
6000	57	345	2HJ6000
7500	51	387	2HJ7500
10000	44	440	2HJ10000
12500	40	500	2HJ12500
15000*	23	346	2HJ15000
20000*	20	400	2HJ20000
25000*	18	447	2HJ25000
35000*	15	529	2HJ35000
40000*	14	566	2HJ40000
50000*	13	632	2HJ50000
75000*	10	773	2HJ75000
100000*	9	894	2HJ100000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

†50 Watt Rating

(†On Values to 25,000 Ohms)
Size: 3/4 x 4 1/2 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
10	2240	22	5HJ10
25	1415	35.4	5HJ25
50	1000	50	5HJ50
100	707	70	5HJ100
250	447	111	5HJ250
500	316	158	5HJ500
750	258	192	5HJ750
1000	224	224	5HJ1000
1500	183	275	5HJ1500
2000	158	316	5HJ2000
2500	141	354	5HJ2500
5000	100	500	5HJ5000
7500	81	610	5HJ7500
10000	70	700	5HJ10000
12500	63	790	5HJ12500
15000	57	850	5HJ15000
20000	50	1000	5HJ20000
25000	44	1100	5HJ25000
30000*	26	774	5HJ30000
40000*	22	894	5HJ40000
50000*	20	1000	5HJ50000
75000*	16	1223	5HJ75000
100000*	14	1414	5HJ100000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

†100 Watt Rating

(†On Values to 50,000 Ohms)
Size: 1 1/8 x 6 1/2 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
25	2000	50	10HJ25
50	1414	70	10HJ50
75	1155	85	10HJ75
100	1000	100	10HJ100
150	815	120	10HJ150
250	632	158	10HJ250
500	447	220	10HJ500
750	365	275	10HJ750
1000	316	315	10HJ1000
1500	258	385	10HJ1500
2000	223	447	10HJ2000
2500	200	500	10HJ2500
5000	141	700	10HJ5000
7500	115	865	10HJ7500
10000	100	1000	10HJ10000
15000	81	1200	10HJ15000
20000	70	1400	10HJ20000
25000	63	1580	10HJ25000
30000	57	1724	10HJ30000
40000	50	2000	10HJ40000
50000	44	2200	10HJ50000
75000*	23	1732	10HJ75000
100000*	20	2000	10HJ100000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

†200 Watt Rating

(†On Values to 75,000 Ohms)
Size: 1 1/8 x 10 1/2 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
25	2830	70	20HJ25
50	2000	100	20HJ50
75	1635	120	20HJ75
100	1414	140	20HJ100
250	894	220	20HJ250
500	632	315	20HJ500
750	515	385	20HJ750
1000	447	447	20HJ1000
1500	361	541	20HJ1500
2000	316	630	20HJ2000
2500	283	705	20HJ2500
3000	258	770	20HJ3000
5000	200	1000	20HJ5000
7500	163	1200	20HJ7500
10000	141	1400	20HJ10000
20000	100	2000	20HJ20000
30000	81	2400	20HJ30000
40000	70	2800	20HJ40000
50000	63	3150	20HJ50000
75000	51	3820	20HJ75000
100000*	28	2828	20HJ100000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

Mallory Variohm Adjustable Resistors

Mallory Variohm Adjustable Resistors, type AV, incorporate all the quality features of the Mallory HJ type of fixed resistors. Because of their adjustable feature these resistors are valuable for replacing voltage dividers in radio receivers, for use in radio transmitter power supplies and general experimental work.

The adjustable clip supplied with each resistor is specially designed for ease of adjustment, and to prevent injury to the resistance wire while providing proper electrical contact. Additional clips are available. Two convenient mounting brackets are supplied with each variohm resistor.

†25 Watt Rating

(†On Values to 12,000 Ohms)
Size: 5/8 x 2 1/2 Tube)

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
1	5000	5	2AV1
3	2890	8.6	2AV3
5	2240	11	2AV5
10	1580	15	2AV10
15	1290	19.3	2AV15
25	1000	25	2AV25
50	707	35	2AV50
75	575	43	2AV75
100	500	50	2AV100
150	400	60	2AV150
200	353	70	2AV200
250	316	79	2AV250
300	288	86	2AV300
400	250	100	2AV400
500	224	112	2AV500
750	182	137	2AV750
1000	158	158	2AV1000
1250	141	176	2AV1250
1500	129	194	2AV1500
2000	112	224	2AV2000
2500	100	250	2AV2500
3000	91	274	2AV3000
3500	84	296	2AV3500
4000	79	316	2AV4000
5000	71	354	2AV5000
6000	64	384	2AV6000
7500	57	431	2AV7500
10000	50	500	2AV10000
12000	44	537	2AV12000
15000*	26	387	2AV15000
20000*	22	447	2AV20000
25000*	20	500	2AV25000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

†50 Watt Rating

(†On Values to 40,000 Ohms)
Size: 5/8 x 4 1/2 Tube)

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
5	3160	15	5AV5
10	2230	22	5AV10
25	1410	35	5AV25
50	1000	50	5AV50
75	816	61	5AV75
100	707	70	5AV100
150	577	86	5AV150
200	500	100	5AV200
250	447	111	5AV250
300	408	122	5AV300
400	354	140	5AV400
500	316	157	5AV500
750	258	192	5AV750
1000	224	224	5AV1000
1500	182	275	5AV1500
2000	158	315	5AV2000
2500	141	350	5AV2500
3000	129	387	5AV3000
4000	112	448	5AV4000
5000	100	500	5AV5000
7500	81	610	5AV7500
10000	70	700	5AV10000
12000	64	768	5AV12000
15000	57	855	5AV15000
20000	50	1000	5AV20000
25000	44	1100	5AV25000
30000	41	1240	5AV30000
40000	35	1415	5AV40000
50000*	20	1000	5AV50000
60000*	18	1080	5AV60000
75000*	17	1275	5AV75000
80000*	16	1265	5AV80000
100000*	14	1414	5AV100000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

†80 Watt Rating

(†On Values to 40,000 Ohms)
Size: 5/8 x 6 1/2 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
10	2830	28.3	8AV10
15	2310	34.6	8AV15
25	1790	44.8	8AV25
50	1265	63.2	8AV50
100	894	89.4	8AV100
250	566	141.5	8AV250
300	517	155	8AV300
400	495	178	8AV400
500	400	200	8AV500
750	327	245	8AV750
1000	283	283	8AV1000
1500	231	346	8AV1500
2000	200	400	8AV2000
2500	179	448	8AV2500
3500	152	530	8AV3500
5000	126	632	8AV5000
7500	103	775	8AV7500
10000	89	894	8AV10000
15000	73	1092	8AV15000
20000	63	1270	8AV20000
25000	57	1414	8AV25000
30000	51	1530	8AV30000
40000	44	1790	8AV40000
50000*	25	1265	8AV50000
60000*	23	1385	8AV60000
75000*	21	1575	8AV75000
80000*	20	1600	8AV80000
100000*	18	1789	8AV100000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

†100 Watt Rating

(†On Values to 50,000 Ohms)
Size: 1 1/8 x 6 1/2 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
50	1413	71	10AV50
100	1000	100	10AV100
500	447	223	10AV500
1000	316	316	10AV1000
2000	223	447	10AV2000
3000	182	547	10AV3000
4000	158	633	10AV4000
5000	141	707	10AV5000
7500	115	860	10AV7500
10000	100	1000	10AV10000
15000	81	1200	10AV15000
20000	70	1400	10AV20000
25000	63	1580	10AV25000
30000	57	1700	10AV30000
35000	53	1850	10AV35000
40000	50	2000	10AV40000
50000	44	2200	10AV50000
75000*	23	1732	10AV75000
100000*	20	2000	10AV100000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

200 Watt Rating

Size: 1 1/8 x 10 1/2 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
50	2000	100	20AV50
100	1414	140	20AV100
500	632	315	20AV500
1000	447	447	20AV1000
1500	361	541	20AV1500
2000	316	632	20AV2000
2500	283	700	20AV2500
5000	200	1000	20AV5000
10000	141	1414	20AV10000
20000	100	2000	20AV20000
25000	89	2225	20AV25000
30000	81	2437	20AV30000
50000	63	3150	20AV50000
75000	51	3825	20AV75000
100000*	28	2828	20AV100000

*Low temperature enamel is used on these sizes because it affords better protection to the small diameter wire that must be used to make the higher resistance values.

Extra Adjustable Clips

Type No. 3V—For 25, 50, and 80-Watt Variohms.
Type No. 4V—For 100-Watt 1" dia. Variohm.
Type No. 5V—For 200-Watt 1 1/4" dia. Variohm.
Type No. 6V—For 100 and 200-Watt 1 1/8" Variohms.

Mallory Truvolt Resistors

Because of their unique design and merit, Truvolt resistors have long been a favorite of servicemen and experimenters. Truvolt construction provides:

1. Greater radiating surface.
2. Cooler operation.
3. Better distribution of heat because of the heat conducting copper core.
4. Larger wire size for a given resistance value.
5. Negligible inductance at broadcast frequencies.

The end terminals of Mallory Truvolt Resistors are adjustable, permitting the use of standard value resistors for the replacement of odd value original equipment resistors in amplifiers and receivers. A removable full-length fiber insulation guard protects each resistor.

Type B Truvolt Resistors are provided with one mounting bracket. Types C and D Truvolt Resistors are provided with two mounting brackets. One extra adjustable clip is supplied with types C and D—additional clips for all types are available.

†10 Watt Rating— 1000 Volt Insulation

(†On Values to 15,000 Ohms)
Size: 3/8 x 1 3/4 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
.5	4500	2.2	A.005
1	3150	3	A.01
2	2200	4.5	A.02
3	1800	5.5	A.03
5	1400	7	A.05
7.5	1150	8.5	A.075
10	1000	10	A.1
15	815	12	A.15
20	700	14	A.2
25	630	16	A.25
30	570	17	A.3
50	450	22	A.5
75	360	27	A.75
100	315	31	A1
200	220	45	A2
300	180	55	A3
400	158	63	A4
500	141	70	A5
750	115	86	A7.5
800	112	89	A8
1000	100	100	A10
1500	81	112	A15
2000	70	141	A20
2500	63	158	A25
3000	56	173	A30
4000	50	200	A40
5000	45	222	A50
7500	36	274	A75
10000	31	316	A100
15000	26	388	A150
20000	20	395	A200
25000	16	400	A250

†25 Watt Rating— 1000 Volt Insulation

(†On Values to 40,000 Ohms)
Size 11/16 x 2 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
2	3500	7	B.02
5	2200	11.4	B.05
10	1580	15.8	B.1
25	1000	25	B.25
50	719	35	B.5
75	575	43.5	B.75
100	500	50	B1
200	353	71	B2
300	289	86.5	B3
500	250	100	B5
750	182	137	B7.5
1000	158	158	B10
1500	129	194	B15
2000	112	223	B20
2500	100	250	B25
3000	91	275	B30
4000	79	316	B40
5000	71	352	B50
7500	58	430	B75
10000	50	500	B100
15000	41	610	B150
20000	35	715	B200
25000	32	780	B250
30000	29	860	B300
40000	25	1000	B400
50000	22.5	1000	B500

†50 Watt Rating— 1000 Volt Insulation

(†On Values to 20,000 Ohms)
Size: 11/16 x 4 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
25	1420	35	C.25
50	1000	50	C.5
100	700	70	C1
200	500	100	C2
300	406	123	C3
400	353	142	C4
500	316	158	C5
750	258	193	C7.5
1000	224	223	C10
1500	182	274	C15
2000	158	316	C20
2500	141	353	C25
3000	129	386	C30
4000	112	446	C40
5000	100	500	C50
7500	82	612	C75
10000	71	707	C100
15000	58	865	C150
20000	50	1000	C200
25000	45	1000	C250
30000	41	1000	C300
40000	35	1000	C400
50000	32	1000	C500
80000	25	1000	C800
100000	22.5	1000	C1000

†75 Watt Rating— 1000 Volt Insulation

(†On Values to 10,000 Ohms)
Size: 11/16 x 6 Tube

Resistance Ohms	Current Milliamperes	Volts Max.	Catalog Number
50	1220	61.5	D.5
100	865	87	D1
200	610	123	D2
300	500	150	D3
400	432	174	D4
500	387	194	D5
750	316	237	D7.5
1000	274	274	D10
1500	224	335	D15
2000	194	387	D20
2500	173	434	D25
3000	158	475	D30
3500	146	514	D35
4000	137	550	D40
4500	129	582	D45
5000	122	615	D50
7500	100	750	D75
10000	86	865	D100
15000	71	1000	D150
20000	61	1000	D200
25000	55	1000	D250
30000	50	1000	D300
50000	39	1000	D500
80000	31	1000	D800
100000	27	1000	D1000

Extra Truvolt Adjustable Clips

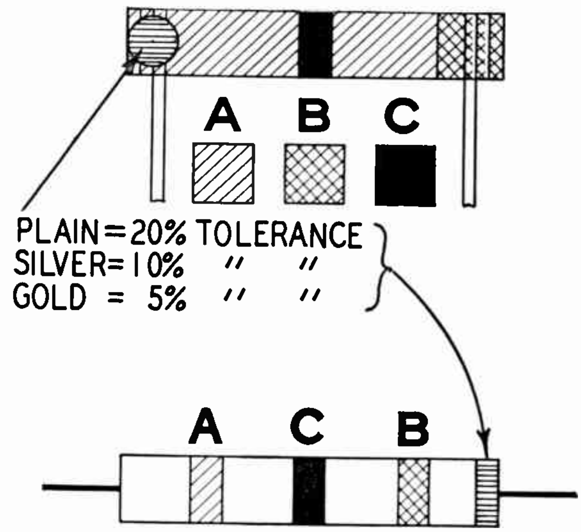
Type 1V—For Truvolt Type A.
Type 2V—For Truvolt Types B, C, and D.

RMA Standard Color Coding for Resistors

Value	Body	Tip	Dot
50 Ω	Green	Black	Black
75 Ω	Violet	Green	Black
100 Ω	Brown	Black	Brown
150 Ω	Brown	Green	Brown
200 Ω	Red	Black	Brown
250 Ω	Red	Green	Brown
300 Ω	Orange	Black	Brown
350 Ω	Orange	Green	Brown
400 Ω	Yellow	Black	Brown
450 Ω	Yellow	Green	Brown
500 Ω	Green	Black	Brown
600 Ω	Blue	Black	Brown
750 Ω	Violet	Green	Brown
1,000 Ω	Brown	Black	Red
1,250 Ω	Brown	Red	Red
1,500 Ω	Brown	Green	Red
2,000 Ω	Red	Black	Red
2,500 Ω	Red	Green	Red
3,000 Ω	Orange	Black	Red
3,500 Ω	Orange	Green	Red
4,000 Ω	Yellow	Black	Red
5,000 Ω	Green	Black	Red
7,500 Ω	Violet	Green	Red
10,000 Ω	Brown	Black	Orange
12,000 Ω	Brown	Red	Orange
15,000 Ω	Brown	Green	Orange
20,000 Ω	Red	Black	Orange
25,000 Ω	Red	Green	Orange
30,000 Ω	Orange	Black	Orange
40,000 Ω	Yellow	Black	Orange
50,000 Ω	Green	Black	Orange
60,000 Ω	Blue	Black	Orange
75.000 Ω	Violet	Green	Orange
100,000 Ω	Brown	Black	Yellow
120,000 Ω	Brown	Red	Yellow
150,000 Ω	Brown	Green	Yellow
200,000 Ω	Red	Black	Yellow
250,000 Ω	Red	Green	Yellow
300,000 Ω	Orange	Black	Yellow
400,000 Ω	Yellow	Black	Yellow
500,000 Ω	Green	Black	Yellow
600,000 Ω	Blue	Black	Yellow
750,000 Ω	Violet	Green	Yellow
1 Meg Ω	Brown	Black	Green
1½ Meg Ω	Brown	Green	Green
2 Meg Ω	Red	Black	Green
3 Meg Ω	Orange	Black	Green
4 Meg Ω	Yellow	Black	Green
5 Meg Ω	Green	Black	Green
6 Meg Ω	Blue	Black	Green
7 Meg Ω	Violet	Black	Green
8 Meg Ω	Gray	Black	Green
9 Meg Ω	White	Black	Green
10 Meg Ω	Brown	Black	Blue

Standardized coding for resistance value identification is confined to ten colors and figures as shown:

Figure	Color	Figure	Color
0	Black	5	Green
1	Brown	6	Blue
2	Red	7	Violet
3	Orange	8	Gray
4	Yellow	9	White

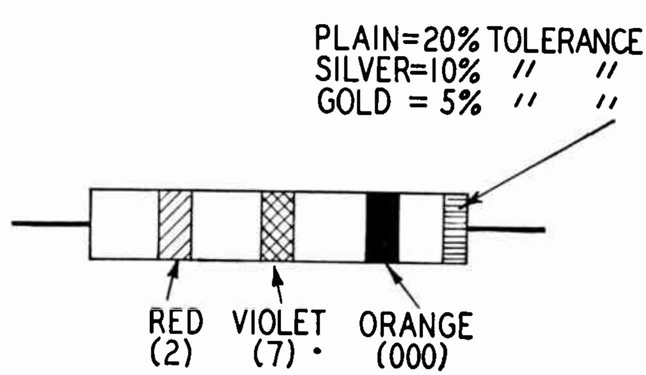


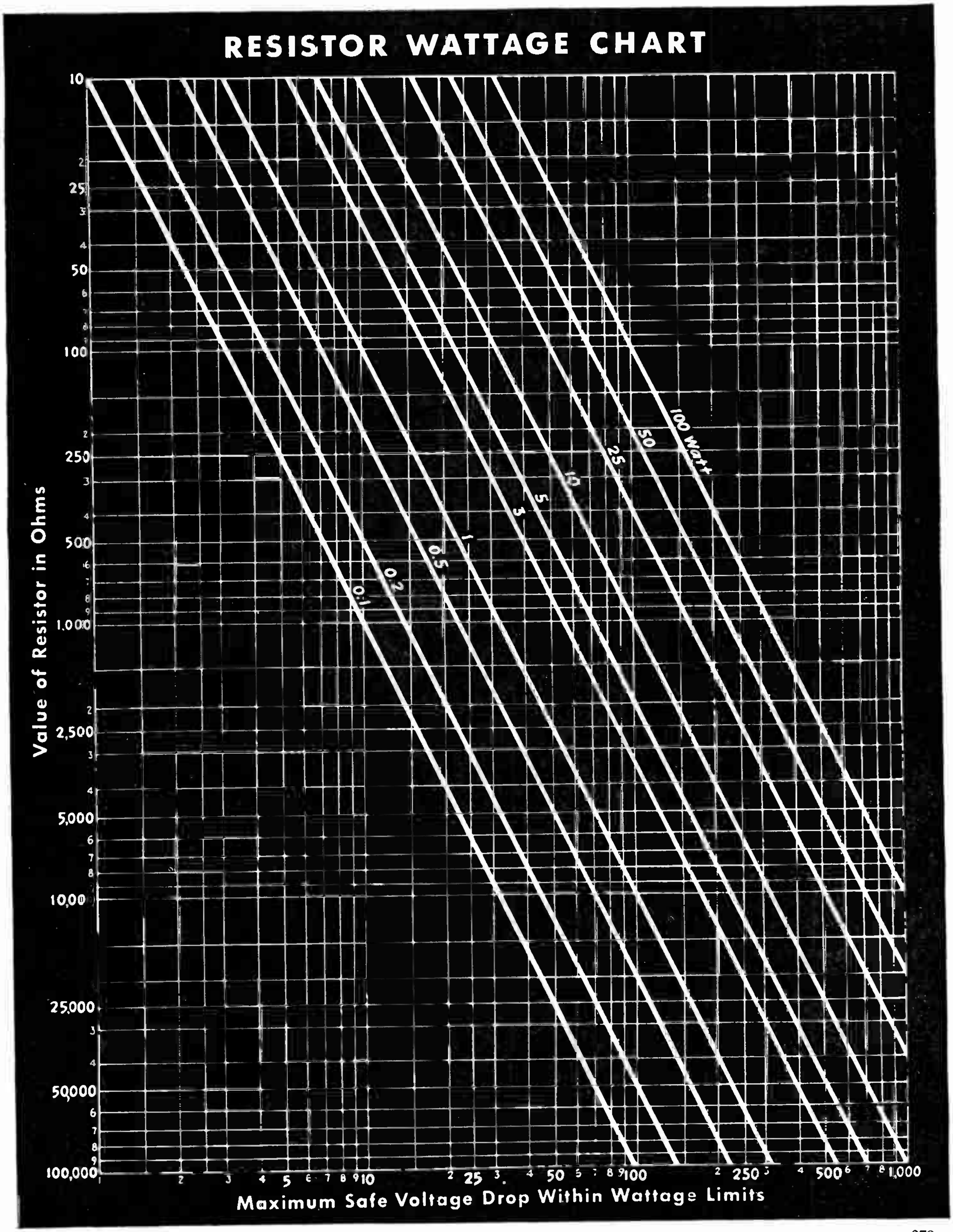
The body (A) of the resistor is colored to represent the first figure of the resistance value. One end (B) of the resistor is colored to represent the second figure. A band, or dot (C) of color, representing the number of ciphers following the first two figures, is located within the body color. The two diagrams illustrate two interpretations of this standard method of coding resistance value.

NOTE: The problem of coding two resistors of the same nominal value when tolerances are different is solved in a parctical manner by using the next higher or lower coded value for the unit with the larger tolerance. For example: if the nominal values of two resistors are 2,500 ohms, one with 10% tolerance and the other with 20%, the unit with 10% tolerance will be 2,500 ohms and be coded as such. The unit with 20% tolerance will be assigned a nominal value of either 2,400 ohms or 2,600 ohms and be so coded.

Some of the larger radio set manufacturers employ mercury vapor lighting in their factories. Certain colors are hard to distinguish in this lighting and in order to overcome this difficulty, odd value of resistors are apparently used, such as 490,000 ohms. In every case where this is found, the next higher value of resistor may be used with success.

In addition to the above color code there is a later type of coding for resistors, particularly for odd values of resistance, such as 27,000 ohms. In this later coding the color bands are read consecutively thus:




RESISTOR WATTAGE CHART
Value of Resistor in Ohms
10
25
50
100
250
500
1,000
2,500
5,000
10,000
25,000
50,000
100,000
0.1
0.2
0.5
1
3
5
10
25
50
100 Watt
5
10
25
50
100
250
500
1,000
Maximum Safe Voltage Drop Within Wattage Limits

Resistor Theory and Practice

IN practically every industry fortunes have been spent to reduce the effects of friction. The radio industry, on the other hand, has spent millions of dollars and employed some of the best engineers in the country in doing just the opposite; that is, in developing more and better sources of friction. Taken literally, a resistor is a device which limits the passage of current through it, by exerting a certain amount of friction to its flow. In a manner quite similar to mechanical friction, heat must be generated when a resistance is present in a circuit in which current is flowing. This is always true. The amount of heat generated depends on the value of resistance in the circuit and on the current flowing. Since Ohm's law gives the relationship between voltage, current, and resistance, it is possible to express the dissipated heat in terms of any two constants of the circuit. When the voltage across a resistor and the current passing through it are known, the power dissipated in the resistor may be computed as follows: (chart shown on page 279).

E multiplied by I = W

Example—A resistor having a potential of 20 volts across it, and a current of 2 amperes flowing through it, would be dissipating 40 watts of power. E(20) times I(2) = W(40).

When the resistance value and the voltage across the resistance is known, the dissipation is computed in the following manner:

$$\frac{E^2}{R} = W$$

Example—A resistor of 10 ohms having a potential of 20 volts across it would be dissipating 40 watts of power.

$$\frac{E^2(400)}{R(10)} = W(40)$$

When the resistance value and the current flowing through it is known, the computation is:

I^2 multiplied by R = W

Example—A resistor of 10 ohms having a current of 2 amperes flowing through it would be dissipating 40 watts of power. $I^2(4)$ times R(10) = W(40).

In all of the above formulae, potential is expressed in volts, resistance in ohms, and current in amperes. If the current is known in milliamperes, it may be converted to amperes by dividing by 1000, or by moving the decimal point three places to the left, i.e., 50. milliamperes = .050 amperes.

There are two general types of resistors in use, those which use some metal alloy having a high resistivity as their resistance element, and those which use as their active resistance element either carbon in some form, or various compounds of metal. This latter group almost invariably has its resistance material held together by some type of binder and depends for its resistance property upon the limited area of contact between adjacent particles. Where extreme stability, dependability, and permanence are required, the wire wound resistor has no equal. When wattages greater than the two watts must be dissipated, the wire wound resistor is used almost exclusively. For resistors dissipating less than 2 watts, a carbon or composition resistor may be used in the majority of cases. A knowledge of the various types and of their advantages and limitations is useful and indispensable to the service engineer.

WIRE WOUND TYPES

Practically all wire wound resistors use some nickel chrome alloy as their resistance element. This element takes the form of wire for all except the very lowest value of resistor (below 1 ohm) in which case the element is frequently formed as a ribbon. In the fixed, or semiadjustable types, resistance wire is wound around a cylindrical ceramic tube and the whole is coated with a protective coating which insulates the unit electrically, prevents mechanical damage, and in some cases guards against corrosion and humidity effects. The protective coating should also serve to increase the effective hot surface, and therefore cause the resistance wire to operate at a lower temperature. The protective coating is generally a vitreous enamel of some type, although there are numerous resistors on the market which use a cement or varnish for this purpose.

VITREOUS TYPES

The vitreous glaze used on vitreous enamel units is composed of about twenty different chemicals and minerals, each one contributing some desirable quality to the finished product. The exact formulae for this glaze have been carefully guarded by the trade. The vitreous enamel is ground to a fine powder and mixed with a liquid. The paste thus formed is applied to the resistor unit and after air drying, is fired in huge electric furnaces at a temperature of above 1000°F. At that high temperature the vitreous powder melts and flows together, forming a very smooth and glossy coat. The advantages of this type of enamel are its relatively high thermal conductivity, its hardness, its durability, and its electrical insulation quality. The thermal conductivity of the insulating coating is very important. By thermal conductivity is meant the ability of a substance to conduct heat readily. The heat generated by a current flowing through the resistance wire heats only the wire itself. Since the wire covers only a portion of the entire resistor only a small portion of the total tube surface would be utilized as a radiating surface if it were not for the enamel. Therefore, for a given resistance and current flow, the temperature of the wire would be much higher and consequently the life of the resistor would be considerably shortened. Most resistance alloys although substantially non-corrosive under ordinary conditions, tend to corrode when operated at high temperatures in contact with air or mositure. Under such circumstances, and especially in the case of very fine resistance wire, the wire is eaten away until it finally opens. The various coatings on resistors of this type are used to prevent this corrosion. Vitreous enamel resistors can be operated at very high temperatures and still not affect the character and properties of the protective coating. In addition, where appearance is important, the beautiful lustre and smoothness of this type of protective coating appeals strongly to the eye. Vitreous enamel units have a large application in industrial apparatus, and in the better radio receivers and associated equipment. Large numbers of them are used in transmitting stations and special equipment where resistors must handle tremendous power and operate for long periods under the most trying conditions without the slightest change in resistance. In radio receivers they are used as bias resistors on power tubes, bleeder resistors, in power packs, and in all positions where a large wattage must be dissipated in a small space. For a given size of tube a vitreous enamel resistor will dissipate approximately three times the wattage that a tube of the same size would dissipate if it were coated with a varnish or bakelite.

Power Rating (Watts)	Outside Diameter	Length
10	5/16"	1¾"
20	½"	2"
25	¾"	2½"
40	¾"	3½"
50	¾"	4½"
80	¾"	6½"
100	1⅛"	6½"
160	1⅛"	8½"
200	1⅛"	10½"

NOTE: When a varnish or organic coating is used, the wattage rating of the various tube sizes are reduced to one-third those given in the above table.

FIGURE 1

The wattage rating of a vitreous resistor can be estimated by referring to the chart (Figure 1) showing the most common sizes of tubes in use at the present time.

The fairly high heat conductivity of the insulating coating increases the effective radiating surface of the resistor. By increasing the radiating surface we increase the number of cubic inches of air which are available for conducting away the heat generated in the unit. When a material having a low conductivity is used as a protective coating, the portions of the insulation between adjacent turns of wire are fairly cool as compared to the wire iteslf. Since the amount of heat which is imparted to the air depends on the difference in temperature between the air and the hot surface, it is obvious that little heat will be imparted to the layer of air next to the resistor at the points between turns.

When a resistor is to be used in a confined space, it should be chosen with a safety factor so as not to overheat the unit. A similar reasoning shows that if the resistor is used in a draft or in a position where air is constantly moving past the resistor, it is possible to use a smaller unit and still not overload it. The temperature of the surrounding air is also important when determining the size of resistor to be used. In a confined space next to a hot transformer or rectifier tube, it is obvious that since the surrounding air is probably hotter than 104°F., the next larger size unit should be chosen. As a specific case, let us say that 200 milliamperes are flowing through a resistance of 250 ohms, the wattage, which is easily calculated from the formula previously given, is 10 watts. A vitreous enamel resistor which is 1¾" long and 5/16" in diameter will suit this requirement nicely. If, however, this resistor were to be placed between two resistors dissipating 40 or 50 watts each and in a confined space such as the under-side of a radio chassis, it would be logical and common sense to choose a ½" x 2", that is, a 20-watt size for this application. Quite frequently one hears the expression, "This resistor gives off too much heat!" Since we know that the amount of heat which is given off from a resistor is dependent upon the current, and also upon the value of resistance in ohms, it is obvious that if we substitute a resistor of 100 times the size of the first resistor, an identical amount of heat would be given off. It is true that less heat would be given off *per square inch* of surface, hence, the unit would be cooler; but when one adds up heat loss in each square inch of surface, the result would be the same whether a huge resistor or only a single strand of fine wire were used. •

ADJUSTABLE VITREOUS ENAMELED RESISTORS

Resistors of this type consist of a vitreous enamel resistor with a small portion of each turn of resistance wire along its entire length exposed so that lugs can be adjusted to secure a number of desired resistance values. This type of resistor is valuable where the service engineer desires an adjustable resistance, or in places where several taps are required, as in the bleeder circuit or voltage divider across the output of a power pack.

TRUVOLT ADJUSTABLE RESISTORS

In the Truvolt resistor, the resistance wire is wound around a 1/16" core of asbestos and this core is then wound in a spiral manner on a ceramic tube. This unit is probably the most satisfactory wire wound resistor for high frequency work. The inductance is negligible and the distributed capacity need not be considered except for the very highest frequencies. This is due to the fact that the diameter of the core is very small and adjacent turns on this asbestos core are widely separated so that the coefficient of coupling between adjacent turns is very slight. Due to the unique manner used in winding this resistor, a much greater length of wire is utilized. Consequently, greater area of wire is exposed to the air and the unit operates at a cooler temperature. For a given resistance value it is also possible, due to this greater length, to use a larger wire size, thus making the unit more dependable and rugged. Adjustable sliding clips permit the selection of any part of the total resistance value. Over a thousand volts can be applied to the Truvolt resistor (provided that the current rating is not exceeded) without danger of sparking over between adjacent turns.

PRECISION RESISTORS

In applications where the power dissipation is less than 1½ watts and where extreme precision and accuracy are required, the precision wire wound resistor finds wide application. These units are especially adapted for voltmeter multipliers, ohmmeter range extenders, and for other instrument applications. This unit meets the requirement for an accurate, dependable resistor with a minimum of inductance and distributed capacitance. The Mallory precision resistor is wound in pies, each succeeding section having its direction of winding reversed. In this manner the inductance of one section is partially neutralized by the mutual inductance existing between it and the succeeding section. These resistors are adjusted individually on a highly sensitive and accurate Wheatstone bridge and are impregnated with a special compound having good insulation properties.

APPLICATION OF FIXED AND SEMI-FIXED TYPES

In many cases it is desired to obtain a small current at a constant voltage. This may be accomplished by connecting a fixed resistor across the output of a power supply, and circulating enough current through this resistor so that any fluctuations in load (either across the whole resistor, or across a section of it) do not affect the voltage of the supply source.

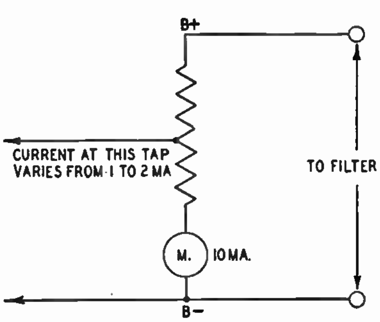


FIGURE 2

If a current of 10 milliamperes is passed through a resistor as shown in Figure 2, and if the current at a certain tap varies from 1 milliampere to 2 milliamperes, it is obvious that this small current flowing through the resistor is not going to change the voltage appreciably. An additional advantage of a bleeder is that it connects a steady load across the power supply at all times and tends to keep the voltages on the filter condensers at a safe value during the period in which the tubes are heating up. In usual bleeder circuit design, the bleeder current is approximately 10% of the total current drawn from the power supply. If a voltage of 250 volts is available at the output of a filter, and the load of the various circuits is 100 milliamperes, the bleeder resistor should draw 10 milliamperes, or 10% of 100. Since the voltage across it is 250 volts, the value of resistance is easily calculated by Ohms law. That is, dividing 250 volts by .01 amperes (10 milliamperes), gives a value of 25,000 ohms. The wattage this resistor must be capable of dissipating is 250 x .01 amperes, or 2½ watts. Where greater stability is required, the bleeder current may be as high as 25% of the total current.

When several values of voltage are required, the bleeder is tapped at several points. If the current drawn at any one of these taps is greater than a small proportion of the bleeder current (in this case 10 milliamperes), then the additional current must be considered in determining the wattage of the resistor.

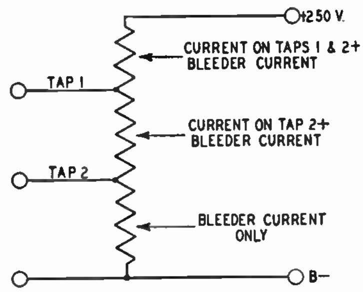


FIGURE 3

Let us consider a bleeder circuit such as shown in Figure 3. The section of the bleeder resistor between the 250 volt B plus lead and tap 1 must be capable of carrying not only the current drawn by tap 1 and the current drawn by tap 2, but also the bleeder current which circulates through the entire bleeder resistance. If we desire a bleeder current of 10 milliamperes, while tap 1 must supply 20 milliamperes and tap 2, 5 milliamperes, then the section between the B plus 250 volts and tap 1 must be able to carry 35 milliamperes. If the voltage required at tap 1 is 150 volts, then the voltage drop in the bleed resistor between B plus and tap 1 must be 250 — 150, or 100 volts.

The resistance value will therefore be 100 divided by .035 amperes (35 milliamperes), or 2860 ohms. The wattage rating of this section of the bleeder should be 100 × .035, or 3.5 watts. The section between tap 1 and tap 2 must carry the bleeder current of 10 milliamperes plus the 5 milliamperes drawn by tap 2, or 15 milliamperes total. Since the voltage at tap 2 must be 90 volts, there will have to be a drop of 150 — 90, or 60 volts in this section of the bleeder. The resistance of this portion therefore will be 60 divided by .015, or 4000 ohms. The wattage required of this section will be 60 × .015 (E × I), or .9 watts. The remaining portion of the bleeder resistor will carry only the 10 milliampere bleeder current and will have a resistance of 90 divided by .01, or 9000 ohms with a wattage capacity of .9 watt. The wattage of the total bleeder resistance would be calculated by assuming that 35 milliamperes flowed through the entire resistance, that is $(2860 + 4000 + 9000) \times (.035)^2$, or 19.4 watts. The nearest stock size would be a Truvolt B-200. This is a 20,000 ohm unit which would allow for the shorting effect of 2 extra lugs. The calculation is simplified greatly by consulting the resistor tables on pages 275 and 276 wherein the maximum current-carrying capacities of various resistor sizes are given. **The important point in bleeder design is that the wattage of the unit should be chosen on the basis of the maximum current which flows through any section of it.**

VOLTMETER MULTIPLIERS

When extending the range of a DC voltmeter, the resistance which must be connected in series with the meter is easily calculated; provided that either the internal resistance of the voltmeter in ohms, or the resistance in ohms per volt is known. If the resistance is given in ohms per volt, the total resistance of the voltmeter may be found by multiplying the ohms per volt by the scale reading of the meter.

If it is desired to extend the range of the meter by 10 times, the resistance of the voltmeter is multiplied by 10 — 1, or 9. As a specific example, let us assume that the voltmeter in question has a sensitivity of 1000 ohms per volt and a full scale deflection of 100 volts. It is desired to increase the range to 500 volts. The range, therefore, is to be increased by 5 or

$$\frac{(500)}{(100)}$$

The resistance of the voltmeter is 1000 × 100, or 100,000 ohms. It is necessary, therefore, to multiply 100,000 by one less than 5, or 4. The resistance necessary in series with the voltmeter is 400,000 ohms. In terms of a simple formula:

$$R_s = R_m \times \frac{(V_2)}{V_1} - 1$$

where R_m is the resistance of the voltmeter in ohms, or the number of ohms per volt times the maximum scale reading of the voltmeter prior to the change. V_1 is the original range of the voltmeter; V_2 is the new maximum range desired and R_s the fixed external resistor which must be connected in the circuit. The wattage required of this resistor is generally less than 1½ watts, which is the rating of the average precision resistor. In special cases where very large meters are used, whose sensitivity is very low, the wattage dissipated in the external precision resistor may be greater than 1.5 watts. In this case two or more precision resistors should be connected in series, the value of each resistor being the resistance required divided by the number used in series. The wattage dissipated in the external resistors is calculated by dividing the maximum range of the meter squared $(V_2)^2$, by the sum of the external resistors plus the resistance of the meter, that is, $(R_m - R_s)$.

Figure 4 shows a switching arrangement which provides a choice of several extension ranges. For illustration let us use the voltmeter mentioned in the preceding paragraph. This has a range of 100 volts and a resistance of 100,000 ohms. In Figure 4 this range is

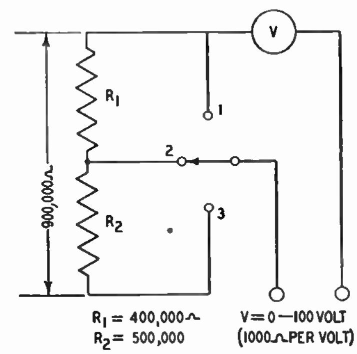


FIGURE 4

available at the number 1 position of the switch. If we desire a 500-volt range at the number 2 position, the multiplier resistance may be calculated by using the formula:

$$R_s = R_m(100{,}000) \times \left(\frac{V_2(500)}{V_1(100)} - 1\right) - 400{,}000 \text{ ohms}$$

In a similar manner we arrive at a value of 900,000 ohms as the correct multiplier for a 1000-volt range at position number 3. However, we already have a resistance of 400,000 ohms for the 500-volt range, so we merely add 500,000 ohms in series with that resistor to obtain our second multiplier value. An accuracy of 1% is generally satisfactory for these resistors unless a very high precision meter is used. The general types of meters encountered in service work are only accurate to ±2% so that it is useless and wasteful to use a resistor with an accuracy of better than ±1%.

To Change Over a DC Milliameter to a DC Voltmeter

Often it is necessary to convert a DC milliameter to a voltmeter, either permanently or by means of a switching arrangment, so as to use the same instrument for the combined purposes of reading current and voltage. Since the internal resistance of most milliameters is very low (in comparison to the external multiplier which must be connected when making this change), it can be neglected without serious error. The resistance which is to be connected in series with the milliameter is calculated by dividing the voltage range which is desired by the current range of the milliameter expressed in amperes. If the maximum current reading on the milliameter scale is given in milliamperes, then the voltage range desired is multiplied by 1000 and then divided by the current range of the milliameter in milliamperes.

Expressed by a simple formula, this is

$$R_S = \frac{V \times 1000}{I_m}$$

where V is the voltage range desired, I_m the current in milliamperes necessary to give the meter a full scale deflection before the change, and R_S the series resistance required in ohms.

To extend the range of a DC milliameter when the resistance of the milliameter is known, the shunt resistor which must be connected across the terminals of the meter is calculated very simply by dividing the resistance of the meter by (K-1) where K is equal to the ratio of the desired maximum reading to the original reading of the meter. This is given as

$$R_{sh} = \frac{R_m}{(K-1)} \text{ when} \qquad \mathrm{I}$$

R_m = resistance of meter

$$K = \frac{I_2 = \text{range desired in milliamperes}}{I = \text{original range in milliamperes}}$$

R_{sh} = value of shunt resistor

If the resistance of the meter is unknown, it may be measured by the half deflection method. Referring to Figure 5, a variable high resistance R_1 is connected in series with the meter, and the meter adjusted to exactly full scale deflection. R_2 is then connected in the circuit and adjusted to make the meter read half scale. R_2 is then equal to the meter resistance and may be measured by any of the usual methods. Never attempt to measure the meter itself by either the ohmmeter or the bridge method.

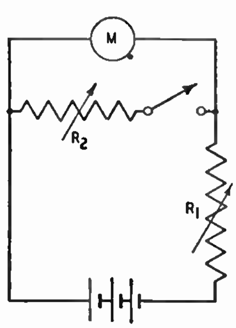


FIGURE 5

It will usually be found advisable, when making a multi-range milliameter, to increase the meter resistance 5 to 10 times. This may be done by connecting a series resistor outside the meter. The shunt is then figured using as the meter resistance, the combined resistances of the meter and the series resistor. The series resistor serves two purposes. First, it allows the shunt to be of more reasonable value, thus decreasing errors due to contact resistance or to slight miscalculation. Second, in case of momentary overload, the resistor acts as a ballast slowing down the meter action and in many cases saving a meter which might otherwise be ruined.

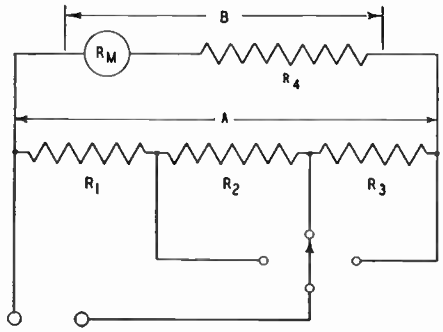


FIGURE 6

Probably the best multi-range milliameter circuit is a modification of the "Universal shunt" type. This is shown in Figure 6. This circuit has several advantages over the usual circuit. First, contact resistance of the switch has absolutely no effect on the accuracy of the meter. The usual circuit has the contact resistance in series with the shunt and thus makes the total shunt resistance inaccurate. If the switch contact should happen to be defective in the usual circuit, the meter would be ruined. Second, with the usual circuit the switch can not be operated while the meter is in the circuit. With the universal shunt arrangement the switch may be operated at any time without damage to the meter.

Though at first glance it would seem to be more difficult to calculate the resistance values for a universal shunt, actually it is quite simple. First we add the series resistor R4 (Figure 6) to bring the meter plus series resistance to a value of approximately 200 ohms. The total shunt resistance is now figured by formula I to make the meter read full scale for the first desired range (5 or 10 milliamperes). The other resistances are figured by the formula as shown in Figure 6:

$$X = \frac{A + B}{K} \qquad \mathrm{II}$$

where $A = R_1 + R_2 + R_3$ (the total shunt resistance) and $B = R_m$ (the internal resistance of the meter) $+ R_4$ (the external series resistor), and K = the desired range divided by the fundamental range of the meter.

As an example, assume that we have a 0–1 ma. meter of 50 ohms resistance, and that we want a multi-range meter giving ranges of 0–5, 0–50, and 0–250 milliamperes. Referring to Figure 6 we first add R_4 (150 ohms) thus bringing total B ($R_m + R_4$) resistance to 200 ohms. Our next step is to find the total shunt resistance. For this we will use formula I and solve for the lowest desired range. For a five milliampere range we would have

$$\frac{B(200)}{K(5) - 1} = A(50).$$

Now we figure the next range using formula II. For a range of fifty milliamperes we will have

$$X\,(R_1 - R_2) = \frac{A(50) + B(200)}{K(50)} = 5.$$

Since $R_1 + R_2 + R_3 = 50$, R_3 will be 45 ohms. Using the same formula for the 0–250 milliampere range we have

$$X\,(R_1) = \frac{A(50) + B(200)}{K(250)} = 1.$$

Since $R_1 + R_2$ was shown to be 5 ohms and R_1 is one ohm, it is obvious that R_2 is equal to 4 ohms. This completes the computation.

This method has one advantage over the ordinary calculations. This advantage lies in the fact that you are always dividing by an even number and consequently do not have to worry about dividing by odd numbers such as 49 and 249 as would be necessary in the usual shunt formulae.

The problem of resistor application is not difficult and it is evident that familiarity with the selection of the proper type and values is absolutely necessary to the service engineer who is eager to outstrip his competition.

Reactance Charts

THE simplifications embodied in the charts on pages 283, 284, and 285 should make them more useful than those heretofore available. The frequency range covered comprises the frequency spectrum from 1 cycle per second up to 1000 megacycles per second. All of the scales involved are plotted in actual magnitudes so that no computations are required to determine the location of the decimal point in the final result.

To make these conditions possible the frequency spectrum has been divided into three parts:

CHART I (page 283)—Covers the range from 1 cycle to 1000 cycles.

CHART II (page 284)—From 1 kilocycle to 1000 kilocycles.

CHART III (page 285)—From 1 megacycle to 1000 megacycles.

Inductance, capacitance, reactance and frequency have been plotted so that the reactance offered by an inductance or capacitance at any frequency may be readily determined by placing a straight-edge across the proper chart so as to connect the known quantities.

Since XL = XC at resonance in most radio circuits, the charts may also be used to find the resonant frequency of any combination of L and C.

To illustrate with a simple example, suppose the reactance of a 0.01 mfd. condenser is desired at a frequency of 400 cycles. Place a straight-edge across the proper chart so as to connect the points 0.01 mfd. and 400 cycles per sec. The quantity desired is the point of intersection with the reactance scale which is 40,000 ohms. The straight-edge also intersects the inductance scale at 15.8 henries indicating that this value of inductance likewise has a reactance of 40,000 ohms at 400 cycles per sec. and furthermore, that these values of L and C produce resonance at this frequency.

There are many practical uses for these charts. The radio service engineer should find them helpful in the rapid solution of many reactance problems. Unusual care was exercised in laying out the various scales in order to secure a high degree of accuracy for the charts. Results should be obtainable which are at least as accurate as might be secured if computations were made with a good ten-inch slide rule.

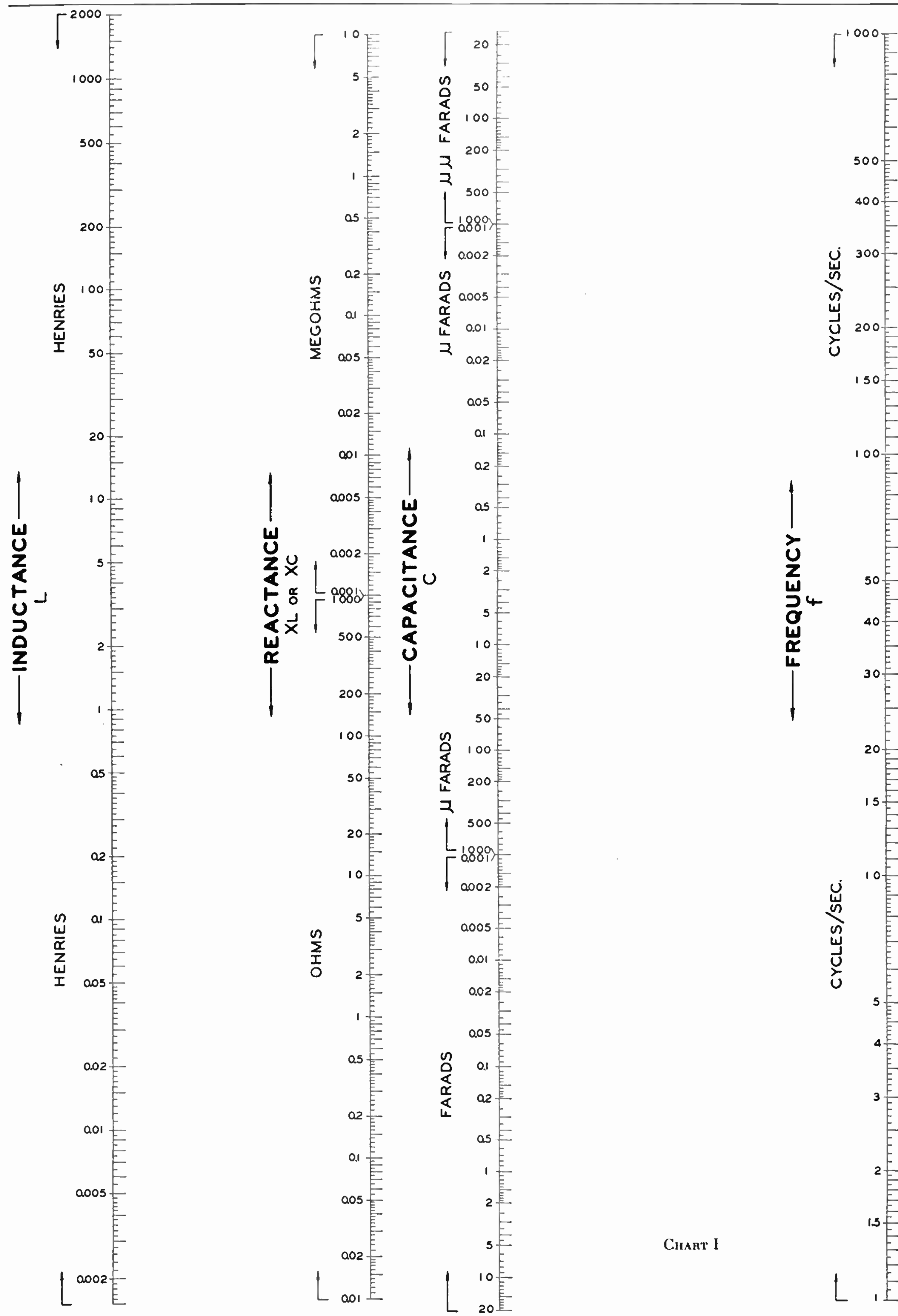

INDUCTANCE
L
HENRIES
HENRIES
REACTANCE
XL OR XC
MEGOHMS
OHMS
CAPACITANCE
C
μμ FARADS
μ FARADS
μ FARADS
FARADS
FREQUENCY
f
CYCLES/SEC.
CYCLES/SEC.

CHART I

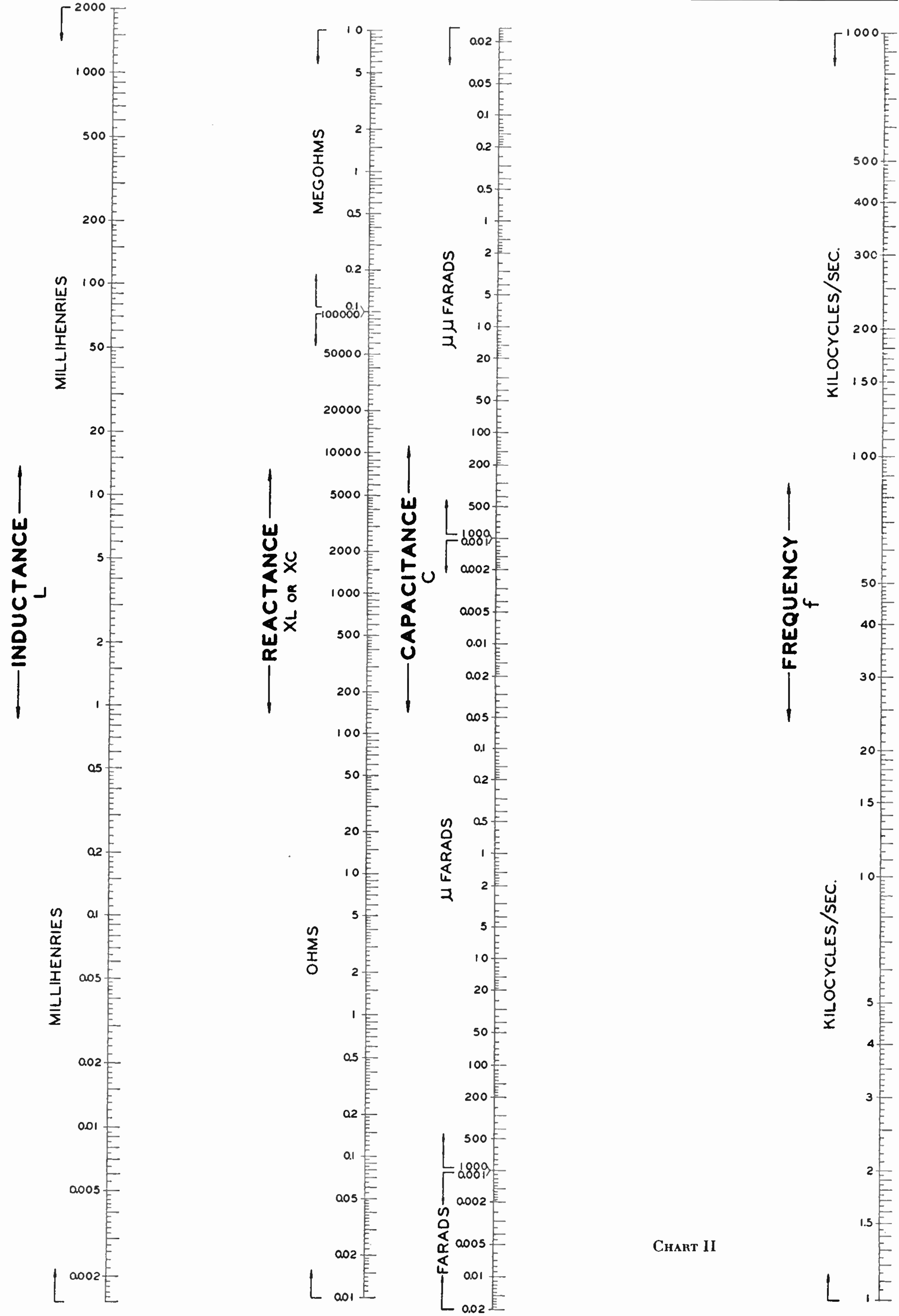

INDUCTANCE
L
MILLIHENRIES
MILLIHENRIES
REACTANCE
XL OR XC
MEGOHMS
OHMS
CAPACITANCE
C
µµ FARADS
µ FARADS
FARADS
FREQUENCY
f
KILOCYCLES/SEC.
KILOCYCLES/SEC.

CHART II

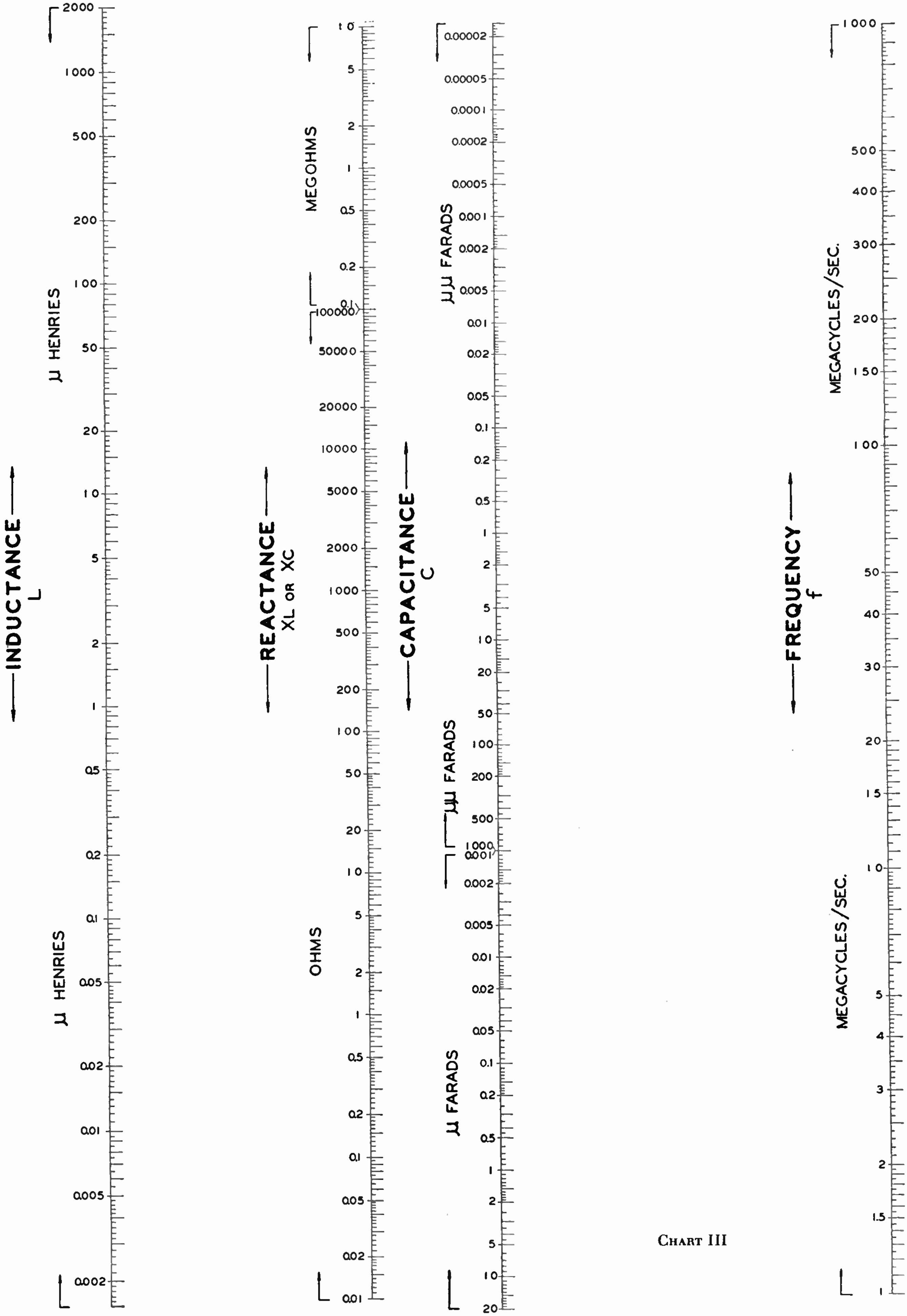

INDUCTANCE
L
µ HENRIES
µ HENRIES
REACTANCE
XL OR XC
MEGOHMS
OHMS
CAPACITANCE
C
µµ FARADS
µµ FARADS
µ FARADS
FREQUENCY
f
MEGACYCLES/SEC.
MEGACYCLES/SEC.

CHART III

Resistance-Capacity Coupled Audio Frequency Amplifiers

THIS discussion has been prepared in an effort to clarify the causes of unusual or unsatisfactory operation of audio amplifiers of the resistance coupled type.

A conventional circuit selected as a typical example, is shown in Figure 1. For reference purpose, the dotted line divides the illustration into two stages.

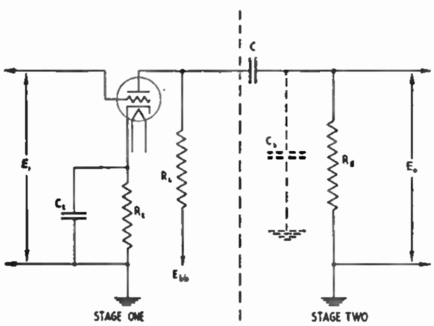


FIGURE 1

In this discussion it is assumed that stage two is operated with sufficient negative bias so that there is a negligible flow of grid current at all times. The grid resistance of the tube used in stage two in this case amounts to several megohms, and may be neglected in these calculations, since it is very large compared to the grid load resistance R_g.

In general, it is not good practice to operate a resistance-coupled amplifier into a low impedance load. The value of the grid resistor R_g is determined by the characteristics of the particular tube used in stage 2, and also upon the method used to obtain bias for the tube (fixed or self bias types). If tube two is of the high vacuum type, such as types 6F5, 6C5, or 6J5, and is operated with self bias, the grid resistor R_g may be one megohm or greater. Output tubes which contain small amounts of gas, and are subject to grid emission due to the high operating temperature (2A3, 6L6, 6V6, 25L6), should use a grid resistance of one-half megohm or less if operated with fixed bias. Whenever a tube is operated with fixed bias, a smaller value of grid resistor should be used than when the same tube is operated with self bias. When high resistance grid leaks are used in output tubes, the small amounts of gas and grid emission currents flow through the grid leak in a direction to reduce the negative bias. Consequently, the tube draws an abnormally high plate current which shortens the tube life and may result in damage to associated parts in the circuit.

There are three important considerations in the choice of the coupling condenser "C." It must be large enough to have only a small impedance compared with R_g at the lowest frequencies to be amplified. It should not be any larger than necessary. If its value is too large, the amplifier may have a tendency to motorboat. Finally, the direct current leakage of the condenser should be as low as possible. Capacity values of "C" ranging from .06 to .001 mfd. may produce reasonably uniform gain down to 100 cycles. Commonly used values in commercial receivers vary from .02 to .05 mfd., depending upon the particular tubes used and the conditions under which they are operated. The effectiveness of coupling condenser "C" is determined by the plate resistance (R_L) of stage one, the grid resistance (R_g) of stage two, and the internal plate resistance of tube one. If a very large value is used for "C" considerable time will be required to charge and discharge the condenser, which, together with the internal impedance and regulation of a power supply common to two or more stages, may cause motorboating. It is therefore desirable to make the capacity of condenser "C" no larger than the amount required to obtain the necessary low frequency response, in order to simplify the design of the power supply as much as possible. Precautions necessary in the design of the power supply to prevent motorboating will be discussed later.

If the coupling condenser "C" has a high DC leakage, direct current will flow through the plate resistor (R_L), the coupling condenser, and the grid resistor (R_g) to produce a DC voltage across R_g which will reduce or even change to positive values, the bias on tube two. If tube two is operated with a low or positive bias, grid current causing low power output and high distortion will result. A high-grade paper dielectric condenser is usually satisfactory. However, if very low frequencies are to be amplified a mica condenser may be necessary.

The value of the plate load resistor R_L resolves itself into a compromise between a low resistance which limits the gain, and a high resistance which makes it necessary to use very low values of grid bias. The tables on pages 288 to 290 show operating conditions for several values of plate load resistances (R_L) for a given type of tube. Operating conditions for additional values of R_L may be obtained from plate characteristic curves of the particular tube used.

It is well known that in order to make a tube operate as a low distortion class "A" amplifier, the grid voltage must be reduced with the plate voltage so that the tube operates over a linear portion of the characteristic curve. If the value of the plate load resistor (R_L) is made very large, the effective plate voltage of the tube is materially reduced because of the voltage drop across R_L. Therefore the grid voltage must be reduced proportionately. The grid voltage, however, cannot be reduced below approximately 0.6 volt plus the peak signal voltage because of contact potential, which produces an effective positive grid bias varying from zero to as high as one volt. In most cases the contact potential is less than 0.6 volts. The contact potential, therefore, limits the minimum grid bias and the maximum allowable value of the plate load resistance R_L.

The maximum value of R_L is further limited by the value of the grid load resistor of the succeeding stage (R_g). Generally speaking, the resistance value of the plate load resistance should not be larger than one-half the value of the associated grid resistor (R_g). If the resistance of R_L is made larger than one-half the value of R_g, the effective plate voltage of tube one is greatly reduced without a proportionate increase in AC load impedance. This load impedance is the parallel combination of R_L and R_g.

The cathode bias resistor (R_c) value may be calculated by dividing the required grid bias by the corresponding plate current, or it may be chosen from the tables on pages 288 to 290 which give the direct values of R_c for most of the commonly used tubes. If conditions other than those shown in the table are required, the grid bias and plate current may be calculated from plate characteristic curves as supplied by the tube manufacturers. In another method, the optimum value of cathode resistance may be determined experimentally by an harmonic analysis of output voltage for various values of cathode resistance.

The cathode by-pass condenser "C_c" may vary from 0.2 mfd. to 10 mfd. The impedance of the cathode by-pass, at the lowest frequency to be amplified, should not be greater than one-fourth the impedance of the cathode bias resistor (R_c). If a large capacity value is assigned to "C_c," the frequency response will be fairly uniform, with a gradual reduction in gain below 1,000 cycles. If a very small capacity value is used for "C_c," the gain will be reduced over the entire audio spectrum, due to degeneration. Degeneration is the process of feeding a certain amount of audio frequency plate voltage back into the grid circuit in such a phase relation as to oppose the signal voltage to the grid. An impedance in the cathode circuit is common to both grid and plate circuits, and consequently can produce degeneration. If the cathode impedance consists of a condenser in parallel with a biasing resistance, it reduces the gain more at low frequencies than it does at high frequencies. This condition occurs because the parallel impedance of the cathode circuit is greater at low frequencies.

The tables on pages 288 to 290 give the capacity value of cathode by-pass condensers (C_c) which result in a ten percent reduction in gain at 100 cycles. The ten percent reduction at this frequency is chosen as an arbitrary value which would probably be unnoticeable in a listening test. It is generally desirable to use larger values of cathode by-pass condensers than the values given in the tables on pages 288 to 290 in order to reduce hum. Although capacity values as large a 50 mfd. are sometimes used, the effect of the DC leakage, which tends to reduce the DC potential across the cathode bias resistor, should be considered for the particular circuit involved.

In addition to the components in the circuit there exists a shunting capacity (C_s) consisting of the rated output capacitance of tube one, the stray capacity of the parts (especially that of the coupling condenser C_c) and wiring, and the effective input capacity of tube two.

The effective input capacity of tube two may be calculated by using the following formula:

$$\text{Effective input capacity} = C_g + (1 + A)C_{gp}$$

where
C_g = rated input capacity of tube two
A = amplification or gain of the stage
C_{gp} = rated grid to plate capacity of tube two.

The various tube capacity ratings may be obtained from the tube sheets (pages 318 to 332). The capacity of the wiring and parts may be measured but it does not often effect the frequency response if wiring and parts are spaced a reasonable distance from the chassis. The shunting capacity (C_s) has the effect of reducing the load impedance and consequently reduces the gain at high frequencies. However, the effect of the shunting capacity is usually not serious in the audio frequency range, and can be minimized by choosing tubes with low interelectrode capacities, and by keeping the capacity of the wiring as low as possible. "C_s" also includes any by-pass condenser on the plate of tube one or on the grid of tube two. These bypasses are often used in superheterodyne receivers to shunt intermediate frequencies to ground.

The gain at medium audio frequencies, approximately 1,000 cycles (since the reactance of "C" may then be neglected) can be calculated from the simplified circuit shown in Figure 2 and the formula

$$A_m = \mu \frac{R_1}{r_p + R_1}, \text{ where } \mu \text{ is the rated ampli-}$$

fication factor obtained from tube data, and r_p is the internal plate resistance of the tube under conditions of operation also obtained from tube data, and R_1 is the load resistance consisting of R_L and R_g in parallel. R_1 may be calculated from the formula

$$R_1 = \frac{R_L \times R_g}{R_L + R_g}$$

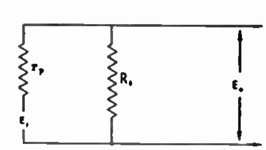


FIGURE 2

The calculation of A_m is based on the assumption that the reactance of "C_c" and "C" are negligible and that "C_s" has no appreciable shunting effect.

At frequencies from 1 to 1,000 cycles the gain is reduced by the impedances of the coupling condenser ("C" Figure 1) and the cathode by-pass condenser ("C_c" Figure 1). If we first consider "C_c" to be very large, then the circuit of Figure 1 can be reduced to the simple circuit shown in Figure 3.

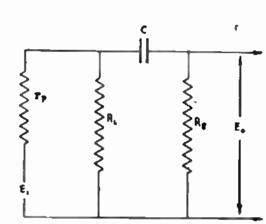


FIGURE 3

The ratio of amplification at some low frequency (A_L) to that at medium frequency may be calculated from the formula

$$\frac{A_L}{A_M} = \frac{1}{\sqrt{1-\left(\frac{X_c}{R_2}\right)^2}}$$

$$\text{where } X_c = \frac{1}{2\pi fc} \text{ and}$$

$$R_2 = R_g + \frac{r_p \times R_L}{r_p + R_L}$$

X_c = the reactance of the coupling condenser "C," and R_2 equals the resistance of the grid leak, in series with the internal and external plate resistances in parallel.

At high audio frequencies the amplifier circuit may be simplified as shown in Figure 4. This figure assumes that at high frequencies the effect of the coupling condenser is negligible and that reduction in gain is due to C_S.

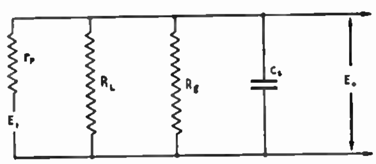


FIGURE 4

The ratio of gain at high frequencies (A_H) to that at medium frequencies may be calculated from the formula

$$\frac{A_H}{A_M} = \frac{1}{\sqrt{1-(R_3 \times X_S)^2}} \text{ where } X_S = \frac{1}{\sqrt{2\pi f C_S}}$$

$$\text{and } R_3 = \frac{R_L R_{g} r_p}{(R_g R_L) + (R_g r_p) + (R_L r_p)}$$

X = reactance of capacity "C_S"

This calculation indicates that small values are desirable for R_L, R_g, r_p, and C_S, to obtain uniform gain at high frequencies.

Figure 5 shows a circuit diagram of a typical resistance coupled amplifier using a pentode tube.

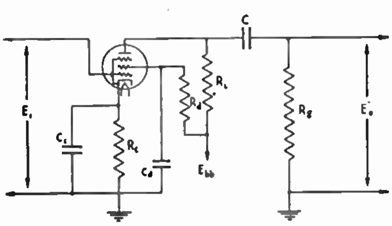


FIGURE 5

The circuit is similar to that for a triode except for the addition of R_d and C_d which supply DC voltage to, and by-pass the audio frequency from, the screen. The screen voltage and current are both small to permit operation over a linear part of the tube characteristic curve. R_d is therefore a high resistance and sometimes reaches a value of 3 megohms. It is, as a result, necessary that C_d should have a small DC leakage, in addition to a low AC impedance to prevent degeneration at low frequencies. Table I shows values of R_d and C_d for the most commonly used pentode amplifiers. The value of C_d given is arbitrarily chosen to give a ten percent reduction in gain at 100 cycles. Larger values will improve the low frequency response.

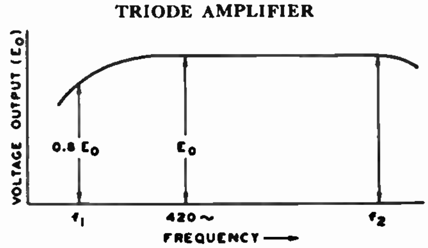
If an audio frequency amplifier of two or more stages is operated from a common power-supply, motorboating may result due to the common impedance. The common impedance can be reduced by increasing the capacity of the final filter condenser in the power-supply unit. If motorboating still persists it may be necessary to use separate filter chokes for each stage, and at the same time reduce the resistance of the rectifier tube and the impedance of the power transformer. Separate resistance-capacity filters in the plate supply of each stage may be effective in stopping motorboating as well as in reducing hum. If motorboating cannot be stopped by any other means two or more entirely separate power supplies may be required.

The frequency response of a multi-stage amplifier is often different than would be expected from a consideration of each individual stage due to regeneration or degeneration between input and output stages. The stray coupling causing regeneration may take the form of capacity coupling between circuit or tube elements, magnetic coupling between component parts and leads, and impedance of the power supply. An arrangement of stages in a straight line tends to reduce regeneration. Using the chassis as ground return leads, often results in stray couplings between any and all circuits. This may not be serious in the last stage of the amplifier, but could easily produce distortion and oscillation if it occurred in a stage followed by considerable amplification.

A large percentage of audio amplifiers are operated from conventional power packs which rectify alternating current and smooth it out to make the AC ripple as low as possible. In all cases, however, these power units supply DC voltages which produce a certain amount of hum in the amplifier. This may not cause hum in the output stage. However, preceding stages are more seriously affected by AC ripple, in proportion to the gain which follows them. It is therefore desirable to use multi-stage filter units which reduce the hum to very low values in the high voltage supply to the early amplifier stages. This can usually be done with resistance capacity filters since only small currents are required.

There is a certain phase shift between the input-voltage to, and the output voltage from, an audio amplifier. This is not serious because the ear is very little, if at all, sensitive to phase shifts.

FREQUENCY CHARACTERISTIC OF SINGLE-STAGE RESISTANCE-COUPLED TRIODE AMPLIFIER



A. Condensers C and C_c have been chosen to give output voltages equal to 0.8 E_O for f_1 of 100 cycles. For any other value of f_1, multiply values of C and C_c by $100/f_1$.

In the case of condenser C_c, the values shown are for an amplifier with DC heater excitation. When AC is used, depending on the character of the associated circuits, the gain, and the value of f_1, it may be necessary to increase the value of C_c to minimize hum-disturbances. It may also be desirable to have a DC potential difference of approximately 10 volts between heater and cathode.

B. f_2 = frequency at which high-frequency response begins to fall off.

C. The voltage output at f_1 for n like stages equals $(0.8\ E_O)^n$.

D. Decoupling filters are not necessary for two stages or less.

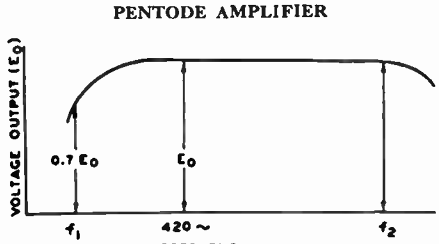
E. For an amplifier of typical construction, the value of f_2 is well above the audio-frequency range for any value of R_L.

F. Always use highest permissible value of R_g.

G. A variation of ±10% in values of resistors and condensers has only a slight effect on performance.

SEE FIGURE 1

FREQUENCY CHARACTERISTIC OF SINGLE-STAGE RESISTANCE-COUPLED PENTODE AMPLIFIER



A. Condensers C, C_c, and C_d have been chosen to give output voltages equal to 0.7 E_O for f_1 of 100 cycles. For any other value of f_1, multiply values of C, C_c, and C_d by $100/f_1$.

In the case of condenser C_c, the values shown are for an amplifier with DC heater excitation. When AC is used, depending on the character of the associated circuits, the gain, and the value of f_1, it may be necessary to increase the value of C_c to minimize hum disturbances. It may also be desirable to have a DC potential difference of approximately 10 volts between heater and cathode.

B. f_2 = frequency at which high-frequency response begins to fall off.

C. The voltage output at f_1 for n like stages equals $(0.7\ E_O)^n$.

D. Decoupling filters are not necessary for two stages or less.

E. For an amplifier of typical construction, approximate values of f_2 for different values of R_L are:

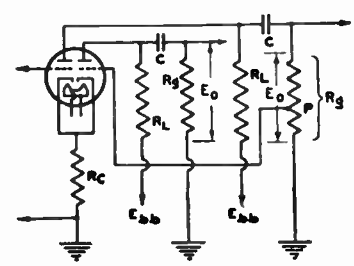
R_L	f_2
0.1 Meg.	20000 cps.
0.25 Meg.	10000 cps.
0.5 Meg.	5000 cps.

F. Always use highest permissible value of R_g.

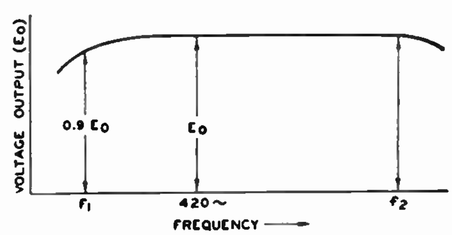
G. A variation of ±10% in values of resistors and condensers has only slight effect on performance.

SEE FIGURE 5

TWIN-TRIODE DIAGRAM WITH LEGEND



FREQUENCY CHARACTERISTIC OF RESISTANCE-COUPLED TWIN-TRIODE AMPLIFIER



The diagram given above is for Phase-Inverter Service. The signal input is supplied to the grid of the left-hand triode unit. The grid of the right-hand unit obtains its signal from a tap (P) on the grid resistor (R_g) in the output circuit of the left-hand triode unit. The tap (P) is chosen so as to make the voltage output of the right-hand unit equal to that of the left-hand unit. Its location is determined from the voltage gain values given in the Chart. For example, if the value of voltage gain is 20 (from the Chart), (P) is chosen so as to supply 1/20 of the voltage across (R_g) to the grid of the right-hand triode.

For phase-inverter service, the cathode resistor (R_c) should not be by-passed by a condenser. Omission of the condenser in this service assists in balancing the output voltages. The value of R_c is specified on the basis that both units are operating simultaneously at the same values of plate load and plate voltage.

Resistance-Coupled Amplifier Chart for Pentodes

TABLE I

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	90									180								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
SCREEN RESISTOR (Rd) - Megohms	0.37	0.44	0.44	1.1	1.18	1.4	2.18	2.6	2.7	0.44	0.5	0.5	1.1	1.18	1.4	2.45	2.9	2.7
CATHODE RESISTOR (Rc) - Ohms	1200	1100	1300	2400	2600	3600	4700	5500	5500	1000	750	800	1200	1600	2000	2600	3100	3500
SCREEN BY-PASS CONDENSER (Cd) - µf	0.05	0.05	0.05	0.03	0.03	0.025	0.02	0.05	0.02	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.025	0.02
CATHODE BY-PASS CONDENSER (Cc) - µf	5.2	5.3	4.8	3.7	3.2	2.5	2.3	2	2	6.5	6.7	6.7	5.2	4.3	3.8	3.2	2.5	2.8
BLOCKING CONDENSER (C) - µf	0.02	0.01	0.006	0.008	0.005	0.003	0.005	0.0025	0.0015	0.02	0.01	0.006	0.008	0.005	0.0035	0.005	0.0025	0.0015
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	17	22	33	23	32	33	28	29	27	42	52	59	41	60	60	45	56	60
VOLTAGE GAIN [4]	41	55	66	70	85	92	93	120	140	51	69	83	93	118	140	135	165	165

PENTODE TYPES: 6C6, 6J7, 57

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	300									600 (max.)								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
SCREEN RESISTOR (Rd) - Megohms	0.44	0.5	0.53	1.18	1.18	1.45	2.45	2.9	2.95	0.48	0.53	0.53	1.18	1.18	1.45	2.5	2.94	3
CATHODE RESISTOR (Rc) - Ohms	500	450	600	1100	1200	1300	1700	2200	2300	200	250	300	500	800	800	1050	1400	1500
SCREEN BY-PASS CONDENSER (Cd) - µf	0.07	0.07	0.06	0.04	0.04	0.05	0.04	0.04	0.04	0.09	0.08	0.08	0.05	0.05	0.05	0.05	0.05	0.05
CATHODE BY-PASS CONDENSER (Cc) - µf	8.5	8.3	8	5.5	5.4	5.8	4.2	4.1	4	11.5	11.1	10.5	8.2	7.2	7	5.7	5.6	4.5
BLOCKING CONDENSER (C) - µf	0.02	0.01	0.006	0.008	0.005	0.005	0.005	0.003	0.0025	0.02	0.01	0.006	0.008	0.005	0.005	0.005	0.003	0.002
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	55	81	96	81	104	110	75	97	100	90	140	150	125	200	180	140	185	165
VOLTAGE GAIN [4]	61	82	94	104	140	185	161	350	240	77	100	112	136	171	210	198	435	350

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	90									180								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
SCREEN RESISTOR (Rd) - Megohms	0.59	0.65	0.7	1.5	1.6	1.7	3.2	3.5	3.7	0.58	0.68	0.71	1.6	1.8	1.9	3.3	3.6	3.8
CATHODE RESISTOR (Rc) - Ohms	870	930	910	1440	1520	1560	2620	2800	3000	530	540	540	850	890	950	1410	1520	1600
SCREEN BY-PASS CONDENSER (Cd) - µf	0.065	0.061	0.057	0.044	0.044	0.043	0.029	0.03	0.031	0.073	0.07	0.065	0.05	0.044	0.046	0.041	0.037	0.031
CATHODE BY-PASS CONDENSER (Cc) - µf	5.1	5	4.58	3.38	3.23	3.22	2.04	1.95	1.92	7.2	6.9	6.6	4.6	4.7	4.4	3.5	3	2.9
BLOCKING CONDENSER (C) - µf	0.018	0.01	0.007	0.007	0.0055	0.004	0.004	0.0026	0.0024	0.017	0.01	0.0063	0.0071	0.005	0.0037	0.0041	0.003	0.0024
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	16	20.5	22.5	13.7	18	19	12	15.4	16.4	33	43	48	32.5	39.5	44	30	37.5	41.5
VOLTAGE GAIN [4]	33.3	46.5	53.5	55.5	66.5	77	59.5	84	93.5	47.4	66	75	79	104	118	109	134	147

PENTODE TYPE 6S7-G

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	300								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
SCREEN RESISTOR (Rd) - Megohms	0.59	0.67	0.71	1.7	1.95	2.1	3.6	3.9	4.1
CATHODE RESISTOR (Rc) - Ohms	430	440	440	620	650	700	1000	1080	1120
SCREEN BY-PASS CONDENSER (Cd) - µf	0.077	0.071	0.071	0.058	0.057	0.055	0.04	0.041	0.043
CATHODE BY-PASS CONDENSER (Cc) - µf	8.5	8	8	6	5.8	5.2	4.1	3.9	3.8
BLOCKING CONDENSER (C) - µf	0.0167	0.01	0.0066	0.0071	0.005	0.0036	0.0037	0.0029	0.0023
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	57	75	82	54	66	76	52	66	73
VOLTAGE GAIN [4]	57	78	89	98	122	136	136	162	174

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	90									180								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
SCREEN RESISTOR (Rd) - Megohms	0.37	0.5	0.6	1.18	1.1	1.35	2.6	2.8	2.9	0.44	0.5	0.6	1.18	1.2	1.5	2.6	2.8	3
CATHODE RESISTOR (Rc) - Ohms	2000	2200	2000	3500	3500	3500	5000	6000	6200	1000	1200	1200	1900	2100	2200	3300	3500	3500
SCREEN BY-PASS CONDENSER (Cd) - µf	0.07	0.07	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.08	0.08	0.07	0.05	0.06	0.05	0.04	0.04	0.04
CATHODE BY-PASS CONDENSER (Cc) - µf	3	3	2.8	1.9	2.1	1.9	1.5	1.55	1.5	4.4	4.4	4	2.7	3.2	3	2.1	2	2.2
BLOCKING CONDENSER (C) - µf	0.02	0.01	0.006	0.008	0.007	0.003	0.004	0.003	0.003	0.02	0.015	0.008	0.01	0.007	0.003	0.005	0.003	0.002
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	19	28	29	26	33	32	22	29	27	30	52	53	39	55	53	47	55	53
VOLTAGE GAIN [4]	24	33	37	43	55	65	63	85	100	30	41	46	55	69	83	81	115	116

DUPLEX-DIODE PENTODE TYPES: 2B7, 6B7, 6B8

PLATE-SUPPLY VOLTAGE (Ebb) - Volts [1]	300									600 (max.)								
PLATE RESISTOR (RL) - Megohms	0.1			0.25			0.5			0.1			0.25			0.5		
GRID RESISTOR (Rg) - Megohms [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
SCREEN RESISTOR (Rd) - Megohms	0.5	0.55	0.6	1.2	1.2	1.5	2.7	2.9	3.4	0.45	0.6	0.65	1.2	1.35	1.5	2.7	3	3.4
CATHODE RESISTOR (Rc) - Ohms	950	1100	900	1500	1600	1800	2400	2500	2800	350	500	350	1000	1100	1000	1500	1800	2000
SCREEN BY-PASS CONDENSER (Cd) - µf	0.09	0.09	0.08	0.06	0.06	0.08	0.05	0.05	0.05	0.1	0.1	0.1	0.08	0.08	0.09	0.08	0.06	0.08
CATHODE BY-PASS CONDENSER (Cc) - µf	4.6	5	4.8	3.2	3.5	4	2.5	2.3	2.8	6.6	7	7	4	4.4	4.6	3.5	3	3.6
BLOCKING CONDENSER (C) - µf	0.025	0.015	0.009	0.015	0.008	0.004	0.006	0.003	0.0025	0.03	0.02	0.01	0.015	0.01	0.004	0.006	0.0025	0.002
VOLTAGE OUTPUT (Eo) - Peak Volts [3]	60	89	86	70	100	95	80	120	90	72	130	120	135	175	150	145	170	190
VOLTAGE GAIN [4]	36	47	54	64	79	100	96	150	145	43	59	67	76	95	110	111	170	180

TABLE II

C = BLOCKING CONDENSER (μf) Cc = CATHODE BY-PASS CONDENSER (μf) Cd = SCREEN BY-PASS CONDENSER (μf) Ebb = PLATE-SUPPLY VOLTAGE (Volts) Eo = VOLTAGE OUTPUT (Peak volts) Rc = CATHODE RESISTOR (Ohms) Rd = SCREEN RESISTOR (Megohms) Rg = GRID RESISTOR (Megohms) RL = PLATE RESISTOR (Megohms) V.G. = VOLTAGE GAIN

TYPES: 6C5 (TRIODE), AND 6C6, 6J7, 57 (AS TRIODES)

Ebb[1]	90									180									300									Ebb[1]
RL	0.05			0.1			0.25			0.05			0.1			0.25			0.05			0.1			0.25			RL
Rg[2]	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	Rg[2]
Rc	2800	3400	3800	4800	6400	7500	11400	14500	17300	2200	2700	3100	3900	5300	6200	9500	12300	14700	2100	2600	3100	3800	5300	6000	9600	12300	14000	Rc
Cc	2	1.62	1.3	1.12	0.84	0.66	0.52	0.4	0.33	2.2	2.1	1.85	1.7	1.25	1.2	0.74	0.55	0.47	3.16	2.3	2.2	1.7	1.3	1.17	0.9	0.59	0.37	Cc
C	0.05	0.025	0.01	0.02	0.01	0.005	0.01	0.006	0.004	0.055	0.03	0.015	0.035	0.015	0.008	0.015	0.008	0.004	0.075	0.04	0.015	0.035	0.015	0.008	0.015	0.008	0.003	C
Eo[3]	14	17	20	16	22	23	18	23	26	34	45	54	41	54	55	44	52	59	57	70	83	65	84	88	73	85	97	Eo[3]
V.G.[4]	9	9	10	10	11	12	12	12	13	10	11	11	12	12	13	13	13	13	11	11	12	12	13	13	13	14	14	V.G.[4]

TRIODE TYPE 6L5-G

Ebb[1]	90									180									300									Ebb[1]
RL	0.05			0.1			0.25			0.05			0.1			0.25			0.05			0.1			0.25			RL
Rg[2]	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1.0	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1.0	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1.0	Rg[2]
Rc	2120	2500	2900	3510	4620	5200	8050	10300	12100	1810	2240	2660	3180	4200	4790	7100	9290	10950	1740	2160	2600	3070	4140	4700	6900	9100	10750	Rc
Cc	2.3	1.85	1.65	1.36	1.08	1	0.61	0.49	0.42	2.9	2.2	1.8	1.46	1.1	1	0.7	0.54	0.46	2.91	2.18	1.82	1.64	1.1	0.81	0.57	0.46	0.4	Cc
C	0.05	0.03	0.014	0.03	0.015	0.0085	0.0125	[illegible]	0.0055	0.06	0.03	0.014	0.03	0.0145	0.009	0.014	0.009	0.0055	0.06	0.032	0.015	0.032	0.014	0.0075	0.013	0.0075	0.005	C
Eo[3]	14	17.8	21	16	21.5	25	17.5	21.5	23.6	32	41	46	36	45.5	50	38	46	52	56	68	79	60	79	89	64	80	88	Eo[3]
V.G.[5]	9.3	10.4	10.9	11	11.7	12	11.8	11.9	12	10.4	11.1	11.5	11.6	12.1	12.3	12.1	12.4	12.5	10.9	11.6	11.9	12.1	12.7	12.9	13	12.9	12.8	V.G.[5]

DUPLEX-DIODE TRIODE TYPE 6Q7

Ebb[1]	90									180									300									Ebb[1]
RL	0.1			0.25			0.5			0.1			0.25			0.5			0.1			0.25			0.5			RL
Rg[2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	Rg[2]
Rc	4000	4200	4300	7200	7600	8000	11500	12300	13700	1600	1900	2100	3400	4000	4500	6000	7100	7900	1200	1500	1700	2600	3000	3600	4600	5500	6200	Rc
Cc	2.07	1.7	1.5	1.17	1.2	0.9	0.72	0.6	0.45	3	2.5	2.3	1.6	1.3	1.05	0.86	0.76	0.63	4.4	3.6	3.05	2.4	1.66	1.45	1.2	0.9	0.9	Cc
C	0.02	0.01	0.005	0.01	0.006	0.003	0.006	0.003	0.0015	0.02	0.01	0.005	0.01	0.005	0.003	0.006	0.003	0.002	0.03	0.015	0.007	0.015	0.007	0.004	0.007	0.004	0.002	C
Eo[3]	5	8	9	8	11	13	9	13	17	19	26	29	25	31	37	30	36	41	35	52	53	43	52	62	47	60	66	Eo[3]
V.G.[4]	23[a]	28[b]	29[c]	31[b]	32	33	31	33	37	28	33	35	36	38	40	39	40	41	34	39	40	42	45	45	45	46	47	V.G.[4]

DUPLEX-DIODE HIGH-MU TRIODE TYPE 6T7-G

Ebb[1]	90									180									300									Ebb[1]
RL	0.1			0.25			0.5			0.1			0.25			0.5			0.1			0.25			0.5			RL
Rg[2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	Rg[2]
Rc	4350	4750	5050	7500	8300	9000	12500	14200	15500	2420	2830	3080	4410	5220	5920	7250	9440	10850	1950	2400	2640	3760	4580	5220	6570	8200	9600	Rc
Cc	1.8	1.5	1.43	1.12	1	0.88	0.67	0.6	0.54	2.55	2.25	2	1.5	1.25	1.11	0.91	0.74	0.6	2.85	2.55	2.25	1.57	1.35	1.23	1.02	0.82	0.7	Cc
C	0.023	0.012	0.007	0.012	0.0075	0.005	0.0065	0.0045	0.0035	0.023	0.0135	0.008	0.012	0.008	0.005	0.007	0.0045	0.0035	0.0245	0.0135	0.008	0.012	0.0075	0.005	0.008	0.0055	0.004	C
Eo[3]	5.6	7.8	8.5	7.7	10.2	11.5	9.4	12.3	13.2	21	28.5	31.6	27	33.8	38.5	31	39	42.6	43.7	58	64	57	69	80	62	76.5	85.5	Eo[3]
V.G.[5]	20.3[e]	24[f]	25	28.2[f]	30	31.6	30.5	32.9	34.2	23.7	28.4	30.6	33.7	36.4	38	38.4	40.5	41	26.5	31.9	33.2	36.6	40	41	41.5	43.3	44	V.G.[5]

DUPLEX-DIODE TRIODE TYPE 6R7

Ebb[1]	90									180									300									Ebb[1]
RL	0.05			0.1			0.25			0.05			0.1			0.25			0.05			0.1			0.25			RL
Rg[2]	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	Rg[2]
Rc	2300	2600	2900	3500	4400	5000	7600	9800	11300	1700	2100	2500	3000	4100	4600	6700	8800	10000	1600	2000	2400	2900	3800	4400	6300	8400	10600	Rc
Cc	2	1.7	1.27	1.2	0.9	0.77	0.54	0.42	0.38	2.3	1.9	1.5	1.3	0.9	0.8	0.54	0.4	0.33	2.6	2	1.6	1.4	1.1	1	0.7	0.5	0.44	Cc
C	0.05	0.03	0.01	0.03	0.01	0.006	0.015	0.007	0.003	0.05	0.03	0.01	0.03	0.01	0.006	0.01	0.006	0.003	0.055	0.03	0.015	0.03	0.015	0.007	0.015	0.007	0.004	C
Eo[3]	14	18	20	15	19	21	15	18	21	31	40	45	35	43	46	33	40	47	50	62	71	52	68	71	54	62	74	Eo[3]
V.G.[4]	8	9	10	10	10	11	10	11	11	9	9	10	10	10	10	10	10	11	9	9	10	10	10	10	10	11	11	V.G.[4]

DUPLEX-DIODE TRIODE TYPES: 55, 85

Ebb[1]	90									180									300									Ebb[1]
RL	0.05			0.1			0.25			0.05			0.1			0.25			0.05			0.1			0.25			RL
Rg[2]	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	Rg[2]
Rc	3800	4600	5400	6620	9000	10300	15100	20500	24400	3200	4100	5000	6200	8700	10000	14500	20000	24000	3200	4100	5100	5900	8300	9600	14300	19400	23600	Rc
Cc	1.4	1.1	0.86	0.7	0.55	0.5	0.31	0.25	0.2	1.8	1.6	1.2	0.9	0.7	0.57	0.43	0.29	0.24	1.9	1.5	1.2	0.8	0.54	0.43	0.3	0.22	0.2	Cc
C	0.06	0.03	0.015	0.04	0.015	0.007	0.015	0.007	0.004	0.06	0.045	0.02	0.04	0.015	0.008	0.015	0.008	0.004	0.08	0.045	0.015	0.03	0.015	0.006	0.01	0.006	0.003	C
Eo[3]	16	19	23	17	22	25	18	23	26	33	44	49	37	47	50	40	48	53	50	74	85	64	82	88	71	84	94	Eo[3]
V.G.[4]	4.5	4.9	5.1	5.1	5.4	5.5	5.3	5.5	5.6	4.9	5.2	5.3	5.3	5.5	5.5	5.6	5.7	5.7	5.2	5.5	5.6	5.5	5.7	5.8	5.7	5.7	5.8	V.G.[4]

TABLE III

C = BLOCKING CONDENSER (µf) Cc = CATHODE BY-PASS CONDENSER (µf) Cd = SCREEN BY-PASS CONDENSER (µf) Ebb = PLATE-SUPPLY VOLTAGE (Volts) Eo = VOLTAGE OUTPUT (Peak Volts) Rc = CATHODE RESISTOR (Ohms) Rd = SCREEN RESISTOR (Megohms) Rg = GRID RESISTOR (Megohms) RL = PLATE RESISTOR (Megohms) V.G. = VOLTAGE GAIN

DUPLEX-DIODE TRIODE TYPES: 2A6, 75

Ebb [1]	90									180									300									Ebb [1]
RL	0.1			0.25			0.5			0.1			0.25			0.5			0.1			0.25			0.5			RL
Rg [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	Rg [2]
Rc	6300	6600	6700	10000	11000	11500	16200	16600	17400	2600	2900	3000	4300	4800	5300	7000	8000	8800	1900	2200	2300	3300	3900	4200	5300	6100	7000	Rc
Cc	2.2	1.7	1.7	1.24	1.07	0.9	0.75	0.7	0.65	3.3	2.9	2.7	2.1	1.8	1.5	1.3	1.1	0.9	4	3.5	3	2.7	2	1.8	1.6	1.3	1.2	Cc
C	0.02	0.01	0.006	0.01	0.006	0.003	0.005	0.003	0.0015	0.025	0.015	0.007	0.015	0.007	0.004	0.007	0.004	0.002	0.03	0.015	0.007	0.015	0.007	0.004	0.007	0.004	0.002	C
Eo [3]	3	5	6	5	7	10	7	10	13	16	22	23	21	28	33	25	33	38	31	41	45	42	51	60	47	62	67	Eo [3]
V.G. [4]	23 [d]	29 [b]	31 [c]	34 [b]	40 [c]	40	39	44	48	29	36	37	43	50	53	52	57	58	31	39	42	48	53	56	58	60	63	V.G. [4]

TRIODE TYPE 6F5

Ebb [1]	90									180									300									Ebb [1]
RL	0.1			0.25			0.5			0.1			0.25			0.5			0.1			0.25			0.5			RL
Rg [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	Rg [2]
Rc	4400	4800	5000	8000	8800	9000	12200	13500	14700	1800	2000	2200	3500	4100	4500	6100	6900	7700	1300	1600	1700	2600	3200	3500	4500	5400	6100	Rc
Cc	2.5	2.1	1.8	1.33	1.18	0.9	0.76	0.67	0.58	4.4	3.3	2.9	2.3	1.8	1.7	1.3	0.9	0.83	5	3.7	3.2	2.5	2.1	2	1.5	1.2	0.93	Cc
C	0.02	0.01	0.005	0.01	0.005	0.003	0.005	0.003	0.0015	0.025	0.015	0.006	0.01	0.006	0.004	0.006	0.003	0.0015	0.025	0.01	0.006	0.01	0.007	0.004	0.006	0.004	0.002	C
Eo [3]	4	5	6	6	7	10	8	10	12	16	23	25	21	26	32	24	33	37	33	43	48	41	54	63	50	62	70	Eo [3]
V.G. [4]	28 [d]	34 [b]	35 [c]	39 [b]	43 [c]	44	43	46	48	37	44	46	48	53	57	53	63	66	42	49	52	56	63	67	65	70	70	V.G. [4]

TWIN-TRIODE TYPES: 6A6, 6N7, 53 (ONE TRIODE UNIT)

Ebb [1]	90									180									300									Ebb [1]
RL	0.1			0.25			0.5			0.1			0.25			0.5			0.1			0.25			0.5			RL
Rg [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	Rg [2]
Rc *	1900	2250	2500	4050	4950	5400	7000	8500	9650	1300	1700	1950	2950	3800	4300	5250	6600	7650	1150	1500	1750	2650	3400	4000	4850	6100	7150	Rc
C	0.025	0.01	0.006	0.01	0.006	0.003	0.006	0.003	0.0015	0.03	0.015	0.007	0.015	0.007	0.0035	0.007	0.0035	0.002	0.03	0.015	0.007	0.015	0.0055	0.003	0.0055	0.003	0.0015	C
Eo [3]	13	19	20	16	20	24	18	23	26	35	46	50	40	50	57	44	54	61	60	83	86	75	87	100	76	94	104	Eo [3]
V.G. [4]	16	19	20	20	22	23	22	23	23	19	21	22	23	24	24	24	25	25	20	22	23	23	24	24	23	24	24	V.G. [4]

TWIN-TRIODE TYPE 79 (ONE TRIODE UNIT)

Ebb [1]	90									180									300									Ebb [1]
RL	0.1			0.25			0.5			0.1			0.25			0.5			0.1			0.25			0.5			RL
Rg [2]	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	Rg [2]
Rc *	2050	2200	2350	4000	4250	4650	6150	6850	7500	1050	1250	1350	2050	2450	2750	3450	4100	4650	800	1000	1100	1650	2050	2350	2850	3600	4450	Rc
C	0.04	0.015	0.009	0.015	0.006	0.004	0.006	0.004	0.002	0.04	0.02	0.009	0.02	0.01	0.005	0.009	0.0035	0.002	0.025	0.01	0.006	0.01	0.0055	0.003	0.0055	0.003	0.0015	C
Eo [3]	5.8	8.4	9.5	7.1	9.7	12	8.8	12	15	21	27	31	26	34	40	30	39	44	40	57	60	56	66	77	61	75	82	Eo [3]
V.G. [4]	23 [b]	29 [c]	29	31 [c]	33	35	34	38	40	27	31	34	37	41	42	42	44	45	29	34	36	39	42	43	44	46	46	V.G. [4]

TRIODE TYPES: 56, 76

Ebb [1]	90									180									300									Ebb [1]
RL	0.05			0.1			0.25			0.05			0.1			0.25			0.05			0.1			0.25			RL
Rg [2]	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	Rg [2]
Rc	2500	3200	3800	4500	6500	7500	11100	15100	18300	2400	3000	3700	4500	6500	7600	10700	14700	17700	2400	3100	3800	4500	6400	7500	11100	15200	18300	Rc
Cc	2	1.6	1.25	1.05	0.82	0.68	0.48	0.36	0.32	2.5	1.9	1.65	1.45	0.97	0.8	0.6	0.45	0.4	2.8	2.2	1.8	1.6	1.2	0.98	0.69	0.5	0.4	Cc
C	0.06	0.03	0.015	0.03	0.015	0.007	0.015	0.007	0.0035	0.06	0.035	0.015	0.035	0.015	0.008	0.015	0.007	0.0045	0.08	0.045	0.02	0.04	0.02	0.009	0.02	0.009	0.005	C
Eo [3]	16	21	23	19	23	25	21	24	28	36	48	55	45	55	57	49	59	64	65	80	95	74	95	104	82	96	108	Eo [3]
V.G. [4]	7	7.7	8.1	8.1	8.9	9.3	9.4	9.7	9.8	7.7	8.2	9	9.3	9.5	9.8	9.7	10	10	8.3	8.9	9.4	9.5	10	10	10	10	10	V.G. [4]

[1] Voltage at plate equals Plate-Supply Voltage minus voltage drop in RL and Rc. For other supply voltages differing by as much as 50% from those listed, the values of resistors, condensers, and gain are approximately correct. The value of voltage output, however, for any of these other supply voltages equals the listed voltage output multiplied by the new plate-supply voltage divided by the plate-supply voltage corresponding to the listed voltage output.

[2] For following stage (see Circuit Diagrams pages 286-287).

* See NOTES under TWIN-TRIODE DIAGRAM on page 287.

[3] Voltage across Rg at grid-current point.

[4] Voltage Gain at 5 volts (RMS) output unless index letter indicates otherwise.
[a] At 2 volts (RMS) output.
[b] At 3 volts (RMS) output.
[c] At 4 volts (RMS) output.
[d] At 2.2 volts (RMS) output.

Audio Degeneration

Much has been written and published concerning the merits of degeneration in audio amplifiers but the use of these circuits has been confined to a relatively few applications. The data contained herein shows operating characteristics of typical output systems using degeneration. The circuits are such as can be used in the small household and automobile receiver without incurring too much additional cost. Charts are included with which degeneration calculations are facilitated.

In general it is now well known that the results of degeneration are:

1. Power output and efficiency remain constant.
2. Distortion is decreased.
3. Much improvement in frequency response results.
4. The signal voltage with degeneration is usually several times that required without degeneration.
5. "Fuzz Frequencies" that result from transients developed in the voice coil circuit as a result of mechanical resonance or shock excitation are minimized.

Inasmuch as power tubes of the beam-power variety, having high power output and efficiency with low distortion, are now available, the practical results of degeneration are:

1. Increase in frequency response.
2. Reduction of transients and "fuzz frequencies."

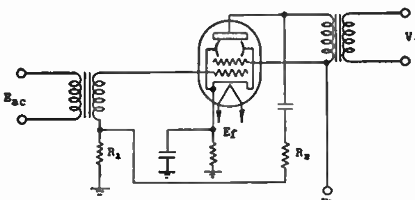
These two characteristics are highly desirable and in most cases can be obtained with the addition of one resistor and one condenser. The results of degeneration are easily calculable and the overall improvement in quality and resulting selling features more than offset the additional costs.

Although feedback either in the positive or negative sense is not new to the radio industry, the general effects of using negative feedback in audio amplifiers have not been fully appreciated.

Negative feedback can be obtained in a number of ways and consists of the feeding back a part of the output voltage to the input so that it is out of phase with the input signal. The feedback path may be such as to include several tubes in the circuit but is usually confined to one or two tubes. This is done because with a number of tubes in the path, the small phase shifts encountered in coupling circuits are accumulative and may be of sufficient magnitude to shift the phase of the voltage fed back so that it will be in phase with the signal instead of out of phase. If the magnitude of the voltage fed back is great enough and is in phase with the signal, oscillation will be experienced. With negative feedback applied on only one or two stages the phase shift is usually small and large values of voltage may be fed back without difficulty.

Figures 1 to 4 inclusive show methods of obtaining negative feedback in single and push-pull circuits.

Figure 1 is a basic circuit that illustrates simply how feedback is obtained. This particular circuit is not practical for most applications because of the prohibitive cost of the isolation transformer. The feedback



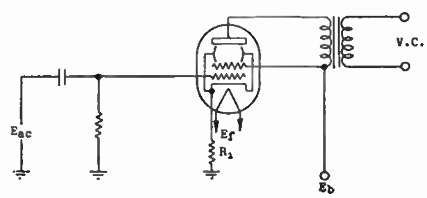
$$K = \frac{R_1}{R_1 + R_2}$$

FIGURE 1

voltage developed across R_1 is fed back in series with the grid. The voltage fed back is $\frac{R_1}{R_1 + R_2} e_o$. In the discussion to follow the factor K will be introduced and will represent the ratio of the voltage fed back to the total output voltage e_o. In this case $K = \frac{R_1}{R_1 + R_2}$.

An analysis of this circuit will show that the voltage in the output load is out of phase with the signal voltage and that if part of the output is added to the signal as shown, degeneration results.

The circuit of Figure 2 shows another method of obtaining negative feedback. Degeneration results from the fact that the voltages developed in the cathode resistor are out of phase with the signal and if the cathode by-pass condenser is omitted, these voltages appear on the grid. A disadvantage of this circuit lies in that the impedance effected by the tube in shunt with the primary of the transformer is greater than the R_p of the tube, whereas with the circuit of Figure 1, the impedance is very much lower than the R_p. This type of degeneration, however, will lower the distortion generated within the tube.



$$K = \frac{R_1}{R_1 + R_L}$$

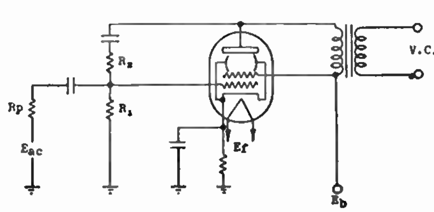
R_L = Load Resistance

FIGURE 2

The circuit of Figure 3 is recommended for resistance coupled input systems. The value of K is readily calculable and is approximately

$$K = \frac{R_1 R_p}{R_1 R_p + R_1 R_2 + R_2 R_p}$$

This circuit has been used satisfactorily with both pentode and triode drivers, the former proving superior because with the high R_p of the pentode the value of resistor R_2 may be kept high thus minimizing the shunting effect of the network on the driver tube.



$$K = \frac{R_T}{R_T + R_2}$$

Where R_T = Parallel Resistance of R_p and R_1

$$K = \frac{R_1 R_p}{R_1 R_p + R_1 R_2 + R_2 R_p}$$

FIGURE 3

Figure 4 shows a typical push-pull output system with degeneration. The double-secondary input transformer is commonly used for this type of service and thus does not represent much of an additional cost.

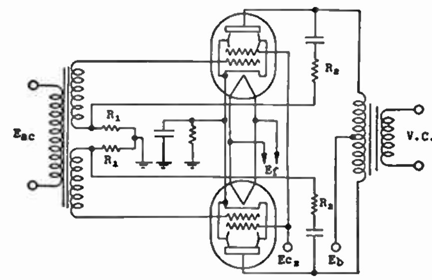


FIGURE 4

Degeneration may be used for the reduction of distortion but in most cases it is used to improve the frequency response and to dampen the speaker by lowering the effective impedance in shunt with the primary of the output transformer. In the latter case the circuit engineer usually has a fixed value of shunting impedance that is optimum or he may know through experience that certain low R_p tubes produce satisfactory damping. Given the shunting impedance it is then desirable to have an equation with which to calculate K or the ratio of voltage fed back to the total output voltage. It can be shown that for any tube

$$^{*}K = \frac{1}{S_m Z_p} - \frac{1}{\mu}$$

Where S_m = Mutual conductance.

Z_p = Shunting impedance desired.

μ = Amplification factor.

For high plate resistance tubes such as pentodes and beam-power amplifiers this equation becomes

$$K = \frac{1}{S_m Z_p}$$

With K calculated for the desired shunting impedance it follows that the ratio of the new signal voltage to the signal voltage with degeneration is

$$^{**}\frac{e_1}{e_g} = 1 + K\mu'$$

Where

e_1 = Signal for full output with degeneration.

e_g = Signal for full output without degeneration.

K = As previously defined.

μ' = Voltage amplification.

Since μ' can be determined from manufacturers' published conditions the equations given can be used to calculate driver requirements.

It is interesting to consider the limiting cases for K in the equation

$$K = \frac{1}{S_m Z_p} - \frac{1}{\mu}$$

With no degeneration

$$K = 0 \text{ and } Z_p = \frac{\mu}{S_m}$$

$$Z_p = R_p$$

With the maximum value of degeneration, K = 1

$$Z_p = \frac{R_p}{1 + \mu}$$

Since $\mu >> 1$ $Z_p = \frac{R_p}{\mu} = \frac{1}{S_m}$

The equation for Z_p in terms of S_m and K and the equation for e_1/e_g in terms of K and μ' are plotted on page 292. These charts should facilitate calculations on degenerative stages. μ' on the bottom chart

*Refer to Appendix I
**Refer to Appendix II

is obtained from published ratings and characteristics on output tubes. The rated load resistance and power output are used to calculate the RMS output voltage. The ratio of the peak output voltage to the bias is assumed to be the gain or μ'.

Many circuit designers like to make calculations of performance from published plate current families. To those familiar with this type of calculation the following method of converting pentode or tetrode plate current families to a new composite family in terms of peak signal volts will be especially attractive. Referring to Figure 9, the plate current family is that of the beam-power type 6V6. This family when converted using a value for K of .1, looks like the triode family in Figure 10 on page 293, with which power output and distortion may be calculated.

Conventional plate current families are measured by varying the plate voltage and reading plate current. The grid bias and screen voltage are held constant. With degeneration a composite characteristic can be developed if when running any bias curve the bias will be increased or decreased with the plate voltage. The bias change will be equal to the factor K times the plate voltage change.

Assume a K of .1. The operating point on the 6V6 curve is with $E_{c1} = -12.5$ and $E_b = 250$. This point is indicated as Q on both the tetrode and the converted family shown in Figure 10, page 293. Individual curves on the tetrode family are marked showing the value of bias. On the converted family it is more convenient to mark the curves in terms of the peak signal volts using the operating bias of -12.5 as zero. The point R on the tetrode curve is on the $E_{ac} = 0$ curve because the plate voltage has been changed in the negative direction by 25 volts. An increase in bias of 2.5 volts must result and the new point is then at the intersection of the $E_{c1} = -15$ curve and the $E_b = 225$ plate voltage line. Similar points are developed by increasing the bias .1 of the plate voltage change. Points R, S, and T are indicated on both families.

The complete plate current family shown in Figure 10, on page 293, was developed in this manner. The curves are similar to those of a triode having a mutual conductance of 4200 micro-mhos, an amplification factor of 10.5 and a plate resistance of 2500 ohms. These values are all measured at the operating point. An analysis of the family shows that the individual lines are equally spaced. Although the curves are similar to a triode they have characteristics peculiar to a converted tetrode family. It will be noted that all lines are drawn to the static value of $E_{c1} = 0$. These plate current lines are all terminated because this line represents the start of grid current. Operation on any load line drawn through "Q" must be restricted to values of signal within the zero-bias line. This indicates that the optimum load insofar as maximum power output is concerned is the same with or without degeneration. The values of AC grid swing corresponding to +12.5, +17.5 and so forth are in a region that would be in positive grid regions on a conventional triode family. Thus it can be said that triode characteristics are obtained with pentode efficiency because of the increased grid swing in the normally positive grid direction.

These data suggest the possibility of matching the the internal impedance of the output tube to the load resistance with which maximum power output is obtained. Under these conditions best performance will result. Using this suggestion most pentodes should be degenerated so that the impedance looking back into the tube will be approximately 7000 ohms. Beam-power tubes such as the 6V6 should be degenerated so that their impedance will be approximately 5000 ohms. These values should be sufficiently low to insure adequate damping of the speaker voice coil.

The curves in Figures 11 and 12 show power output versus load resistance, for several values of signal voltage as measured on a type 6V6 with and without degeneration. The curves in Figure 11 are without degeneration and those in Figure 12 with degeneration. These data are useful in the following manner. Most speakers offer a resistive load to an output tube at only one frequency. At higher frequencies the reflected load is an inductive reactance whose value increases with frequency. Thus an output tube operates into a variable load and to anticipate its operation characteristics the power output versus load resistance characteristics should be studied. The 6V6, if operated at the rated load of 5000 ohms as shown in Figure 11, will have a rising power output versus frequency characteristic. This type of output tube will therefore accentuate high frequencies. This ac-

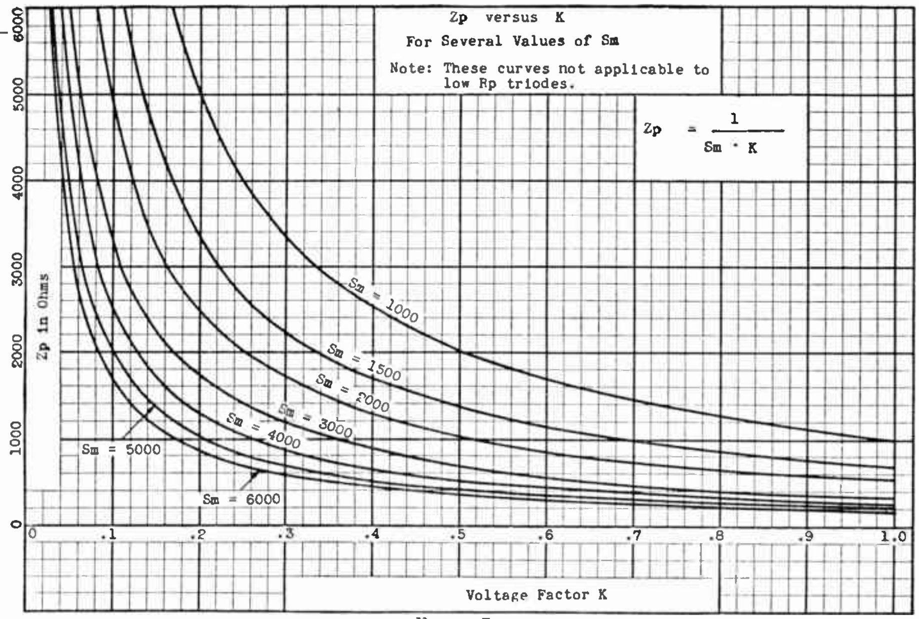


FIGURE 7

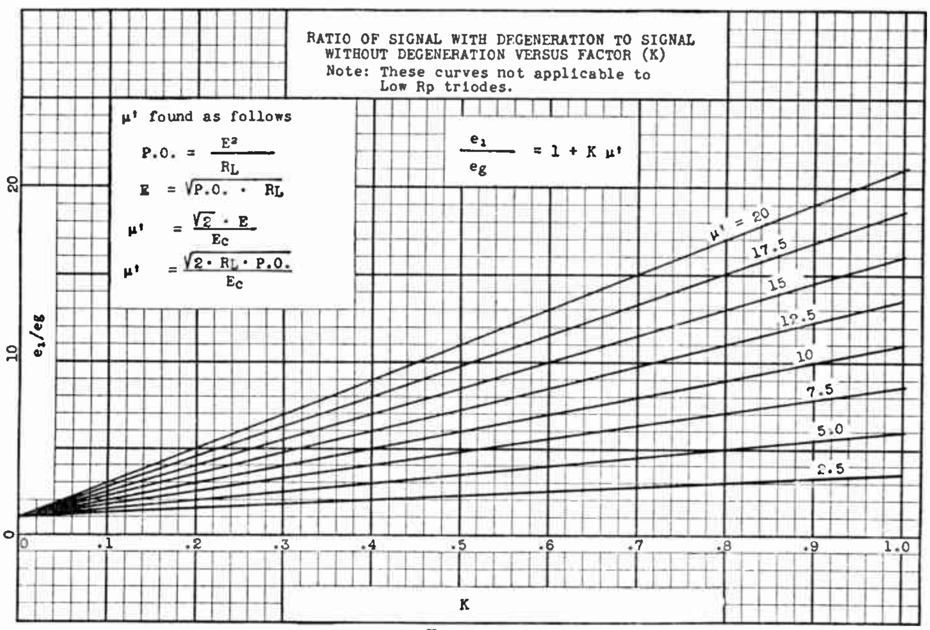


FIGURE 8

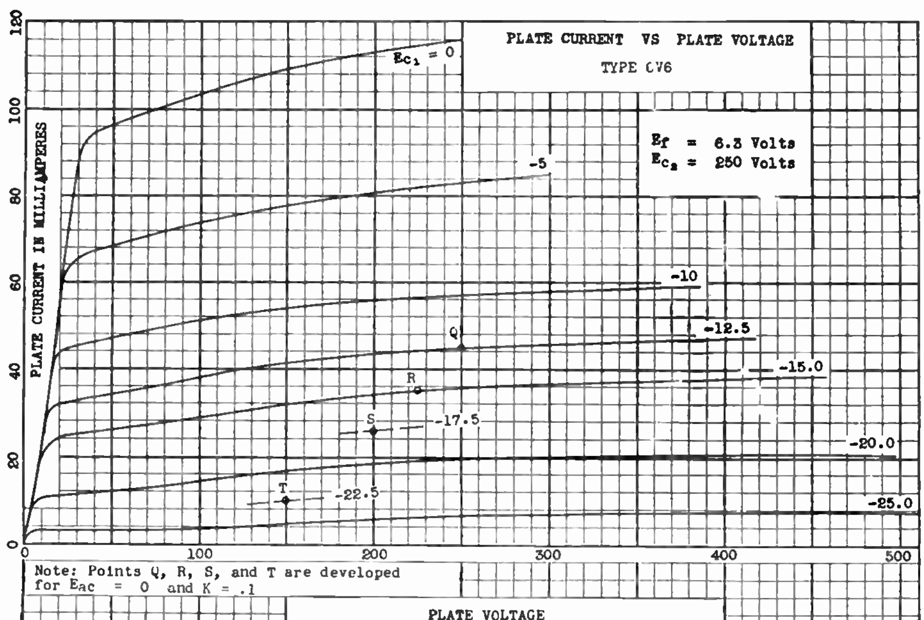


FIGURE 9

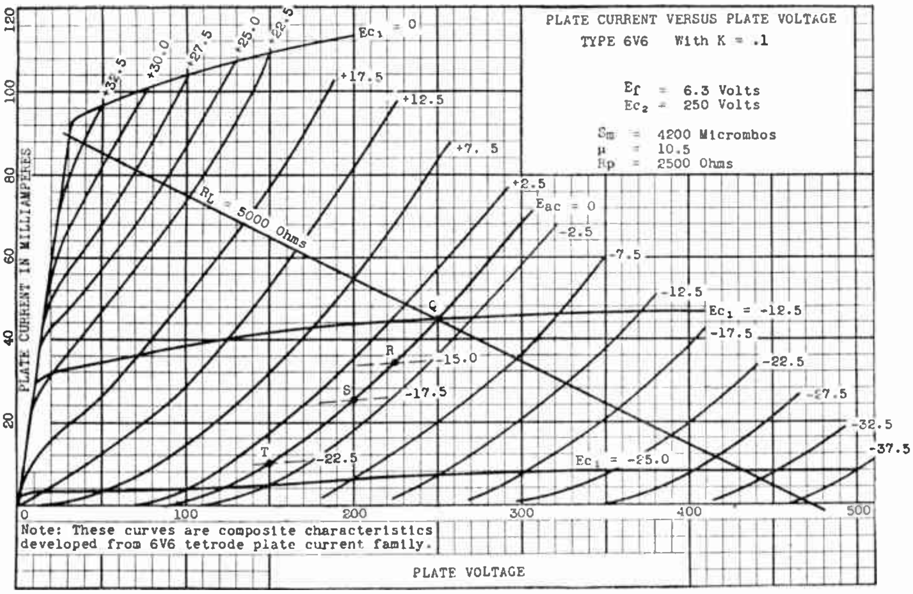


FIGURE 10

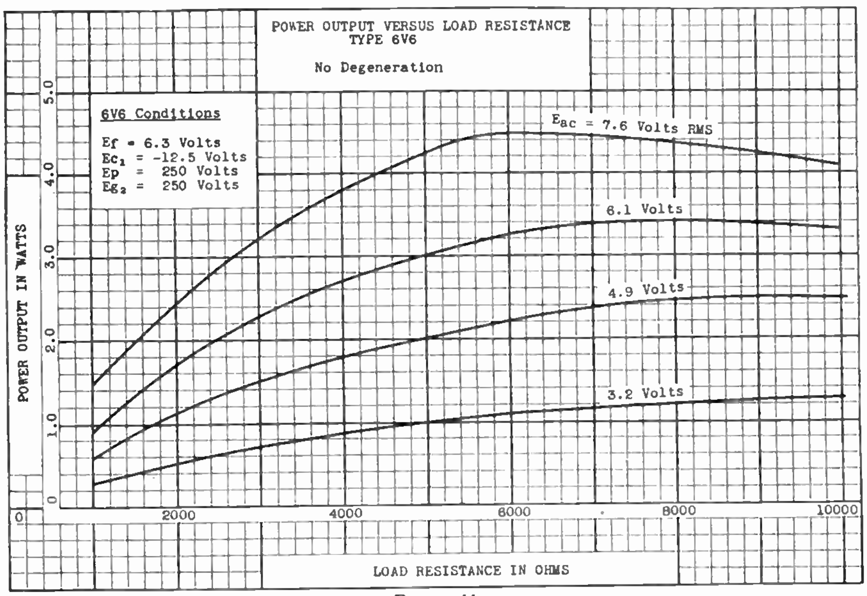


FIGURE 11

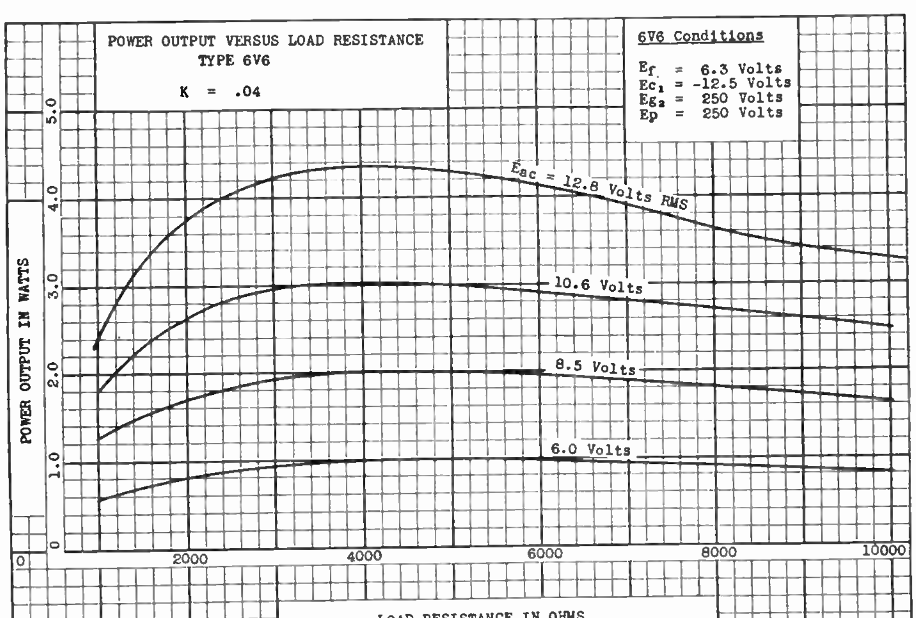


FIGURE 12

counts for the apparent "brilliancy" of most pentode and tetrode output systems. The curves in Figure 12 are those of a 6V6 degenerated so that the impedance looking back into the tube is approximately 500 ohms. It can be seen that the power output versus load resistance curve is essentially flat for medium values of signal voltage. With this connection the frequency characteristic will be excellent and overall performance improved.

The use of more degeneration, that is, a higher value of K, is illustrated by the curve in Figure 13, page 294. The power output maximizes at a load resistance of approximately 2000 ohms. Using this value of degeneration and a load resistance of approximately 5000 ohms the amplifier would be given a rising characteristic at the low frequency end of the audio spectrum.

The distortion characteristics of the 6V6 with degeneration and without degeneration are shown in Figures 14 and 15 on page 294. A study of these curves shows that, in general, with higher values of K the distortion is much lower. For example, the third harmonic with a load resistance of 5000 ohms is, 4.5% with K = 0, 3.3% with K = .04, and 2.4% with K = .1. The slope of the third harmonic curve with increase in load resistance is also very much reduced. The second harmonic curve minimizes (as would be expected) at the same value of load resistance for each value of K. This results from the fact that the operation is restricted within the regions of negative instantaneous grid voltage. It should be noted that the signal voltage for each of these curves is adjusted for the start of grid current. This accounts for the non-linearity of the power output versus load resistance curve.

Two typical circuit diagrams showing the use of a single output tube with degeneration driven with a resistance-coupled driver are given on page 295. The circuit in Figure 17 on page 295 illustrates the use of the diode-pentode driver. The full-output characteristics with and without degeneration are tabulated just under the circuit. It can be seen that with degeneration the distortion values are substantially reduced. With the value of K indicated the impedance in shunt with the output transformer has been reduced from 52,000 ohms, approximately, to 2,000 ohms, approximately. Values of K intermediate to these two will give slightly different distortion values and a shunt impedance as calculated with the chart (Figure 7) on page 292.

The circuit in Figure 18 shows the use of the 6Q7 as a driver. With this system little is gained insofar as the reduction of distortion is concerned because of the distortion resulting from the increased signal to the 6Q7. However, the reduction of the shunting impedance from 52,000 to 2,000 should merit its use. The signal voltage of 0.650 RMS should be easily obtained in most applications. With values of K somewhat smaller than .1 the driver distortion should be low enough that the overall harmonic content will be less than obtained with no degeneration.

APPENDIX I

Assume the case of a tube working into a speaker load. The transformer has unity coupling with the primary turns equal to the secondary turns. The grid is returned to the tap at R_1 and K is $R_1/(R_1 + R_2)$.

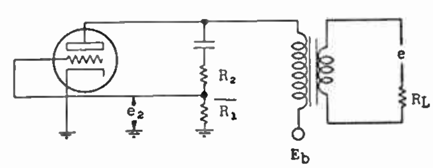
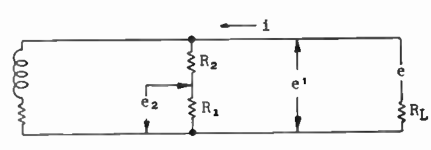


FIGURE 5

R_L is the voice coil impedance. e is an e.m.f. developed in the voice coil.

This circuit can be simplified to:



R_1 and R_2 are made sufficiently high that they dissipate negligible power and the current through R_1 and R_2 can then be neglected.

$$K = \frac{R_1}{R_1 + R_2} \text{ and } K = \frac{e_2}{e'}$$

Where:

$$e' = e - i R_L$$

$$i = \frac{e' + \mu e_2}{R_p}$$

$$Z_p = \frac{e'}{i}$$

$$Z_p = \frac{e' R_p}{e' + \mu e_2}$$

Since $e_2 = K e'$

$$Z_p = \frac{e' R_p}{e' + e' K\mu}$$

or

$$Z_p = \frac{R_p}{1 + K\mu}$$

$$K = \frac{R_p}{\mu \ Z_p} - \frac{1}{\mu}$$

or

$$K = \frac{1}{S_m \ Z_p} - \frac{1}{\mu}$$

For pentodes or tetrodes

$$K = \frac{1}{S_m \ Z_p}$$

Note: In the above equations

R_p = Plate Resistance.

μ = Amplification Factor.

S_m = Mutual Conductance.

APPENDIX II

The equivalent circuit is similar to the circuit used for calculating Z_p.

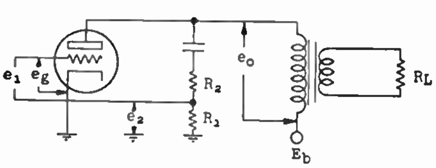


FIGURE 6

As before, the transformer is assumed to have unity coupling with T_p equal to T_s. e_1 is the input signal and e_g the effective grid signal.

$$K = \frac{R_1}{R_1 + R_2} = \frac{e_2}{e_o}$$

Then

$$e_1 = e_g + e_2$$

Since $e_2 = Ke_o = K \mu' e_g$

$$e_1 = e_g + K \mu' e_g$$

$$e_1 = e_g (1 + K \mu')$$

$$\frac{e_1}{e_g} = 1 + K \mu'$$

Note: In the above equations μ' = voltage amplification of the tube.

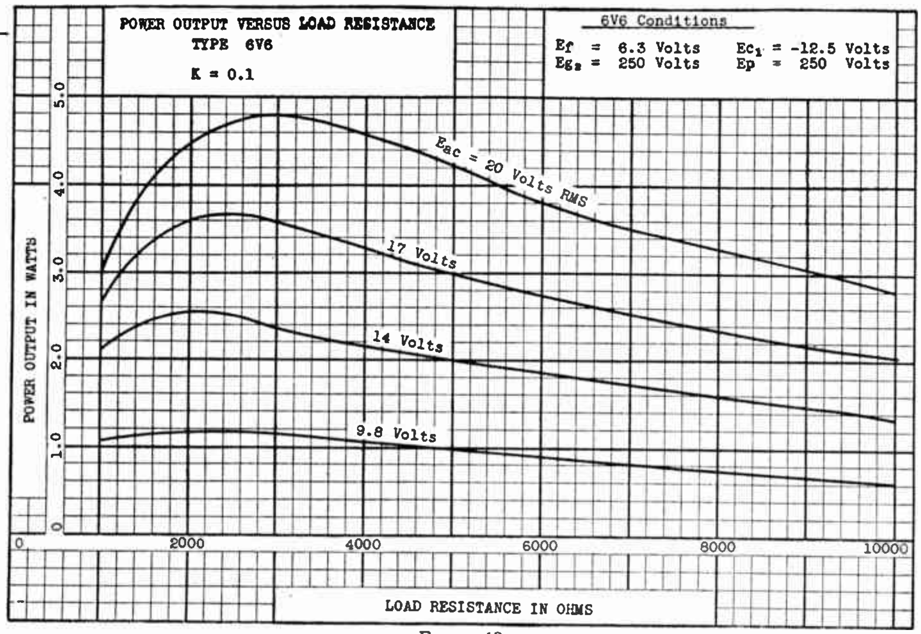


FIGURE 13

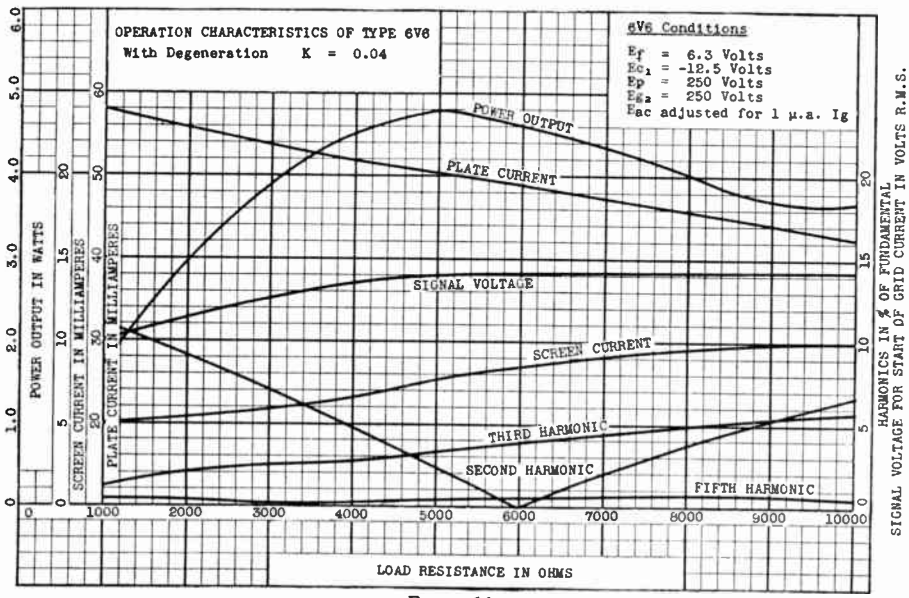


FIGURE 14

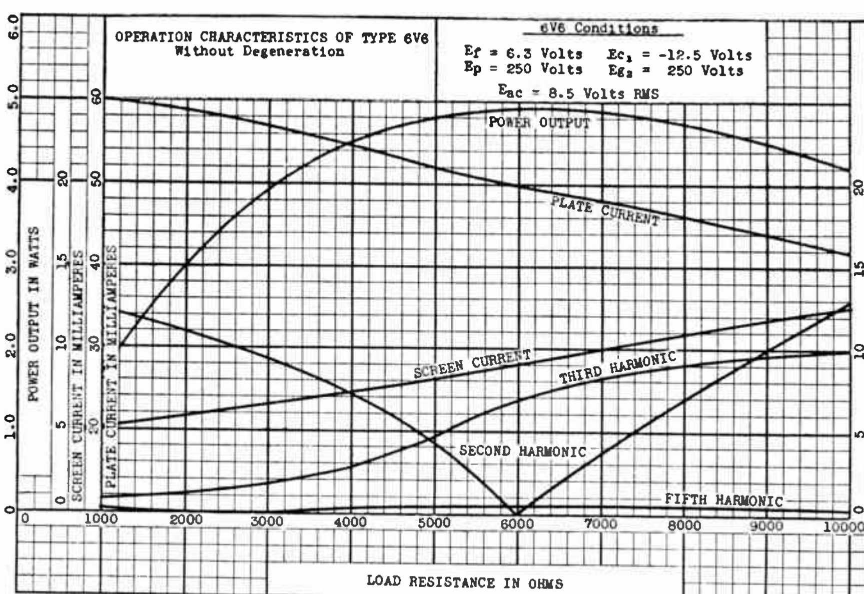


FIGURE 15

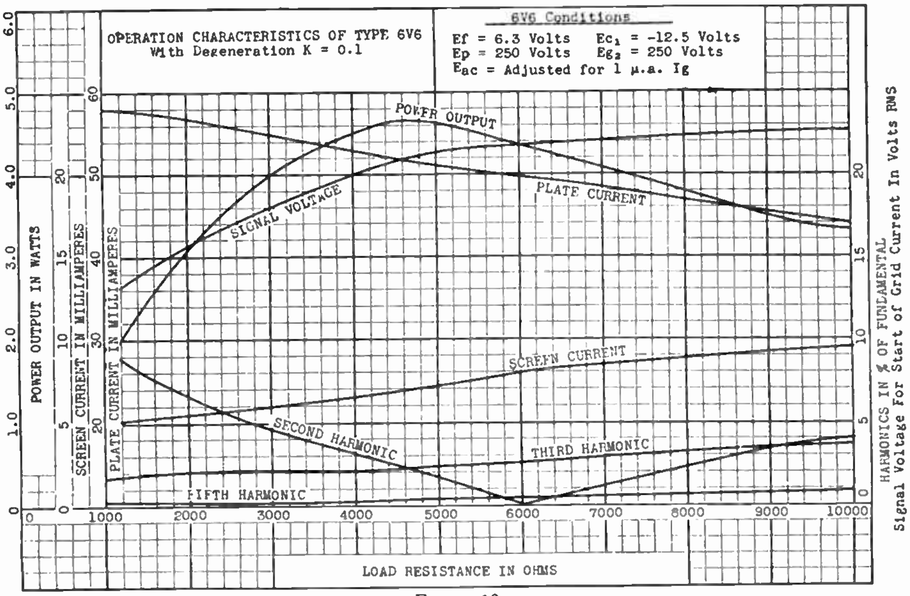
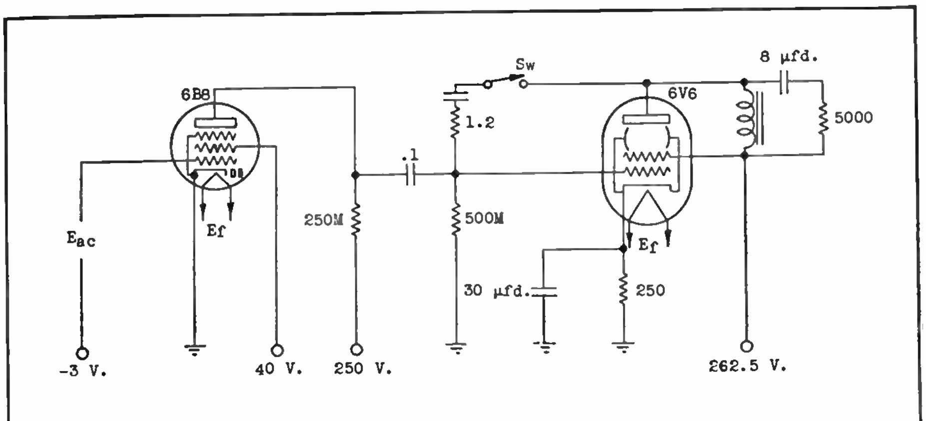
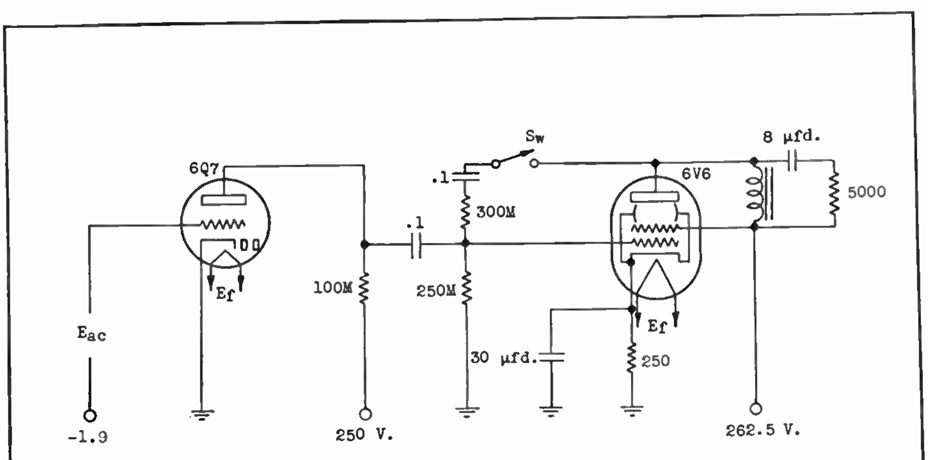


FIGURE 16



	P.O.	E_{ac} RMS	H_2	H_3	H_5	Imp. in Shunt with Pri. of Trans.
No Degeneration K=0	4.25	.11	3.5	4.7	1.2	52,000 Approx.
K = .1	4.25	.35	2.5	1.5	.13	2,000 Approx.

FIGURE 17



	P.O.	E_{ac} RMS	H_2	H_3	H_5	Imp. in Shunt with Pri. of Trans.
No Degeneration K=0	4.25	.190	3.5	3.1	.6	52,000 Approx.
K = .1	4.25	.650	8.0	3.0	.3	2,000 Approx.

FIGURE 18

AMPLIFIER CLASSIFICATIONS

Vacuum tubes are operated under varying conditions of bias, grid drive, and load resistance. These various operating conditions are conveniently classified in the following manner:

CLASS A AMPLIFIER

An amplifier in which the grid bias and the exciting grid voltage are such that the plate current through the tube flows at all times.

The ideal Class A amplifier is one in which the alternating component of the plate current is an exact reproduction of the form of the alternating grid voltage, and the plate current flows during the 360 electrical degrees of the cycle.

The characteristics of a Class A amplifier are low efficiency and output.

CLASS AB AMPLIFIER

An amplifier in which the grid bias and the exciting grid voltage are such that the plate current flows during appreciably more than 180 electrical degrees but less than 360 electrical degrees of the cycle. This has been called Class "A prime."

A Class AB amplifier stage operates under conditions intermediate between Class A and Class B. The grid bias is fixed at a value between that for Class A operation and cut-off and plate current flows in each plate circuit for less than one complete cycle but for more than one half-cycle of the signal voltage. If the normal maximum peak value of the signal voltage does not exceed the grid bias and no grid current flows during any part of the input cycle, the amplifier may be designated as Class AB1. If grid current flows during any portion of the input cycle the amplifier may be designated as Class AB2. The characteristics of power output, plate current, plate efficiency and plate current fluctuations with signal and driving power are intermediate between those of Class A and Class B operation. The idle plate current and attendant dissipation may be made substantially less than is possible with Class A amplifiers.

CLASS B AMPLIFIER

An amplifier in which the grid bias is approximately equal to the cut-off value so that the plate current is approximately zero when no exciting grid voltage is applied, and so that the plate current in each tube flows during approximately one-half of each cycle when an exciting grid voltage is present.

The ideal Class B amplifier is one in which the alternating component of plate current is an exact replica of the alternating grid voltage for the half cycle when the grid is positive with respect to the bias voltage, and the plate current flows during 180 electrical degrees of the cycle.

The characteristics of a Class B amplifier are medium efficiency and output.

CLASS BC AMPLIFIER

An amplifier in which the grid bias and the exciting grid voltage are such that the plate current flows during less than 180 electrical degrees but yet for a considerable part of the cycle.

The characteristics of a Class BC amplifier are efficiency and output intermediate to those of a Class B and a Class C amplifier. Class BC amplifiers are not in general use.

CLASS C AMPLIFIER

An amplifier in which the grid bias is appreciably beyond the cut-off so that the plate current in each tube is zero when no exciting grid voltage is present, and so that the plate current flows in each tube for appreciably less than one-half of each cycle when an exciting grid voltage is present.

Class C amplifiers find application where high plate-circuit efficiency is a paramount requirement and where departures from linearity between input and output are permissible. Class C amplifiers are primarily used for RF applications.

The characteristics of a Class C amplifier are high plate-circuit efficiency and high power output.

Audio Frequency Distribution Systems

THERE are but few phases of radio which have as little written matter available as the problems of audio frequency distribution. By "audio frequency distribution" we mean the factors involved in the installation of multi-speaker systems, the control of audio levels on such speakers and associated lines, the general considerations of impedance matching and the effects of various mismatches on distortion and power transfer. It is the purpose of this article to give a clear understanding not only of these terms and what they signify but also the general method of procedure in solving the various problems with which these factors are associated.

The chief source of audio frequency power is obtained by the use of power amplifier vacuum tubes. Common types of power tubes are triodes, pentodes and beam tubes. Two power tubes connected in push-pull or four tubes connected in a parallel push-pull arrangement are often used where considerable power is required. The plate voltage of a power tube must have, as nearly as possible, the same wave form as the voltage driving its grid, and this must be true over the entire audio frequency spectrum. The wave form requirement is necessary in order that the amplifier may do its part in supplying to the listener, a true reproduction of sounds made in the studio or from a recording, without distortion. Of course, the amplifier alone cannot prevent distortion. Any part of the system is a possible source of distortion and it is, therefore, necessary that every part of the equipment from the studio or recording room through the loud speaker be free of distortion.

A tube supplying power, therefore, has more rigid requirements than a 60 cycle generator and, in addition to this, the tube has a large internal (plate) impedance compared to that of a power generator and is more critical to load impedance. In fact, for any one particular set of conditions a tube can operate for optimum performance into one certain load resistance only. It is possible to get fair results with loads varying from one-half to twice the rated value but best results are obtained if rated loads are used.

The rated, or optimum, load resistance for any tube is determined by the grid, plate and screen voltages, if any, and the tube's construction. All leading tube manufacturers publish recommended conditions of operations for every type of tube which they make, and these should be followed as closely as possible. It is, of course, possible to operate tubes under a large number of conditions with good results but, unless the reader is familiar enough with tube characteristic curves to determine desired operating regions from them or has suitable equipment for measuring harmonic distortion (harmonic analyzer) and power output, the best results will be obtained by using the recommended values.

Best results are obtained if a tube operates into a pure resistance load and all values given in a tube data book assume this condition. This, however, is never completely attained in actual practice as the transformer or choke supplying DC current to the plate of the tube has an impedance which, although it may be very large compared to the total plate load, still contributes a certain reactive load on the tube. This will be discussed further under "Transformers."

In most cases triodes and beam tubes require a relatively low plate load resistance; pentodes require a relatively high plate load. Low power tubes, especially battery-operated tubes, work best with comparatively high plate loads, even up to 20,000 ohms in some cases.

The optimum load resistance is that value which results in maximum output power with only a certain maximum allowable total distortion of approximately five percent for most tubes. If the plate load resistance is other than optimum, either increased distortion or decreased power will result. If the power tube is badly mismatched, it may not be possible to obtain any power without considerable distortion.

LOUD SPEAKERS

The ultimate purpose of all audio frequency equipment is to produce motion in air near the listener which will give him the same sensation as if he were in the studio listening to the program. It is, therefore, necessary to have apparatus which will change this audio frequency power back into the original sound. This sound, originating in the studio, is picked up by a microphone, amplified and perhaps transformed in many ways until it is finally converted to audio frequency power at the receiver. Such a unit, called a loud speaker, may take one of several forms. Speakers which have been commonly used are diaphragm or headphone, magnetic, inductor, dynamic and horn types. The most commonly used speakers at present are of the dynamic or horn types. Many other types have been experimented with but seldom, if ever, used.

The diaphragm type of speaker consists essentially of a thin diaphragm held at right angles to a permanent magnet or electromagnet, as shown in Figure 1.

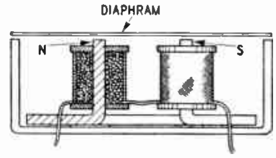


FIGURE 1

This diaphragm vibrates in response to electrical currents flowing through the coils which are wound around the magnet. The vibrations of the diaphragm are comunicated through the air to the listener by wave motion set up in the air. The action which occurs is briefly as follows: The magnetic circuit is completed through the magnetic diaphragm so that any variations in the current through the winding will either attract or repel the diaphragm. If no permanent magnet were present, the diaphragm would vibrate at every impulse or double the frequency of the signal. In other words, it would be attracted whenever the current in the coils is at maximum, which occurs twice during every cycle of the signal. In order to prevent this distortion a permanent magnet or, in some cases, an electromagnet is introduced. The amount of distortion decreases as the magnet is made more powerful.

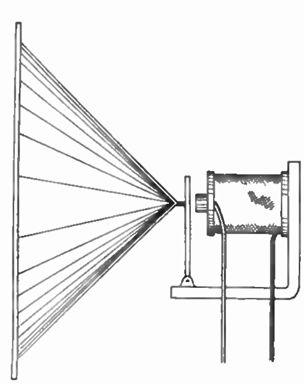


FIGURE 2

The lever type of speaker, shown in Figure 2, consists essentially of a flat reed suspended similarly to a cantilever, one end of which is held a short distance from the pole pieces of the magnet. This reed is connected to a cone type diaphragm. When a signal current flows through the coils, the magnetic field in the air gap between the reed and the pole faces fluctuates correspondingly. Since the attractive force on the reed depends upon the strength of the field and since the strength of the field varies according to the signal in the coils, the reed will vibrate and drive the cone.

The inductor type of loud speaker operates essentially on the same principle as the lever type except that the attractive force of the magnet operates on a section of a piston arrangement which is located in the air gap of the magnet.

The inductor, lever and diaphragm types of speakers in general have impedances of from 72 to 15,000 ohms. When connecting a number of these types of speakers, they should be so arranged that the load they present to the output stage is that recommended by the tube manufacturer. Blocking condensers and a shunt feed choke should be used to keep the DC plate current out of the speaker system. If this is impossible a transformer should be inserted so as to present the proper load to the amplifier. If individual volume control is required at each speaker, instructions for connecting an "L" pad are given in the section on "H," "L," and "T" pads later in this article.

The moving coil dynamic speaker is not by any means a new device since it was first suggested by Sir Oliver Lodge in 1898. Approximately 90% of all receivers manufactured at present use this type of speaker. A sectional view is shown in Figure 3

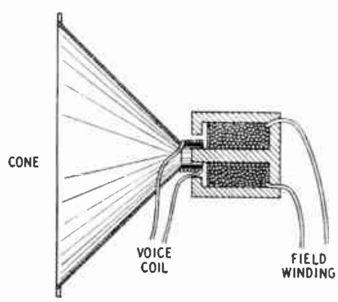


FIGURE 3

A coil of wire is wound on a hollow circular form which in turn is attached to the paper cone. The coil is so placed in the magnetic field in the permanent magnet or electromagnet that the magnetic lines of force pass through it in traversing the air gap from the outer pole to the central pole. When a signal current flows through the coil, the resulting magnetic field causes it to move either in or out, according to the direction of the current flow.

Moving coil speakers are essentially low impedance devices having voice coil impedance in most cases of from 1.5 to 15 ohms.

Commercial horn type speakers consist of a diaphragm at the base of a horn driven by a coil moving in a magnetic field similar to a dynamic speaker. The diaphragm throat and horn of the speaker may be designed to give good frequency response with an efficiency approximately ten times that of the dynamic speaker. They are usually used in theaters and large public address systems where space is available. Horn speaker size makes it unsatisfactory for radio receivers.

The impedance of loud speakers varies with frequency and, therefore, a tube amplifier cannot be matched perfectly to a loud speaker at all audio frequencies by a simple transformer. Since a tube will operate into impedances slightly lower or higher than optimum without serious distortion, and since the commonly used moving coil speakers have less impedance change with frequency than other types, the situation is not as serious as it might be. If a magnetic type of speaker is used or if the best possible performance is desired from a moving coil speaker, an equalizing network connected across the plate of the output tube may be used. The value of this compensating network is determined by the load impedance of the tube and the characteristics of the loud speaker. A method of checking the loud speaker impedance will be explained under "Measurements." The equalizer network should be chosen to keep this impedance constant.

The impedance of a moving coil speaker is usually measured at 400 cycles for matching purposes and at this frequency the load is practically resistive. A rough approximation can be made by measuring the DC resistance of the voice coil with a bridge or ohmmeter and multiplying this value by 1.5.

The impedance of a speaker is a combination of electrical and acoustical components and depends upon the motion of the diaphragm, the way in which the diaphragm vibrates, that is, as a unit or in segments, the cabinet in which the speaker is mounted and other factors. The value of the impedance increases steadily with increasing frequency, and at the low frequency resonance point of the speaker rises sharply in the region of 50 to 150 cycles, depending on the size and construction of the speaker.

The effect of the tube upon the speaker is not nearly so serious as the speaker upon the tube, but it is not entirely negligible. If we consider a speaker driven by one short impulse from power supplied to the voice coil, it is evident there will be a tendency for the cone to move after the driving power has stopped due to the inertia of the cone. This inertia of the cone actually generates energy which is dissipated back through the plate circuit of the tube. Therefore, the lower the impedance of the power amplifier plate, the greater will be the load on the voice coil, and the sooner the vibration of the cone will be damped out. If the cone vibrations are damped out quickly, the speaker output will sound clear and crisp, but if a very high plate impedance allows cone vibrations to die down slowly after the driving force is removed the extraneous sound produced by the speaker will affect the signal which is being supplied to it. This effect is a function of the speaker design as well as the internal plate impedance of the power tube.

TRANSFORMERS

Having decided upon the 400 cycle impedance of the speaker to be driven by a given power tube, it is evident that something must be done to make the few ohms of the speaker look like several thousand (2000 to 20,000 ohms) to the tube. The device which changes audio power from one impedance to another is called a transformer. It consists of a laminated iron core which forms the common path for the magnetic flux. The magnetic flux, in turn, links two windings, one called the primary and the other the secondary.

If we assume an ideal transformer, then the following conditions exist:

$$\frac{E_1}{E_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

where

E_1 = Primary voltage E_2 = Secondary voltage
N_1 = Primary turns N_2 = Secondary turns
I_1 = Primary current I_2 = Secondary current

then it is also true that

$$\frac{R_1}{R_2} = \left(\frac{N_1}{N_2}\right)^2$$

where

R_2 = Resistance load across the secondary
R_1 = Resistance across the primary which has the same effect as load R_2 across the secondary.

The transformer ratio can then be determined when the impedances between it must work, are known. For example, suppose it is required to match a 5 ohm speaker to a tube with a recommended plate load of 7000 ohms. Then

$$\frac{N_1}{N_2} = \sqrt{\frac{R_1}{R_2}} = \sqrt{\frac{7000}{5}} = 37 \text{ turns ratio.}$$

It is also necessary to know the primary reactance of the transformer in order to tell how it will perform in the circuit in which it is to be used. Calculation of the primary reactance is rather difficult since it is a function of the size and characteristic of the iron used, the air gap in the iron (if any), the number of primary turns, and the direct current flowing in the primary (if any). The effect of direct current cancels in the primary of a push-pull output transformer. Primary reactance can best be measured as explained in the section entitled "Measurements." Primary reactance should be approximately three times the matching load resistance for pentode and beam tubes and approximately twice the internal plate resistance for triodes at the lowest frequency to be amplified. A low primary reactance tends to shunt the plate load, thus wasting power and reducing the power output especially at low frequencies. It also increases distortion because the tube is not working into its optimum resistive load.

Not all of the flux in a transformer links both primary and secondary windings. Flux which links only one of the windings is called leakage reactance. There is also a certain capacity between layers of winding and between winding and core. A series of these small capacities forms an effective shunt capacity across both the primary and secondary windings.

The leakage reactance and distributed capacity resonate at some frequency which determines the upper limit of frequency at which the transformer will work efficiently. At higher frequencies than this the response falls off. A method of determining the point at which high frequency amplification is reduced will be explained later.

It is also necessary to know the power handling capacity of a transformer to apply it correctly. This means that the primary and secondary wire size must be large enough to carry the primary and secondary currents without overheating. The currents can be estimated from the power to be transformed and the input and output impedances. If, for instance, 5 volts is to be delivered to a resistor of two ohms which has been substituted for a voice coil of that impedance, a current must flow equal to

$$I = K\sqrt{\frac{W}{R}}$$

where I = Currents in amperes
W = Power in watts
R = Resistor replacing voice coil
K = For ordinary dynamic speaker K = 1.5

or

$$I = \sqrt{\frac{5}{2}} \times 1.5 = 2.4 \text{ amperes for above case.}$$

The primary current can then be determined by multiplying the value found above by the turns ratio. It is general practice to use a wire size which has approximately 500 circular mils per ampere, but it is preferable to use a wire having 1000 circular mils per ampere if possible. The iron in the transformer may be overloaded due to saturation caused by high current and resulting in distortion. The saturation of the iron occurs most readily at low frequencies and may be determined by checking the wave form of the secondary as a variable 60 cycle voltage is applied to the primary. As the voltage is increased, the point at which distortion begins can readily be noted.

The last, but not least, thing to be considered in the choice of a transformer is efficiency. Possibly, the fact that a transformer is generally considered to have high efficiency has led to the use of small output transformers which have efficiencies as low as 50%. In order to have good efficiency the resistance of the primary and secondary windings and the losses in the iron must be small. An approximate estimate of transformer efficiency should be made under the conditions of actual use. First, apply a constant known signal to the grid of the input tube at 400 cycles; second, measure the voltage across the secondary loaded by a resistor equal to .82 x the voice coil impedance; third, calculate the output power from the formula

$$W = \frac{E^2}{R}$$

where

W = Output in watts
E = Voltage across the voice coil
R = Secondary load resistor = .82 × voice coil resistance

and fourth, replace the transformer in the plate of the tube by .82 x voice coil impedance choke of high inductance and low resistance. Two or more chokes may be used in series if necessary but the resistance should be such that the DC voltage measured at the plate of the power tube is the same as it was with the transformer; fifth, connect a resistance in parallel with the choke or chokes having the value recommended by the tube manufacturer for plate load at the particular conditions of operation; sixth, measure the DC voltage across the load resistance with a vacuum tube voltmeter or other high resistance meter; seventh, calculate the power input to the transformer from the same formula as used for the secondary except use the plate load resistance for "R" and the voltage across the resistor for "E." The efficiency may then be easily calculated:

$$\text{Efficiency} = \frac{\text{Output watts}}{\text{Input watts}}$$

Output transformers are usually purchased to work between given loads such as a certain tube and voice coil impedance. After checking a few transformers, it will soon be possible to tell approximately the characteristics of a unit from inspection or a few simple checks.

IMPEDANCE MATCHING IN DISTRIBUTION CIRCUITS

In general, the conditions which determine the value of a load impedance for a vacuum tube circuit are those which make the distortion in the system at a minimum and at the same time transfer as much power to the output circuit as possible. In transmitting this power to a speaker system, however, the distortion is negligible if certain fundamental precautions are taken. The general problem is to secure those conditions which will result in the maximum transfer of power from the input to the output of such a transmission system. In order to better explain the problem let us consider the circuit shown below in Figure 4.

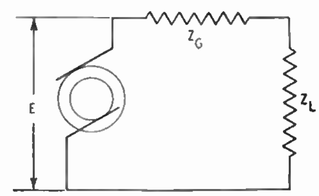


FIGURE 4

In Figure 4, "E" is the open circuit voltage of the input circuit, that is, the voltage under no load conditions, Z_g is the input circuit impedance and Z_L is the impedance of the load. The problem is to find which value of ZL will enable the generator to deliver the greatest amount of power to the external load. If we make Z_L large in comparison with Z_g most of the voltage, E, will be lost across Z_L, but the total impedance of the circuit ($Z_g + Z_L$) will be high. The current which flows through the circuit will, therefore, be small. Inasmuch as the power delivered to the load is a function of the product of the voltage across it and the current through it, the total power dissipated across Z_L will be small. If, on the other hand, we make Z_L very small the current through the entire circuit will be large but most of the voltage will be lost across Z_g, and thus most of the power will be dissipated in the input circuit. Somewhere between these two extreme values of Z_L is a value which will give us the most power dissipation across Z_L. This can be found by assuming a value for Z_g and calculating the power across the load for various values of Z_L. If this is done it will be found that when Z_L is equal to Z_g the maximum possible power is utilized across Z_L. If the phase angle of the load can be adjusted, the condition for maximum power transfer is obtained when the resistance component of the load is equal to the resistance component of the source, and the reactance component of the load is of the same magnitude but of opposite kind to that of the source. An illustration of this case is when a source or generator has a resistance of 10 ohms and a *capacitive* reactance of 20 ohms, then the conditions for maximum energy transfer would occur when the load had a pure resistance of 10 ohms and an *inductive* reactance of 20 ohms. However, it is generally impossible to adjust the reactive components of the load. The next best condition can be shown to prevail when the total impedance of the output or load is equal to the total impedance of the input.

An interesting case which arises quite frequently in practice is where a line can be matched either to a value of impedance lower than the ideal match or to a value higher by the same amount. Such a case might occur if a 500 ohm line were available, but the transformer was designed for either a 400 or 600 ohm match. Which, under these conditions, should be used? In this event the higher of the two should be chosen since the curve for power output versus load impedance drops off less rapidly for values of load impedances higher than the input impedance. This curve is shown in Figure 5.

From the foregoing discussion we gather that, in order to have the maximum power transfer from one circuit to another, definite impedance relationships should exist between the two circuits.

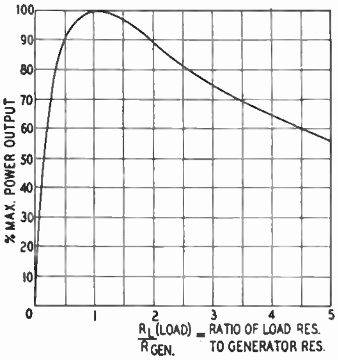


FIGURE 5

A mismatch in impedance may result in several difficulties. There may be a reflection from the end of the line with resulting frequency and phase distortion or it may result in poor economy due to the major portion of the power being expended internally at the source of the signal. An analysis of the operation of a transformer will disclose the fact that, if the impedance of the load is much lower than the value for which the transformer is designed, the response at the high frequency end will be lowered while there may be a slight increase in low frequency response. The major disadvantage, however, is shown by the curve of Figure 5, wherein we see that a lower impedance will result in a considerable decrease in the power delivered to the load.

In the case where a mismatch occurs due to the impedance of the load being higher than that for which the transformer was designed, we have a different effect. The peak at which the secondary winding is resonant will be very high and apt to cause singing or feedback at that frequency. The low frequency loss due to the by-pass effect of the primary inductance will be much greater and consequently that system will be unbalanced and sound "tinny." The power output will also be decreased since the current in the circuit will be limited by the high impedance of the load. The importance of properly matching the output of an amplifier to the speaker network is quite evident.

MULTI-SPEAKER INSTALLATIONS

When several speakers are required at remote points it is generally customary to use a 500 ohm line. A 500 ohm line is selected usually as the best compromise between the inherent disadvantages of high impedance and low impedance lines. If an 8 ohm line is run for a considerable distance, there will be an appreciable loss in the line. If 50 watts are impressed on an 8 ohm line which has a resistance of 6.5 ohms, the current will be 2.5 amperes for peak powers. The power loss in this 8 ohm line would then be over 22 watts. The selection of a 500 ohm line of the same resistance would result in a power loss in the line of only .64 watt. The disadvantage of using low impedance lines to feed remote speakers is, therefore, easily understood. One might ask whether it would be wise under these conditions to use a very high impedance line, say of 10,000 ohms. We would then be confronted with the fact that one conductor at least would have a high impedance above ground and extraneous noises and cross-talk would be induced in this line. In addition, the effects of the small capacity between conductors would be deleterious and result in the by-passing of the higher audio frequencies. The table below gives, approximately, the longest cable lengths which should be used if the power loss in the line is not to exceed 1 D.B.

Ohms	Gauge	Feet
500	18	4000
125	16	1600
36	14	700
16	14	325
8	14	160
4	12	125
2	12	65
1	10	50

These values are calculated only for the actual power distribution of the line. The actual capacity between wires may be too great to enable the transmission of high audio frequencies over more than 2000 feet unless single spaced wires are used. In general, the following rules may be observed for conditions not covered in the above table:

(1) If the length of the cable to be used is only one-half that shown in the table for certain impedances, the gauge of the wire can be three sizes smaller.

(2) If the cable length to be used is to be twice as long as that shown in the table for a given impedance, the gauge of the wire should be three sizes larger.

(3) If the line impedance is one-half of any value shown in the table, the cable length should never be over one-half that listed.

(4) If a smaller wire size than that shown in the table is desired for a given line impedance, the cable length should be halved for every three sizes decrease in the gauge of the wire.

When the audio distribution systems involve the use of lines longer than those given in the above table, then the surge impedance of the line should be calculated and so chosen as to match the impedance of the input source. The surge impedance is calculated by finding the impedance of the line by means of an impedance bridge for the two conditions when the far end of the line is opened and when it is short circuited. When these values have been measured they are multiplied together and the square root of the product is extracted. This is the value of the surge impedance.

METHOD OF COUPLING SEVERAL SPEAKERS TO AN AUDIO DISTRIBUTION LINE

In general, when several speakers must be connected to a single transmission line the following procedure should be followed:

Determine the impedance of each voice coil by multiplying its DC resistance by 1.5, the number of speakers to be attached to the line, and the desired distribution of power at each speaker. If uniform distribution of volume is required, select the transformer ratio for each speaker from the chart that follows. Thus, for three speakers each with different voice coil impedance, select the transformer ratios under each voice coil impedance in the line designated for three speaker outlets. These three transformers are then connected with their primaries in parallel across the 500 ohm line. For half-volume on two duplicate speakers and full volume on a third speaker with the same or different impedance, find the transformer which will feed the two half-volume speakers by selecting the transformer ratio in the column for two-speaker outlets and under a voice coil impedance equal to one-half that of one speaker. This case is treated as if it had only two speaker outlets since the two half-volume speakers are fed from one outlet. The full volume speaker transformer is selected opposite the two outlet column. The two half-volume speaker voice coils are then connected in parallel.

As an illustration, let us suppose that two 8 ohm voice coil speakers are to be worked at half-volume and one 20 ohm speaker at full volume. Then the transformer which feeds the two half-volume speakers is chosen to work into 4 ohms (8 ohms in parallel with 8 ohms) and since we will have two outlets we find the transformation ratio opposite the two speaker outlet and under the 4 ohm impedance, which gives us a value of 16.

For the other, or full volume speaker, we find the transformation ratio opposite the two speaker outlet listing and under 20 ohms, giving us a value of 7. The two half-volume speakers are then connected with their voice coils in parallel across the secondary of the transformer with the 16 to 1 transformation ratio. The full volume speaker is connected across the secondary of the 7 to 1 transformer and both transformer primaries are connected across the 500 ohm line in parallel.

Method of Individual Speaker Volume Control on a Transmission Line

An individual "T" pad, capable of dissipating the same audio power as the speaker is expected to handle, should be connected between the transmission line and the individual speaker's transformers. The following table gives the size "T" pad for each speaker on the various transmission lines.

Total Number of Spkr. Outlets	Desired value of line impedance (Figures in squares = constant resistance of "T" pad in ohms)				
	125	250	500	750	1,000
1	125	250	500	750	1,000
2	250	500	1,000	1,500	2,000
3	375	750	1,500	2,250	3,000
4	500	1,000	2,000	3,000	4,000
5	625	1,250	2,500	3,750	5,000
6	750	1,500	3,000	4,500	6,000
7	875	1,750	3,500	5,250	7,000
8	1,000	2,000	4,000	6,000	8,000
9	1,125	2,250	4,500	6,750	9,000
10	1,250	2,500	5,000	7,500	10,000

Chart for Matching Speaker Voice Coils to Standard Transmission Lines

Assuming a 500-Ohm Line Circuit, Figures in Squares = Correct Transformer Ratio

Total Number of Spkr. Outlets	Voice Coil Impedance in Ohms (1.5 × DC Resistance)														
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20
1	22	16	13	11	10	9	8	8	7	7	7	6	6	5	5
2	33	22	18	16	14	13	12	11	11	10	9	8	8	7	7
3	39	27	22	19	17	16	14	14	13	12	11	10	10	9	9
4	45	33	26	22	20	18	17	16	15	14	13	12	11	11	10
5	50	36	29	25	22	20	19	18	17	16	15	13	13	12	11
6	55	39	33	28	25	22	21	19	18	17	16	15	14	13	12
7	59	42	34	30	27	24	22	21	20	19	17	16	15	14	13
8	64	45	37	33	29	26	24	22	21	20	18	17	16	15	14
9	67	48	39	34	30	28	26	24	22	21	19	18	17	16	15
10	71	50	41	36	33	29	27	25	24	22	20	19	18	17	16

"T," "H," "L" AND MISCELLANEOUS ATTENUATION NETWORKS

As we have seen from the discussion of the previous section, it is necessary to maintain an impedance match between any input circuit and an output circuit, in order to secure the maximum power transfer and also to prevent distortion. Frequently, as in the case where the volume of a loud speaker must be verified, it is necessary to introduce a loss between the input and output. To secure attenuation and at the same time avoid the introduction of distortion, various types of resistance networks are used.

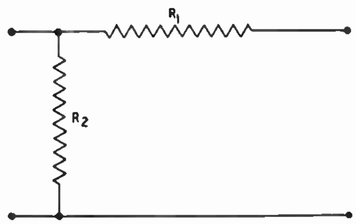


FIGURE 6

The simplest of these is called an "L" pad and is shown in Figure 6. This pad, or attenuator, consists of two resistance units on a common shaft, so arranged that as the resistance of one is increased, the resistance of the second decreases, thus presenting the same value of impedance to the input source for all degrees of attenuation. This "L" pad is used extensively in speaker installations. These "L" pads are fairly inexpensive and are available in various ranges of impedance as listed in the Mallory-Yaxley general parts catalog. Quite frequently a constant impedance must be presented both to the input source and to the output source. In this case, a "T" pad is used. A typical "T" pad circuit is shown in Figure 7.

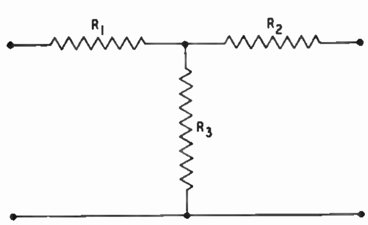


FIGURE 7

As R_1 and R_2 increase, R_3 approaches zero, so that for the condition of maximum attenuation (minimum volume) R_1 is equal to the impedance of the input source while R_3 is equal to zero. When the pad is designed to work between equal impedances, that is, where the impedance of the input circuit is equal to that of the output circuit, R_1 and R_2 are equal at all points in the rotation of the shaft. "T" pads can also be supplied to match unequal impedances, such as a 250-ohm input source to a 100-ohm output load. It must be remembered, however, that in all cases where resistors are used to match unequal impedances, there will be a certain loss in the circuit, depending upon

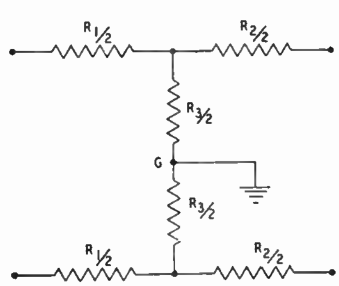


FIGURE 8

the ratio of the inequality of input and output impedances. The minimum loss necessary for various ratios of input and output impedances is given in the table at the right of Figure 10 under the heading of "Minimum Loss Pad."

In special cases where a transmission line must be balanced with respect to ground, the "T" pad is modified to form a balanced "H" pad, shown in Figure 8. The center point, "G" is grounded and in this manner, disturbances induced on each side of the line will be at the same potential to ground and will, therefore, cancel out at the output terminals. A more common use of the "H" pad circuit is shown in Figure 9.

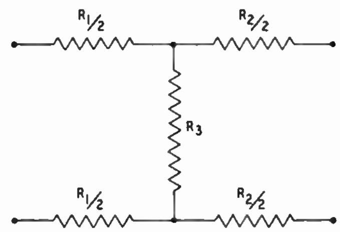


FIGURE 9

This does not have the center point of the shunt resistance connected to ground, but it does, however, introduce the same amount of resistance in both sides of the line.

THE DESIGN OF FIXED PADS

When designing various types of fixed attenuation pads, it is usually desired to accomplish one or more of three purposes: First, in a balanced network (one with equal input and output impedance) to introduce a given loss or attenuation; second, to match, by means of a pad, two networks of unequal impedances in which case the amount of loss is required to be a minimum; third, to match two networks whose impedances are unequal and at the same time introduce an attenuation greater than the minimum loss required to match these circuits. To design various pads from a mathematical angle necessitates considerable familiarity with the subject. The use of the chart, shown in Figure 10, simplifies any of the above problems, so that they can be solved quickly and with sufficient accuracy for all ordinary applications. The procedure in determining any of these networks is outlined at the right of Figure 10. For elucidating the general procedure, a few examples are worked below.

EXAMPLE 1—To introduce an attenuation of 10 db. into a matched network of 200 ohms input impedance and 200 ohms output impedance (Figure 11).

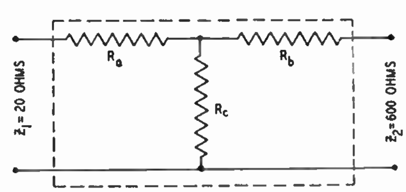


FIGURE 11

a. The value of R_c, the shunt resistance, is found by drawing a line from the point on Scale A equal to the line impedance Z_1 (200 ohms) through the point on Scale C equal to the desired attenuation (10 db.) to Scale F. The reading on Scale F at this point gives the value of the shunt resistance R_c (142 ohms).

b. The value of the series resistance R_a is found by drawing a line from the point on Scale A equal to the line impedance Z_1 (200 ohms) through the point on Scale D equal to the desired attenuation (10 db.). The value where this line crosses Scale F gives the value of the series plus shunt resistance ($R_a + R_c =$ 240 ohms). Subtracting the value of R_a, already found, leaves the value of R_a required (98 ohms).

c. $R_b - R_a$ (98 ohms).

EXAMPLE 2—To match a 20-ohm line to a 600-ohm line and keep the attenuation at a minimum (Figure 12).

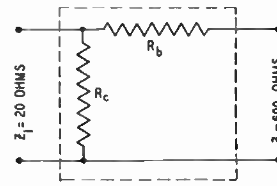


FIGURE 12

a. To find the minimum attenuation to balance the network, draw a line from the point on Scale F equal to the lower line impedance Z_1 (20 ohms) to the point on Scale A equal to the higher line impedance Z_2 (600 ohms). Where this line crosses Scale E, the value of the minimum loss is read (20.7 db.).

b. Find the $\sqrt{Z_1Z_2}$ (the mean value of the two line impedances) by drawing a line from the point on Scale F equal to the lower line impedance Z_1 (20 ohms) through the point on Scale B equal to the higher line impedance Z_2 (600 ohms) to Scale A. The value on Scale A at this point gives the value of $\sqrt{Z_1Z_2} = 110$ ohms.

c. The value of the shunt resistance R_c is found by drawing a line from the point on Scale A equal to $\sqrt{Z_1Z_2}$ (110 ohms) through the point on Scale C equal to the minimum loss (20.7 db.). The reading where this line crosses Scale F gives the value of R_c (20.5 ohms).

d. The value of the series resistance R_d is next found by drawing a line from the point on Scale A equal to the higher line impedance Z_2 (600 ohms) through the point on Scale D equal to the minimum loss (20.7 db.) and continue this line to meet Scale F, the value of the series plus shunt resistance $R_b + R_c$ is equal to 600 ohms. Subtracting the value of the shunt resistance (R_c equal 20 ohms) leaves the value of the series resistance (R_b equal 580 ohms).

EXAMPLE 3—To match two unequal impedances, a 20-ohm line to a 600-ohm line, and introduce at the same time a total loss of 30 db. into the circuit (Figure 13).

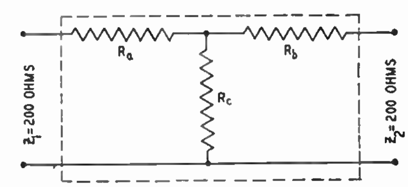


FIGURE 13

a. Find $\sqrt{Z_1Z_2}$ by drawing a line from the point on Scale F equal to the lower line impedance (Z_1 = 20 ohms) through the point on Scale B equal to the higher line impedance (Z_2 = 600 ohms) and extend this line to meet Scale A, giving the desired value of $\sqrt{Z_1Z_2}$ (110 ohms).

b. To find the value of the shunt resistance R_c draw a line from the point on Scale A equal to $\sqrt{Z_1Z_2}$ (110 ohms) through the point on Scale C equal to the desired loss (30 db.) and extend this line to meet Scale F, giving the value of R_c (7 ohms).

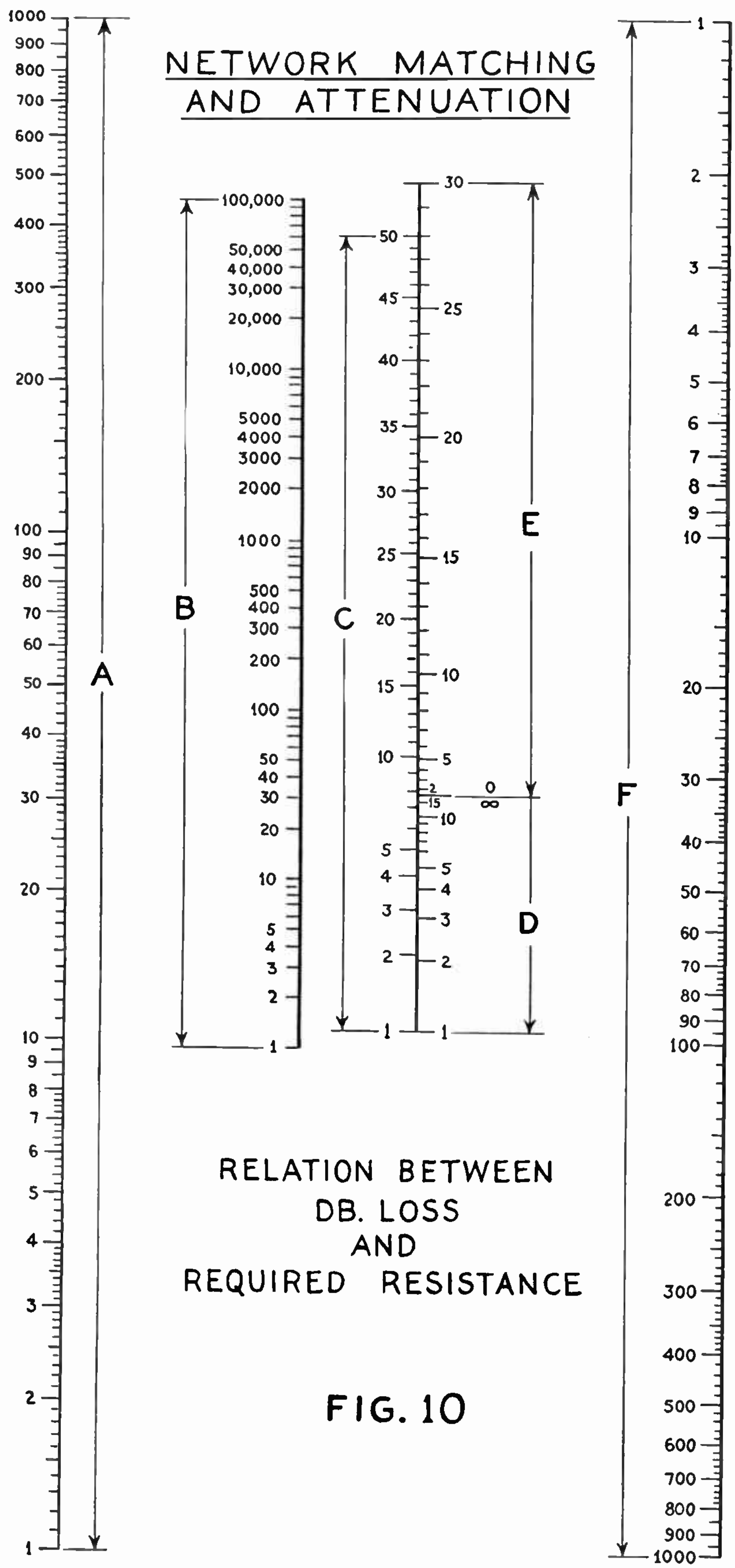
c. To find the value of the series resistance R_b, draw a line from the point on Scale A equal to the line impedance Z_2 (600 ohms) through the point on Scale D equal to the attenuation (30 db.), continuing this line to meet Scale F gives the value of $R_b + R_c$ (600 ohms). Subtracting the value of R_c leaves the value of R_b (593 ohms).

d. To find the value of R_a (the other series resistance) the line impedance Z_1 (20 ohms) is used on Scale A and the value of $R_a + R_c$ is found as in (c) to be 20 ohms. Subtracting R_a from this value leaves R_c = 13 ohms.

In some cases, as mentioned before, a balanced "H" pad is required so as to offer a neutral or ground point for the network, in which case this can be done simply as follows:

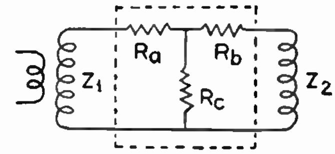
The values are calculated for the "T" pad corresponding to the attenuation and matching impedances involved, after which each series resistor is divided by two and one-half placed in each branch of the circuit. The shunt resistance is center tapped and this middle point is grounded. As an assembly, the "H"

NETWORK MATCHING AND ATTENUATION



RELATION BETWEEN DB. LOSS AND REQUIRED RESISTANCE

FIG. 10



Z_1 and Z_2 are line impedances, R_a and R_b are series and R_c is shunt resistance of pad.

Connect points 1 and 2 with straight edge. Find required value on 3.

ATTENUATING PAD

$Z_1 = Z_2$; $R_a = R_b$

I

1. Z_1 on 'A'
2. DB. loss on 'C'
3. Read R_c on 'F'

II

a—1. Z_1 on 'A'
 2. DB. loss on 'D'
 3. Read $R_a + R_c$ on 'F'

b—Subtract R_c, giving R_a

MINIMUM LOSS PAD

$Z_1 > Z_2$; $R_b = 0$

I

1. Z_1 on 'A'
2. Z_2 on 'F'
3. Read loss (DB.) on 'E'

II

a—1. Z_2 on 'F'
 2. Z_1 on 'B'
 3. Read $\sqrt{Z_1 Z_2 \text{ on 'A'}}$

b—1. $\sqrt{Z_1 Z_2 \text{ on 'A'}}$
 2. DB. loss on 'C'
 3. Read R_c on 'F'

III

a—1. Z_1 on 'A'
 2. DB. loss on 'D'
 3. Read $R_a + R_c$ on 'F'

b—Subtract R_c, giving R_a

MATCHING PAD

I

a—1. Z_1 on 'F'
 2. Z_2 on 'B'
 3. Read $\sqrt{Z_1 Z_2 \text{ on 'A'}}$

b—1. $\sqrt{Z_1 Z_2 \text{ on 'A'}}$
 2. DB. loss on 'C'
 3. Read R_c on 'F'

II

a—1. Z_1 on 'A'
 2. DB. loss on 'D'
 3. Read $R_a + R_c$ on 'F'

b—Subtract R_c, leaving R_a

III

a—1. Z_2 on 'A'
 2. DB. loss on 'D'
 3. Read $R_b + R_c$ on 'F'

b—Subtract R_c, leaving R_b

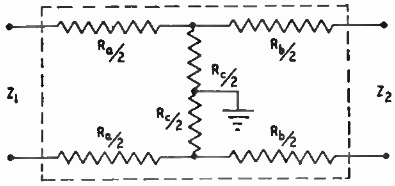


FIGURE 14

pad in Figure 14 is electrically equivalent to the "T" pad of Figure 11. When the line impedances involved are of such magnitude that they fall outside the range of the chart, they may be found by dividing or multiplying the impedances by a multiple of ten and subsequently dividing or multiplying the final results by the same number.

There is a general misconception that the use of a constant impedance attenuator will always yield better results than an ordinary potentiometer circuit. This is not necessarily the case and there are applications where the use of a constant impedance attenuator is not only uneconomical, but needless. For example, when working into the grid of a Class A amplifier tube, the input impedance of the grid circuit is so high that it is impractical to attempt an impedance match. Practical considerations limit the highest impedance of a "T" or an "H" pad that can be manufactured, to a value of approximately 50,000 ohms. If we refer to Figure 15A, we can easily realize the absurdity of the application of a constant impedance pad to this circuit.

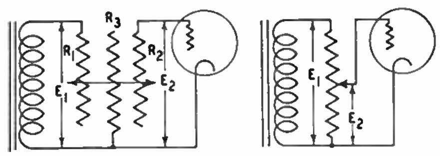


FIGURE 15 (A and B)

Since the grid does not draw current in a practical sense, the voltage at the junction of the "T" pad, E_1, will be equal to E_2. There is no current flowing through the resistor or tube (since when the current is zero, the voltage drop will be zero between any two points of a resistor). Therefore, the circuit degenerates to the equivalent shown in Figure 15B which is an ordinary potentiometer circuit. It is obvious from this discussion that when volume controls are used in the grid circuit of a vacuum tube operated as a Class A amplifier, or in circuits where the output impedance is very high compared with the impedance of the input circuit, a potentiometer circuit should be used.

MEASUREMENT

The turns ratio of a transformer can be measured by connecting approximately 50 volts to the primary and measuring the voltage across the primary and secondary as shown below in Figure 23.

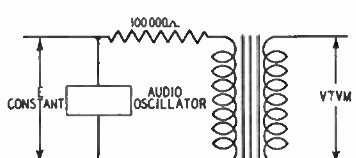


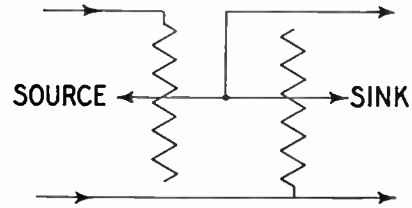
FIGURE 23

The turns ratio is calculated from $\frac{N_p}{N_s} = \frac{E_p}{E_s}$

The impedance of a transformer primary is reduced by the DC plate current flowing through the winding. It is, therefore, necessary to measure the impedance with the DC plate current flowing in the winding to obtain that value which is actually effective in operation. This can be accomplished with the circuit shown in Figure 24. A 60-cycle power supply will probably be most convenient. (Continued on page 302.)

PRACTICAL APPLICATIONS OF "T" AND "L" PADS

The figures which follow show the connections of the "T" and "L" pads and various arrangements in which they are used.



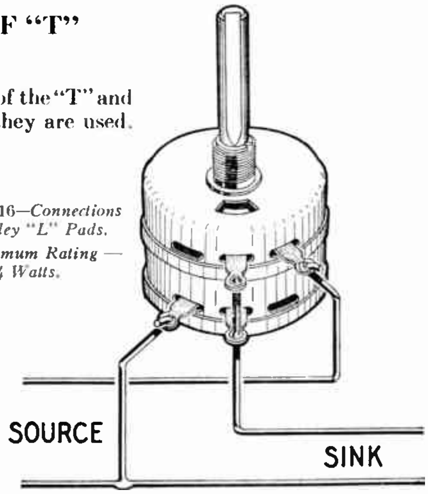
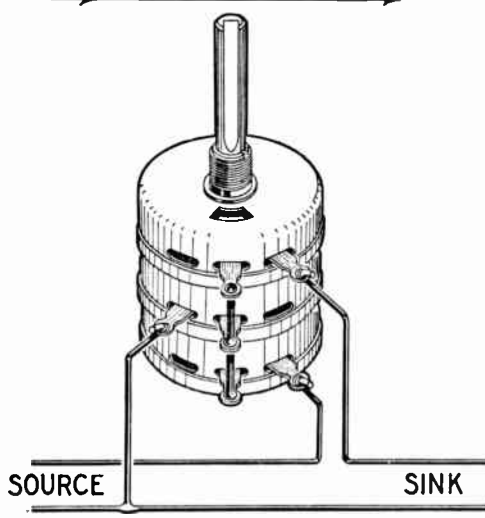


FIGURE 16—*Connections of Yaxley "L" Pads. Maximum Rating — 4 Watts.*



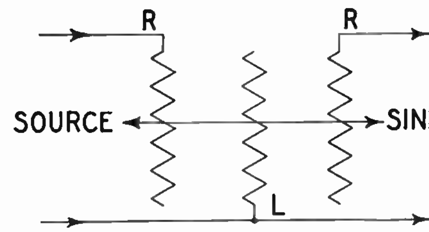


FIGURE 17—*Connections of Yaxley "T" Pads. Maximum Rating—4 Watts.*

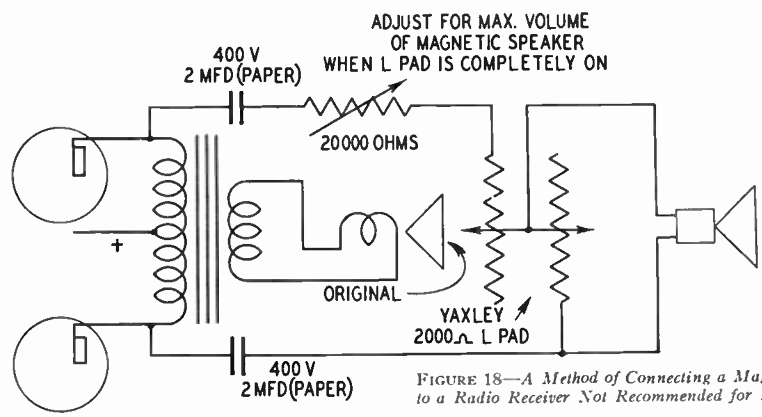


FIGURE 18—*A Method of Connecting a Magnetic Speaker to a Radio Receiver Not Recommended for High Fidelity.*

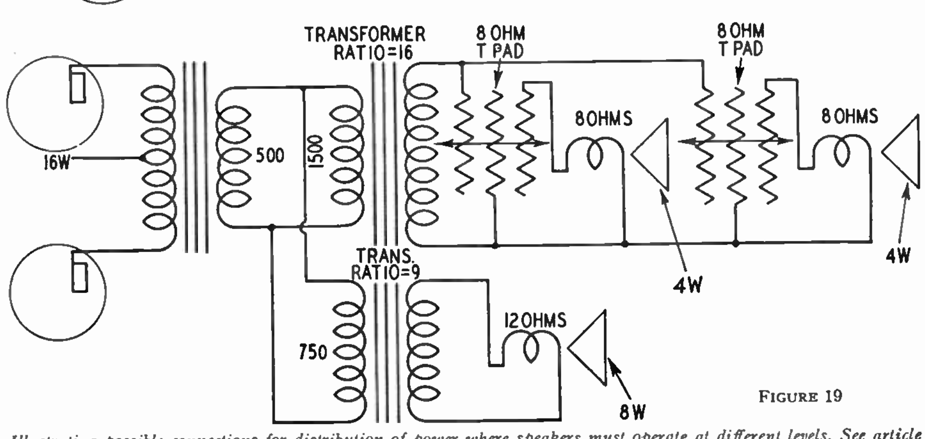


FIGURE 19

Illustrating possible connections for distribution of power where speakers must operate at different levels. See article on "Audio Distribution Systems" and Tables 1 and 2 for proper selection of transformer. The "T" pads should be selected to operate between the secondary impedance of the transformer and the input impedance of the speaker. (Continued on page 302.)

PRACTICAL APPLICATIONS OF "T" and "L" PADS — (*Continued*)

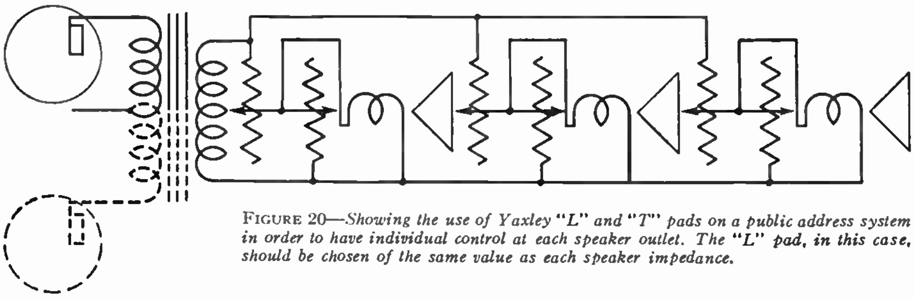


FIGURE 20—*Showing the use of Yaxley "L" and "T" pads on a public address system in order to have individual control at each speaker outlet. The "L" pad, in this case, should be chosen of the same value as each speaker impedance.*

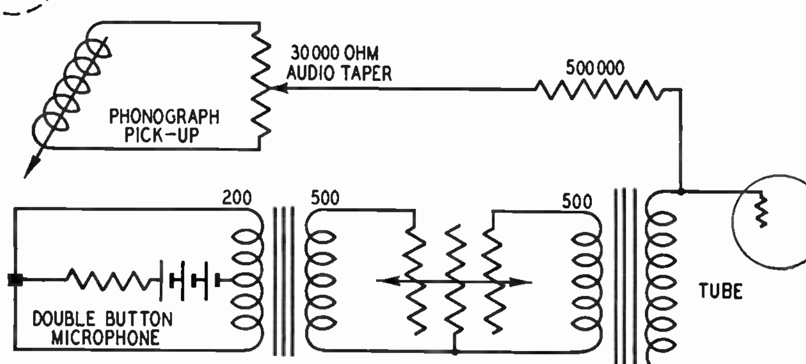


FIGURE 21—*Showing the connection of a microphone and phonograph pickup.*

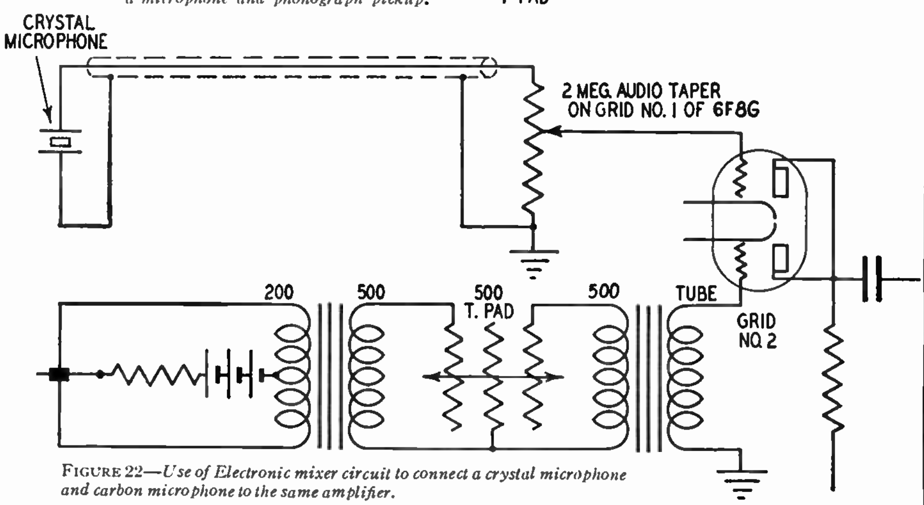


FIGURE 22—*Use of Electronic mixer circuit to connect a crystal microphone and carbon microphone to the same amplifier.*

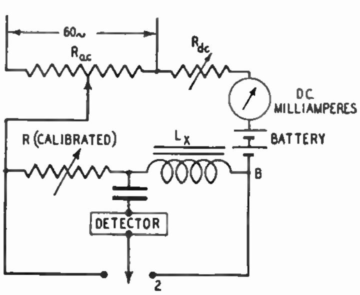


FIGURE 24

The 60-cycle voltage impressed in the measuring circuit is controlled by R_{ac}. The direct current flowing through L_x is supplied by the battery and measured by the DC milliammeter. The meter should be a type which does not respond to alternating current and may be by-passed by a paper or oil condenser if the pointer vibrates. The direct current is changed by varying either R_{dc}, R_{ac}, or R. It will, therefore, be necessary to make several adjustments of each resistance before a measurement can be made at the desired direct current. The indicator is any device which will indicate AC voltage and draw very little current from the circuit to which it is connected. It does not need to be calibrated. It may be a cathode ray oscillograph, an amplifier followed by an indicating device, such as a vacuum tube voltmeter, or a high-resistance AC voltmeter.

The measurement is made as follows:

Adjust R_{ac} to give a suitable supply voltage; 50 to 100 volts may usually be used. Switch indicator to No. 2 and note reading; switch indicator to No. 1 and adjust R to give same reading. Adjust R_{dc} to give desired direct current. It may be necessary to repeat the above adjustments one or two times to obtain the value of R. When the indicator reads the same at No. 1 and No. 2, the value of R is equal to the impedance of L_x. The inductance may be calculated from the impedance and the formula:

$$L = \frac{Z}{6.28f} \text{ henries}$$

where Z = impedance or R as measured above
f = frequency in cycles

or $L = \frac{Z}{377}$ henries if the measurement is made at 60 cycles.

The preceding formulae neglect the resistance which is usually small compared to the reactance.

The impedance of a loud speaker may be measured in the same manner as explained for L_x. Since no direct current flows through the voice coil R_{dc}, the DC milliammeter, and battery may be replaced by a connection from A to B. In order to obtain the impedance of the voice coil under actual operating conditions, this measurement should be made with a voltage equal to the square root of the DC resistance across it. The impedance of a speaker varies with the cabinet or baffle on which it is mounted and the frequency at which it is measured. To obtain a true picture, the speaker should be mounted in the manner which it is to be used and its impedance measured at several frequencies.

The leakage reactance of a transformer may be measured on a 1000-cycle bridge or the above circuit supplied from a 1000-cycle source. Shorting the secondary terminals of the transformer and measuring the impedance across the primary terminals, the value of leakage reactance referred to the primary is obtained.

The resonant frequency of an audio frequency transformer may be determined with the use of a variable audio frequency oscillator and a vacuum tube voltmeter as shown below in Figure 25.

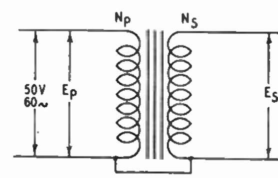


FIGURE 25

Increasing the frequency of the constant audio frequency input voltage will result in a sharp increase of vacuum tube voltmeter reading at some frequency. The frequency at which this peak is noted is the highest frequency at which uniform amplification may be expected.

Decibels—Watts Output Levels

DB.	Watts	DB.	Watts
−20	0.00006	20	0.600
−19	0.00007	21	0.759
−18	0.00009	22	0.948
−17	0.00011	23	1.185
−16	0.00015	24	1.518
−14	0.00023	26	2.371
−13	0.00030	27	3.036
−12	0.00039	28	3.795
−11	0.00047	29	4.743
−10	0.0006	30	6.000
−9	0.00076	31	7.590
−8	0.00095	32	9.487
−7	0.00119	33	11.859
−6	0.00152	34	15.180
−5	0.00190	35	18.975
−4	0.00237	36	23.718
−3	0.00303	37	30.360
−2	0.00397	38	37.950
−1	0.00474	39	47.43
0	0.006	40	60.00
1	0.0076	41	75.90
2	0.0095	42	94.87
3	0.0119	43	118.59
4	0.0153	44	151.8
6	0.0237	46	237.18
7	0.0305	47	303.60
8	0.0380	48	379.50
9	0.0474	49	474.37
10	0.060	50	600.00
11	0.0759	51	759.00
12	0.0948	52	948.75
13	0.1187	53	1185.94
14	0.1518	54	1518.00
15	0.1898	55	1897.50
16	0.2372	56	2371.88
17	0.3037	57	3036.00
18	0.3795	58	3795.00
19	0.4744	59	4743.75
		60	6000.00

Decibel Conversion Tables

IT IS convenient in measurements and calculations on communications systems to express the ratio between any two amounts of electric or acoustic power in units on a logarithmic scale. The *decibel* (1/10th of the *bel*) on the briggsian or base-10 scale and the *neper* on the napierian or base-*e* scale are in almost universal use for this purpose.

Since voltage and current are related to power by impedance, both the *decibel* and the *neper* can be used to express voltage and current ratios, if care is taken to account for the impedances associated with them. In a similar manner the corresponding acoustical quantities can be compared.

Table I and Table II on the following pages have been prepared to facilitate making conversions in either direction between the number of *decibels* and the corresponding power, voltage, and current ratios. Both tables can also be used for *nepers* and the *mile of standard cable* by applying the conversion factors from the table "A" shown at right.

Decibel—The number of decibels N_{db} corresponding to the ratio between two amounts of power P_1 and P_2 is

$$N_{db} = 10 \log_{10} \frac{P_1}{P_2} \qquad (1)$$

When two voltages E_1 and E_2 or two currents I_1 and I_2 operate in the same or equal impedances,

$$N_{db} = 20 \log_{10} \frac{E_1}{E_2} \qquad (2)$$

and

$$N_{db} = 20 \log_{10} \frac{I_1}{I_2} \qquad (3)$$

If E_1 and E_2 or I_1 and I_2 operate in unequal impedances,

$$N_{db} = 20 \log_{10} \frac{E_1}{E_2} + 10 \log_{10} \frac{Z_2}{Z_1} + 10 \log_{10} \frac{k_2}{k_1} \qquad (4)$$

and

$$N_{db} = 20 \log_{10} \frac{I_1}{I_2} + 10 \log_{10} \frac{Z_1}{Z_2} + 10 \log_{10} \frac{k_1}{k_2} \qquad (5)$$

where Z_1 and Z_2 are the absolute magnitudes of the corresponding impedances and k_1 and k_2 are the values of power factor for the impedances. Note that Table I and Table II can be used to evaluate the impedance and power factor terms, since both are similar to the expression for power ratio, equation (1).

Neper—The number of nepers N_{nep} corresponding to a power ratio $\frac{P_1}{P_2}$ is

$$N_{nep} = \frac{1}{2} \log_e \frac{P_1}{P_2} \qquad (6)$$

For voltage ratios $\frac{E_1}{E_2}$ or current ratios $\frac{I_1}{I_2}$ working in the same or equal impedances,

$$N_{nep} = \log_e \frac{E_1}{E_2} \qquad (7)$$

and

$$N_{nep} = \log_e \frac{I_1}{I_2}$$

When E_1 and E_2 or I_1 and I_2 operate in unequal impedances,

$$N_{nep} = \log_e \frac{E_1}{E_2} + \frac{1}{2} \log_e \frac{Z_2}{Z_1} + \frac{1}{2} \log_e \frac{k_2}{k_1} \qquad (8)$$

and

$$N_{nep} = \log_e \frac{I_1}{I_2} + \frac{1}{2} \log_e \frac{Z_1}{Z_2} + \frac{1}{2} \log_e \frac{k_1}{k_2} \qquad (9)$$

where Z_1 and Z_2 and k_1 and k_2 are as in equations (4) and (5).

TABLE "A"—Relations Between Decibels, Nepers, and Miles of Standard Cable

Multiply	*By*	*To Find*
decibels......	.1151	......nepers
decibels......	1.056	miles of standard cable
miles of standard cable	.947	......decibels
miles of standard cable	.109	......nepers
nepers.......	8.686	......decibels
nepers.......	9.175	miles of standard cable

To Find Values Outside the Range of Conversion Tables

Values outside the range of either Table I or Table II on the following pages can be readily found with the help of the following simple rules.

TABLE I: DECIBELS TO VOLTAGE AND POWER RATIOS

Number of decibels positive (+):
Subtract +20 decibels successively from the given number of decibels until the remainder falls within range of Table I. *To find the voltage ratio,* multiply the corresponding value from the right-hand voltage-ratio column by 10 for each time you subtracted 20 db. *To find the power ratio,* multiply the corresponding value from the right-hand power-ratio column by 100 for each time you subtracted 20 db.

Example—*Given:* 49.2 db

49.2 db − 20 db − 20 db = 9.2 db

Voltage ratio: 9.2 db ⟶

2.884 × 10 × 10 = 288.4

Power ratio: 9.2 db ⟶

8.318 × 100 × 100 = 83180

Number of decibels negative (−):
Add +20 decibels successively to the given number of decibels until the sum falls within the range of Table I. *For the voltage ratio,* divide the value from the left-hand voltage-ratio column by 10 for each time you added 20 db. *For the power ratio,* divide the value from the left-hand power-ratio column by 100 for each time you added 20 db.

Example—*Given:* −49.2 db

−49.2 db + 20 db + 20 db = −9.2 db

Voltage ratio: −9.2 db ⟶

.3467 × 1/10 × 1/10 = .003467

Power ratio: −9.2 db ⟶

.1202 × 1/100 × 1/100 = .00001202

TABLE II: VOLTAGE RATIOS TO DECIBELS

For ratios smaller than those in table—Multiply the given ratio by 10 successively until the product can be found in the table. From the number of decibels thus found, subtract +20 decibels for each time you multiplied by 10.

Example—*Given:* Voltage ratio = .0131

.0131 × 10 = .131 × 10 = 1.31

From Table II, 1.31 ⟶

2.345 db − 20 db − 20 db = −37.655 db

For ratios greater than those in table—Divide the given ratio by 10 successively until the remainder can be found in the table. To the number of decibels thus found, add +20 db for each time you divided by 10.

Example—*Given:* Voltage ratio = 712

712 × 1/10 = 71.2 × 1/10 = 7.12

From Table II, 7.12 ⟶

17.050 db + 20 db + 20 db = 57.050 db

TABLE I

***Given:* Decibels** ***To Find:* Power and {Voltage / Current} Ratios**

TO ACCOUNT FOR THE SIGN OF THE DECIBEL

For positive (+) values of the decibel—Both voltage and power ratios are greater than unity. Use the two right-hand columns.

For negative (−) values of the decibel—Both voltage and power ratios are less than unity. Use the two left-hand columns.

Example—*Given:* ± 9.1 db. *Find:*

	Power Ratio	*Voltage Ratio*
+9.1 db.	8.128	2.851
−9.1 db.	0.1230	0.3508

Voltage Ratio (← −db)	*Power Ratio* (← −db)	*db*	*Voltage Ratio* (+db →)	*Power Ratio* (+db →)
1.0000	1.0000	0	1.000	1.000
.9886	.9772	.1	1.012	1.023
.9772	.9550	.2	1.023	1.047
.9661	.9333	.3	1.035	1.072
.9550	.9120	.4	1.047	1.096
.9441	.8913	.5	1.059	1.122
.9333	.8710	.6	1.072	1.148
.9226	.8511	.7	1.084	1.175
.9120	.8318	.8	1.096	1.202
.9016	.8128	.9	1.109	1.230
.8913	.7943	1.0	1.122	1.259
.8810	.7762	1.1	1.135	1.288
.8710	.7586	1.2	1.148	1.318
.8610	.7413	1.3	1.161	1.349
.8511	.7244	1.4	1.175	1.380
.8414	.7079	1.5	1.189	1.413
.8318	.6918	1.6	1.202	1.445
.8222	.6761	1.7	1.216	1.479
.8128	.6607	1.8	1.230	1.514
.8035	.6457	1.9	1.245	1.549
.7943	.6310	2.0	1.259	1.585
.7852	.6166	2.1	1.274	1.622
.7762	.6026	2.2	1.288	1.660
.7674	.5888	2.3	1.303	1.698
.7586	.5754	2.4	1.318	1.738
.7499	.5623	2.5	1.334	1.778
.7413	.5495	2.6	1.349	1.820
.7328	.5370	2.7	1.365	1.862
.7244	.5248	2.8	1.380	1.905
.7161	.5129	2.9	1.396	1.950
.7079	.5012	3.0	1.413	1.995
.6998	.4898	3.1	1.429	2.042
.6918	.4786	3.2	1.445	2.089
.6839	.4677	3.3	1.462	2.138
.6761	.4571	3.4	1.479	2.188
.6683	.4467	3.5	1.496	2.239
.6607	.4365	3.6	1.514	2.291
.6531	.4266	3.7	1.531	2.344
.6457	.4169	3.8	1.549	2.399
.6383	.4074	3.9	1.567	2.455
.6310	.3981	4.0	1.585	2.512
.6237	.3890	4.1	1.603	2.570
.6166	.3802	4.2	1.622	2.630
.6095	.3715	4.3	1.641	2.692
.6026	.3631	4.4	1.660	2.754
.5957	.3548	4.5	1.679	2.818
.5888	.3467	4.6	1.698	2.884
.5821	.3388	4.7	1.718	2.951
.5754	.3311	4.8	1.738	3.020
.5689	.3236	4.9	1.758	3.090
.5623	.3162	5.0	1.778	3.162
.5559	.3090	5.1	1.799	3.236
.5495	.3020	5.2	1.820	3.311
.5433	.2951	5.3	1.841	3.388
.5370	.2884	5.4	1.862	3.467
.5309	.2818	5.5	1.884	3.548
.5248	.2754	5.6	1.905	3.631
.5188	.2692	5.7	1.928	3.715
.5129	.2630	5.8	1.950	3.802
.5070	.2570	5.9	1.972	3.890

Voltage Ratio (← −db)	*Power Ratio* (← −db)	*db*	*Voltage Ratio* (+db →)	*Power Ratio* (+db →)
.5012	.2512	6.0	1.995	3.981
.4955	.2455	6.1	2.018	4.074
.4898	.2399	6.2	2.042	4.169
.4842	.2344	6.3	2.065	4.266
.4786	.2291	6.4	2.089	4.365
.4732	.2239	6.5	2.113	4.467
.4677	.2188	6.6	2.138	4.571
.4624	.2138	6.7	2.163	4.677
.4571	.2089	6.8	2.188	4.786
.4519	.2042	6.9	2.213	4.898
.4467	.1995	7.0	2.239	5.012
.4416	.1950	7.1	2.265	5.129
.4365	.1905	7.2	2.291	5.248
.4315	.1862	7.3	2.317	5.370
.4266	.1820	7.4	2.344	5.495
.4217	.1778	7.5	2.371	5.623
.4169	.1738	7.6	2.399	5.754
.4121	.1698	7.7	2.427	5.888
.4074	.1660	7.8	2.455	6.026
.4027	.1622	7.9	2.483	6.166
.3981	.1585	8.0	2.512	6.310
.3936	.1549	8.1	2.541	6.457
.3890	.1514	8.2	2.570	6.607
.3846	.1479	8.3	2.600	6.761
.3802	.1445	8.4	2.630	6.918
.3758	.1413	8.5	2.661	7.079
.3715	.1380	8.6	2.692	7.244
.3673	.1349	8.7	2.723	7.413
.3631	.1318	8.8	2.754	7.586
.3589	.1288	8.9	2.786	7.762
.3548	.1259	9.0	2.818	7.943
.3508	.1230	9.1	2.851	8.128
.3467	.1202	9.2	2.884	8.318
.3428	.1175	9.3	2.917	8.511
.3388	.1148	9.4	2.951	8.710
.3350	.1122	9.5	2.985	8.913
.3311	.1096	9.6	3.020	9.120
.3273	.1072	9.7	3.055	9.333
.3236	.1047	9.8	3.090	9.550
.3199	.1023	9.9	3.126	9.772
.3162	.1000	10.0	3.162	10.000
.3126	.09772	10.1	3.199	10.23
.3090	.09550	10.2	3.236	10.47
.3055	.09333	10.3	3.273	10.72
.3020	.09120	10.4	3.311	10.96
.2985	.08913	10.5	3.350	11.22
.2951	.08710	10.6	3.388	11.48
.2917	.08511	10.7	3.428	11.75
.2884	.08318	10.8	3.467	12.02
.2851	.08128	10.9	3.508	12.30
.2818	.07943	11.0	3.548	12.59
.2786	.07762	11.1	3.589	12.88
.2754	.07586	11.2	3.631	13.18
.2723	.07413	11.3	3.673	13.49
.2692	.07244	11.4	3.715	13.80
.2661	.07079	11.5	3.758	14.13
.2630	.06918	11.6	3.802	14.45
.2600	.06761	11.7	3.846	14.79
.2570	.06607	11.8	3.890	15.14
.2541	.06457	11.9	3.936	15.49

Voltage Ratio (← −db)	*Power Ratio* (← −db)	*db*	*Voltage Ratio* (+db →)	*Power Ratio* (+db →)
.2512	.06310	12.0	3.981	15.85
.2483	.06166	12.1	4.027	16.22
.2455	.06026	12.2	4.074	16.60
.2427	.05888	12.3	4.121	16.98
.2399	.05754	12.4	4.169	17.38
.2371	.05623	12.5	4.217	17.78
.2344	.05495	12.6	4.266	18.20
.2317	.05370	12.7	4.315	18.62
.2291	.05248	12.8	4.365	19.05
.2265	.05129	12.9	4.416	19.50
.2239	.05012	13.0	4.467	19.95
.2213	.04898	13.1	4.519	20.42
.2188	.04786	13.2	4.571	20.89
.2163	.04677	13.3	4.624	21.38
.2138	.04571	13.4	4.677	21.88
.2113	.04467	13.5	4.732	22.39
.2089	.04365	13.6	4.786	22.91
.2065	.04266	13.7	4.842	23.44
.2042	.04169	13.8	4.898	23.99
.2018	.04074	13.9	4.955	24.55
.1995	.03981	14.0	5.012	25.12
.1972	.03890	14.1	5.070	25.70
.1950	.03802	14.2	5.129	26.30
.1928	.03715	14.3	5.188	26.92
.1905	.03631	14.4	5.248	27.54
.1884	.03548	14.5	5.309	28.18
.1862	.03467	14.6	5.370	28.84
.1841	.03388	14.7	5.433	29.51
.1820	.03311	14.8	5.495	30.20
.1799	.03236	14.9	5.559	30.90
.1778	.03162	15.0	5.623	31.62
.1758	.03090	15.1	5.689	32.36
.1738	.03020	15.2	5.754	33.11
.1718	.02951	15.3	5.821	33.88
.1698	.02884	15.4	5.888	34.67
.1679	.02818	15.5	5.957	35.48
.1660	.02754	15.6	6.026	36.31
.1641	.02692	15.7	6.095	37.15
.1622	.02630	15.8	6.166	38.02
.1603	.02570	15.9	6.237	38.90
.1585	.02512	16.0	6.310	39.81
.1567	.02455	16.1	6.383	40.74
.1549	.02399	16.2	6.457	41.69
.1531	.02344	16.3	6.531	42.66
.1514	.02291	16.4	6.607	43.65
.1496	.02239	16.5	6.683	44.67
.1479	.02188	16.6	6.761	45.71
.1462	.02138	16.7	6.839	46.77
.1445	.02089	16.8	6.918	47.86
.1429	.02042	16.9	6.998	48.98
.1413	.01995	17.0	7.079	50.12
.1396	.01950	17.1	7.161	51.29
.1380	.01905	17.2	7.244	52.48
.1365	.01862	17.3	7.328	53.70
.1349	.01820	17.4	7.413	54.95
.1334	.01778	17.5	7.499	56.23
.1318	.01738	17.6	7.586	57.54
.1303	.01698	17.7	7.674	58.88
.1288	.01660	17.8	7.762	60.26
.1274	.01622	17.9	7.852	61.66

To find decibel values outside the range of this table, see preceding page

TABLE I—continued

← − Voltage Ratio	Power Ratio	db	Voltage Ratio	Power Ratio + →
.1259	.01585	18.0	7.943	63.10
.1245	.01549	18.1	8.035	64.57
.1230	.01514	18.2	8.128	66.07
.1216	.01479	18.3	8.222	67.61
.1202	.01445	18.4	8.318	69.18
.1189	.01413	18.5	8.414	70.79
.1175	.01380	18.6	8.511	72.44
.1161	.01349	18.7	8.610	74.13
.1148	.01318	18.8	8.710	75.86
.1135	.01288	18.9	8.811	77.62

← − Voltage Ratio	Power Ratio	db	Voltage Ratio	Power Ratio + →
.1122	.01259	19.0	8.913	79.43
.1109	.01230	19.1	9.016	81.28
.1096	.01202	19.2	9.120	83.18
.1084	.01175	19.3	9.226	85.11
.1072	.01148	19.4	9.333	87.10
.1059	.01122	19.5	9.441	89.13
.1047	.01096	19.6	9.550	91.20
.1035	.01072	19.7	9.661	93.33
.1023	.01047	19.8	9.772	95.50
.1012	.01023	19.9	9.886	97.72
.1000	.01000	20.0	10.000	100.00

← − Voltage Ratio	Power Ratio	db	Voltage Ratio	Power Ratio + →
3.162×10^{-1}	10^{-1}	10	3.162	10
10^{-1}	10^{-2}	20	10	10^2
3.162×10^{-2}	10^{-3}	30	3.162×10	10^3
10^{-2}	10^{-4}	40	10^2	10^4
3.162×10^{-3}	10^{-5}	50	3.162×10^2	10^5
10^{-3}	10^{-6}	60	10^3	10^6
3.162×10^{-4}	10^{-7}	70	3.162×10^3	10^7
10^{-4}	10^{-8}	80	10^4	10^8
3.162×10^{-5}	10^{-9}	90	3.162×10^4	10^9
10^{-5}	10^{-10}	100	10^5	10^{10}

TABLE II

Given: **{Voltage / Current} Ratio** ***To Find:*** **Decibels**

POWER RATIOS

To find the number of decibels corresponding to a given power ratio—Assume the given power ratio to be a voltage ratio and find the corresponding number of decibels from the table. The desired result is exactly one-half of the number of decibels thus found.

Example—*Given:* a power ratio of 3.41.
Find: 3.41 in the table:

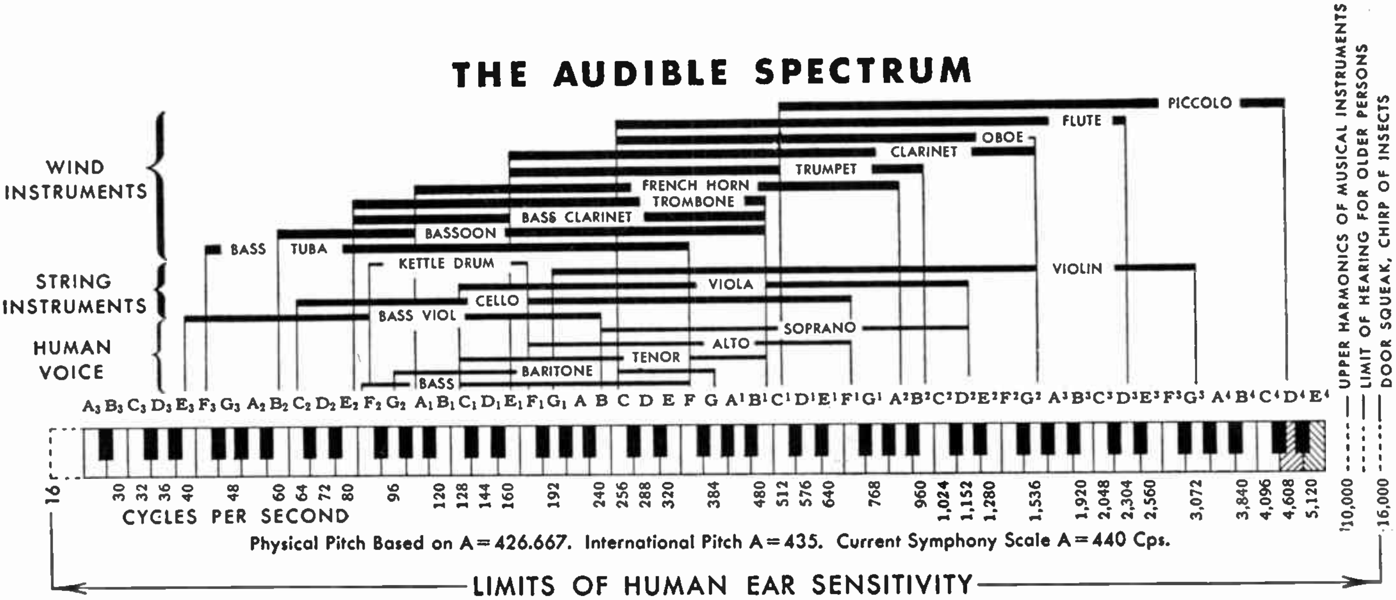
3.41→10.655 db × ½ = 5.328 db

Voltage Ratio	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
1.0	.000	.086	.172	.257	.341	.424	.506	.588	.668	.749
1.1	.828	.906	.984	1.062	1.138	1.214	1.289	1.364	1.438	1.511
1.2	1.584	1.656	1.727	1.798	1.868	1.938	2.007	2.076	2.144	2.212
1.3	2.279	2.345	2.411	2.477	2.542	2.607	2.671	2.734	2.798	2.860
1.4	2.923	2.984	3.046	3.107	3.167	3.227	3.287	3.346	3.405	3.464
1.5	3.522	3.580	3.637	3.694	3.750	3.807	3.862	3.918	3.973	4.028
1.6	4.082	4.137	4.190	4.244	4.297	4.350	4.402	4.454	4.506	4.558
1.7	4.609	4.660	4.711	4.761	4.811	4.861	4.910	4.959	5.008	5.057
1.8	5.105	5.154	5.201	5.249	5.296	5.343	5.390	5.437	5.483	5.529
1.9	5.575	5.621	5.666	5.711	5.756	5.801	5.845	5.889	5.933	5.977
2.0	6.021	6.064	6.107	6.150	6.193	6.235	6.277	6.319	6.361	6.403
2.1	6.444	6.486	6.527	6.568	6.608	6.649	6.689	6.729	6.769	6.809
2.2	6.848	6.888	6.927	6.966	7.008	7.044	7.082	7.121	7.159	7.197
2.3	7.235	7.272	7.310	7.347	7.384	7.421	7.458	7.495	7.532	7.568
2.4	7.604	7.640	7.676	7.712	7.748	7.783	7.819	7.854	7.889	7.924
2.5	7.959	7.993	8.028	8.062	8.097	8.131	8.165	8.189	8.232	8.266
2.6	8.299	8.333	8.366	8.399	8.432	8.465	8.498	8.530	8.563	8.595
2.7	8.627	8.659	8.691	8.723	8.755	8.787	8.818	8.850	8.881	8.912
2.8	8.943	8.974	9.005	9.036	9.066	9.097	9.127	9.158	9.188	9.218
2.9	9.248	9.278	9.308	9.337	9.367	9.396	9.426	9.455	9.484	9.513
3.0	9.542	9.571	9.600	9.629	9.657	9.686	9.714	9.743	9.771	9.799
3.1	9.827	9.855	9.883	9.911	9.939	9.966	9.994	10.021	10.049	10.076
3.2	10.103	10.130	10.157	10.184	10.211	10.238	10.264	10.291	10.317	10.344
3.3	10.370	10.397	10.423	10.449	10.475	10.501	10.527	10.553	10.578	10.604
3.4	10.630	10.655	10.681	10.706	10.731	10.756	10.782	10.807	10.832	10.857
3.5	10.881	10.906	10.931	10.955	10.980	11.005	11.029	11.053	11.078	11.102
3.6	11.126	11.150	11.174	11.198	11.222	11.246	11.270	11.293	11.317	11.341
3.7	11.364	11.387	11.411	11.434	11.457	11.481	11.504	11.527	11.550	11.573
3.8	11.596	11.618	11.641	11.664	11.687	11.709	11.732	11.754	11.777	11.799
3.9	11.821	11.844	11.866	11.888	11.910	11.932	11.954	11.976	11.998	12.019
4.0	12.041	12.063	12.085	12.106	12.128	12.149	12.171	12.192	12.213	12.234
4.1	12.256	12.277	12.298	12.319	12.340	12.361	12.382	12.403	12.424	12.444
4.2	12.465	12.486	12.506	12.527	12.547	12.568	12.588	12.609	12.629	12.649
4.3	12.669	12.690	12.710	12.730	12.750	12.770	12.790	12.810	12.829	12.849
4.4	12.869	12.889	12.908	12.928	12.948	12.967	12.987	13.006	13.026	13.045
4.5	13.064	13.084	13.103	13.122	13.141	13.160	13.179	13.198	13.217	13.236
4.6	13.255	13.274	13.293	13.312	13.330	13.349	13.368	13.386	13.405	13.423
4.7	13.442	13.460	13.479	13.497	13.516	13.334	13.552	13.570	13.589	13.607
4.8	13.625	13.643	13.661	13.679	13.697	13.715	13.733	13.751	13.768	13.786
4.9	13.804	13.822	13.839	13.857	13.875	13.892	13.910	13.927	13.945	13.962
5.0	13.979	13.997	14.014	14.031	14.049	14.066	14.083	14.100	14.117	14.134
5.1	14.151	14.168	14.185	14.202	14.219	14.236	14.253	14.270	14.287	14.303
5.2	14.320	14.337	14.353	14.370	14.387	14.403	14.420	14.436	14.453	14.469
5.3	14.486	14.502	14.518	14.535	14.551	14.567	14.583	14.599	14.616	14.632
5.4	14.648	14.664	14.680	14.696	14.712	14.728	14.744	14.760	14.776	14.791
5.5	14.807	14.823	14.839	14.855	14.870	14.886	14.902	14.917	14.933	14.948
5.6	14.964	14.979	14.995	15.010	15.026	15.041	15.056	15.072	15.087	15.102
5.7	15.117	15.133	15.148	15.163	15.178	15.193	15.208	15.224	15.239	15.254
5.8	15.269	15.284	15.298	15.313	15.328	15.343	15.358	15.373	15.388	15.402
5.9	15.417	15.432	15.446	15.461	15.476	15.490	15.505	15.519	15.534	15.549

Voltage Ratio	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
6.0	15.563	15.577	15.592	15.606	15.621	15.635	15.649	15.664	15.678	15.692
6.1	15.707	15.721	15.735	15.749	15.763	15.778	15.792	15.806	15.820	15.834
6.2	15.848	15.862	15.876	15.890	15.904	15.918	15.931	15.945	15.959	15.973
6.3	15.987	16.001	16.014	16.028	16.042	16.055	16.069	16.083	16.096	16.110
6.4	16.124	16.137	16.151	16.164	16.178	16.191	16.205	16.218	16.232	16.245
6.5	16.258	16.272	16.285	16.298	16.312	16.325	16.388	16.351	16.365	16.378
6.6	16.391	16.404	16.417	16.430	16.443	16.456	16.469	16.483	16.496	16.509
6.7	16.521	16.534	16.547	16.560	16.573	16.586	16.599	16.612	16.625	16.637
6.8	16.650	16.663	16.676	16.688	16.701	16.711	16.726	16.739	16.752	16.764
6.9	16.777	16.790	16.802	16.815	16.827	16.840	16.852	16.865	16.877	16.890
7.0	16.902	16.914	16.927	16.939	16.951	16.964	16.976	16.988	17.001	17.013
7.1	17.025	17.037	17.050	17.062	17.074	17.086	17.098	17.110	17.122	17.135
7.2	17.147	17.159	17.171	17.183	17.195	17.207	17.219	17.231	17.243	17.255
7.3	17.266	17.278	17.290	17.302	17.314	17.326	17.338	17.349	17.361	17.373
7.4	17.385	17.396	17.408	17.420	17.431	17.443	17.455	17.466	17.478	17.490
7.5	17.501	17.513	17.524	17.536	17.547	17.559	17.570	17.582	17.593	17.605
7.6	17.616	17.628	17.639	17.650	17.662	17.673	17.685	17.696	17.707	17.719
7.7	17.730	17.741	17.752	17.764	17.775	17.786	17.797	17.808	17.820	17.831
7.8	17.842	17.853	17.864	17.875	17.886	17.897	17.908	17.919	17.931	17.942
7.9	17.953	17.964	17.975	17.985	17.996	18.007	18.018	18.029	18.040	18.051
8.0	18.062	18.073	18.083	18.094	18.105	18.116	18.127	18.137	18.148	18.159
8.1	18.170	18.180	18.191	18.202	18.212	28.223	18.234	18.244	18.255	18.266
8.2	18.276	18.287	18.297	18.308	18.319	18.329	18.340	18.350	18.361	18.371
8.3	18.382	18.392	18.402	18.413	18.423	18.434	18.444	18.455	18.465	18.475
8.4	18.486	18.496	18.506	18.517	18.527	18.537	18.547	18.558	18.568	18.578
8.5	18.588	18.599	18.609	18.619	18.629	18.639	18.649	18.660	18.670	18.680
8.6	18.690	18.700	18.710	18.720	18.730	18.740	18.750	18.760	18.770	18.780
8.7	18.790	18.800	18.810	18.820	18.830	18.840	18.850	18.860	18.870	18.880
8.8	18.890	18.900	18.909	18.919	18.929	18.939	18.949	18.958	18.868	18.978
8.9	18.988	18.998	19.007	19.017	19.027	19.036	19.046	19.056	19.066	19.075
9.0	19.085	19.094	19.104	19.114	19.123	19.133	19.143	19.152	19.162	19.171
9.1	19.181	19.190	19.200	19.209	19.219	19.228	19.238	19.247	19.257	19.266
9.2	19.276	19.285	19.295	19.304	19.313	19.323	19.332	19.342	19.351	19.360
9.3	19.370	19.379	19.388	19.398	19.407	19.416	19.426	19.435	19.444	19.453
9.4	19.463	19.472	19.481	19.490	19.499	19.509	19.518	19.527	19.536	19.545
9.5	19.554	19.564	19.573	19.582	19.591	19.600	19.609	19.618	19.627	19.636
9.6	19.645	19.654	19.664	19.673	19.682	19.691	19.700	19.709	19.718	19.726
9.7	19.735	19.744	19.753	19.762	19.771	19.780	19.789	19.798	19.807	19.816
9.8	19.825	19.833	19.842	19.851	19.860	19.869	19.878	19.886	19.895	19.904
9.9	19.913	19.921	19.930	19.939	19.948	19.956	19.965	19.974	19.983	19.991

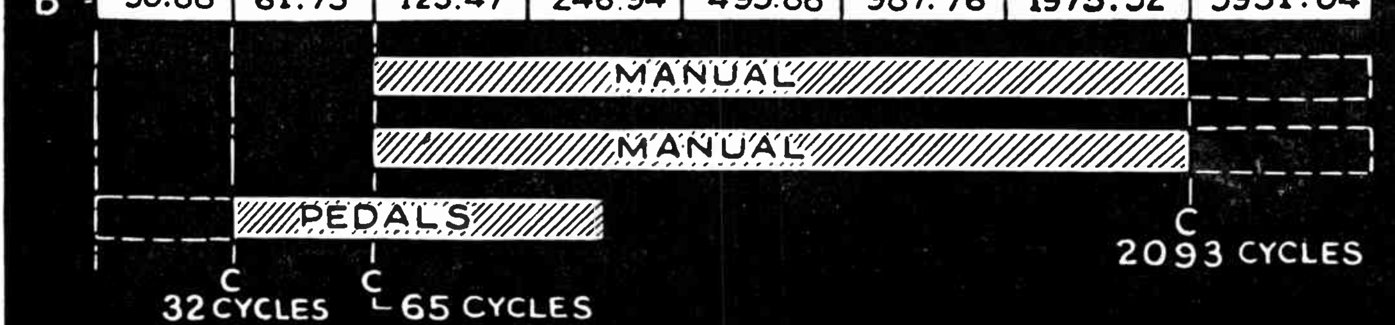
Voltage Ratio	0	1	2	3	4	5	6	7	8	9
10	20.000	20.828	21.584	22.279	22.923	23.522	24.082	24.609	25.105	25.575
20	26.021	26.444	26.848	27.235	27.604	27.959	28.299	28.627	28.943	29.248
30	29.542	29.827	30.103	30.370	30.630	30.881	31.126	31.364	31.596	31.821
40	32.041	32.256	32.465	32.669	32.869	33.064	33.255	33.442	33.625	33.804
50	33.979	34.151	34.320	34.486	34.648	34.807	34.964	35.117	35.269	35.417
60	35.563	35.707	35.848	35.987	36.124	36.258	36.391	36.521	36.650	36.777
70	36.902	37.025	37.147	37.266	37.385	37.501	37.616	37.730	37.842	37.953
80	38.062	38.170	38.276	28.382	38.486	38.588	38.690	38.790	38.890	38.988
90	39.085	39.181	39.276	39.370	39.463	39.554	39.645	39.735	39.825	39.913
100	40.000	—	—	—	—	—	—	—	—	—

To find ratios outside the range of this table, see page 303.



A Correct Table of Musical Frequencies, Pitch A=440

	0	1	2	3	4	5	6	7
C =	16.35	32.70	65.40	130.81	261.62	523.26	1046.52	2093.04
C#=	17.32	34.64	69.29	138.59	277.18	554.36	1108.72	2217.44
D =	18.35	36.70	73.41	146 83	293.67	587.34	1174.68	2349.36
D#=	19 44	38.89	77.78	155.56	311. 13	622.26	1244.52	2489.04
E =	20.60	41.20	82.41	164.82	329.63	659.26	1318.52	2637.02
F =	21.82	43.65	87.30	174.61	349.23	698.46	1396.92	2793.82
F#=	23.12	46.24	92,49	184 99	369.99	739.98	1479.96	2959.95
G =	24.49	48.99	97.99	195.99	391 99	783.98	1567.96	3135.96
G#=	25 95	51.91	103.82	207.65	415.31	830.62	1661.24	3322.48
A =	27.50	55.00	110.00	220.00	440.00	880.00	1760.00	3520.00
A#=	29.13	58.27	116.54	233.08	466.17	932.34	1864.68	3729.36
B =	30.86	61.73	123.47	246.94	493.88	987.76	1975.52	3951.04



Rectifiers

EXPRESSED in the simplest language a rectifier is a device for changing an alternating current of electricity to direct current. The utility of rectifiers will be appreciated when it is realized that a large number of our most useful devices will operate only on direct current, while the common source of electric power is alternating current, used by the power and light companies because of its low transmission losses.

With this wide range of application there are naturally many types of rectifiers. High vacuum thermionic rectifiers are used in every alternating current operated radio receiver to provide direct current for the plate circuits of the amplifying tubes. The voltages of such direct current supply systems range from one hundred to several hundred volts, and the currents are conveniently measured in milliamperes. However, there are many applications for rectifiers where the currents range from one-half to hundreds of amperes and the potentials are in the order of a few volts. In this classification are power supplies for battery charging, filament heating, electroplating, the operation of railroad signal devices, relays, motion picture arc lights, talking picture exciter lamps, electric time clocks—thousands of commercial and industrial devices that contribute to the comfort, efficiency, and pleasure of modern life.

This article will treat the low voltage, medium and high current rectifiers described in the preceding paragraph.

DIFFERENT FORMS OF RECTIFIERS

1. Motor generator sets
2. Mechanical and vibrating reed rectifiers.
3. Thermionic rectifiers:
   (a) High vacuum
   (b) Mercury arc
   (c) Tungsten—argon
4. Electrolytic rectifiers
   (a) Aluminum-lead-ammonium carbonate
   (b) Tantalum-lead-sulphuric acid.
5. Dry plate metal rectifiers
   (a) Copper-cuprous oxide
   (b) Magnesium-cupric sulphide
   (c) Selenium-iron-tin

Of these various types, the dry plate metal variety is the most widely used and is rapidly replacing other types now in service. Principal reasons for this are:

1. High efficiency
2. Low initial cost
3. Low maintenance cost
4. Dependability and long life
5. Smaller space required
6. No liquids to spill, no bulbs to break, no moving parts to get out of order.

Dry plate metal rectifiers are made in many different forms, shapes and types. This discussion will be limited to the magnesium-cupric sulphide variety.

MAGNESIUM-CUPRIC-SULPHIDE RECTIFIERS

In 1924 Samuel Ruben discovered that when a properly treated magnesium-disc was brought together into proper contact with a disc of copper sulphide, and a current passed between the two discs so that a reaction took place at the boundaries in contact, an asymmetrical conducting, or unidirectional film was formed. This film had the property of offering a low resistance to a current flowing in one direction and a high resistance to a current flowing in the other direction. Since 1924 considerable time and effort has been spent on the further development of the rectifying couple. Many basic patents have been issued to Mr. Ruben and the P. R. Mallory & Co., Inc., licensee under the Ruben patents.

In the short space of 14 years, the copper sulphide rectifier has emerged from a laboratory development to a commercial rectifier which today is being applied to electroplating, arc welding, motion picture projector arc power supplies, railway car and industrial truck battery charging, as well as to a number of smaller applications which include: automobile storage battery chargers, coin machine power supplies, automobile radio demonstrators, model and toy railroad power supplies and control, along with a number of other applications which are too lengthy to list. Copper sulphide rectifiers are adaptable to most any application requiring low voltage at medium or high current.

Copper sulphide rectifiers are made in heavy-duty types for single and polyphase service, both convectional and forced cooling.

LOW COST

Copper sulphide rectifiers are noted for their ability to rectify heavy currents. This characteristic results in a lower equipment cost per watt of rectified power.

OPERATING LIFE AND TEMPERATURES

The operating life of any dry disc rectifier is directly related to the temperature at which the rectifier is normally operated. **Copper sulphide rectifiers are distinguished by their ability to operate continuously at a relatively high temperature without destroying those characteristics essential to long operating life.**

Extensive tests conducted over a period of ten years indicate that, when properly applied, the life of the rectifier is practically unlimited.

For maximum life the rectifier should be operated at a temperature not greater than 85°C (185°F).

For applications where the longest possible operating life is not a requisite, a safe operating temperature of 130°C (265°F) is permissible. Many rectifier installations, operating continuously at this temperature, have been in operation for periods in excess of 10,000 hours. Copper sulphide rectifiers have been operated at overload currents creating temperatures as high as 350°C (660°F) for brief intervals without failure. Although not practical nor recommended, this fact proves that copper sulphide rectifiers may be overloaded many times without failure should abnormal conditions or emergencies arise. This is an outstanding characteristic of copper sulphide rectifiers.

AMBIENT TEMPERATURES

Another outstanding feature of copper sulphide rectifiers is the fact that they may be operated continuously at ambient temperatures as low as 40° below zero (Centigrade and Fahrenheit), and at ambient temperatures higher than will ever be normally encountered, with little or no change in their output or efficiency.

The DC ampere ratings listed in Tables B and C on pages 309 and 310 are the maximum ratings recommended for continuous operation under conditions of average ambient temperatures, not in excess of 40°C (104°F), with the surfaces of the radiator plates in **vertical** planes and with the flow of air through the rectifier being entirely free and unobstructed by other objects.

Information on operating rectifiers under conditions of restricted ventilation will be given on request.

HUMIDITY

The rectifier assemblies are sealed by a special compound, which thoroughly protects the rectifier against external conditions, high humidity, acid and alkali fumes. This special compound is applied in several heavy coats to insure thorough protection. It is baked at a temperature much higher than that at which the rectifier is rated to operate.

COMPACTNESS

The ability of copper sulphide rectifiers to be operated safely at high temperatures makes it possible to build a compact unit per watt of DC output. (See Dimensions in Tables B and C, pages 309 and 310.) This is a desirable feature because space is limited in most applications.

VOLTAGE OVERLOAD AND SELF-HEALING

If an abnormal AC voltage surge were applied to the rectifier, such as might be caused by lightning striking a power line, the rectifying film may break down for an instant but will re-form almost immediately because of the self-healing characteristics of the rectifying junction.

REGULATION

Copper sulphide rectifiers have a low internal resistance in the conducting direction. In fact, for the same unit area, the internal resistance of the rectifier is considerably lower than any other dry plate metal rectifier. This characteristic results in excellent regulation of the rectifier output voltage over a wide range of load conditions. With the correct type of transformer (secondary voltage regulation 15% or less), it makes possible automatic tapering or modified constant potential battery charging.

SEASONING

Any rectifier will tend to "age" or "season" and change in internal resistance. **Unlike other types of dry disc rectifiers, which experience an appreciable change in characteristics as a result of ageing, the output of copper sulphide rectifiers decreases only 10% on the average. All of this change takes place within a few hundred hours of the initial installation of the rectifier.** In an application where even this minor change is a factor, voltage compensating provisions can be made in the design of the transformer or in other equipment associated with the rectifier. In practically every instance, ageing adjustments have been unnecessary when using copper sulphide rectifiers.

Throughout their life, and also over wide ranges of load and of ambient and operating temperatures, the efficiency of copper sulphide rectifiers remains practically constant. This superior characteristic is of considerable importance in those applications where a material decrease in efficiency, either during life or at light loads or at low temperatures, is undesirable.

MALLORY REPLACEMENT AND ORIGINAL EQUIPMENT RECTIFIERS

Mallory "Replacement" and "Standard" rectifiers are constructed from similar parts. Mallory "Replacement" rectifiers are carried by most Mallory-Yaxley Radio Parts Distributors. Mallory "Standard" rectifiers are assembled to order from standard stock components, shipment being made within a few days after the receipt of the order.

TYPE CODE

Every Mallory Rectifier has a type number constituting a code. This code explanation follows:

I. When insulated stud or bolt mounting is desired (insulated foot mountings are not standard, although supplied on certain replacement rectifiers) the letter "I" should prefix the entire Type Number explained as follows. **This prefix should not be used if grounded stud or bolt is satisfactory.**

II. First letter to be added in front of the type numbers listed in Tables B and C on pages 309 and 310, represents the style of mounting.

(1) "S"—Stud Mounting. Available on all sizes of rectifiers.

(2) "B"—Bolt Mounting. Available on all Series B rectifiers from 4 to 12 junctions inclusive, and 4 to 24 junctions inclusive on Series C rectifiers. Not available on rectifiers using No. 11 radiator plates.

(3) "F"—Foot Mounting. Available on all rectifiers using No. 1, No. 3, and No. 7 radiator plates. Not available on rectifiers using No. 9 and No. 11 radiator plates.

When the style of mounting is not specified, rectifiers will be supplied with foot mounting where No. 1, No. 3, and No. 7 radiator plates are used, and stud mounting where No. 9 and No. 11 radiator plates are used.

III. A number in some multiple of 4 up to 36 represents the total number of junctions in any one rectifier. Mallory Standard Rectifiers are not made with more than 36 junctions.

IV. Series designation:
"B"—One rectifying junction per radiator plate (characteristics listed in Table B).
"C"—Two rectifying junctions per radiator plate (characteristics listed in Table C).
"G"—No radiator plates used in these rectifiers (for replacement use only).
"H"—No radiator plates used in these rectifiers (for replacement use only).
"L"—No radiator plates used in these rectifiers (for replacement use only).
When more than two series designations are included in the type number, this means a special mechanical arrangement, in which certain sections of the rectifier are constructed in accordance with one of the series designations and other sections of the rectifier constructed in accordance with the other series designation.

V. The last digit, or digits, designates the size of the radiator and terminal plates as follows:

No. 1	1¼" Square
No. 3	1¾" Square
No. 7	2½" Square
No. 9	3½" Square
No. 11	5" Square

See dimensions in Tables B and C for length of terminal tabs.

VI. When no suffix is used, it designates a single-phase, full-wave bridge rectifier.
"B" indicates that the rectifier is mounted on a Bakelite base.
"M" represents a rectifier with certain mechanical variations from standard construction. All variations cannot be listed in this discussion. Rectifiers with "M" prefixed are for replacement use only and can only be described by detailed drawings.
"P" indicates that the rectifier is so stacked that the center terminal is plus and the end terminals, or mounting feet, are minus. In other words: reverse polarity. Standard polarity rectifiers may be used to replace reverse polarity rectifiers, of course, by alternating the DC wires to the rectifier and for this reason, reverse polarity rectifiers are not listed.
"Y" indicates a half-wave, single-phase rectifier assembly.

CONNECTIONS

Figure 1 shows the correct connections for a standard Mallory rectifier used in a full-wave bridge circuit. The center lug or terminal of the rectifier is the negative (−) DC output connection. The two adjacent AC terminals connect to the secondary winding of the power transformer. Except in the insulated types the mounting foot, bolt, or stud provides the positive (+) DC output connection. On insulated types the positive (+) DC connection is made to the two end terminal lugs.

When replacing rectifiers of other manufacture with Mallory rectifiers, care should be taken that the DC wires are properly connected. Be sure to check the polarity of the old rectifier and tag the DC connecting wires (+) and (−). If the polarity of the original rectifier differs from that of the Mallory replacement, correction for polarity can be made by simply reversing the DC wires, and connecting as described in the preceding paragraph.

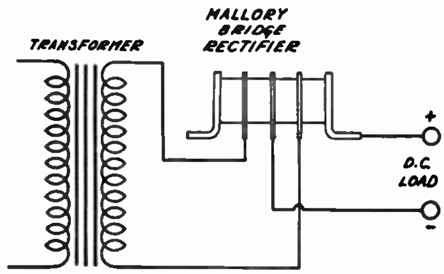


FIGURE 1

RECTIFIER ENGINEERING SERVICE

P. R. Mallory and Company is eager to co-operate with all users and prospective users of rectifiers. Ask for the special "Rectifier Catalog and Technical Bulletin" Form R-610; and the "Rectifier Application Questionnaire," supplied for convenience in describing proposed operating conditions. The Mallory Rectifier Engineering department will be glad to make specific recommendations for any installation on receipt of the necessary information as to operating conditions and requirements.

TABLES "B" AND "C"

Ratings shown are based on maximum AC voltage conditions which may be encountered. When used on commercial power lines with normal line voltage variations, ratings shown should be used with transformers designed to supply the recommended voltages at the highest line voltage. Past experience indicates that power lines rated at 110-115 volts will frequently deliver as high as 130 volts.

A resistive load is any load which does not contain a battery, appreciable inductance, or capacity.

Where a filter is used between rectifier and load, reference should be made to the explanation and description of the various types of loads described in booklet R-610 on Mallory Standard Rectifiers. A loud speaker field or relay system operated without a shunt capacitor should be considered as an inductive load. Information on capacitor shunted loads should be obtained from our Rectifier Engineering Department.

MALLORY STANDARD RECTIFIER DIMENSIONS
SEE TABLES B and C

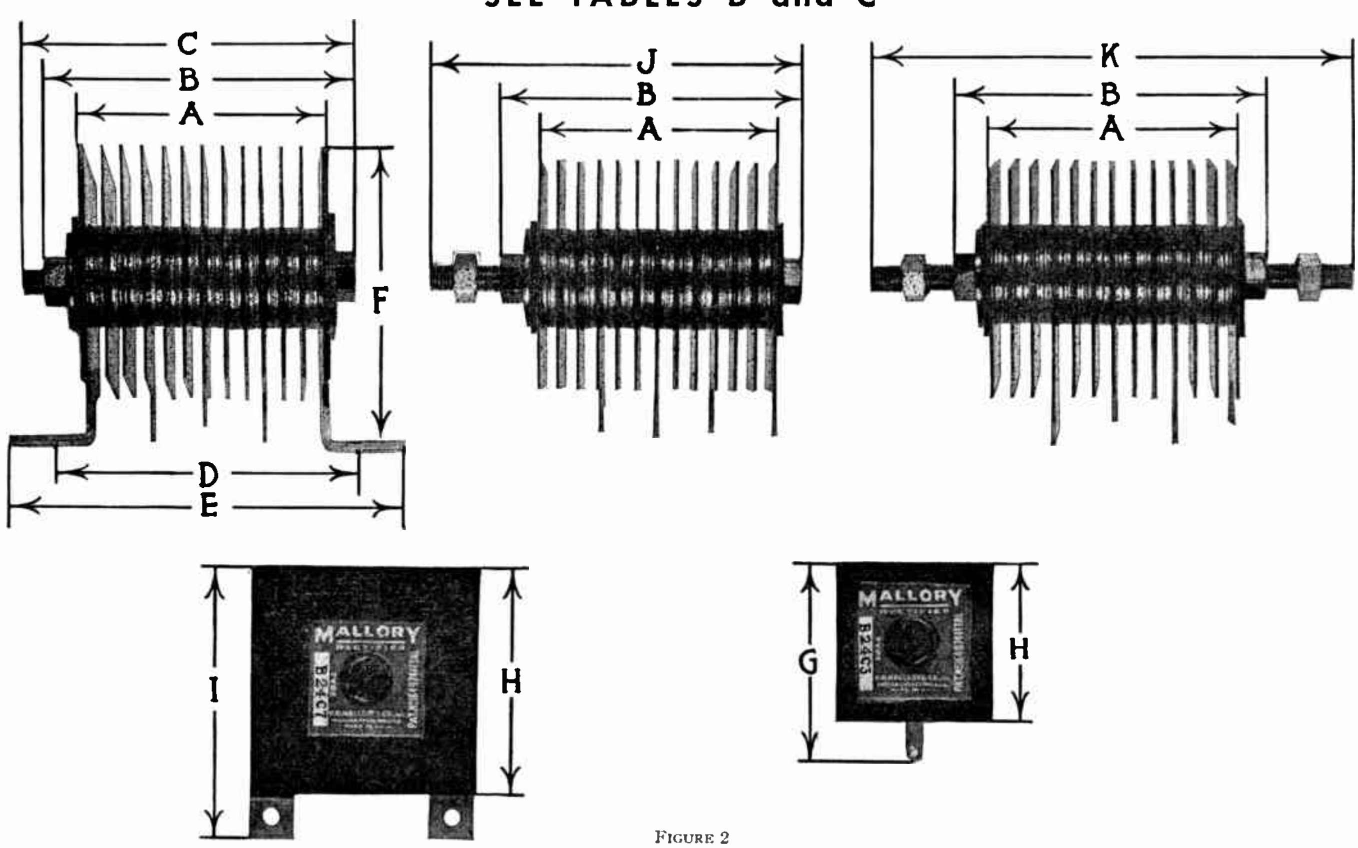


FIGURE 2

TABLE B

MALLORY STANDARD SERIES B SINGLE-PHASE FULL-WAVE BRIDGE RECTIFIERS

Ratings are maximum under conditions of continuous operation at ambient temperatures of 40° C (104° F) or lower with unrestricted ventilation. Battery load ratings are based on half (½) charged unloaded lead-acid storage batteries only.

Available Mounting (Prefix to Type)	Type Number (See Note Below)	Max. No Load AC Voltage	RESISTIVE LOAD				LEAD-ACID BATTERY LOAD							INDUCTIVE LOAD				Approximate Dimension to Nearest ⅛"										
			Max. AC Operating Volts	Approx. AC Input Amps.	Approx. DC Output Volts	Max. DC Output Amps.	Max. AC Input Volts	Approx. AC Input Volts	Approx. AC Input Amps.	Approx. Battery Volts	Max. DC Charging Amps.	No. of Cells Lead Acid	No. of Cells Nickel Iron	Max. AC Operating Volts	Approx. AC Input Amps.	Approx. DC Output Volts	Max. DC Output Amps.	A	B	C	D	E	F	G	H	I	J	K
FBS	4B1	3.75	3.3	6.0	1.7	4.5	3.3	3.17	6.7	2.23	4.5	1	1	3.3	5.1	1.48	4.5	1	1⅝	2	1⅜	1⅞	1⅝	1⅝	1¼	....	2¼	3
FBS	4B3	3.75	3.3	8.0	1.7	6.0	3.3	3.19	7.7	2.24	5.0	1	1	3.3	6.8	1.45	6.0	⅞	1⅝	2	1½	2	2⅛	2⅛	1¾	....	2¼	3
FBS	4B7	3.75	3.3	12.0	1.7	9.0	3.3	3.24	10.8	2.25	7.0	1	1	3.3	10.2	1.38	9.0	⅞	1⅝	2	1¾	2½	3¼	....	2½	3	2¼	3
BS	4B9	3.75	3.3	16.0	1.6	12.0	3.3	3.3	15.3	2.27	10.0	1	1	3.3	13.5	1.34	12.0	⅞	1⅝	....	....	....	....	....	3½	4¼	2¼	3
S	4B11	3.75	3.3	26.0	1.6	20.0	3.3	3.3*	28.0	2.22	18.0	1	1	3.3	22.5	1.25	20.0	1⅛	1⅞	....	....	....	....	....	5	6½	....	3½
FBS	8B1	7.5	6.6	6.0	3.4	4.5	6.6	6.34	6.7	4.46	4.5	2	2	6.6	5.1	2.95	4.5	1⅞	2½	2¾	2¼	2¾	1⅜	1⅝	1¼	....	3½	4
FBS	8B3	7.5	6.6	8.0	3.3	6.0	6.6	6.38	7.7	4.48	5.0	2	2	6.6	6.8	2.9	6.0	1¾	2½	2¾	2⅜	2⅞	2⅛	2⅛	1¾	....	3½	4
FBS	8B7	7.5	6.6	12.0	3.3	9.0	6.6	6.48	10.8	4.5	7.0	2	2	6.6	10.2	2.76	9.0	1¾	2½	2¾	2¾	3⅛	3¼	....	2½	3	3½	4
BS	8B9	7.5	6.6	16.0	3.3	12.0	6.6	6.6	15.3	4.54	10.0	2	2	6.6	13.5	2.68	12.0	1¾	2½	....	....	....	....	....	3½	4¼	3½	4
S	8B11	7.5	6.6	26.0	3.2	20.0	6.6	6.6*	28.0	4.45	18.0	2	2	6.6	22.5	2.5	20.0	2	2¾	....	....	....	....	....	5	6½	....	4¼
FBS	12B1	11.25	9.9	6.0	5.1	4.5	9.9	9.5	6.7	6.7	4.5	3	3-4	9.9	5.1	4.45	4.5	2⅝	3¼	3¾	3	3½	1⅝	1⅝	1¼	....	4¼	4¾
FBS	12B3	11.25	9.9	8.0	5.1	6.0	9.9	9.6	7.7	6.7	5.0	3	3-4	9.9	6.8	4.35	6.0	2⅜	3⅜	3¾	3¼	3¾	2⅛	2⅛	1¾	....	4¼	4¾
FBS	12B7	11.25	9.9	12.0	5.0	9.0	9.9	9.7	10.8	6.8	7.0	3	3-4	9.9	10.2	4.15	9.0	2⅝	3⅜	3¾	3½	4⅛	3¼	....	2½	3	4¼	4¾
BS	12B9	11.25	9.9	16.0	4.9	12.0	9.9	9.9	15.3	6.8	10.0	3	3-4	9.9	13.5	4.0	12.0	2⅝	3⅜	....	....	....	....	....	3½	4¼	....	4¾
S	12B11	11.25	9.9	26.0	4.8	20.0	9.9	9.9*	28.0	6.65	18.0	3	3-4	9.9	22.5	3.75	20.0	3	3¾	....	....	....	....	....	5	6½	....	5¼
FS	16B1	15.00	13.2	6.0	6.8	4.5	13.2	12.7	6.7	8.9	4.5	4	5	13.2	5.1	5.9	4.5	3½	4⅛	4½	3⅞	4⅜	1⅝	1⅜	1¼	....	....	5¾
FS	16B3	15.00	13.2	8.0	6.8	6.0	13.2	12.8	7.7	8.9	5.0	4	5	13.2	6.8	5.8	6.0	3½	4¼	4½	4⅛	4⅝	2⅛	2⅛	1¾	....	....	5¾
FS	16B7	15.00	13.2	12.0	6.6	9.0	13.2	13.0	10.8	9.0	7.0	4	5	13.2	10.2	5.5	9.0	3½	4¼	4½	4⅛	5	3¼	....	2½	3	....	5¾
S	16B9	15.00	13.2	16.0	6.6	12.0	13.2	13.2	15.3	9.1	10.0	4	5	13.2	13.5	5.3	12.0	3½	4¼	....	....	....	....	....	3½	4¼	....	5¾
S	16B11	15.00	13.2	26.0	6.4	20.0	13.2	13.2*	28.0	8.9	18.0	4	5	13.2	22.5	5.0	20.0	3⅞	4⅝	....	....	....	....	....	5	6½	....	6¼
FS	20B1	18.75	16.5	6.0	8.5	4.5	16.5	15.8	6.7	11.2	4.5	5	6	16.5	5.1	7.4	4.5	4⅜	5	5¼	4¾	5¼	1⅝	1⅝	1¼	....	....	6½
FS	20B3	18.75	16.5	8.0	8.5	6.0	16.5	16.0	7.7	11.2	5.0	5	6	16.5	6.8	7.3	6.0	4⅜	5⅛	5¼	5	5½	2⅛	2⅛	1¾	....	....	6½
FS	20B7	18.75	16.5	12.0	8.3	9.0	16.5	16.2	10.8	11.3	7.0	5	6	16.5	10.2	6.9	9.0	4⅜	5⅛	5¼	5¼	5⅞	3¼	....	2½	3	....	6½
S	20B9	18.75	16.5	16.0	8.2	12.0	16.5	16.5	15.3	11.4	10.0	5	6	16.5	13.5	6.7	12.0	4⅜	5⅛	....	....	....	....	....	3½	4¼	....	6½
S	20B11	18.75	16.5	26.0	8.1	20.0	16.5	16.5*	28.0	11.1	18.0	5	6	16.5	22.5	6.2	20.0	4⅞	5⅝	....	....	....	....	....	5	6½	....	7½
FS	24B1	22.50	19.8	6.0	10.2	4.5	19.8	19.0	6.7	13.4	4.5	6	7-8	19.8	5.1	8.9	4.5	5⅛	5¾	6¼	5½	6	1⅝	1⅝	1¼	....	....	7½
FS	24B3	22.50	19.8	8.0	10.3	6.0	19.8	19.2	7.7	13.5	5.0	6	7-8	19.8	6.8	8.7	6.0	5⅛	5⅞	6¼	5¾	6¼	2⅛	2⅛	1¾	....	....	7½
FS	24B7	22.50	19.8	12.0	10.0	9.0	19.8	19.5	10.8	13.6	7.0	6	7-8	19.8	10.2	8.3	9.0	5⅛	5⅞	6¼	6	6⅝	3¼	....	2½	3	....	7½
S	24B9	22.50	19.8	16.0	9.9	12.0	19.8	19.8	15.3	13.6	10.0	6	7-8	19.8	13.5	8.0	12.0	5⅛	5⅞	....	....	....	....	....	3½	4¼	....	7½
S	24B11	22.50	19.8	26.0	9.7	20.0	19.8	19.8*	28.0	13.3	18.0	6	7-8	19.8	22.5	7.5	20.0	5⅞	6⅝	....	....	....	....	....	5	6½	....	8½
FS	28B1	26.25	23.1	6.0	11.9	4.5	23.1	22.2	6.7	15.7	4.5	7	9	23.1	5.1	10.3	4.5	6	6⅝	7	6⅜	6⅞	1⅝	1⅜	1¼	....	....	8½
FS	28B3	26.25	23.1	8.0	12.0	6.0	23.1	22.4	7.7	15.8	5.0	7	9	23.1	6.8	10.1	6.0	6	6¾	7	6⅝	7⅛	2⅛	2⅛	1¾	....	....	8½
FS	28B7	26.25	23.1	12.0	11.7	9.0	23.1	22.7	10.8	15.8	7.0	7	9	23.1	10.2	9.7	9.0	6	6¾	7	6⅞	7½	3¼	....	2½	3	....	8½
S	28B9	26.25	23.1	16.0	11.5	12.0	23.1	23.1	15.3	15.9	10.0	7	9	23.1	13.5	9.3	12.0	6	6¾	....	....	....	....	....	3½	4¼	....	8½
S	28B11	26.25	23.1	26.0	11.3	20.0	23.1	23.1*	28.0	15.6	18.0	7	9	23.1	22.5	8.7	20.0	6⅞	7⅝	....	....	....	....	....	5	6½	....	9½
FS	32B1	30.00	26.4	6.0	13.6	4.5	26.4	25.4	6.7	17.9	4.5	8	10	26.4	5.1	11.8	4.5	6¾	7⅜	8	7⅛	7⅝	1⅝	1⅝	1¼	....	....	9
FS	32B3	30.00	26.4	8.0	13.7	6.0	26.4	25.5	7.7	18.0	5.0	8	10	26.4	6.8	11.6	6.0	6¾	7½	8	7⅜	7⅞	2⅛	2⅛	1¾	....	....	9
FS	32B7	30.00	26.4	12.0	13.3	9.0	26.4	25.9	10.8	18.1	7.0	8	10	26.4	10.2	11.0	9.0	6¾	7½	8	7¾	8¼	3¼	....	2½	3	....	9
S	32B9	30.00	26.4	16.0	13.2	12.0	26.4	26.4	15.3	18.2	10.0	8	10	26.4	13.5	10.7	12.0	6¾	7½	....	....	....	....	....	3½	4¼	....	9
S	32B11	30.00	26.4	26.0	13.0	20.0	26.4	26.4*	28.0	17.8	18.0	8	10	26.4	22.5	10.0	20.0	7¾	8½	....	....	....	....	....	5	6½	....	10
FS	36B1	33.75	29.7	6.0	15.3	4.5	29.7	28.5	6.7	20.1	4.5	9	11-12	29.7	5.1	13.2	4.5	7⅝	8¼	8½	8	8½	1⅝	1⅝	1¼	....	....	10
FS	36B3	33.75	29.7	8.0	15.4	6.0	29.7	28.7	7.7	20.2	5.0	9	11-12	29.7	6.8	13.0	6.0	7⅝	8⅜	8½	8¼	8¾	2⅛	2⅛	1¾	....	....	10
FS	36B7	33.75	29.7	12.0	15.0	9.0	29.7	29.2	10.8	20.3	7.0	9	11-12	29.7	10.2	12.4	9.0	7⅝	8⅜	8½	8⅝	9⅛	3¼	....	2½	3	....	10
S	36B9	33.75	29.7	16.0	14.8	12.0	29.7	29.7	15.3	20.4	10.0	9	11-12	29.7	13.5	12.0	12.0	7⅝	8⅜	....	....	....	....	....	3½	4¼	....	10
S	36B11	33.75	29.7	26.0	14.6	20.0	29.7	29.7*	28.0	20.0	18.0	9	11-12	29.7	22.5	11.2	20.0	8½	9¼	....	....	....	....	....	5	6½	....	11

*Indicates ¼ charged battery only.

NOTE: When stud or bolt (not foot) is to be insulated from assembly prefix type number with "I," add ⅛" to dimension B.

DIMENSIONS AND RATINGS SUBJECT TO CHANGE WITHOUT NOTICE

TABLE C

MALLORY STANDARD SERIES C SINGLE-PHASE FULL-WAVE BRIDGE RECTIFIERS

Ratings are maximum under conditions of continuous operation at ambient temperatures of 40° C (104° F) or lower with unrestricted ventilation. Battery load ratings are based on half (½) charged unloaded lead-acid storage batteries only.

Available Mounting (Prefix to Type)	Type Number (See Note Below)	Max. No Load AC Voltage	RESISTIVE LOAD: Max. AC Operating Volts	Approx. AC Input Amps.	Approx. DC Output Volts	Max. DC Output Amps.	LEAD-ACID BATTERY LOAD: Max. AC Input Volts	Approx. AC Input Volts	Approx. AC Input Amps.	Approx. Battery Volts	Max. DC Charging Amps.	No. of Cells: Lead Acid	No. of Cells: Nickel Iron	INDUCTIVE LOAD: Max. AC Operating Volts	Approx. AC Input Amps.	Approx. DC Output Volts	Max. DC Output Amps.
FBS	4C1	3.75	Exactly Same as 4B1 With Same Ratings and Price.														
FBS	4C3	3.75	Exactly Same as 4B3 With Same Ratings and Price.														
FBS	4C7	3.75	Exactly Same as 4B7 With Same Ratings and Price.														
BS	4C9	3.75	Exactly Same as 4B9 With Same Ratings and Price.														
S	4C11	3.75	Exactly Same as 4B11 With Same Ratings and Price.														
FBS	8C1	7.5	6.6	3.0	3.5	2.25	6.6	6.0	3.5	4.36	2.25	2	2	6.6	2.6	3.12	2.25
FBS	8C3	7.5	6.6	4.5	3.47	3.25	6.6	6.1	4.7	4.38	3.0	2	2	6.6	3.7	3.05	3.25
FBS	8C7	7.5	6.6	6.1	3.5	4.5	6.6	6.15	5.4	4.41	3.5	2	2	6.6	5.1	2.95	4.5
BS	8C9	7.5	6.6	8.0	3.45	6.0	6.6	6.38	7.7	4.48	5.0	2	2	6.6	6.8	2.9	6.0
S	8C11	7.5	6.6	13.5	3.34	10.0	6.6	6.6	14.0	4.54	9.0	2	2	6.6	11.2	2.68	10.0
FBS	12C1	11.25	9.9	3.0	5.25	2.25	9.9	9.0	3.5	6.5	2.25	3	3-4	9.9	2.7	4.7	2.25
FBS	12C3	11.25	9.9	4.5	5.2	3.25	9.9	9.2	4.7	6.6	3.0	3	3-4	9.9	3.7	4.6	3.25
FBS	12C7	11.25	9.9	6.1	5.25	4.5	9.9	9.3	5.4	6.6	3.5	3	3-4	9.9	5.1	4.4	4.5
BS	12C9	11.25	9.9	8.0	5.2	6.0	9.9	9.6	7.7	6.7	5.0	3	3-4	9.9	6.8	4.4	6.0
S	12C11	11.25	9.9	13.5	5.0	10.0	9.9	9.9	14.0	6.8	9.0	3	3-4	9.9	11.2	4.0	10.0
FBS	16C1	15.00	13.2	3.0	7.0	2.25	13.2	12.0	3.5	8.7	2.25	4	5	13.2	2.7	6.2	2.25
FBS	16C3	15.00	13.2	4.5	6.9	3.25	13.2	12.2	4.7	8.8	3.0	4	5	13.2	3.7	6.1	3.25
FBS	16C7	15.00	13.2	6.1	7.0	4.5	13.2	12.3	5.4	8.8	3.5	4	5	13.2	5.1	5.9	4.5
BS	16C9	15.00	13.2	8.0	6.9	6.0	13.2	12.8	7.7	9.0	5.0	4	5	13.2	6.8	5.8	6.0
S	16C11	15.00	13.2	13.5	6.7	10.0	13.2	13.2	14.0	9.1	9.0	4	5	13.2	11.2	5.4	10.0
FBS	20C1	18.75	16.5	3.0	8.8	2.25	16.5	15.0	3.5	10.8	2.25	5	6	16.5	2.7	7.8	2.25
FBS	20C3	18.75	16.5	4.5	8.7	3.25	16.5	15.3	4.7	10.9	3.0	5	6	16.5	3.7	7.6	3.25
FBS	20C7	18.75	16.5	6.1	8.8	4.5	16.5	15.4	5.4	11.0	3.5	5	6	16.5	5.1	7.4	4.5
BS	20C9	18.75	16.5	8.0	8.6	6.0	16.5	16.0	7.7	11.2	5.0	5	6	16.5	6.8	7.3	6.0
S	20C11	18.75	16.5	13.5	8.3	10.0	16.5	16.5	14.0	11.4	9.0	5	6	16.5	11.2	6.7	10.0
FBS	24C1	22.50	19.8	3.0	10.5	2.25	19.8	18.0	3.5	13.1	2.25	6	7-8	19.8	2.7	9.4	2.25
FBS	24C3	22.50	19.8	4.5	10.4	3.25	19.8	18.3	4.7	13.2	3.0	6	7-8	19.8	3.7	9.2	3.25
FBS	24C7	22.50	19.8	6.1	10.5	4.5	19.8	18.5	5.4	13.3	3.5	6	7-8	19.8	5.1	8.9	4.5
BS	24C9	22.50	19.8	8.0	10.4	6.0	19.8	19.2	7.7	13.5	5.0	6	7-8	19.8	6.8	8.7	6.0
S	24C11	22.50	19.8	13.5	10.5	10.0	19.8	19.8	14.0	13.6	9.0	6	7-8	19.8	11.2	8.0	10.0
FS	28C1	26.25	23.1	3.0	12.3	2.25	23.1	21.0	3.5	15.3	2.25	7	9	23.1	2.7	10.9	2.25
FS	28C3	26.25	23.1	4.5	12.2	3.25	23.1	21.4	4.7	15.4	3.0	7	9	23.1	3.7	10.7	3.25
FS	28C7	26.25	23.1	6.1	12.3	4.5	23.1	21.6	5.4	15.4	3.5	7	9	23.1	5.1	10.3	4.5
S	28C9	26.25	23.1	8.0	12.1	6.0	23.1	22.4	7.7	15.7	5.0	7	9	23.1	6.8	10.2	6.0
S	28C11	26.25	23.1	13.5	11.7	10.0	23.1	23.1	14.0	15.9	9.0	7	9	23.1	11.2	9.4	10.0
FS	32C1	30.00	26.4	3.0	14.0	2.25	26.4	24.0	3.5	17.5	2.25	8	10	26.4	2.7	12.5	2.25
FS	32C3	30.00	26.4	4.5	13.9	3.25	26.4	24.4	4.7	17.5	3.0	8	10	26.4	3.7	12.2	3.25
FS	32C7	30.00	26.4	6.1	14.0	4.5	26.4	24.6	5.4	17.6	3.5	8	10	26.4	5.1	11.8	4.5
S	32C9	30.00	26.4	8.0	13.8	6.0	26.4	25.5	7.7	17.9	5.0	8	10	26.4	6.8	11.6	6.0
S	32C11	30.00	26.4	13.5	13.4	10.0	26.4	26.4	14.0	18.2	9.0	8	10	26.4	11.2	10.7	10.0
FS	36C1	33.75	29.7	3.0	15.8	2.25	29.7	27.0	3.5	19.7	2.25	9	11-12	29.7	2.7	14.0	2.25
FS	36C3	33.75	29.7	4.5	15.7	3.25	29.7	27.4	4.7	19.7	3.0	9	11-12	29.7	3.7	13.7	3.25
FS	36C7	33.75	29.7	6.1	15.8	4.5	29.7	27.8	5.4	19.8	3.5	9	11-12	29.7	5.1	13.3	4.5
S	36C9	33.75	29.7	8.0	15.5	6.0	29.7	28.7	7.7	20.2	5.0	9	11-12	29.7	6.8	13.0	6.0
S	36C11	33.75	29.7	13.5	15.0	10.0	29.7	29.7	14.0	20.4	9.0	9	11-12	29.7	11.2	12.1	10.0

Approximate Dimension to Nearest 1/8"

Type Number	A	B	C	D	E	F	G	H	I	J	K
4C1	1	1 5/8	2	1 3/8	1 7/8	1 5/8	1 5/8	1 1/4	....	2 1/4	3
4C3	7/8	1 5/8	2	1 1/2	2	2 1/8	2 1/8	1 3/4	....	2 1/4	3
4C7	7/8	1 5/8	2	1 3/4	2 1/2	3 1/4	....	2 1/2	3	2 1/4	3
4C9	7/8	1 5/8	....	....	....	....	....	3 1/2	4 1/4	2 1/4	3
4C11	1 1/8	1 7/8	....	....	....	....	....	5	6 1/2	....	3 1/2
8C1	1	1 5/8	2	1 3/8	1 7/8	1 5/8	1 5/8	1 1/4	....	2 1/4	3
8C3	7/8	1 5/8	2	1 1/2	2	2 1/8	2 1/8	1 3/4	....	2 1/4	3
8C7	7/8	1 5/8	2	1 3/4	2 1/2	3 1/4	....	2 1/2	3	2 1/4	3
8C9	7/8	1 5/8	....	....	....	....	....	3 1/2	4 1/4	2 1/4	3
8C11	1 1/8	1 7/8	....	....	....	....	....	5	6 1/2	....	3 1/2
12C1	1 3/4	2 3/8	2 3/4	2 1/8	2 5/8	1 5/8	1 5/8	1 1/4	....	3 1/2	4
12C3	1 5/8	2 3/8	2 3/4	2 1/4	2 3/4	2 1/8	2 1/8	1 3/4	....	3 1/2	4
12C7	1 3/4	2 1/2	2 3/4	2 5/8	3 3/8	3 1/4	....	2 1/2	3	3 1/2	4
12C9	1 3/4	2 1/2	....	....	....	....	....	3 1/2	4 1/4	3 1/2	4
12C11	2	2 3/4	....	....	....	....	....	5	6 1/2	....	4 1/4
16C1	1 3/4	2 3/8	2 3/4	2 1/8	2 5/8	1 5/8	1 5/8	1 1/4	....	3 1/2	4
16C3	1 5/8	2 3/8	2 3/4	2 1/4	2 3/4	2 1/8	2 1/8	1 3/4	....	3 1/2	4
16C7	1 3/4	2 1/2	2 3/4	2 5/8	3 3/8	3 1/4	....	2 1/2	3	3 1/2	4
16C9	1 3/4	2 1/2	....	....	....	....	....	3 1/2	4 1/4	3 1/2	4
16C11	2	2 3/4	....	....	....	....	....	5	6 1/2		4 1/4
20C1	2 5/8	3 1/4	3 1/2	2 7/8	3 3/8	1 5/8	1 5/8	1 1/4		4 1/4	4 3/4
20C3	2 1/2	3 1/4	3 1/2	3	3 1/2	2 1/8	2 1/8	1 3/4	....	4 1/4	4 3/4
20C7	2 5/8	3 3/8	3 1/2	3 1/2	4 1/4	3 1/4	....	2 1/2	3	4 1/4	4 3/4
20C9	2 5/8	3 3/8	....	....	....	....	....	3 1/2	4 1/4	4 1/4	4 3/4
20C11	2 7/8	3 5/8	....	....	....	....	....	5	6 1/2		5 1/4
24C1	2 5/8	3 1/4	3 1/2	2 7/8	3 3/8	1 5/8	1 5/8	1 1/4	....	4 1/4	4 3/4
24C3	2 1/2	3 1/4	3 1/2	3	3 1/2	2 1/8	2 1/8	1 3/4	....	4 1/4	4 3/4
24C7	2 5/8	3 3/8	3 1/2	3 1/2	4 1/4	3 1/4	....	2 1/2	3	4 1/4	4 3/4
24C9	2 5/8	3 3/8	....	....	....	....	....	3 1/2	4 1/4	4 1/4	4 3/4
24C11	2 7/8	3 5/8	....	....	....	....	....	5	6 1/2	....	5 1/4
28C1	3 3/8	4	4 1/4	3 3/4	4 1/4	1 5/8	1 5/8	1 1/4	....	....	5 1/2
28C3	3 1/4	4	4 1/4	3 7/8	4 3/8	2 1/8	2 1/8	1 3/4	....	....	5 1/2
28C7	3 3/8	4 1/8	4 1/4	4 1/4	5	3 1/4	....	2 1/2	3	....	5 1/2
28C9	3 3/8	4 1/8	....	....	....	....	....	3 1/2	4 1/4	....	5 1/2
28C11	3 7/8	4 5/8	....	....	....	....	....	5	6 1/2	....	6 1/4
32C1	3 3/8	4	4 1/4	3 3/4	4 1/4	1 5/8	1 5/8	1 1/4	....	....	5 1/2
32C3	3 1/4	4	4 1/4	3 7/8	4 3/8	2 1/8	2 1/8	1 3/4	....	....	5 1/2
32C7	3 3/8	4 1/8	4 1/4	4 1/4	5	3 1/4	....	2 1/2	3	....	5 1/2
32C9	3 3/8	4 1/8	....				....	3 1/2	4 1/4	....	5 1/2
32C11	3 7/8	4 5/8	....	....			....	5	6 1/2	....	6 1/4
36C1	4 1/4	4 7/8	5 1/4	4 5/8	5 1/8	1 5/8	1 5/8	1 1/4	....	....	6 1/2
36C3	4 1/8	4 7/8	5 1/4	4 3/4	5 1/4	2 1/8	2 1/8	1 3/4	....	....	6 1/2
36C7	4 1/4	5	5 1/4	5 1/8	5 7/8	3 1/4	....	2 1/2	3	....	6 1/2
36C9	4 1/4	5	....	....	....	....	....	3 1/2	4 1/4	....	6 1/2
36C11	4 3/4	5 1/2	....	....	....	....	....	5	6 1/2	....	7

NOTE: When stud or bolt (not foot) is to be insulated from assembly prefix type number with "1," add 1/8" to dimension B.

DIMENSIONS AND RATINGS SUBJECT TO CHANGE WITHOUT NOTICE

Note: For higher outputs, Rectifiers may be connected in series, parallel, or series-parallel, subject to the conditions outlined in Rectifier Catalog Form R-610.

Mallory Replacement Rectifiers

The widespread use of dry disc rectifiers provides the serviceman with an additional source of profit. The following tables list the Mallory Rectifiers commonly used for replacements and show their application. Recommendations as to the proper replacement rectifier for unlisted devices can be made on receipt of complete information on the original equipment.

Replacement Table—Battery Chargers, Boosters, "A" Eliminators and Speaker Power Supplies

Make	Model	Use Mallory Rectifier Cat. No.*
BATTERY CHARGERS		
Acme		4A1B
Arvin	400	B8C3M
Arvin	500-600	F16C3M
American Television & Radio	400	IB12C1M
American Television & Radio	600	F16C83
Bernard		4A1B
B-L	2-4 amp.	IB12C1M
B-L	4-6 amp.	IF12C7P
Blackstone		IF12C1M
Bosch	250H-250J	F16C3M
Briggs-Stratton		F16C3MB
Cadillac	A1109-A1180	F16CB3
Chevrolet	250B	F16C3M
Chrysler		IB12C1M
Elkon	B-T	4A1B
Elkon	E	IB12C1M
Elkon	3 amp.	F16C3MB
Elkon	310	F16C3M
Elkon	Battery Booster	IB12C1M
Evans		IB12C1M
General Motors	250-600503	F16C3M
Hudson	2-4 amp.	IB12C1M
Jordan		IB12C1M
Kingston		IB12C1M
Kingston	Auto Battery	B8C3M
Knapp	No. 2	IB12C1M
Knapp	No. 3	B8C3M
K R W		IB12C3P
Lundy	250	F16C3M
Lundy	600	F16CB3
Mallory	No. 3	B8C3M
Mallory	No. 2	IB12C1M
Mallory	5535	F16CB3
Mallory	5535A	IF16CB7M
Mallory	3C	IB12C1M
Mallory-Elkon	250	F16C3M
Mallory-Elkon	5535	F16CB3
National		4A1B
Newman		IB12C1M
Otwell	Safety-Super	F16CB3
Packard		F16CB3
Philco		F12G1Y
Precision		4A1B
Sears-Roebuck	2-4 amp.	IB12C1M
Sears-Roebuck	4-6 amp.	IF12C7P
Silvertone		IB12C1M
Song Bird		IB12C1M
Truetest	Battery Booster	IB12C1M
Truetest		B8C3M
United Motor Service	4017	IB12C3P
United Motor Service		IB12C1M
Utah		IB12C3P
Utah-Carter		IB12C3P
Wards (Montgomery-Ward)	2-4 amp.	IB12C1M
Wards (Montgomery-Ward)	4-6 amp.	IF12C7P
WLS		IB12C1M
LOUD SPEAKER POWER SUPPLIES		
Amervox		F16C3MB
Farrand		F16C3MB
Stevens		F16C3MB
Vitaltone		F16C3MB

Make	Model	Use Mallory Rectifier Cat. No.*
AUTO RADIO POWER SUPPLIES		
B-L Electric Co.		IF20B9P
Chrysler		IF20B9P
Electric Products Co. (EPCO)	10 amps., 6 volts	IS24B9
Galvin		IF20B9P
Hudson		IF20B9P
United Motors		IF20B9P
"A" ELIMINATORS		
American Television & Radio		F20C7
Bernard		F16C3MB
Brach		F16C3MB
Elkon		F16C3MB
Fada		F16C3MB
Green-Brown		F16C3MB
Knapp		F16C3MB
Majestic		F16C3MB
Metro		F16C3MB
Philco	(Elkon equipped)	F16C3MB
Philco		F12G1Y
Philco	Comb. A & B	F12G1Y
Sentinel		F16C3MB
Tobe Mayolian		F16C3MB
Webster		F16C3MB

*Catalog type numbers are in the latest code. Refer to table for old equivalent type number (4A1B is an exception).

REPLACEMENT RECTIFIERS

Catalog Numbers	Replaces Old Type Numbers
*4A1B	XB4
*B8C3M	4A3, 8A3, W8A3
*F12G1Y (without base)	12A1BY, XP12, UP8
*IB12C1M	12C1, 12C1B, 12C1E, 12C1F†, 12C1K, IB12C1, X112, X12, U12
IB12C3P	
IF12C7P	
*F16C3M	16C3, X116, X16, ME16
*F16C3MB	16C3B, XB16, M16
*F16CB3	16CD3
*IF16CB7M	
*F16G1	W16A1, F16G1P†
*F20G1	20A1, W20A1, F20G1P (See page 308), X20
IF20B9P	
F24C7	FCX24D7
IS24B9	SCX24H9
*F24G1	W24A1, F24G1P†
F28C7	FCX28F7
*F28G1	W28A1, F28G1P†

*These rectifiers are carried in stock. The other rectifiers are not stocked and can be supplied within a week or ten days from receipt of order.

†Reversed polarity types. See paragraph headed "Connections," page 308.

Useful Servicing Formulas

A KNOWLEDGE of the elementary principles of electricity is necessary so that all the problems encountered in radio receiver servicing can be isolated and solved by the proper application of fundamental truths. Without further preamble, let us consider that statement upon which all forms and branches of electrical engineering is based:

OHMS LAW

Statement of Ohms Law: "Current flowing in a conductor will increase directly with an increase in voltage, and will decrease directly with an increase in resistance." In other words, voltage is the *cause*, while current is the *effect;* and the amount of the effect is directly dependent upon the amount of cause and inversely upon the amount of opposition offered to the effect.

Mechanical Analogy: Suppose that by exerting a certain effort, a man is able to walk a certain distance on a smooth city road. With double the effort, he can walk double the distance on the same road. Assume that on a rough country road, with the same effort, he can walk only half this distance, or with double the effort, he can walk the original distance. Applying this analogy to electricity, a certain voltage causes a certain current to flow. Double the voltage will cause double the current to flow, if the resistance is the same. If the resistance is doubled, however, the same voltage will result in only half the current flow. With double the voltage and double the resistance, the same current will flow.

Ohms Law (Equation)

$$I = \frac{E}{R}; \quad \text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

Where I, E, and R are expressed in amperes, volts, and ohms respectively. The terms of voltage, current and resistance are used with the understanding that the reader has some elementary knowledge of electricity. Inasmuch as the limitations of this book prevent a complete review of the fundamentals, reference can be made to books covering the subject of fundamentals in electrical engineering.

The equations below all mean the same thing, and serve to express in various forms the idea set forth above.

$$E = I \times R; \quad \text{Voltage} = \text{Current} \times \text{Resistance}$$

$$R = \frac{E}{I}; \quad \text{Resistance} = \frac{\text{Voltage}}{\text{Current}}$$

The substitution of numerical values in place of names or letters will make the meaning clearer. It will be seen that if any two values are known, the third can be determined from these equations.

Problem: A choke used in the filter system of a "B" supply unit has a resistance of 100 ohms, and the voltage drop across the choke is 50 volts. What is the current flowing through the choke?

Using the first statement of Ohms Law, and substituting values for words: I equals 50 volts divided by 100 ohms. Thus, the current is .5 ampere (Figure 1A).

Figure 1B shows another application of the law that can be solved by the third

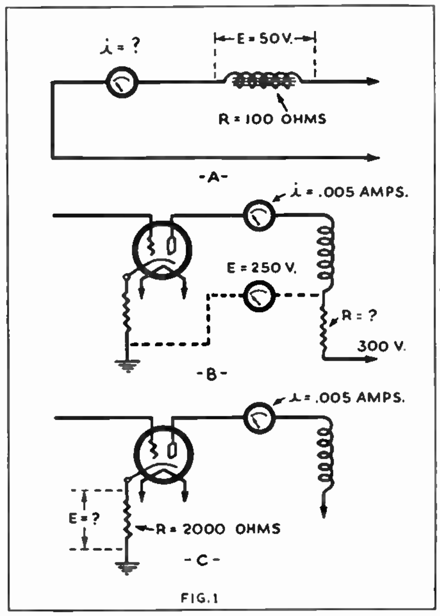


FIGURE 1. *Illustrating fundamental radio circuit calculations which require familiarity with ohms law. (A) Solving for current flowing in a circuit; (B) the resistance required to effect a known voltage drop; (C) the voltage drop across a known value of resistance.*

statement. Note should be taken of the fact that the voltage across the resistor R is not 300 volts, but the difference between the two voltages indicated, or 50 volts. Substituting in the equation:

$$R = \frac{E}{I}; \quad R = \frac{50}{.005} = 10{,}000 \text{ ohms.}$$

In Figure 1C is shown a common calculation necessary in modern service work. Here we must determine the value of the bias resistor for a particular tube. This value is easy to obtain, thus:

$$E = I \times R; \quad E = .005 \times 2{,}000 = 10 \text{ volts.}$$

Ohms Law in a Nutshell

$$\frac{E}{I \times R}$$

E = Voltage I = Current
× = Multiply by R = Resistance

Put your thumb over the unknown—or the symbol designating the value you want to know—thus to find voltage, cover E and the answer is: multiply current by resistance.

Power

Definition. "Power is the rate of doing work." Thus, one man may perform a certain piece of work in a day, while another may do the same thing in an hour. The second man has expended more power. "Electrical power is the product of the voltage times the current," or in symbols:

$W = E \times I$; Power (watts) = Voltage (in volts) × Current (in amperes).

Problem: In Figure 1B, how many watts are dissipated in the resistor? Watts = 50 volts × .005 amperes = .25 Watt.

In many cases it is more convenient to find the electrical power loss in terms of resistance. Thus, the equation W equals E times I can be stated in terms of the circuit resistance and the current flowing through it.

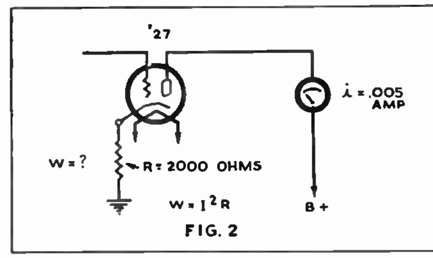


FIGURE 2. *A specific illustration of calculating the wattage rating of a resistor in a radio circuit.*

$W = I$ times I times R; or $W = I^2 \times R$ or, in other words, watts equal current (amperes) times current (amperes) times resistance (ohms).

In Figure 2 there is a circuit with a resistor in series with the cathode and the ground of a '27 type tube. This resistor supplies the bias for the tube. If the resistance has a value of 2,000 ohms, what is the power loss in the resistor?

$W = .005 \times .005 \times 2{,}000 = .05$ watt.

Another form of this equation states the power in terms of voltage and resistance.

$$W = \frac{\text{voltage} \times \text{voltage}}{\text{resistance}} \text{ or } W = \frac{E^2}{R}$$

A tube has a DC plate resistance of 40,000 ohms and the voltage applied between plate and ground is 200 volts. What is the power lost in the plate circuit of the tube? See Figure 3.

$$W = \frac{200 \times 200}{40{,}000} = 1 \text{ Watt.}$$

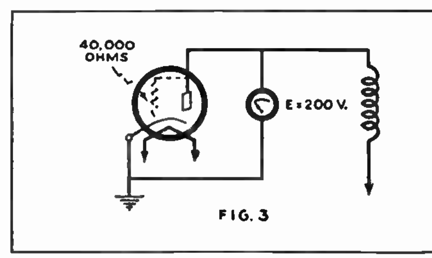


FIGURE 3. *Figuring the power or "watts" dissipated in a radio circuit.*

Kirchhoff's Laws

These laws depend on Ohms Law. They constitute a further application of Ohms Law to more complicated circuits.

In addition to simple electrical circuits, conductors may be connected in various complicated networks, all of which come under the heading of "divided circuits." By means of Kirchhoff's Laws, the current in any part of a divided circuit may be found, if the resistances of the various parts, and the e.m.f.'s (volts) are known.

Kirchhoff's First Law: "Any current flowing to a point in any electrical circuit is equal to the *sum of the currents flowing away from that point.*"

Kirchhoff's Second Law: "In any closed electrical circuit the sum of the impressed electromotive forces will equal the sum of the voltage drops." This statement requires modification, in so far as "addition" of voltages is concerned. Voltages are added, provided that they are in the same direction, but must be subtracted if in opposite directions.

An example of Kirchhoff's first law is seen in Figure 4 where the sum of the currents, 8 amperes and 4 amperes, flowing towards point A, is equal to the current, 12 amperes leaving point A.

Kirchhoff's second law is also numerically illustrated in Figure 4. Assume that the resistances of various parts of the circuit are as marked, and that the total internal resistance of the battery is .06 ohm. Then according to the statement of the second law, if the impressed voltage is 7.12 volts:

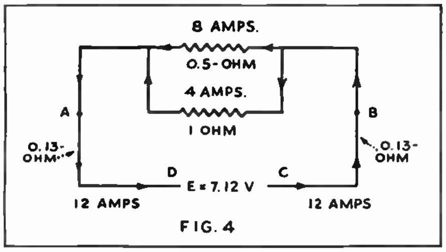


FIGURE 4. *Illustrating Kirchhoff's first law: "a current flowing into a circuit is the equal to the current leaving the circuit."*

Impressed Voltage = 7.12 = total voltage drop through the lower circuit.

Impressed Voltage = 12 × .1 (C to B) plus 4 × 1 (B to A in lower branch) plus 12 × .1 (A to D) plus 12 × .06 (D to C through battery).

Impressed Voltage = total of 7.12 volts.

In a like manner, impressed voltage equals *total voltage drop through the upper circuit.* 7.12 = 12 × .1 (C to B) plus 8 × .5 (B to A through upper circuit) plus 12 × .1 (A to D) plus 12 × .06 (D to C through battery), a total of 7.12 volts.

Conductors and Resistors

Materials are divided into two classes—conductors and non-conductors. Materials which offer a relatively easy path for the flow of electricity are called "conductors." In general, the pure metals are of this class, copper wire being nearly always used as a low-resistance conductor.

In reality there are no materials which are not conductors of electricity, but certain materials are such poor conductors that they may be classed as *non-conductors.* When such non-conductors are used to reduce an electric current to a predetermined small value, they are called "*resistors.*"

Determining Resistance
(Excepting Temperature Change)

The material of which a conductor is composed has an important bearing upon its resistance. Thus a unit length and unit cross-section of aluminum has about one and one-half times the resistance of copper having the same dimensions. Platinum has about six times the resistance of copper.

The longer the conductor, the greater the resistance; while the greater the cross-sectional area, the less the resistance. The length of a conductor is usually expressed in feet, while the cross-sectional area is expressed in circular mils (equivalent to its diameter in thousandths of an inch, squared).

It can be conveniently remembered that No. 10 copper wire has a diameter of .1 of an inch (100 mils, or 10,000 circular mils), and that 1,000 feet of such wire will have a resistance of 1 ohm. It is possible to calculate the approximate resistances of copper wire (Brown and Sharpe or American Wire Gauge) from the above. Thus, for wires larger than No. 10, the resistance is *halved* for every *third* number of larger wire. As an example, No. 7 wire has an approximate resistance of 1/2-ohm per 1,000 ft. In a like manner, for wires smaller than No. 10, the resistance is doubled for every third number of smaller wire. The resistance of No. 13 is about 2 ohms per thousand feet; of No. 16, approximately 4 ohms per thousand feet, etc. The two numbers between every third may be calculated from the others, since the next smaller size has about 1.25 greater resistance, while the second smaller size has about 1.6 greater resistance. Thus the resistance of No. 11 wire is approximately 1 × 1.25 equals 1.25 ohms per thousand feet; and that of No. 14, approximately 1.6 ohms per thousand feet.

Effect of Temperature on Resistance: The resistance of practically all electrical conductors increases with increase of temperature. Carbon, practically the only exception, decreases in resistance with any substantial increase in temperature.

Two words synonymous with a resistance are "temperature coefficient." The term "coefficient" refers to a number used as a multiplier. The temperature coefficient is that multiplier which will give the increase in resistance per degree rise in temperature for each ohm of the material. For all pure metals, the temperature coefficient is approximately .0023 (where temperature is measured in degrees Fahrenheit). The figure .0023 is close enough for all ordinary work although the temperature coefficient is not constant for all initial temperatures.

Current Carrying Capacity

The allowable rise in temperature of the conductors or resistors in an electrical circuit is the final factor which determines its current carrying capacity. If the conductors or resistors are covered, the maximum allowable temperature of the insulation will impose the limitation, since the insulation or the enamel covering may crack, char, or even burn at high temperatures.

The temperature rise will be determined by the difference between the heat generated and the heat dissipated, or removed. Thus, a certain amount of electrical energy will be converted into heat and some of this heat will be carried away. The remaining heat will serve to increase the temperature. Of course, a certain amount of heat energy will raise the temperature of some materials a great deal more than others. Hence, the material of the conductor will also have some bearing on the temperature rise, aside from its resistance.

The heat generated in an electrical circuit will depend upon the value of the current flowing and upon the resistance in the circuit. If the current is doubled, the heat generated will be quadrupled. If the resistance is doubled, the heat generated will simply be doubled (if the current is constant). Thus, an increase of current has a much greater effect on the amount of heat generated than

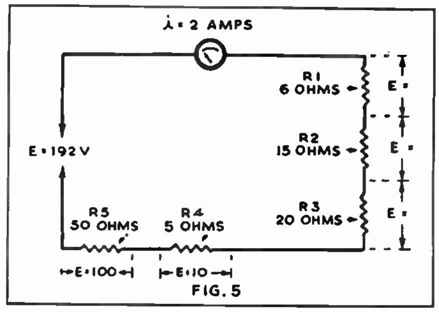


FIGURE 5. *Illustrating the effect of resistances connected in series. The total resistance is equal to the sum of the resistances in the circuit.*

proportionate increase of resistance. Anything that will increase the resistance of a circuit will increase the amount of heat generated.

Safe Current Carrying Capacities: In cases of resistor replacement, it is wise to replace with a resistor that will dissipate at least three times the power to be wasted in the circuit.

Voltage Drop: There is a difference in voltage between any two points in a circuit between which there is resistance, and this difference in voltage is known as the *voltage drop.* The difference in the voltage is determined by the resistance between the two points and the current flowing. If we desire to know the value of the resistance to be placed in series with a 201A type tube in order to operate it from a 6-volt storage battery, we must first determine the voltage drop required between the battery and the filament of the tube, namely 1 volt. Having determined the voltage to be dropped, and knowing the current required by the tube (.25 ampere), we can find the value of the resistance by Ohms Law. R equals E/I. Thus the resistor has a value of 4 ohms.

Circuits: Circuits can be classified into three general groups: Series, parallel, and series parallel. Examples of which will be covered in greater detail.

Circuits with Resistors in Series: If resistances are connected in series, the total resistance is the sum of all of the resistors in the circuit. See Figure 5. Thus the equation may be written R (eff.) equals R1 plus R2 plus R3 plus R4 plus R5, etc.

It will be noted on examination of the diagram that in series circuits the current is the same through all the resistors, but that the voltage drop across the resistors will depend upon the value of the individual resistor.

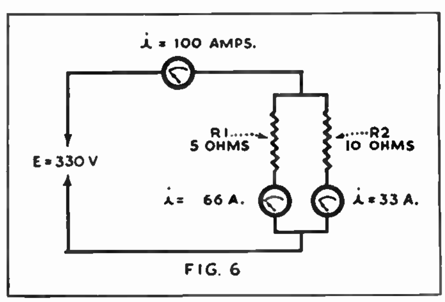


FIGURE 6. *Illustrating the effect of paralleled resistances. The current divides into each resistor so that the sum of the currents flowing in each equal that flowing out of the battery or generator.*

Circuits with Resistors in Parallel (equal value of resistance): In many circuits there are combinations of resistors in parallel: that is to say, the current path is divided through two or more resistors. If the numerical values of the resistors are equal, then the effective circuit resistance can be obtained from the following equation:

$$R \text{ (eff.) equals } R/N,$$

wherein R is the value of one of the resistors and N is the number of resistors in the circuit.

Example: There are 6 resistors in a circuit and they are in parallel. The resistance of each one is 12 ohms. Then dividing 12 by 6 we have the effective resistance, which is 2 ohms.

The solution of equal values of resistors in parallel is an extremely simple operation, but it must be remembered that the formula is useful only when the resistors are equal in value.

A circuit with resistors in parallel is shown in Figure 6. Note that if the resistors are equal in value, the same current will flow through both resistors, and the same voltage drop will appear across them. The sum of the currents through the resistors will equal the total current flowing out of the battery, E.

Circuits with Resistors in Parallel (unequal values of resistance): Many times we will come across circuits with resistors in parallel which are unequal in value. This is shown in Figure 6. If there are but two resistors in the circuit, as shown, then we can use the following formula:

$$R \text{ (eff.)} = \frac{R1 \times R2}{R1 + R2}$$

Example: We have two resistors in parallel of 5 and 10 ohms, respectively. What is the effective value of resistance? Now, 5 times 10 is 50; 5 plus 10 is 15; 50 divided by 15 gives the effective value of resistance which is 3.3 ohms.

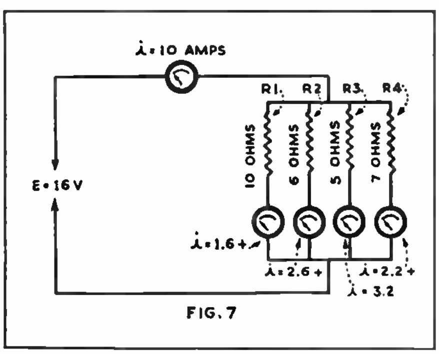


FIGURE 7. *The effect of a multiple number of resistors in parallel in a circuit. See text for full details.*

Note that in circuits with resistors in parallel, the same voltage will appear across the resistors, but that the current through the resistors will vary with the value of the individual resistor.

Circuit with Resistors in Parallel (two or more of unequal value): Figure 7 shows a circuit in which there are four resistors in parallel and unequal in value. In this case we would use the formula commonly known as the "reciprocal of the sum of the reciprocals."

Thus:

$$R \text{ (eff.)} = \frac{1}{\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}+\frac{1}{R4}} \text{ etc.;}$$

substituting:

$$R \text{ (eff.)} = \frac{1}{\frac{1}{10}+\frac{1}{6}+\frac{1}{5}+\frac{1}{7}};$$

solving:

$$\frac{1}{10} = .1; \frac{1}{6} = .166; \frac{1}{5} = .2; \frac{1}{7} = .14;$$

adding:

.1 plus .166 plus .2 plus .14 equals .606;

Finding the reciprocal:

$$\frac{1}{.606} = 1.6 \text{ ohms effective.}$$

The sum of the currents in the branches of a parallel circuit will equal the total current flowing into the circuit. From an examination of the circuit, we find that the sum of the currents is 9.6 + amperes.

The complete solution of the problem of Figure 7 has been carried out so that any one desiring to use these methods of calculation can do so. This solution will serve as a model and aid in studying just how the formula is to be handled. The author has gone to some lengths here in the solution of the problem but his experience indicates that there is never enough said on this subject as far as the average Service Man is concerned. Note that the same voltage appears across all the resistors and that the current through the individual resistors will be dependent on their value.

Resistance Networks (with resistors in series and in parallel): Circuits are encountered with resistors in series and in parallel. The solution of the effective value of resistance is obtained by breaking up the circuit into its local circuits, solving each portion consisting of parallel circuits, and then resolving them into simple series circuits. Figure 8 is an example along these lines.

Solution: The first thing to do is to solve all of the branch circuits. Circuit R1, R2, R3 has an effective resistance of 3 ohms.

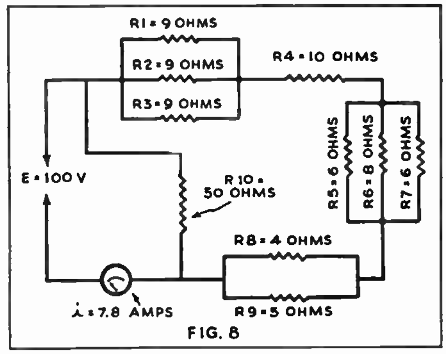


FIGURE 8. *A series circuit arrangement of paralleled resistors and how they affect the current flow. Refer to text for method of calculating.*

Circuit R5, R6, R7 has a resistance of 2.2 ohms.

Circuit R8, R9 has a resistance of 2.2 ohms.

As the above parallel circuits are in series with resistor R4, we find the effective value of resistance by adding 10, 3, 2.2 and 2.2 together. This totals 17.4 ohms.

Resistor R10 is connected across the voltage supply, and the effective value of the resistance network R1 and R9 is, in turn, connected across R10. Thus, R10 is in parallel to the 17.4 ohm resistance of the network.

Solving for parallel circuits 50 × 17.4 / 50 plus 17.7 we have the effective total circuit resistance of 12.8 ohms.

Knowing that the voltage applied across this network is 100 volts, and that the effective resistance is 12.8 ohms, then 100/12.8 is 7.8 amperes, or the total current flowing in the circuit.

The reader may think that a problem of this type can hardly occur, but if he will study the circuit of Figure 9 he will see the need for some practical knowledge on the solution of similar problems. The circuit of Figure 9 is a receiver breakdown circuit of the RCA Radiola 80. Note that there are many small series circuits and that they are all in parallel across the power supply which takes the place of the battery E in all the problems set out above.

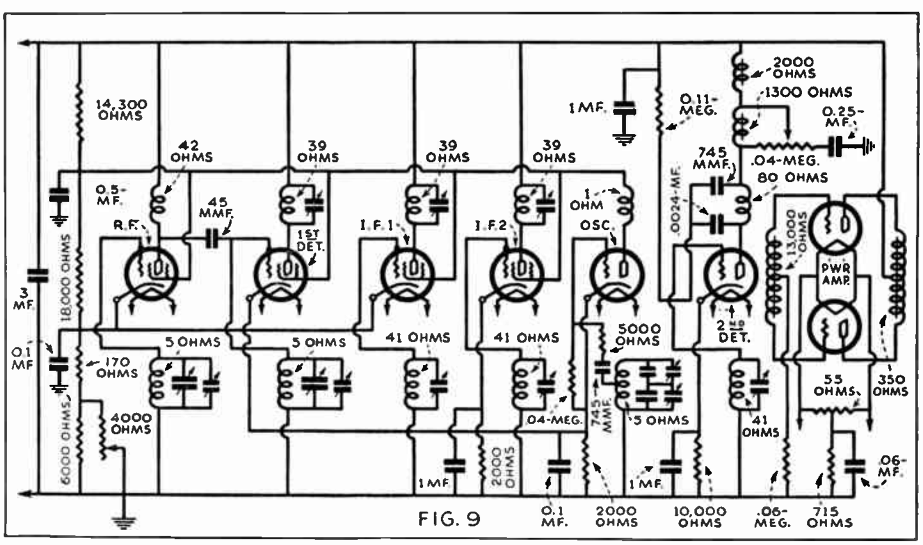


FIGURE 9. *A typical radio receiving circuit, the Radiola 80, and how series and parallel resistors are practically applied.*

AC Voltage and Power

Where Z is the *Impedance* in Ohms, E is *Effective* Electromotive Force in Volts, and I is Current Intensity in Amperes, then

$$I = \frac{E}{Z} \qquad E = Z \times I \qquad Z = \frac{E}{I}$$

The *Maximum* Voltage Em is $1.414 \times$ the *Effective* Voltage Ee.

The *Effective* Voltage Ee is $0.707 \times$ the *Maximum* Voltage Em.

The *Average* Voltage Ee is $0.636 \times$ the *Maximum* Voltage Em.

The *Power* in an AC circuit W =

$$I \times E \times \frac{R}{Z}$$

Where the Angle of Lag or lead, Φ and the

$$\text{Power Factor } \frac{R}{Z} = \textit{Cosine } \Phi,$$

$$\textit{Sine } \Phi = \frac{X}{Z}, \text{ and } \textit{Tangent } \Phi = \frac{X}{R}$$

Reactance (Inductive) of a Coil

$$X_L = 2\pi fL$$

Where $\pi = 3.14$
f = frequency in cycles per second
L = inductance in henries

Example: What is the reactance of a 20-henry choke at 50 cycles?

$$6.3 \times 50 \times 20 = 6{,}300 \text{ ohms}$$

Reactance (Capacitative) of a Condenser

$$Xc = \frac{10^6}{2\pi fC}$$

Where: $\pi = 3.14$
f = frequency
C = capacity in microfarads

Example: What is the reactance of a 2-mf. condenser at 50 cycles?

$$\frac{10^6}{6.3 \times 50 \times 2} = 1{,}590 \text{ ohms}$$

Conversion Table Frequency to Wavelength

$$\text{Wavelength in Meters} = \begin{cases} \dfrac{300{,}000}{\text{Frequency in Kilocycles}} \\ \text{or} \\ \dfrac{300}{\text{Frequency in Megacycles}} \end{cases}$$

Long-Wave Broadcast Band		Short Waves	
Frequency Kilocycles	Wavelength Meters	Frequency Megacycles	Wavelength Meters
550	545	1.5	200
600	500	2	150
650	461	3	100
700	429	4	75.0
750	400	5	60.0
800	375	6	50.0
850	353	7	42.9
900	333	8	37.5
950	316	9	33.3
1000	300	10	30.0
1050	286	11	27 3
1100	273	12	25.0
1150	261	13	23.1
1200	250	14	21.4
1250	240	15	20.0
1300	231	16	18.8
1350	222	17	17.6
1400	214	18	16.7
1450	207	19	15.8
1500	200	20	15.0

Impedance of a Circuit

The impedance of a circuit consisting of a resistor and capacitor in series is:

$$Z = \sqrt{R^2 + Xc^2}$$

The impedance of a circuit consisting of a resistor in parallel with a condenser is:

$$Z = \frac{RXc}{\sqrt{R^2 + Xc^2}}$$

Equivalent Impedance of a Series Circuit

When an inductance, capacity and a resistance are connected in series, the combined effect is called the impedance of the circuit.

$$Zo = \sqrt{R_L - (X - Xc)^2}$$

Where: Z = impedance in ohms
R = resistance in ohms
X_L = reactance of inductance in ohms
Xc = reactance of capacity in ohms

Greek Alphabet

Name	Letters		Commonly used to designate
	Cap.	Small	
Alpha	Α	α	Angles. Coefficients. Area.
Beta	Β	β	Angles. Coefficients.
Gamma	Γ	γ	Specific gravity. Conductivity.
Delta	Δ	δ	Decrements. Variation. Density.
Epsilon	Ε	ε	E.m.f. Base of hyperbolic logarithms.
Zeta	Ζ	ζ	Impedance. Co-ordinates.
Eta	Η	η	Hysteresis coefficient. Efficiency.
Theta	Θ	ϑ	Angular phase displacement. Time constant.
Iota	Ι	ι	Current in amperes.
Kappa	Κ	ϰ	Dielectric constant. Susceptibility. Kilo. Visibility.
Lambda	Λ	λ	(Small) Wave length.
Mu	Μ	μ	Permeability. Amplification factor. Prefix micro-
Nu	Ν	ν	Reluctivity.
Xi	Ξ	ξ	
Omicron	Ο	ο	
Pi	Π	π	Circumference divided by diameter, 3.1416.
Rho	Ρ	ρ	Resistivity.
Sigma	Σ	σ	(Cap) Sign of summation.
Tau	Τ	τ	Time constant. Time-phase displacement.
Upsilon	Υ	υ	
Phi	Φ	φ	Flux. Angle of lag or lead.
Chi	Χ	χ	Reactance.
Psi	Ψ	ψ	Angular velocity in time. Phase difference. Dielectric flux.
Omega	Ω	ω	Resistance in ohms. Resistance in megohms. $2\pi F$. Angular velocity.

Conversion

Factors for conversion—alphabetically arranged.

Multiply	By	To Get	Multiply	By	To Get
Amperes	× 1,000,000,000,000	micromicroamperes	Micro-ohms	× .000,001	ohms
Amperes	× 1,000,000	microamperes	Microvolts	× .000,001	volts
Amperes	× 1,000	milliamperes	Microwatts	× .000,001	watts
Cycles	× .000,001	megacycles	Micromicrofarads	× .000,000,000,001	farads
Cycles	× .001	kilocycles	Micromicro-ohms	× .000,000,000,001	ohms
Farads	× 1,000,000,000,000	micromicrofarads	Milliamperes	× .001	amperes
Farads	× 1,000,000	microfarads	Millihenrys	× .001	henrys
Farads	× 1,000	millifarads	Millimhos	× .001	mhos
Henrys	× 1,000,000	microhenrys	Milliohms	× .001	ohms
Henrys	× 1,000	millihenrys	Millivolts	× .001	volts
Kilocycles	× 1,000	cycles	Milliwatts	× .001	watts
Kilovolts	× 1,000	volts	Ohms	× 1,000,000,000,000	micromicro-ohms
Kilowatts	× 1,000	watts	Ohms	× 1,000,000	micro-ohms
Megacycles	× 1,000,000	cycles	Ohms	× 1,000	milliohms
Mhos	× 1,000,000	micromhos	Volts	× 1,000,000	microvolts
Mhos	× 1,000	millimhos	Volts	× 1,000	millivolts
Microamperes	× .000,001	amperes	Watts	× 1,000,000	microwatts
Microfarads	× .000,001	farads	Watts	× 1,000	milliwatts
Microhenrys	× .000,001	henrys	Watts	× .001	kilowatts
Micromhos	× .000,001	mhos			

Equivalent Impedance of a Parallel Circuit

When an inductance, capacity and resistance are connected in parallel the equivalent impedance

$$Zo = \frac{RX_L\,Xc}{\sqrt{(RX_L - RXc)^2 + X_L^2Xc^2}}$$

Resonant Frequency

Where L is the *Inductance* in henries and C the *Capacity* in farads, f is the Frequency in cycles (per second), then in ohms,

The Inductive Reactance $X_L = 6.283 \times fL$

The Capacitative Reactance $Xc = \dfrac{1}{6.283\sqrt{LC}}$

Frequency

Where: f = frequency in cycles
π = 3.14
L = inductance in microhenries
C = capacity in microfarads (mf.)

$$f = \frac{10^6}{2\pi\sqrt{LC}}$$

Example: To what frequency will a 0.0005 mf. (500 mmf.) condenser, in parallel with a 180-microhenry coil, tune?

$$\frac{10^6}{6.3\sqrt{180 \times 0.0005}} = 530{,}000 \text{ cycles} = 530 \text{ kilocycles} = 565 \text{ meters}$$

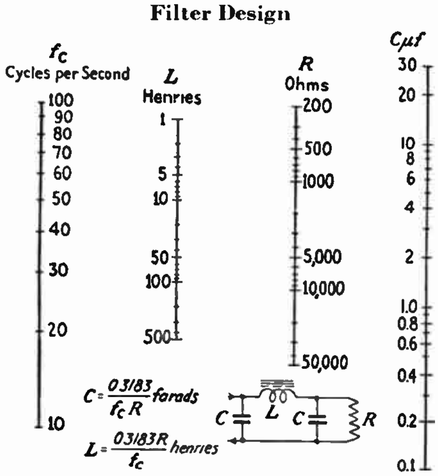
Dissipation Factor Q

The ratio Q of reactance to resistance is generally used as the factor of merit of a coil or condenser and is called the dissipation constant.

For a coil $Q = \dfrac{\omega L}{R}$

For a condenser $Q = \dfrac{1}{\omega RC}$

Filter Design



Fc = cut-off frequency
R = resistance of the load

The cut-off frequency Fc should be lower than the ripple frequency which for 60-cycle supply is 60 cycles for a half-wave rectifier and 120 cycles for a full-wave rectifier. The lower the frequency of cut-off, the better the filtering of the ripple frequency. Preferably the cut-off frequency should be below the lowest frequency to be handled by the amplifier with which the filter is associated.

Capacity of Parallel Plates

When two conducting plates are parallel, close together, and of large area, the capacity is given by

$$C = 0.0885 \text{ times } \frac{KS}{t}$$

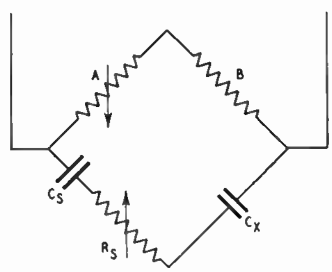
Where C = capacity in micromicrofarads
K = dielectric constant
S = area of one plate in square centimeters
t = distance between plates in centimeters

Power Factor of a Condenser

$$Pf = \frac{R}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}}$$

Where: R = the resistance of the condenser
ω = 6.28 times the frequency
C = capacity in farads

On a bridge the resistance (R) is determined by dividing the reading of the series resistance (Rs) by the ratio of A/B (where the resistance of Cs is negligible).



Resistances in Series

$$R_t = R_1 + R_2 + R_3 \ldots R_n$$

Where: R_t is the total value of all resistors connected in series.
R_1, R_2, etc., are the individual resistors.

Resistances in Parallel

$$R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Where: R_t is the effective value of all the resistors connected in parallel.
R_1, R_2 are the individual resistors.

Example: What is the effective value of resistance of a circuit having resistors of 30,000 and 60,000 ohms connected in parallel?

$$R_t = \frac{30{,}000 \times 60{,}000}{30{,}000 + 60{,}000} = 20{,}000 \text{ ohms}$$

Color Code Chart for Fixed Condensers
(Total Indicates mmf.)

First Dot	Second Dot	Third Dot
Black........0	Black......0	
Brown........1	Brown......1	Brown.........0
Red..........2	Red........2	Red..........00
Orange.......3	Orange.....3	Orange.......000
Yellow.......4	Yellow.....4	Yellow.....0,000
Green........5	Green......5	Green.....00,000
Blue.........6	Blue.......6	Blue.....000,000
Purple.......7	Purple.....7	Purple..0,000,000
Gray.........8	Gray.......8	Gray...00,000,000
White........9	White......9	White 000,000,000

Vacuum-Tube Formulas

Amplification constant ("mu") μ equals

$$\frac{\text{Change in Plate Voltage } (E_p)}{\text{Change in Grid Voltage } (E_g)}$$

Plate Impedance (in ohms) r_p equals

$$\frac{\text{Change in Plate Voltage } (E_p)}{\text{Change in Plate Current } (I_p)}$$

Mutual Conductance g_m equals

$$\frac{\text{Change in Plate Current } (I_p)}{\text{Change in Grid Voltage } (E_g)}$$

When the Plate Current is measured in Amperes; the Mutual Conductance

$$g_m \text{ in MICROMHOS} = \frac{\mu}{r_p} \times 1{,}000{,}000$$

When E_g is the Input Voltage, r_p is the Plate Impedance and R_p is the External Plate Impedance or Load Impedance, the

$$\text{Voltage Amplification} = \frac{\mu \times E_g \times R_p}{r_p + R_p}$$

The Decibel

The number of decibels corresponding to a given power ratio is 10 times the common logarithm of the ratio.

$$N = 10 \operatorname{Log}_{10} \frac{P_2}{P_1}$$

Where: N = decibels.

$$\frac{P_2}{P_1} = \text{power ratio}$$

In the case of voltage or current the number of decibels corresponds to 20 times the common logarithm of the ratio.

Example: What gain in decibels will there be if the voltage in an amplifier rises to 7 times the normal level at a certain frequency?

$$N = 20 \log_{10} 7 = 20 \times 0.845 = 17 \text{ decibels.}$$

Transformer Ratios

$$\frac{\text{The Voltage across the Secondary}}{\text{The Voltage across the Primary}} \text{ equals } \frac{\text{The Number of Secondary Turns}}{\text{The Number of Primary Turns}}$$

Power Output

When E_g expresses the RMS (Root-Mean-Square) Effective Value of the AC Input, the

$$\text{POWER OUTPUT} = \frac{\mu^2 \times E_g^2 \times R_p}{(r_p + R_p)^2}$$

The MAXIMUM Power Output is $\dfrac{\mu^2 \times E_g^2}{4r_p}$

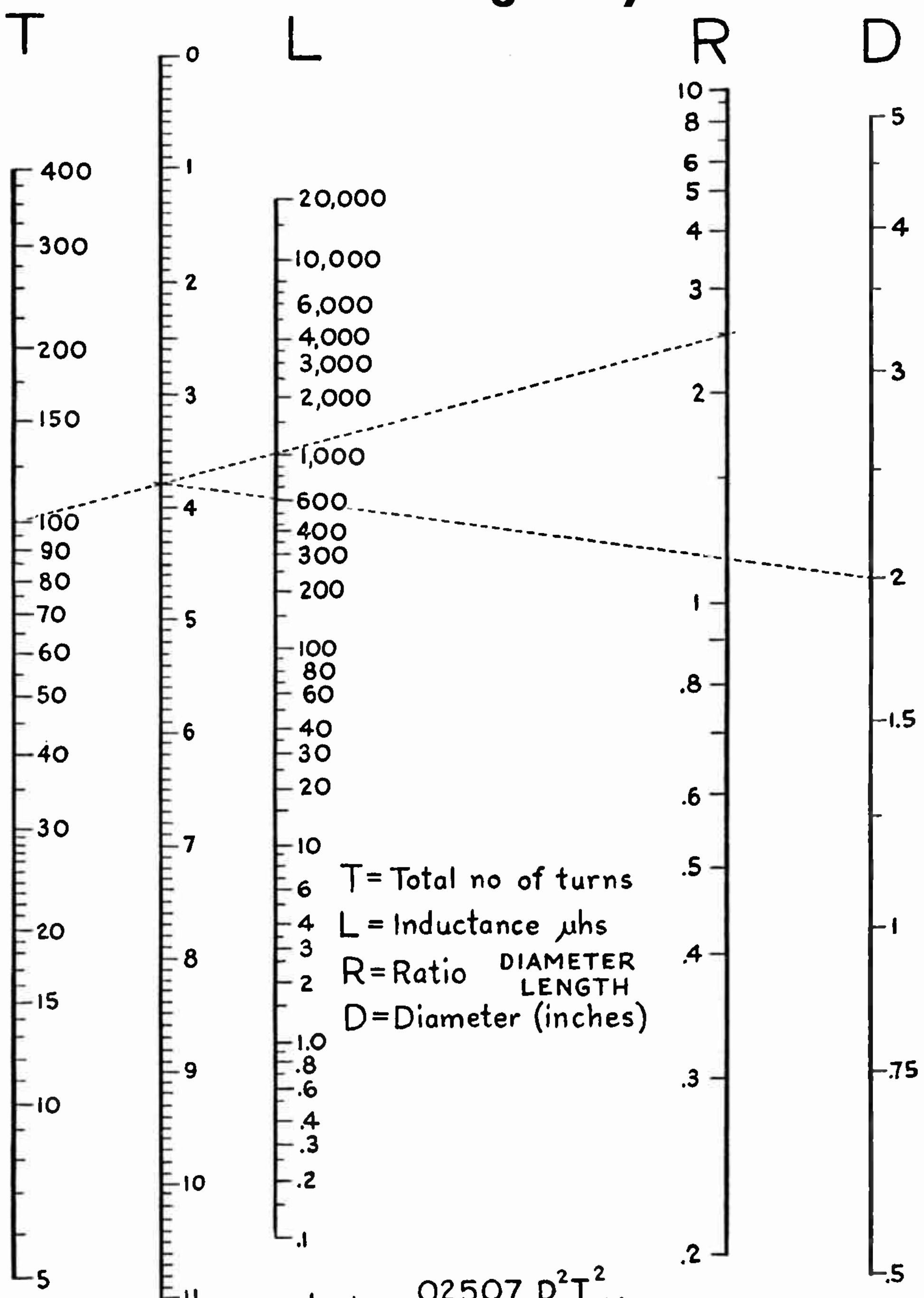
The Maximum UNDISTORTED Power Output is $\dfrac{2\,\mu^2 \times E_g^2}{9r_p}$

When E_g is the Maxmum (Peak) A. C. Input Value

The Maximum Undistorted Power Output is

$$\frac{\mu^2 \times E_g^2}{9r_p}$$

Inductance of Single Layer Coils



$$L\mu h = \frac{.02507\ D^2T^2}{l}K$$

$$K = f\ \frac{D}{l}$$

$$l = \text{length}$$

COIL TURNS, INDUCTANCE AND DIAMETER

Knowing the turns of a coil, its length of winding, and the diameter, the inductance may be found by using a straight-edge from the turns column to the ratio (diameter ÷ length) column, intersecting the axis column; then a second line from the intersection of the axis column to the diameter column. The inductance in microhenries will be the point where the second line intersects the inductance column. In the above chart the first line is laid from 100 turns to 2.5 ratio, this first line intersecting the axis at 3.8 on the scale. The second line is from 3.8 on the axis scale to the 2-inch diameter, intersecting the inductance column at 600 microhenries.

Knowing the diameter, ratio and the inductance, the number of turns may be found by reversing the process. As shown in the chart, draw a line from 2 inch diameter through the 600 microhenries intersecting axis at 3.8 on the scale; then run line from 3.8 on axis scale to 2.5 on ratio, the extension of this line cutting the turns scale at 100 which is the number of turns.

After finding number of turns, consult wire table to determine size of wire which will permit given number of turns in a given length of winding.

RECEIVING TUBE CHARACTERISTICS

IN THE radio service field, one of the most rapid methods of trouble shooting is by an analysis of voltage or resistance values taken at the various pins of a tube. This procedure, using the tube pins as convenient test points, usually indicates which circuit or circuits are offending. A complete knowledge of the pin arrangements of all tube types is necessary. Since there is a large variety of pin arrangements in use, it is almost impossible for any serviceman to remember each particular type. Therefore, one of the first requirements of any tube table or chart is to provide complete and authentic base layout information.

If the particular trouble is not in the associated circuits, but in the tube itself, it is desirable to have a quick reference to the characteristic data and operating conditions of the tube in question. The ability of a tube chart to give accurate characteristic information in a clear, concise manner, places a second evaluation on its worth.

PRESENT NUMBERING SYSTEM

The application of type designations to vacuum tubes was a haphazard process until the Radio Manufacturers Association set up a committee of engineers from the radio tube industry to handle the numbering of tubes and associated problems connected with the new types. From this committee came the present numbering system: a numeral to indicate approximate filament or heater operating voltage; a letter to show the function of the tube, and a numeral to indicate the number of elements. Thus the 25Z5 tells by its first numeral group that the filament or heater operates at approximately 25 volts, by the letter Z that the tube is a rectifier; and by the final numeral that the tube has five connected elements, i.e., two plates, two cathodes and one common heater. Reference to the charts will show that more than seventy-five tubes appear under the old numbering system of an arbitrary numeral. No doubt there are many more tubes in this class which for some reason (usually poor adaptability to circuits) were dropped by the manufacturer who introduced them.

The tendency to designate equivalent tubes among glass, metal, and metal-glass types has not been entirely satisfactory. It is true that the equivalent or cross reference system does establish the general characteristic identity more quickly. The confusion arises from the fact that the pin arrangements may differ, the difference in interelectrode capacities may create alignment difficulties, and in the case of rectifier types maximum current ratings are sometimes altered to allow for a variance in dissipation properties.

It has been popular in the past to group certain filament or heater voltage values of tubes. This method of listing was very helpful until the number of types in use became so large that any attempt at extensive grouping resulted in confusion rather than the simplicity intended. To prevent any such condition, and to facilitate reference work the new tube charts included in this encyclopedia are presented in only four divisions, namely:

(a) The original number types (01A, 15, 24, 27, 35, etc.).

(b) The newer letter types (1A4, 1J7, 2A7, 6K7, 6F8G, etc.).

(c) The complete rectifier types (5Z3, 5W4, 6X5, 80, etc.).

(d) The special tubes, i.e., those manufactured for a special application, or exclusive use by a certain manufacturer.

The decision to use this new method of listing was reached only after a comprehensive survey of opinions representing a majority of the servicing profession. We believe this system to be the most logical and easy to use reference method.

BIAS RESISTOR CALCULATIONS

The serviceman often finds it necessary to replace the grid bias resistor in receivers employing a self-biasing arrangement for obtaining the proper grid voltage. When the resistance value is not known, it may be calculated by dividing the grid voltage required (at the plate voltage at which the tube is operating), by the plate current in amperes, plus the screen current in amperes, times the number of tubes passing current through the resistor.

Under this rule, the grid bias resistor value is given by the following formula:

$$R = \frac{E_{c1} \times 1{,}000}{(I_B + I_{c2})n}$$

where: R = Grid bias resistor value in ohms.

E_{c1} = The grid bias required in volts.

I_B = The plate current of a single tube in milliamperes.

I_{c2} = The screen grid current of a single tube in milliamperes.

n = The number of tubes passing current through the resistor.

Example—It is desired to determine the value of bias resistor used to obtain the proper value of grid bias on three type '35 tubes working in the radio frequency stages of a receiver. First, determine the plate and screen voltages employed in this set. Suppose, in this case, it is found that the plate supply voltage is 250 and the screen voltage is 90. Looking in the characteristics chart on page 319, it is found that the proper grid bias for the '35 under these conditions is −3.0 volts. In addition, the plate current is 6.5 milliamperes. The screen current is 2.5 milliamperes. Substituting in the formula,

$$R = \frac{3.0 \times 1{,}000}{(6.5 + 2.5)3} = 111 \text{ ohms}$$

The value of grid bias resistors can be calculated in this manner for any type and any number of tubes. In the case of triodes, the screen current term drops out entirely.

Be sure to determine the plate voltage at which the tubes are working, the number of tubes being supplied from the bias resistor, the screen voltage (if a tetrode or pentode), the correct value of grid bias voltage required (whether the tube cathode is operated from AC or DC will affect the value of bias voltage), and the plate and screen current for the given plate voltage.

In the case of resistance-coupled amplifiers which employ high resistance in the plate circuit, it must be remembered that the plate voltage is equal to the plate supply voltage minus the voltage drop in the plate load resistance caused by the plate current. The net plate voltage alone determines the correct value of grid bias.

The foregoing methods of calculations apply to self bias only.

Size of Bias Resistors—In addition to having the proper resistance, a resistor should have sufficient size and heat dissipating ability to carry the current. The actual wattage dissipated in a resistor can easily be calculated from the following application of Ohms law:

$$\text{Watts} = \frac{E^2}{R}$$

where
E = voltage across resistors
R = resistance in ohms

When selecting the proper resistor for a given application, the actual wattage given by the formula should be multiplied from two to ten times, depending upon such factors as air circulation, mounting position, and amount of heat which may be developed without injury to other parts. For a given dissipation, the larger the resistor, the lower the operating temperature per unit of area.

Cut-Off Bias—Every serviceman should be familiar with the formula for calculating "cut-off." This is the point where plate current ceases to flow as the grid voltage is made increasingly negative. In volume control circuits, the control range should never be extended into the "cut-off" region, otherwise serious distortion will result. The formula *for triodes* is:

$$\text{"Cut-off" voltage} = \frac{\text{Plate voltage}}{\text{Mu}}$$

"The cut-off" voltage for tetrodes, pentodes and variable mu tubes cannot be calculated from this simple formula, and should be obtained from the tube manufacturers' tables.

COMPLETE TUBE CHART

Type No.	DESCRIPTION Type	DESCRIPTION Cathode	Basing See Socket Connection Chart on Pages 327-329	Fil. Curr. Amps.	CAPACITANCES Micro-Microfarads Plate	Input	Output	OPERATING CONDITIONS CHARACTERISTICS When Used As	Plate Supply Volts	Screen Grid Volts	Grid Bias Volts (Neg.)	Plate Current Ma.	Screen Current Ma.	Ampl. Factor	Plate Resist. Ohms	Mut. Cond. µ Mhos.	Max. Undist. Output Watts	Recomm. Load Resist. Ohms	Cut-Off Bias Volts
01A	Triode	Fil. 5.0V	4D Medium 4 Pin	0.25	8.1	3.1	2.2	Grid Leak Det.	45		+A	1.8		8.0	12,000	670			
								Amplifier	90		4.5	2.5		8.0	11,000	725	0.015	25000	
									135		9.0	3.0		8.0	10,000	800	0.055	20000	
10	Triode	Fil. 7.5V	4D Medium 4 Pin	1.25	7.0	4.0	3.0	Amplifier	350		32	16		8.0	5,150	1550	0.9	11000	
									425		40	18		8.0	5,000	1600	1.6	10200	
WD11 / WX12	Triode	Fil. 1.1V	4F Special 4 Pin / 4D Medium 4 Pin	0.25	3.3	2.5	2.5	Grid Leak Detector	45		+A								
								Amplifier	90		4.5	2.5		6.6	15,500	425	0.007	15000	
									135		10.5	3.0		6.6	15,000	440	0.040	15000	
12A	Triode	Fil. 5.0V	4D Medium 4 Pin	0.25	8.0	4.0	2.0	Amplifier	135		9.0	6.2		8.5	5,100	1650	0.130	9000	
									180		13.5	7.7		8.5	4,700	1800	0.85	10700	
15	Pentode	Heater 2.0V	5F Small 5 Pin	0.220	0.01	2.35	7.80	Detector-Oscillator	135	67.5	1.5	1.85	0.30	600	800,000	750			
18	Pentode	Heater 14V	6B Small 6 Pin	0.3				Power Amplifier	250	250	16.5	34	7.5	185	79,000	2350	3.0	7000	
19	Twin Triode	Fil. 2.0V	6C Small 6 Pin	0.260				Complete Class B	135		0	5 (Zero signal plate current per plate)					2.1	10000	
									135		3.0	2 (Zero signal plate current per plate)					1.9	10000	
20	Triode	Fil. 3.3V	4D Small 4 Pin	0.132	3.7	2.4	2.3	Power Amplifier	135		22.5	6.0		3.5	5,850	600	0.130	6500	
22	Screen Grid	Fil. 3.3V	4K Medium 4 Pin	0.132	0.02	4.0	12.0	RF Amplifier	135	67.5	1.5	3.7	1.3	125	250,000	500			
24A	Screen Grid Tetrode	Heater 2.5V	5E Medium 5 Pin	1.75	0.007	5.3	10.5	RF Amplifier	180	90	3.0	4.0	1.7	400	400,000	1000			15
									250	90	3.0	4.0	1.7	630	600,000	1050			15
26	Triode	Fil. 1.5V	4D Medium 4 Pin	1.05	8.1	2.8	2.5	Amplifier	135		10	5.5		8.3	7,600	1100	0.080	8800	
									180		14.5	6.2		8.3	7,300	1150	0.180	10500	
27	Triode	Heater 2.5V	5A Small 5 Pin	1.75	3.3	3.1	2.8	Detector	250		30								
								Amplifier	135		9.0	4.7		9	9,000	1000	0.080	13000	
									180		13.5	5.0		9	9,000	1000	0.165	19000	
30	Triode	Fil. 2.0V	4D Small 4 Pin	0.060	6.0	3.0	2.1	Amplifier	135		9.0	3.0		9.3	10,300	900	0.070	20000	
									180		13.5	3.1		9.3	10,300	900	0.130	20000	
31	Triode	Fil. 2.0V	4D Small 4 Pin	0.130	5.7	3.5	2.7	Amplifier	135		22.5	8.0		3.8	4,100	925	0.185	7000	
									180		30.0	12.3		3.8	3,600	1050	0.375	5700	
32	Screen Grid Tetrode	Fil. 2.0V	4K Medium 4 Pin	0.60	0.015	6.0	12.0	Amplifier	135	67.5	3.0	1.7	0.4	610	950,000	640			9.0
									180	67.5	3.0	1.7	0.4	780	1,200,000	650			9.0
33	Pentode	Fil. 2.0V	5K Medium 5 Pin	0.260	1.0	8.0	12.0	Amplifier	135	135	13.5	14.5	3.0	70	50,000	1450	0.700	7000	
									180	180	18.0	22.0	5.0	90	55,000	1700	1.400	6000	
34	Variable Mu Pentode	Fil. 2.0V	4M Medium 4 Pin	0.060	0.015	6.0	12.6	1st Detector	67.5 to 180	67.5	5.0								
								Amplifier	135	67.5	3.0	2.8	1.0	360	600,000	600			22.5
									180	67.5	3.0	2.8	1.0	620	1,000,000	620			22.5
35/51	Variable Mu Tetrode	Heater 2.5V	5E Medium 5 Pin	1.75	0.007	5.0	10.5	1st Detector	250	90 max.	7.0								
								Amplifier	180	90	3.0	6.3	2.5	305	300,000	1020			40
									250	90 max.	3.0	6.5	2.5	420	400,000	1050			40

Type No.	Description: Type	Description: Cathode	Basing See Socket Connection Chart on Pages 327-329	Fil. Curr. Amps.	Capacitances Micro-Microfarads: Plate	Input	Output	Operating Conditions Characteristics: When Used As	Plate Supply Volts	Screen Grid Volts	Grid Bias Volts (Neg.)	Plate Current Ma.	Screen Current Ma.	Ampl. Factor	Plate Resist. Ohms	Mut. Cond. μ Mhos.	Max. Undist. Output Watts	Recomm. Load Resist. Ohms	Cut-Off Bias Volts
36	Screen Grid Tetrode	Heater 6.3V	5E Small 5 Pin	0.30	0.007	3.7	9.2	Detector	180	67.5	6.0								
								Amplifier	100	55	1.5	1.8		470	550,000	850			6.0
									250	90	3.0	3.2	1.7	595	550,000	1080			8.0
37	Triode	Heater 6.3V	5A Small 5 Pin	0.30	2.0	3.5	2.9	Detector	180		20								
								Amplifier	90		6.0	2.5		9.2	11,500	800	0.030	17500	10
									250		18.0	7.5		9.2	8,400	1100	0.340	20000	30
38	Pentode	Heater 6.3V	5F Small 5 Pin	0.30	0.30	3.5	7.5	Amplifier	100	100	9.0	7.0	1.2	120	140,000	875	0.270	15000	
									135	135	13.5	9.0	1.5	120	130,000	925	0.550	13500	
									250	250	25	22	3.8	120	100,000	1200	2.5	10000	
39/44	Variable Mu Pentode	Heater 6.3V	5F Small 5 Pin	0.30	.007	4.0	10.0	1st Detector	90 to 250	90	7. approx.								
								Amplifier	90	90	3.0	5.6	1.6	360	375,000	960			42.5
									250	90	3.0	5.8	1.4	1050	1,000,000	1050			42.5
40	Triode	Fil. 5.V	4D Medium 4 Pin	0.25	8.0	2.8	2.2	Detector	180		4.5	0.1		30				250,000	
								Amplifier	180		3.0	0.2		30	150,000	200		250,000	
41	Pentode	Heater 6.3V	6B Small 6 Pin	0.40				Amplifier	180	180	13.5	18.5	3.0	150	81,000	1850	1.5	9,000	
									250	250	18.0	32.0	5.5	150	68,000	2200	3.4	7,600	
42	Pentode	Heater 6.3V	6B Medium 6 Pin	0.70				Amplifier	250	250	16.5	34.0	7.5	220	79,000	2350	3.0	7,000	
									315	315	22.0	43.0	8.5	250	100,000	2600	5.0	7,000	
								AB_2 P.P.	375	250	26.0	17.0	2.5				19.0	10,000	(P. to P.)
43	Pentode	Heater 25.0V	6B Medium 6 Pin	0.30				Amplifier	95	95	15.0	20.0	4.0	90	45,000	2000	0.9	4,500	
									180	135	20.0	38.0	7.5	100	40,000	2500	2.75	5,000	
45	Triode	Fil. 2.5V	4D Medium 4 Pin	1.50	6.5	3.6	3.0	Amplifier	180		31.5	31.0		3.5	1,650	2125	0.83	2,700	
									275		56.0	36.0		3.5	1,700	2050	2.00	4,600	
								AB_2 P.P.	275		68.0	14 to 69 per tube					18.00	3,200	(P. to P.)
46	Double Grid Triode	Fil. 2.5V	5C Medium 5 Pin	1.75				Class A	250		33	22.0		5.6	2,380	2350	1.25	6,400	
								Class B	300		0	4 (Zero signal plate current per tube)					16.00	5,200	(P. to P.)
									400		0	6 (Zero signal plate current per tube)					20.00	5,800	(P. to P.)
47	Pentode	Fil. 2.5V	5B Medium 5 Pin	1.75	1.2	8.6	13.0	Amplifier	250	250	16.5	31.0	6.0	150	60,000	2500	2.7	7,000	
48	Tetrode	Heater 30V	6A Medium 6 Pin	0.40				Amplifier	95	95	20.0	52.0	12.0	15.6	4,000	3900	2.0	1,500	
									125	100	22.5	56.0	12.0	43	11,000	3900	2.5	1,500	
49	Double Grid Triode	Fil. 2.0V	5C Medium 5 Pin	0.12				Class A	135		20.0	6.0		4.7	4,175	1125	0.170	11,000	
								Class B	180		0	2 (Zero signal plate current per tube)					3.0	9,000 min.	
50	Triode	Fil. 7.5V	4D Medium 4 Pin	1.25	8.4	4.4	2.7	Amplifier	350		63.0	45.0		3.8	1,900	2000	2.4	4,100	
									450		84.0	55.0		3.8	1,800	2100	4.6	4,350	
53	Twin Triode	Heater 2.5V	7B Medium 7 Pin Large Pin Circle	2.0				Class A	294 (Parallel Conn.)		6.0	7.0		35	11,000	3200	0.37	30,000	
								Class B	250		0	14 (Zero signal current per plate)					8.0	8,000	
									300		0	17.5 (Zero signal current per plate)					10.0	10,000	
55	Duplex Diode Triode	Heater 2.5V	6G Small 6 Pin	1.0	1.5	1.5	4.3 (Triode Section)	Diode Detector, Triode Amplifier	180		13.5	6.0		8.3	8,500	975	0.160	20,000	
									250		20.0	8.0		8.3	7,500	1100	0.350	20,000	
56	Triode	Heater 2.5V	5A Small 5 Pin	1.0	3.2	3.2	2.2	Detector	250		20.0	(Plate current—Adjust to 0.2 ma. with no AC input signal)							
								Amplifier	250		13.5	5		13.8	9,500	1450	0.260		

57	Pentode	Heater 2.5V	6F Small 6 Pin	1.0	.007	5.0	6.5	Detector	250	100	4.3							500,000	
								Amplifier	250	100	3.0	2.0	0.5	1500	1.5MΩ	1225			7
58	Variable Mu Pentode	Heater 2.5V	6F Small 6 Pin	1.0	.007	4.7	6.3	1st Detector	250	100	10.0								
								Amplifier	250	100	3.0	8.2	2.0	1280	0.8MΩ	1600			50
59	Triple Grid	Heater 2.5V	7A Medium 7 Pin Large Pin Circle	2.0				Triode	250		28.0	26.0		6	2,400	2600	1.25	5,000	
								Pentode	250	250	18.0	35.0	9.0	100	40,000	2500	3.00	6,000	
								Class B	400		0	13 (Zero signal plate current per tube)					20.0	6,000	(P. to P.)
71A	Triode	Fil. 5.0V	4D Medium 4 Pin	0.25	6.6	3.2	2.9	Amplifier	135		27.0	17.3		3	1,820	1650	0.4	3,000	
									180		40.5	20.0		3	1,750	1700	0.79	4,800	
75	Duplex Diode Triode	Heater 6.3V	6G Small 6 Pin	0.30	1.7 (Triode	1.7 Section)	3.8	Diode Detector, Triode Amplifier	250		2.0	0.8		100	91,000	1100			
76	Triode	Heater 6.3V	5A Small 5 Pin	0.30	2.8	3.5	2.5	Amplifier	100		5.0	2.5		13.8	12,000	1150			
									250		13.5	5.0		13.8	9,500	1450			
77	Pentode	Heater 6.3V	6F Small 6 Pin	0.30	.007	4.7	11.0	Detector	250	100	4.3	0.43						500,000	
								Amplifier	250	100	3.0	2.3	0.5	1500	1.5MΩ	1250			7.5
78	Variable Mu Pentode	Heater 6.3V	6F Small 6 Pin	0.30	.007	4.5	11.0	1st Detector	250	100	10.0	(Suppressor tied to cathode)							
								Amplifier	250	100	3.0	7.0	1.7	1160	800,000	1450			42.5
79	Twin Triode	Heater 6.3V	6H Small 6 Pin	0.60				Complete Class B	250		0	10.5		(Zero signal current, per plate)			8.0	14,000	
85	Duplex Diode Triode	Heater 6.3V	6G Small 6 Pin	0.30	1.5 (Triode	1.5 Section)	4.3	Diode Detector, Triode Amplifier	135		10.5	3.7		8.3	11,000	750	.075	25,000	
									180		13.5	6.0		8.3	8,500	975	0.160	20,000	
									250		20.0	8.0		8.3	7,500	1100	0.350	20,000	
89	Triple Grid	Heater 6.3V	6F Small 6 Pin	0.40				Triode	250		31.0	32		4.7	2,600	1800	0.9	5,500	
								Pentode	250	250	25.0	32	5.5	125	70,000	1800	3.4	6,750	
								Class B	180		0	6 (Zero signal current per plate)					3.5	9,400	(P. to P.)
V99 / X99	Triode	Fil. 3.3V	4E Small 4 Nub / 4D Small 4 Pin	.063	3.6	2.5	2.2	Amplifier	90 max.		4.5	2.5		6.6	15,500	425	.007		
VR150	Voltage Regulator	Cold	Octal Cathode No. 2 Anode No. 5	(Gas Discharge)				Regulator	Minimum Starting Voltage, 180 Volts Operating Voltage, 150 Volts Operating Current, 5 Ma. Min., 30 Ma. Max.										
864	Non-Microphonic Triode	Fil. 1.1V	4D Small 4 Pin	0.25	4.0	2.6	2.1	Amplifier	135		9.0	3.5		8.2	12,700	645		15,000	
874	Voltage Regulator	Cold	Medium 4 Pin Cathode No. 1 Anode No. 3	(Gas Discharge)				Regulator	Minimum Starting Voltage, 125 Volts Operating Voltage, 90 Volts Operating Current, 10 Ma. Min., 50 Ma. Max.										
954	Acorn Pentode	Heater 6.3V	Special	0.150	.007	3.0	3.0	Amplifier	90	90	3.0	1.2	0.5	1100	1MΩ	1100			
									250	100	3.0	2.0	0.7	2000	1.5MΩ	1400			
								Detector	250	100	6.0							.25MΩ	
955	Acorn Triode	Heater 6.3V	Special	0.150	1.4	1.0	0.6	Class A Amplifier	90		2.5	2.5		25	14,700	1700			
									135		3.75	3.5		25	13,200	1900			
									180		5.0	4.5		25	12,500	2000	.135	20,000	
								Class C Amplifier	180		35	7.0					0.5		
956	Variable Mu Acorn Pentode	Heater 6.3V	Special	0.150	.007	2.7	3.5	Amplifier	250	100	3.0	5.5	1.8	1440	800,000	1800			
1602	Triode	Fil. 7.5V	4D Medium 4 Pin Bayonet	1.25	7	4	3	Class A	425		40	18		8.0	5,000	1600	1.6	10,200	
								Class B (Two Tubes)	425		50	8 (Zero signal current per plate)					25.0	8,000	(P. to P.)
	(Formerly designated as 10 Special)							Class C	450		200	60					13.0		

Type No.	DESCRIPTION Type	DESCRIPTION Cathode	Basing See Socket Connection Chart on Pages 327-329	Fil. Curr. Amps.	CAPACITANCES Micro-Microfarads Plate	Input	Output	OPERATING CONDITIONS CHARACTERISTICS When Used As	Plate Supply Volts	Screen Grid Volts	Grid Bias Volts (Neg.)	Plate Current Ma.	Screen Current Ma.	Ampl. Factor	Plate Resist. Ohms	Mut. Cond. µMhos.	Max. Undist. Output Watts	Recomm. Load Resist. Ohms	Cut-Off Bias Volts
1603	Non-Microphonic Pentode	Heater 6.3V	6F Small 6 Pin	0.30	Pentode .007	5.0	6.5	Amplifier Pentode	250	100	3.0	2		1500	1.5MΩ	1225			7
					2.0	Triode 3.0	10.5	Triode Connection	250		8.0	6.5		20	10,500	1900			
1A4P*	Pentode	Fil. 2.0V	4M Small 4 Pin	0.060	.007	5	11	Amplifier	90	67.5	3.0	2.2	0.9	425	600,000	720			15
									180	67.5	3.0	2.3	0.8	750	1,000,000	750			15
1A4T*	Tetrode	Fil. 2.0V	4K Small 4 Pin	0.060	.010	4.4	10.8	Amplifier	135	67.5	3.0	2.2	0.7	220	350,000	625			15
									180	67.5	3.0	2.2	0.7	400	600,000	650			15
1A6	Pentagrid Converter	Fil. 2.0V	6L Small 6 Pin	0.060	0.8	5.0	6.0	Oscillator Section	180	(Through 20,000 ohm dropping resistor)		2.3							
					0.25	10.5	9.0	Mixer Section	180	67.5	3.0	1.3	2.4		500,000	300	(Conv. Cond.)		22.5
1B4* / 951	Pentode	Fil. 2.0V	4M Small 4 Pin	0.060	.007	4.6	11.0	Amplifier	135	67.5	3.0	1.6	0.7	440	700,000	625			6.0
									180	67.5	3.0	1.7	0.6	700	1.1MΩ	650			6.0
1B5/25S	Duplex Diode Triode	Fil. 2.0V	6M Small 6 Pin	0.060	3.6 (Triode Section)	1.6	1.9	Amplifier	135		3.0	0.8		20	35,000	575			
1C6	Pentagrid Converter	Fil. 2.0V	6L Small 6 Pin	0.120	1.5	6.0	6.0	Oscillator Section	180	(Through 20,000 ohm dropping resistor)		3.3							
					0.3	10.0	10.0	Mixer Section	180	67.5	3.0	1.5	2.0		750,000	325	(Conv. Cond.)		14.0
1C7G	Pentagrid Converter	Fil. 2.0V	7Z Octal 8 Pin	0.120					See Date on	1C6									
1D5GP*	Variable Mu Pentode	Fil. 2.0V	5R Octal 7 Pin	0.060	.007	5.0	11.0	Amplifier	135	67.5	3.0	2.2	0.9	325	500,000	675			15.0
									180	67.5	3.0	2.3	0.8	600	850,000	700			15.0
1D5GT*	Variable Mu Tetrode	Fil. 2.0V	5R Octal 7 Pin	0.060	0.010	4.4	10.8	Amplifier	135	67.5	3.0	2.2	0.7	220	350,000	625			15.0
									180	67.5	3.0	2.2	0.7	400	600,000	650			15.0
1D7G	Pentagrid Converter	Fil. 2.0V	7Z Octal 8 Pin	0.060	0.2	5.0	6.0	Oscillator Section	See Data on	1A6									
					0.25	11.0	9.0	Mixer Section											
1E5G	Pentode	Fil. 2.0V	5R Octal 7 Pin	0.060	0.007	4.6	11.0	Amplifier	See Data on	1B4									
1E7G	Double Pentode	Fil. 2.0V	8C Octal 8 Pin	0.240				Push Pull Class AB_1	135	135	7.5	Per Section 3.25	1.0				0.650	24,000	(P. to P.)
								Single Section	135	135	4.5	7.5	2.1	350	220,000	1600			
1F4	Pentode	Fil. 2V	5K Medium 5 Pin	0.120	0.8	10.0	8.0	Amplifier	135	135	4.5	8.0	2.6	340	200,000	1700	0.340	16,000	
1F5G	Pentode	Fil. 2.0V	6X Octal 7 Pin																
1F6	Duplex Diode Pentode	Fil. 2.0V	6W Small 6 Pin	0.060	0.007 (Pentode Section)	4.0	9.0	RF or IF Amplifier	180	67.5	1.5	2.0	0.6	650	1MΩ	650			12.0
1F7G	Duplex Diode Pentode	Fil. 2.0V	7AD Octal 8 Pin					AF Resistance Coupled Amplifier	135	135† †Through 1	1.0 MΩ dropping	0.42 resistor		48 (Voltage Amplification)				250,000	
1G5G	Pentode	Fil. 2.0V	6X Octal 7 Pin	0.120				Amplifier	90	90	6.0	8.5	2.5	200	133,000	1500	0.250	8,500	
									124	124	11.0	10.0	3.0	220	145,000	1500	0.600	8,000	
									135	135	13.5	8.7	2.5	250	160,000	1550	0.550	9,000	
1H4G	Triode	Fil. 2.0V	5S Octal 7 Pin	0.60	6.0	3.0	2.1	Amplifier	90		4.5	2.5		9.3	11,000	850			
									135		9.0	3.0		9.3	10,300	900			
									180		13.5	3.1		9.3	10,300	900			

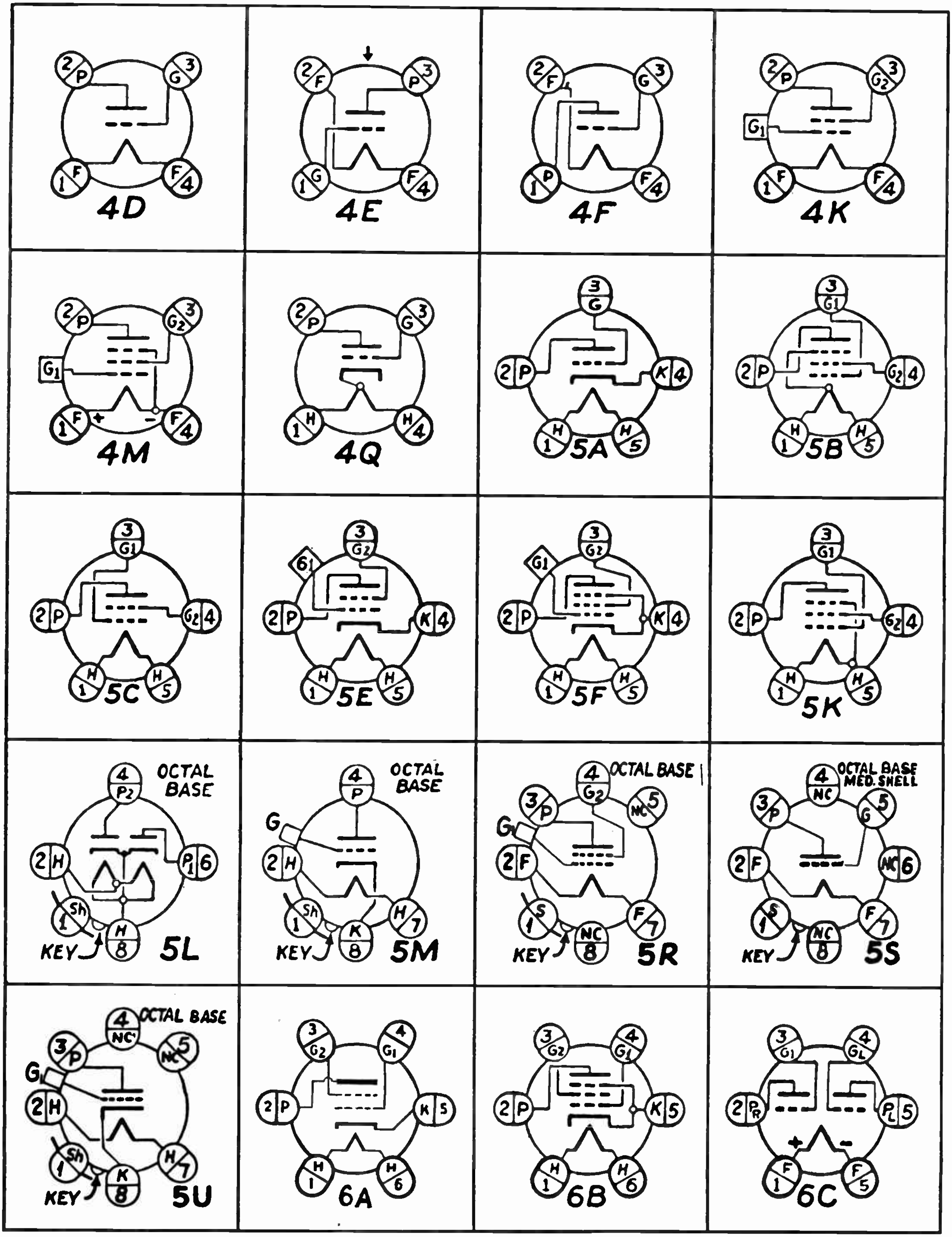
NOTE: *These tubes were originally introduced as tetrodes, with a suppressor grid type added later. With the sharp cut-off types, such as 1B4 and 1E5G, pentode and tetrode types may be used interchangeably. Variable mu types may, or may not be used interchangeably, depending on the characteristics of the receiver. Note differences in interelectrode capacities and plate resistance.

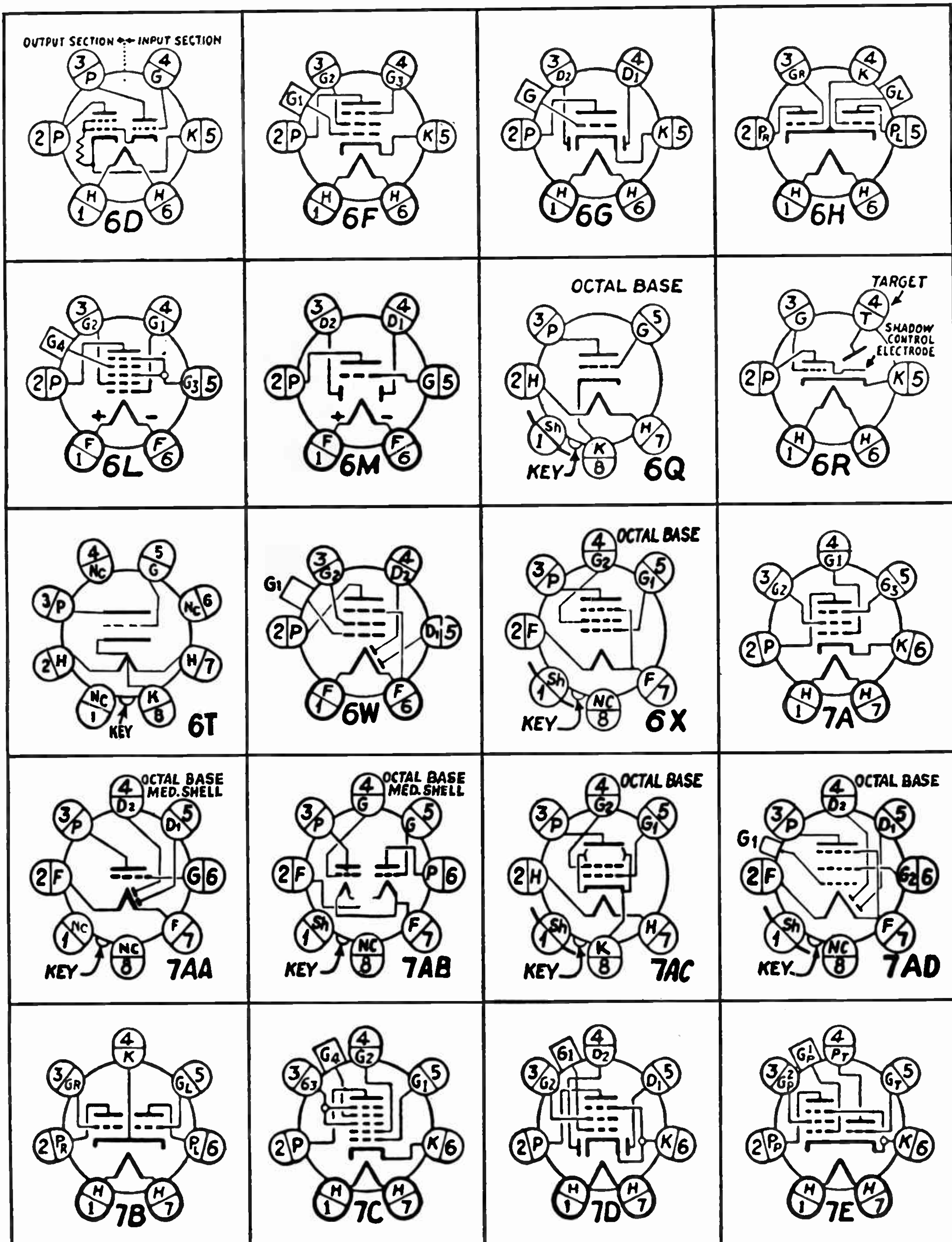
1H6G	Duplex Diode Triode	Fil. 2.0V	7AA Octal 8 Pin	0.060	3.6 (Triode Section)	1.6	1.9	Amplifier	135		3.0	0.8		20	35,000	575			
1J5G	Pentode	Fil. 2.0V	6X Octal 7 Pin	0.120				Amplifier	135	135	16.5	7.0	2.0	100	105,300	950	0.450	13,500	
										Electrical characteristics identical to Type 950									
1J6G	Twin Triode	Fil. 2.0V	7AB Octal 8 Pin	0.240				Class B	135		0	5 (Zero signal current, per plate)					2.100		
									135		3	2 (Zero signal current, per plate)					1.900		
									135		6.0	0.5 (Zero signal current, per plate)					1.600		
2A3	Triode	Fil. 2.5V	4D Medium 4 Pin	2.5				Class A Single Tube	250		45.0	60.0		4.2	800	5,250	3.5	2,500	
2A3H		Heater 2.5V	4Q Medium 4 Pin	2.8				Class AB1	300		62.0	40.0	(Zero signal, per tube)				15.0	3,000	(P. to P.)
2A5	Pentode	Heater 2.5V	6B Medium 6 Pin	1.75				Pentode Amplifier	250	250	16.5	34.0	7.5	185	79,000	2,350	3.0	7,000	
									315	315	22.0	43.0	8.5	260	100,000	2,600	5.0	7,000	
								Triode	250		20.0	31.0		6.2	2,700	2,300	0.650	3,000	
								Triode P.P. Class AB	350		38.0	21.0	(Zero signal, per tube)				18.0	8,000	(P. to P.)
2A6	Duplex Diode Triode	Heater 2.5V	6G Small 6 Pin	0.8	1.7 (Triode Section)	1.7	3.8	Amplifier	250		2.0	1.0		100	91,000	1,100			
									250		1.35	0.4						250,000	
2A7	Pentagrid Converter	Heater 2.5V	7C Small 7 Pin	0.8	1.0	7.0	5.5	Oscillator	250	(Through 20,000 ohm dropping resistor)		4.0							
					0.3	8.5	9.0	Mixer Section	250	100	3.0	3.5	2.2		360,000	520	(Conv.Cond.)		45
2B6	Direct Coupled Twin Triode	Heater 2.5V	7A Medium 7 Pin	2.25				Input Section	250		24	4.0		7.2		600		8,000	
								Output Section	250		+2.5	40.0		18.0		3,500	4.0	5,000	
2B7	Duplex Diode Pentode	Heater 2.5V	7D Small 7 Pin	0.8	0.007 (Pentode Section)	3.5	9.5	Amplifier	100	100	3.0	5.8	1.7	285	300,000	950			17
								RF	250	125	3.0	9.0	2.3	730	650,000	1,125			21
								AF	250	50	4.5	0.65						250,000	
2E5	Tuning Indicator	Heater 2.5V	6R Small 6 Pin	0.8				Tuning Indicator	With Plate, 250V (through 1.0M Ω), Target 250V, $I_p=\frac{1}{4}$ ma. Shadow Angle 90° when $E_g=0$. Shadow Angle 0° when $E_g=-8V$ approx.										
2G5	Tuning Indicator	Heater 2.5V	6R Small 6 Pin	0.8				Tuning Indicator	With Plate, 250V (through 1.0M Ω), Target 250V $I_p=\frac{1}{4}$ ma. Shadow Angle, 90° when $E_g=0$. Shadow Angle 0° when $E_g=-22V$.										
6A3	Triode	Fil. 6.3V	4D Medium 4 Pin	1.0	16.0	7.0	3.5	Amplifier One Tube	250		45.0	60		4.2	800	5,250	3.2	2,500	
								Class AB1	325		68.0	40 (per tube)					15.0	3,000	(P. to P.)
6A4	Pentode	Fil. 6.3V	5B Medium 5 Pin	0.30				Amplifier	135	135	9	13	2.8	100	52,600	1,900	0.700	9,500	
LA									180	180	12	22	4.5	100	45,500	2,200	1.4	8,000	
6A5G	Triode	Heater 6.3V	6T Octal 8 Pin	1.25	16.0	7	5	Amplifier One Tube	250		45.0	60		4.2	800	5,250	3.75	2,500	
								Class AB1	325		68.0	40 (per tube)					15.0	3,000	(P. to P.)
									325	(Self bias 850 Ohms)		40 (per tube)					10.0	5,000	(P. to P.)
6A6	Twin Triode	Heater 6.3V	7B Medium 7 Pin Large Pin Circle	0.80				Class A Parallel Conn.	294		6.0	7.0		35	11,000	3,200	0.400		
								Class B	250		0	14 (Zero signal, per plate)					8.0	8,000	(P. to P.)
									300		0	17.5 (Zero signal, per plate)					10.0	10,000	(P. to P.)
6A7	Pentagrid Converter	Heater 6.3V	7C Small 7 Pin	0.30	1.0	7.0	5.5	Oscillator	250	(Through 20,000 ohm dropping resistor)		4.0							
					0.30	8.5	9.0	Mixer Section	250	100	3.0	3.5	2.2		300,000	550	(Conv. Cond.)		45
					M0.8	6.5	5.0												
6A8	Pentagrid Converter	Heater 6.3V	8A Octal 8 Pin	0.3	G1.0	7.0	5.5	Oscillator Section	250	(Through 20,000 ohm dropping resistor)		4.0							
6A8G					M.03 G.03	12.5 8.5	12.5 9.0	Mixer Section	250	100	3.0	3.5	2.2		300,000	550	(Conv. Cond.		45
6AB5	Tuning Indicator	Heater 6.3V	6R Small 6 Pin	0.150				Tuning Indicator	135V through .25 M Ω, $I_p=.5$ Ma. $E_g=0$, Shadow Angle=90°. $E_g=7.5$, Shadow Angle=0°.										

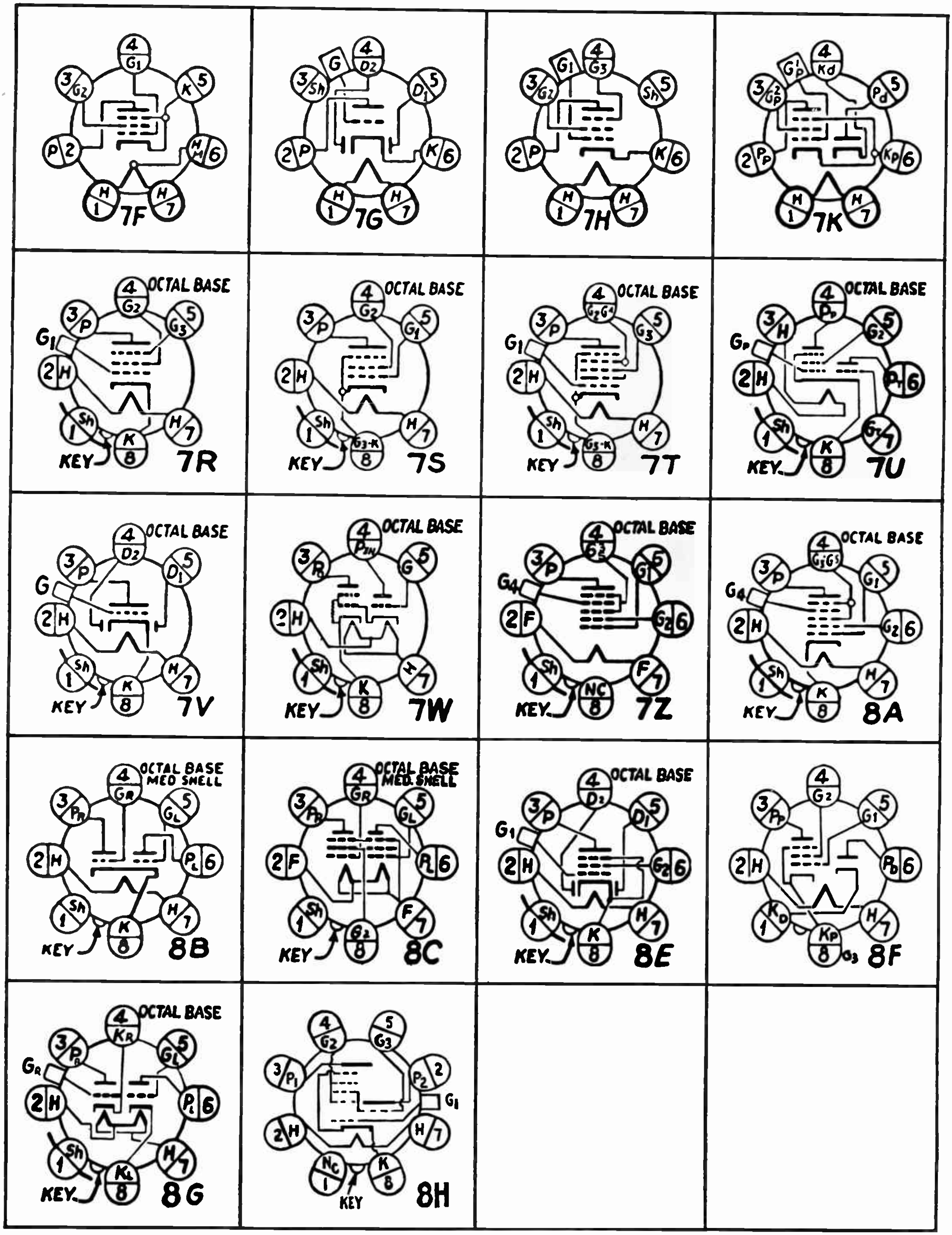
Type No.	DESCRIPTION Type	Cathode	Basing See Socket Connection Chart on Pages 327-329	Fil. Curr. Amps.	CAPACITANCES Micro-Microfarads Plate	Input	Output	When Used As	Plate Supply Volts	Screen Grid Volts	Grid Bias Volts (Neg.)	Plate Current Ma.	Screen Current Ma.	Ampl. Factor	Plate Resist. Ohms	Mut. Cond. µMhos.	Max. Undist. Output Watts	Recomm. Load Resist. Ohms	Cut-Off Bias Volts
6AC5G	Triode	Heater 6.3V	6Q Octal 6 Pin	0.4				Dynamic Coupled	250		+13	32		125	36,700	3,400	3.7	7,000	
								Class B	250		0	2.5 (Zero signal current, per tube)					8.0	10,000	(P. to P.)
6B4G	Triode	Fil. 6.3V	5S Octal 8 Pin	1.0	16	7	5	Amplifier	Identical to 6A3.										
6B5	Direct Coupled Twin-Triode	Heater 6.3V	6D Medium 6 Pin	0.80				Dynamic Coupled Amplifier	300 each		0	In-put 8 / Out-put 45		58	24,100	2,400	4.0	7,000	
								Push-Pull	325 ea.		0	9 / 51					5.2	7,000	
									325 ea.		0	9 / 51					13.5	10,000	(P. to P.)
6B6G	Duplex Diode Triode	Heater 6.3V	7V Octal 7 Pin	0.3	1.7	2.7	4.5 (Triode Section)	Diode Detector Triode Amplifier	See Date on 75										
6B7	Duplex Diode Pentode	Heater 6.3V	7D Small 7 Pin	0.3	0.007	3.5	9.5 (Pentode Section)	RF Ampl.	100	100	3.0	5.8	1.7	285	300,000	950			17
									250	100	3.0	6.0	1.5	800	800,000	1,000			17
								AF Ampl.	250	50	4.5	0.65						250,000	
6B8	Duplex Diode Pentode	Heater 6.3V	8E Octal 8 Pin	0.3	0.005	6.0	9.0	RF Ampl.	250 Max.	125 Max.	3.0	10.0	2.3	800	600,000	1325			21
6B8G					0.007	3.3	9.5		See characteristics of 6B7.										
6C5	Triode	Heater 6.3V	6Q Octal 6 Pin	0.3	1.8	4.0	3.0	Amplifier	250		8.0	8.0		20	10,000	2,000			
6C5G					1.9	4.4	10.4												
6C6	Pentode	Heater 6.3V	6F Small 6 Pin	0.3	0.007	5.0	6.5	Amplifier	250	100	3.0	2.0	0.5	1500	1.5MΩ	1225			7
								Triode Amplifier	250		8.0	6.5		20	10,000	1900			
								Detector	250	100	4.3							250,000	
6C8G	Twin Triode	Heater 6.3V	8G Octal 8 Pin	0.3	2.4	2.5	3.9 (Top cap section)	Class A One Triode	250		4.5	3.1		38	26,000	1450			
					2.5	3.4	3.5 (Base pin section)	Phase Inverter	250		3.0	1.0 (Common Cathode Resistor 1500 ohms)						100,000	
6D6	Variable Mu Pentode	Heater 6.3V	6F Small 6 Pin	0.3	0.007	4.7	6.5	Amplifier	100	100	3.0	8.0	2.2	375	250,000	1500			40
									250	100	3.0	8.2	2.0	1280	800,000	1600			40
6D8G	Pentagrid Converter	Heater 6.3V	8A Octal 8 Pin	0.150	1.0	7.0	6.0	Oscillator	250	(Through 20,000 ohm) (dropping resistor)		4.5							
					0.3	8.0	11.0	Mixer	250	100	3.0	3.0	3.5		320,000	500	(Conversion	Conductance)	40
6E5	Tuning Indicator	Heater 6.3V	6R Small 6 Pin	0.3				Tuning Indicator	250V through 1 MΩ. Ip=.25 ma. Target current 3.0 ma. Eg=0, Shadow Angle=90°. Eg=8.0V. Shadow Angle=0°.										
6E6	Twin Triode	Heater 6.3V	7B Medium 7 Pin	0.60				Class A (Both Sections)	180		20.0	Per Section 11.5		6	Per Section 4,300	1400	0.750	15,000	(P. to P.)
									250		27.5	Per Section 18		6	Per Section 3,500	1700	1.600	14,000	(P. to P.)
6F5	High-Mu Triode	Heater 6.3V	5M Octal 5 Pin	0.30	2.0	6.0	12.0	Amplifier	250		2.0	1.1		100	66,000	1500			
6F5G					2.0	3.5	11.0		250		1.3	.2 to .4						.25MΩ	
6F6 **6F6G**	Pentode	Heater 6.3V	7S Octal 7 Pin	0.70				Single Pentode	250	250	16.5	34	7.5	185	79,000	2350	3.0	7,000	
									315	315	22.5	43	8.5	260	100,000	2600	5.0	7,000	
								Single Triode	250		20	31		7	2,700	2600	0.85	4,000	
								AB Triode	350		38	22.5	(Zero signal current, per tube)				18.0	6,000	(P. to P.)
								AB Pentode	375	250	26	17	(Zero signal current, per tube)				19.0	10,000	(P. to P.)
								AB Pentode	375	250	300Ω	27	(Zero signal current, per tube)				19.0	10,000	(P. to P.)
6F7	Triode Pentode	Heater 6.3V	7E Small 7 Pin	0.30	2.0	2.5	3.0	Triode	100 Max.		3.0	3.5		8.5	16,200	525			
					.008	3.2	12.5	Pentode	250	100	3.0	6.5	1.5	900	850,000	1100			35
								Converter	250	100	10.0	2.8	0.6		2MΩ	300	(Conversion	Conductance)	

6F8G	Twin Triode	Heater 6.3V	8G Octal 8 Pin	0.60	4.2			Phase Inverter	250		8.0	9.0		20	7,700	2600			
					4.5				Individual sections of this tube are identical with 6J5G.										
6G5	Tuning Indicator	Heater 6.3V	6R Small 6 Pin	0.30				Tuning Indicator	250V. Through 1 MΩ Ip=0.24 ma. Eg=0, Shadow Angle=90°. Eg=22 Shadow Angle=0°.										
6H5																			
6G6G	Pentode	Heater 6.3V	7S Octal 7 Pin	0.15				Amplifier	135	135	6.0	11.5	2.0	360	170,000	2100	0.600	12,000	
									180	180	9.0	15	2.5	400	175,000	2300	1.100	10,000	
6H6	Twin Diode	Heater 6.3V	7Q Octal 7 Pin	0.30				Diode Detector	100 Max. AC			2.0 Max.							
6H6G																			
6J5	Triode	Heater 6.3V	6Q Octal 7 Pin	0.30	3.4	3.4	3.6	Amplifier	250		8.0	9.0		20	7,700	2600			
6J5G					3.4	3.8	3.3												
6J7	Pentode	Heater 6.3V	7R Octal 7 Pin	0.30	.005	7.0	12.0	Amplifier	100	100	3.0	2.0	0.5	1,185	1MΩ	1185			7
6J7G					.007	4.7	11.0		250	100	3.0	2.2	0.5	1,500	1.5MΩ	1225			7
								Bias Detector	100	36	2.0	0.1						¼MΩ	
									250	50	2.0	0.1						¼MΩ	
									250	100	4.3	0.1						¼MΩ	
6J8G	Triode Heptode	Heater 6.3V	8H Octal 8 Pin	0.30				Triode	250	(Through 20 000 ohms)		5.0							
								Heptode	250	100	3.0	1.2	2.8		4MΩ	290	(Conversion	Conductance)	20
6K5G	Triode	Heater 6.3V	5U Octal 7 Pin	0.30	2.0	2.4	3.6	Amplifier	100		1.5	0.35		70	78,000	900	(Rating values, not operating conditions)		
									250		3.0	1.1		70	50,000	1400			
6K6G	Pentode	Heater 6.3V	7S Octal 7 Pin	0.40				Amplifier	125	125	10.0	11.0	2.0	150	100,000	1525	0.650	11,000	
									167.5	167.5	12.5	17.0	3.0	150	85,000	1800	1.250	9,500	
									180	180	13.5	18.5	3.0	150	81,000	1850	1.500	9,000	
									250	250	18.5	32.0	5.5	150	68,000	2200	3.400	7,600	
6K7	Pentode	Heater 6.3V	7R Octal 7 Pin	0.30	0.005	7.0	12.0	Amplifier	90	90	3.0	5.4	1.3	400	315,000	1275			38.5
6K7G					.007	4.5	11.0		250	125	3.0	10.5	2.6	990	600,000	1650			52.5
								Converter	250	100	10.0	(Oscillator peak 7.0 volts)							
6L5G	Triode	Heater 6.3V	6Q Octal 7 Pin	0.15	2.7	3.0	5.0	Amplifier	100		3.0	4.0		15	10,000	1500			
									250		9.0	8.0		17	9,000	1900			20
6L6	Tetrode	Heater 6.3V	7AC Octal 7 Pin	0.9	1.1	0.7	9.1	Class A1 One Tube	250	250	14 (Fixed)	72–79	5	135	22,500	6500	6.5	2,500	
6L6G									250	250	13.5 (Self)	75–78	5.4				6.5	2,500	
									300	200	12.5 (Fixed)	48–55	2.5–4.7				6.5	4,500	
									300	200	11.8 (Self)	51–54	3–4.6				6.5	4,500	
									375	250	17.5	57–67	2.5–6				11.5	4,000	
								Class A1 Push-Pull	250	250	16 (Fixed)	120–140	10–16				14.5	5,000	(P. to P.)
								Class AB1 Push-Pull	400	250	20 (Fixed)	88–126	4–9				20.0	6,000	(P. to P.)
								Class AB2 Push-Pull	400	300	25 (Fixed)	102–230	6–20				60.0	3,800	(P. to P.)
6L7	Pentagrid Mixer	Heater 6.3V	7T Octal 7 Pin	0.3	G_1 .0005 G_2 .025	G_1 8.5 G_3 11.5	13	Mixer	250	100	G_1 −3.0 G_3 −10.0	2.4	6.2		1MΩ	350 (Conversion Conductance)			30
6L7G									250	250	G_1 −6.0 G_3 −15.0	2.4	8.3		1MΩ min.	350 (Conversion Conductance)			45
					G_1 .003 G_2 .25	G_1 5.8 G_3 11.5	12.5	Amplifier	250	100	G_1 −3.0 G_3 −3.0	5.3	5.5		800,000	1100			15 (Both Grids)
6N5	Tuning Indicator	Heater 6.3V	6R Small 6 Pin	0.150				Tuning Indicator	135	Through 0.25 MΩ Ip=.5 ma. Eg=0, Shadow Angle=90°. Eg=12, Shadow Angle=0°.									
6N6	Direct Coupled Twin Triode	Heater 6.3V	7W Octal 7 Pin	0.8				Amplifier	300 ea.		0	9. Input		58	24,000	2400	4.0	7,000	
6N6G									See characteristics of 6B5			42. Output							

Type No.	DESCRIPTION: Type	DESCRIPTION: Cathode	Basing See Socket Connection Chart on Pages 327-329	Fil. Curr. Amps.	CAPACITANCES Micro-Microfarads: Plate	Input	Output	OPERATING CONDITIONS CHARACTERISTICS: When Used As	Plate Supply Volts	Screen Grid Volts	Grid Bias Volts (Neg.)	Plate Current Ma.	Screen Current Ma.	Ampl. Factor	Plate Resist. Ohms	Mut. Cond. µMhos.	Max. Undist. Output Watts	Recomm. Load Resist. Ohms	Cut-Off Bias Volts
6N7 6N7G	Twin Triode	Heater 6.3V	8B Octal 8 Pin	0.8				Class A Parallel Conn.	294		6.0	7		35	11,000	3200	0.400		
								Class B	250		0	14 (Zero signal, per plate)					8.0	8,000	(P. to P.)
								Class B	300		0	17.5 (Zero signal, per plate)					10.0	10,000	(P. to P.)
6P7G	Triode Pentode	Heater 6.3V	7U Octal 8 Pin	0.3	2.2	2.5	3.0	See Characteristics of 6F7											
					.008	3.2	12.5												
6Q7 6Q7G	Duplex Diode Triode	Heater 6.3V	7V Octal 7 Pin	0.3	1.4	4.8	5.0	Amplifier (Rating Value Only)	100		1.5	0.35		70	88,000	800		.05 to .1MΩ	
					1.7	2.2	4.0		250		3.0	1.1		70	58,000	1200		.1 to .25MΩ	
6R7 6R7G	Duplex Diode Triode	Heater 6.3V	7V Octal 7 Pin	0.3	2.1	5.0	4.4	Amplifier	250		9.0	9.5		16	8,500	1900			
					2.3	2.0	3.1												
6S7G	Variable Mu Pentode	Heater 6.3V	7R Octal 7 Pin	0.150	.010	4.7	6.5	Amplifier	100	100	3.0	8.0	2.2	375	250,000	1500			40
									250	100	3.0	8.5	2.0	1,100	630,000	1750			40
6T5	Tuning Indicator	Heater 6.3V	6R Small 6 Pin	0.3				Tuning Indicator	250	Through 1MΩ Ip=.24 Max. Eg=0, Illumination is Max. Eg=22, Illumination is Min.									
6T7G	Duplex Diode Triode	Heater 6.3V	7V Octal 7 Pin	0.150	1.7	1.8	3.7	Amplifier (Rating Values Only)	100		1.5	0.3		65	95,000	680		.05 to .1MΩ	
									250		3.0	0.9		65	6,500	1000		.1 to .25MΩ	
6U5	Tuning Indicator	Heater 6.3V	6R Small 6 Pin	0.3					See Characteristics of 6G5.										
6U7G	Variable Mu Pentode	Heater 6.3V	7R Octal 7 Pin	0.3	.007	4.7	6.5		See Characteristics of 6D6										
6V6 6V6G	Tetrode	Heater 6.3V	7AC Octal 7 Pin	0.45				Amplifier	250	250	12.5	45–47	4.5–6.5	218			4.25	5,000	
								Class AB1	250	250	15.0	70–79	5–12				8.5	10,000	
									300	300	20.0	78–90	5–13				13.5	8,000	
6V7G	Duplex Diode Triode	Heater 6.3V	7V Octal 7 Pin	0.3	1.5	1.5	4.3		See Characteristics of 85										
6Y6G	Tetrode	Heater 6.3V	7AC Octal 7 Pin	1.25				Amplifier	135 Max.	135 Max.	13.5	58	3.0			7000	3.6	2,000	
6Y7G	Twin Triode	Heater 6.3V	8B Octal 8 Pin	0.60					See Characteristics of 79										
6Z7G	Twin Triode	Heater 6.3V	8B Octal 8 Pin	0.3				Class B	135		0	3 (Zero signal current, per plate)					1.5	15,000	
									135		0	3 (Zero signal current, per plate)					2.5	9,000	
									180		0	4.2 (Zero signal current, per plate)					2.2	20,000	
									180		0	4.2 (Zero signal current, per plate)					4.2	12,000	
12A5	Pentode	Heater 6.3V or 12.6V	7F Small 7 Pin	0.60 or 0.30				Amplifier	100	100	15.0	17	3.0	70	41,000	1700	1.700	4,500	
									180	180	27.0	40	8.0	80	35,000	2300	3.000	3,800	
12A7	Rectifier Pentode	Heater 12.6V	7K Small 7 Pin	0.30				Rectifier	125 Max.			30 Max.							
								Amplifier	135	135	13.5	9.0		100	102,000	975	0.550	13,500	
25A6 25A6G	Pentode	Heater 25.0V	7S Octal 7 Pin	0.30				Amplifier	95	95	15	20	4	90	4,500	2000	0.900	4,500	
									135	135 Max.	20	37	8	85	35,000	2450	2.000	4,000	
									180	135 Max.	20	38	7.5	100	40,000	2500	2.750	5,000	
25A7G	Rectifier Pentode	Heater 25.0V	8F Octal 8 Pin	0.30				Rectifier	125 Max.			75 Max.							
								Amplifier	100 Max.	100	15	20.5	4.0	80	50,000	1800	0.770	4,500	
25B6G	Pentode	Heater 25.0V	7S Octal 7 Pin	0.30				Amplifier	95	95	15	45	4–12		Variable	4000	1.750	2,000	
25L6 25L6G	Tetrode	Heater 25.0V	7AC Octal 7 Pin	0.30				Amplifier	110	110	7.5	49	4–9		10,000	8200	2.100	1,500	
									110	110	7.5	49	4–11		10,000	8200	2.200	2,000	


4D
4E
4F
4K
4M
4Q
5A
5B
5C
5E
5F
5K
OCTAL BASE
KEY
5L
OCTAL BASE
KEY
5M
OCTAL BASE
KEY
5R
OCTAL BASE MED. SHELL
KEY
5S
OCTAL BASE
KEY
5U
6A
6B
6C

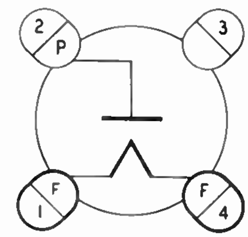

OUTPUT SECTION INPUT SECTION
6D
6F
6G
6H
6L
6M
OCTAL BASE
KEY
6Q
TARGET
SHADOW CONTROL ELECTRODE
6R
KEY
6T
6W
OCTAL BASE
KEY
6X
7A
OCTAL BASE MED. SHELL
KEY
7AA
OCTAL BASE MED. SHELL
KEY
7AB
OCTAL BASE
KEY
7AC
OCTAL BASE
KEY
7AD
7B
7C
7D
7E


7F
7G
7H
7K
OCTAL BASE
KEY
7R
OCTAL BASE
KEY
7S
OCTAL BASE
KEY
7T
OCTAL BASE
KEY
7U
OCTAL BASE
KEY
7V
OCTAL BASE
KEY
7W
OCTAL BASE
KEY
7Z
OCTAL BASE
KEY
8A
OCTAL BASE
MED SHELL
KEY
8B
OCTAL BASE
MED. SHELL
KEY
8C
OCTAL BASE
KEY
8E
8F
OCTAL BASE
KEY
8G
KEY
8H

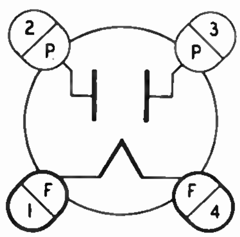
RECTIFIER TUBES

Type	Description		Cathode	Base (See page 331)	Fil. Amps.	Fil. Volts	Max. AC Volts Per Anode	Max. DC Output Curr. Ma.	Max. Peak Inverse Volts	Max. Peak Pl. Curr. Ma.	Max. Volts Delivered to Filter (Nom.) Condenser Input	Choke Input
BA	Full Wave	Gas	Cold	4J—Med. 4 Pin			350	350	1,000	1,000		300
BH	Full Wave	Gas	Cold	4J—Med. 4 Pin			350	125	1,000	400		300
BR	Half Wave	Gas	Cold	4H—Med. 4 Pin			300	50	850	200	300	
1V	Half Wave	High Vacuum	Heater	4G—Small 4 Pin	0.3	6.3	350	50	1,000	200	400	
80	Full Wave	High Vacuum	Fil.	4C—Med. 4 Pin	2.0	5.0	350	125	1,000	400	300	225
							400	110	1,100	350	370	275
							550	135	1,500	300	For choke input only use 20H min.	425
81	Half Wave	High Vacuum	Fil.	4B—Med. 4 Pin	1.25	7.5	700	85	2,000	600 Full Wave	750	550
82	Full Wave	Mercury Vapor	Fil.	4C—Med. 4 Pin	3.0	2.5	500	125	1,400	400	590	525
83	Full Wave	Mercury Vapor	Fil.	4C—Med. 4 Pin	3.0	5.0	500	250	1,400	800	530	400
83V	Full Wave	High Vacuum	Heater	4L—Med. 4 Pin	2.0	5.0	400	200	1,100	700	450	325
84/6Z4	Full Wave	High Vacuum	Heater	5D—Small 5 Pin	0.5	6.3	350	75	1,000	375	380	280
0Z3	Full Wave	Gas	Cold	5N—Small 5 Pin			350	75 max. 30 min.	1,250	200	425	300
0Z4							350					
0Z4G	Full Wave	Gas	Cold	4R—Octal 4 Pin			350	75 max. 30 min.	1,250	200	425	300
5T4	Full Wave	High Vacuum	Fil.	5T—Octal 5 Pin	2.0	5.0	450	250	1,250		450	325
5U4G	Full Wave	High Vacuum	Fil.	5T—Octal 5 Pin	3.0	5.0			SEE DATA FOR 5Z3			
5V4G	Full Wave	High Vacuum	Heater	5L—Octal 8 Pin	2.0	5.0			SEE DATA FOR 83V			
5W4/5W4G	Full Wave	High Vacuum	Fil.	5L—Octal 5 Pin	1.5	5.0	350	110	1,000		375	250
5X4G	Full Wave	High Vacuum	Fil.	5Q—Octal 8 Pin	3.0	5.0			SEE DATA FOR 5Z3			
5Y3G	Full Wave	High Vacuum	Fil.	5T—Octal 5 Pin	2.0	5.0			SEE DATA FOR 80			
5Y4G	Full Wave	High Vacuum	Fil.	5Q—Octal 8 Pin	2.0	5.0						
5Z3	Full Wave	High Vacuum	Fil.	4C—Med. 4 Pin	3.0	5.0	500	250	1,400	700	480	360
5Z4	Full Wave	High Vacuum	Heater	5L—Octal 5 Pin	2.0	5.0	400	125	1,100	500	460	325
5Z4G												
6W5	Full Wave	High Vacuum	Heater	6S—Octal 6 Pin	0.9	6.3	350	100	1,250	350		310
6X5	Full Wave	High Vacuum	Heater	6S—Small Octal 6 Pin	0.6	6.3	350	75	1,250	375	380	280
6X5G												
6ZY5G	Full Wave	High Vacuum	Heater	6S—Small Octal 6 Pin	0.3	6.3	350	35	1,000	150	420	
12Z3	Half Wave	High Vacuum	Heater	4G—Small 4 Pin	0.3	12.6	250	60	700	300	300	
25Z5	Rectifier	High Vacuum	Heater	6E—Small 6 Pin	0.3	25.0	125	85 Each Plate	700		120	
	Doubler							100	700	500	200	
25Z6	Rectifier	High Vacuum	Heater	7Q—Small Octal 7 Pin	0.3	25.0	125	85 Each Plate	700		115	
	Doubler							85	700	500	225	
25Z6G	Rectifier Doubler	High Vacuum	Heater	7Q—Small Octal 7 Pin					SEE DATA FOR 25Z5			

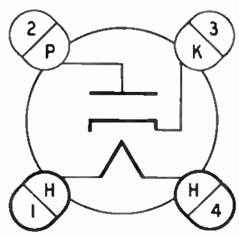
RECTIFIER BASE CHARTS



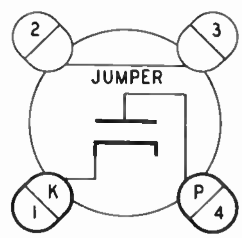
4B



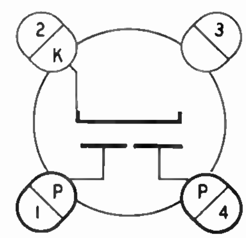
4C



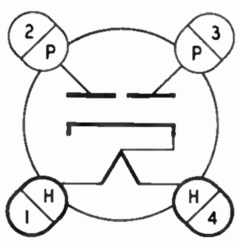
4G



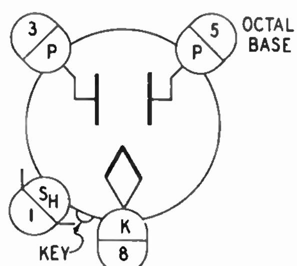
4H



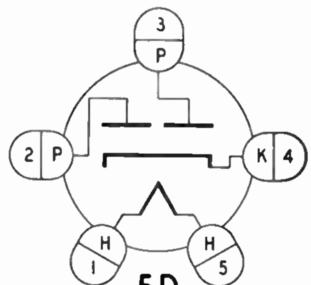
4J



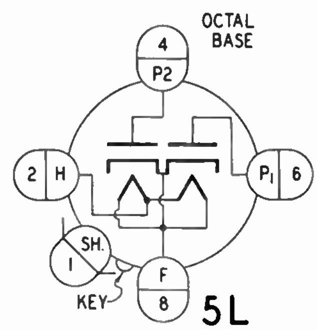
4L



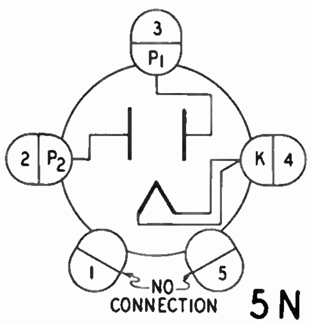
4R



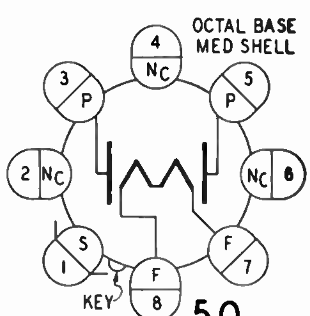
5D



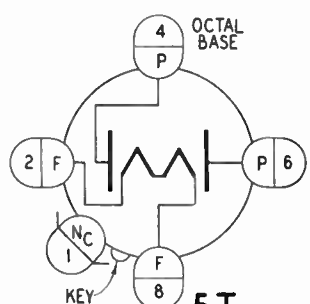
5L



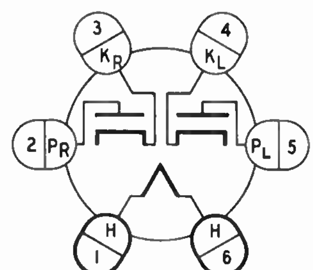
5N



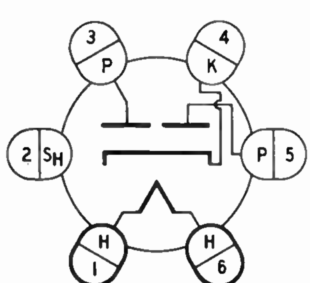
5Q



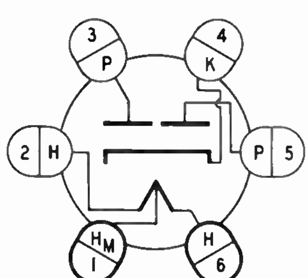
5T



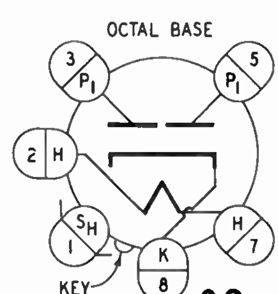
6E



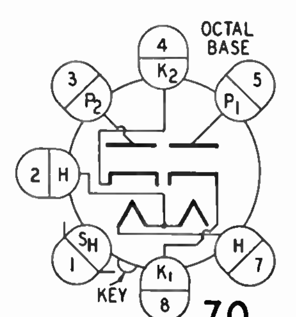
6J



6K



6S



7Q

SPECIAL TUBES

Type No.	FILAMENT		BASING		CHARACTERISTICS USE AND DIMENSIONS
	Volts	Amps.	View	Shield Conn. to	
2S/4S	2.5	1.35	5D	Cathode Pin	Approximately 40 Ma. on each Diode Plate at 50 volts DC.: Duplex Diode Detector.
24S	2.5	1.75	5E	Cathode Pin	Same as 24A
27S	2.5	1.75	5A	Cathode Pin	Same as 27
35S/51S	2.5	1.75	5E	Cathode Pin	Same as 35
55S	2.5	1.0	6G	Cathode Pin	Same as 55
56S	2.5	1.0	5A	Cathode Pin	Same as 56
56AS	6.3	0.4	5A	Cathode Pin	Same as 76 except Heater Amps.
57S	2.5	1.0	6F	Cathode Pin	Same as 57
57AS	6.3	0.4	6F	Cathode Pin	Same as 6C6 except Heater Amps.
58S	2.5	1.0	6F	Cathode Pin	Same as 58
58AS	6.3	0.4	6F	Cathode Pin	Same as 6D6 except Heater Amps.
75S	6.3	0.3	6G	Cathode Pin	Same as 75
85AS	6.3	0.3	6G	Heater pin Adjacent to Cathode Pin	Similar to 85 except Amp. Factor =20; Mutual Cond. =1250; Plate Curr. = 4.5 Ma.; Pl. Volts =250V; Gr. Bias = −9V.
182B/482B	5.0	1.25	4D	No Shield	Similar to 45 except Fil. Volts; Amp. Fact. =5.0; Mutual Cond. =1500; Plate Curr. =18 Ma.; Pl. Volts =250 V; Gr. Bias = −35V.
183/483	5.0	1.25	4D	No Shield	Similar to 45 except Fil. Volts; Amp. Fact. =3.0; Mut. Cond. =1500; Pl. Curr. =20 Ma.; Pl. Volts =250V; Gr. Bias = −58V.
485	3.0	1.25	5A	No Shield	Similar to 27 except Heater Volts; Amp. Fact. =12.8; Mut. Cond. =1300; Pl. Curr. =5.2 Ma.; Pl. Volts =180V; Gr. Bias = −10V.
950	2.0	0.12	5K	No Shield	Similar to 33 except Fil. Amps; Pl. Curr. =7 Ma.; Power Output =0.45 Watts; Pl. and Scr. Volts =135V; Max. Cont. Gr. Bias = −16.5V.
2A7S	2.5	1.0	7C	Cathode Pin	Same as 2A7
2Z2 G84	2.5	1.5	4B	No Shield	Half Wave Rectifier, Filament Type Cathode
6A7S	6.3	0.3	7C	Cathode Pin	Same as 6A7
6B7S	6.3	0.3	7D	Cathode Pin	Same as 6B7
6C7	6.3	0.3	7G	Separate Pin	Similar to 85AS
6D7	6.3	0.3	7H	Separate Pin	Similar to 6C6
6E7	6.3	0.3	7H	Separate Pin	Similar to 6D6
6F7S	6.3	0.3	7E	Cathode Pin	Same as 6F7
6Y5	6.3	0.8	6J	Separate Pin	Similar to 6Z4/84
6Z5	12.6 6.3	0.4 0.8	6K	No Shield	Similar to 6Z4/84

COMPARISON CHART

Original Glass	Octal Base Glass	Metal	Original Glass	Octal Base Glass	Metal	Original Glass	Octal Base Glass
5Z3	5U4G, 5X4G		75	6B6G, 6Q7G, 6T7G	6Q7	(The following 2.0-Volt types have no metal equivalent)	
6A3	6B4G		79	6Y7G, 6Z7G			
6A6	6N7G	6N7	80	5Y3G, 5Y4G	5W4, 5Z4	1A4P, 1A4T, 34	1D5GP, 1D5GT
6A7	6A8G	6A8	83V	5V4G		1A6	1D7G
6B5	6N6G		84	6X5G, 6ZY5G	6X5	1B4, 32	1E5G
6B7	6B8G	6B8	85	6R7G, 6V7G	6R7	1B5/25S	1H6G
6C6, 36, 77	6J7G, 6W7G			6F5G, 6K5G	6F5	1C6	1C7G
6D6, 39/44, 78	6K7G, 6S7G, 6U7G	6K7		6H6G	6H6	1F4	1F5G
6F7	6P7G			6F8G (2-6J5G)		1F6	1F7G
37, 76	6C5G, 6J5G, 6L5G	6C5		6J8G	6K8	19	1J6G
41	6K6G			6L6G	6L6	30	1H4G
42	6F6G	6F6		6L7G	6L7		
				6V6G	6V6		

The above chart is presented for convenience in grouping tubes according to their function or application. The tubes in the majority of cases are not interchangeable.

RADIO DEFINITIONS*

"A" Power Supply. A power supply device providing heating current for the cathode of a vacuum tube.

Alternating Current. A current, the direction of which reverses at regularly recurring intervals, the algebraic average value being zero.

Amplification Factor. A measure of the effectiveness of the grid voltage relative to that of the plate voltage in affecting the plate current.

Amplifier. A device for increasing the amplitude of electric current, voltages or power, through the control by the input power of a larger amount of power supplied by a local source to the output circuit.

Anode. An electrode to which an electron stream flows.

Antenna. A conductor or a system of conductors for radiating or receiving radio waves.

Atmospherics. Strays produced by atmospheric conditions.

Attenuation. The reduction in power of a wave or a current with increasing distance from the source of transmission.

Audio Frequency. A frequency corresponding to a normally audible sound wave. The upper limit ordinarily lies between 10,000 and 20,000 cycles.

Audio-Frequency Transformer. A transformer for use with audio-frequency currents.

Autodyne Reception. A system of heterodyne reception through the use of a device which is both an oscillator and a detector.

Automatic Volume Control. A self-acting device which maintains the output constant within relatively narrow limits while the input voltage varies over a wide range.

"B" Power Supply. A power supply device connected in the plate circuit of a vacuum tube.

Baffle. A partition which may be used with an acoustic radiator to impede circulation between front and back.

Band-Pass Filter. A filter designed to pass currents of frequencies within a continuous band limited by an upper and a lower critical or cut-off frequency and substantially reduce the amplitude of currents of all frequencies outside of that band.

Beat. A complete cycle of pulsations in the phenomenon of beating.

Beat Frequency. The number of beats per second. This frequency is equal to the difference between the frequencies of the combining waves.

Beating. A phenomenon in which two or more periodic quantities of different frequencies react to produce a resultant having pulsations of amplitude.

Broadcasting. Radio transmission intended for general reception.

By-Pass Condenser. A condenser used to provide an alternating-current path of comparatively low impedance around some circuit element.

"C" Power Supply. A power supply device connected in the circuit between the cathode and grid of a vacuum tube so as to apply a grid bias.

Capacitive Coupling. The association of one circuit with another by means of capacity common or mutual to both.

Carbon Microphone. A microphone which depends for its operation upon the variation in resistance of carbon contacts.

Carrier. A term broadly used to designate carrier wave, carrier current, or carrier voltage.

Carrier Frequency. The frequency of a carrier wave.

Carrier Suppression. That method of operation in which the carrier wave is not transmitted.

Carrier Wave. A wave which is modulated by a signal and which enables the signal to be transmitted through a specific physical system.

Cathode. The electrode from which the electron stream flows. (See Filament.)

Choke Coil. An inductor inserted in a circuit to offer relatively large impedance to alternating current.

Class A Amplifier. A class A amplifier is an amplifier in which the grid bias and alternating grid voltages are such that plate current in a specific tube flows at all times.

Class AB Amplifier. A class AB amplifier is an amplifier in which the grid bias and alternating grid voltages are such that plate current in a specific tube flows for appreciably more than half but less than the entire electrical cycle.

*Most of these definitions are based on I. R. E. standards.

Class B Amplifier. A class B amplifier is an amplifier in which the grid bias is approximately equal to the cut-off value so that the plate current is approximately zero when no exciting grid voltage is applied, and so that plate current in a specific tube flows for approximately one-half of each cycle when an alternating grid voltage is applied.

Class C Amplifier. A class C amplifier is an amplifier in which the grid bias is appreciably greater than the cut-off value so that the plate current in each tube is zero when no alternating grid voltage is applied, and so that plate current flows in a specific tube for appreciably less than one-half of each cycle when an alternating grid voltage is applied.

Note: To denote that grid current does not flow during any part of the input cycle, the suffix 1 may be added to the letter or letters of the class identification. The suffix 2 may be used to denote that grid current flows during some part of the cycle.

Condenser Loud Speaker. A loud speaker in which the mechanical forces result from electrostatic reactions.

Condenser Microphone. A microphone which depends for its operation upon variations in capacitance.

Continuous Waves. Continuous waves are waves in which successive cycles are identical under steady state conditions.

Conversion Transconductance is the ratio of the magnitude of a single beat-frequency component ($f_1 + f_2$) or ($f_1 - f_2$) of the output current to the magnitude of the input voltage of frequency f_1 under the conditions that all direct voltages and the magnitude of the second input alternating voltage f_2 must remain constant. As most precisely used, it refers to an infinitesimal magnitude of the voltage of frequency f_1.

Converter (generally in superheterodyne receivers). A converter is a vacuum-tube which performs simultaneously the functions of oscillation and mixing (first detection) in a radio receiver.

Coupling. The association of two circuits in such a way that energy may be transferred from one to the other.

Cross Modulation. A type of intermodulation due to modulation of the carrier of the desired signal in a radio apparatus by an undesired signal.

Current Amplification. The ratio of the alternating current produced in the output circuit of an amplifier to the alternating current supplied to the input circuit for specific circuit conditions.

Cycle. One complete set of the recurrent values of a periodic phenomenon.

Damped Waves. Waves of which the amplitude of successive cycles, at the source, progressively diminishes.

Decibel. The common transmission unit of the decimal system, equal to 1/10 bel.

$$1 \text{ bel} = 2 \log_{10} \frac{E_1}{E_2} = 2 \log_{10} \frac{I_1}{I_2}$$

(See Transmission Unit.)

Detection is any process of operation on a modulated signal wave to obtain the signal imparted to it in the modulation process.

Detector. A detector is a device which is used for operation on a signal wave to obtain the signal imparted to it in the modulation process.

Diaphragm. A diaphragm is a vibrating surface which produces sound vibrations.

Diode. A type of thermionic tube containing two electrodes which passes current wholly or predominantly in one direction.

Direct Capitance (C) between two conductors—The ratio of the charge produced on one conductor by the voltage between it and the other conductor, divided by this voltage, all other conductors in the neighborhood being at the potential of the first conductor.

Direct Coupling. The association of two circuits by having an inductor, a condenser, or a resistor common to both circuits.

Direct Current. A unidirectional current. As ordinarily used, the term designates a practically non-pulsating current.

Distortion. A change in wave form occurring in a transducer or transmission medium when the output wave form is not a faithful reproduction of the input wave form.

Double Modulation. The process of modulation in which a carrier wave of one frequency is first modulated by the signal wave and is then made to modulate a second carrier wave of another frequency.

Dynamic Amplifier. The RCA Dynamic Amplifier is a variable gain audio amplifier, the gain of which is proportional to the average intensity of the audio signal. Such an amplifier compensates for the contraction of volume range required because of recording or transmission line limitations.

Dynamic Sensitivity of a Phototube. The alternating-current response of a phototube to a pulsating light flux at specified values of mean light flux, frequency of pulsation, degree of pulsation, and steady tube voltage.

Electro-Acoustic Transducer. A transducer which is actuated by power from an electrical system and supplies power to an acoustic system or vice versa.

Electron Emission. The liberation of electrons from an electrode into the surrounding space. In a vacuum tube it is the rate at which the electrons are emitted from a cathode. This is ordinarily measured as the current carried by the electrons under the influence of a voltage sufficient to draw away all the electrons.

Electron Tube. A vacuum tube evacuated to such a degree that its electrical characteristics are due essentially to electron emission.

Emission Characteristic. A graph plotted between a factor controlling the emission (such as the temperature, voltage, or current of the cathode) as abscissas, and the emission from the cathode as ordinates.

Facsimile Transmission. The electrical transmission of a copy or reproduction of a picture, drawing or document. (This is also called picture transmission.)

Fading. The variation of the signal intensity received at a given location from a radio transmitting station as a result of changes occurring in the transmission path (see Distortion.)

Fidelity. The degree to which a system, or a portion of a system, accurately reproduces at its output the signal which is impressed upon it.

Filament. A cathode in which the heat is supplied by current passing through the cathode.

Filter. A selective circuit network, designed to pass current within a continuous band or bands of frequencies or direct current, and substantially reduce the amplitude of currents of undesired frequencies.

Frequency. The number of cycles per second.

Full-Wave Rectifier. A double element rectifier arranged so that current is allowed to pass in the same direction to the load circuit during each half cycle of the alternating-current supply, one element functioning during one-half cycle and the other during the next half cycle, and so on.

Fundamental Frequency. The lowest component frequency of a periodic wave or quantity.

Fundamental or Natural Frequency (of an antenna). The lowest resonant frequency of an antenna, without added inductance or capacity.

Gas Phototube. A type of phototube in which a quantity of gas has been introduced, usually for the purpose of increasing its sensitivity.

Grid. An electrode having openings through which electrons or ions may pass.

Grid Bias. The direct component of the grid voltage.

Grid Condenser. A series condenser in the grid or control circuit of a vacuum tube.

Grid Leak. A resistor in a grid circuit, through which the grid current flows, to affect or determine a grid bias.

Grid-Plate Transconductance. The name for the plate current to grid voltage transconductance. (This has also been called mutual conductance.)

Ground System (of an antenna). That portion of the antenna system below the antenna loading devices or generating apparatus most closely associated with the ground and including the ground itself.

Ground Wire. A conductive connection to the earth.

Half-Wave Rectifier. A rectifier which changes alternating current into pulsating current, utilizing only one-half of each cycle.

Harmonic. A component of a periodic quantity having a frequency which is an integral multiple of the fundamental frequency. For example, a component the frequency of which is twice the fundamental frequency is called the second harmonic.

Heater. An electrical heating element for supplying heat to an indirectly heated cathode.

Heterodyne Reception. The process of receiving radio waves by combining in a detector a received voltage with a locally generated alternating voltage. The frequency of the locally generated voltage is commonly different from that of the received voltage. (Heterodyne reception is sometimes called beat reception.)

Homodyne Reception. A system of reception by the aid of a locally generated voltage of carrier frequency. (Homodyne reception is sometimes called zero-beat reception.)

Hot-Wire Ammeter, Expansion Type. An ammeter dependent for its indications on a change in dimensions of an element which is heated by the current to be measured.

Indirectly Heated Cathode. A cathode of a thermionic tube, in which heat is supplied from a source other than the cathode itself.

Induction Loud Speaker is a moving coil loud speaker in which the current which reacts with the polarizing field is induced in the moving member.

Inductive Coupling. The association of one circuit with another by means of inductance common or mutual to both.

Interelectrode Capacitance. The direct capacitance between two electrodes.

Interference. Disturbance of reception due to strays, undesired signals, or other causes; also, that which produces the disturbance.

Intermediate Frequency in Superheterodyne Reception. A frequency between that of the carrier and the signal, which results from the combination of the carrier frequency and the locally generated frequency.

Intermodulation. The production, in a non-linear circuit element, of frequencies corresponding to the sums and differences of the fundamentals and harmonics of two or more frequencies which are transmitted to that element.

Interrupted Continuous Waves. Interrupted continuous waves are waves obtained by interruption at audio frequency in a substantially periodic manner of otherwise continuous waves.

Kilocycle. When used as a unit of frequency, is a thousand cycles per second.

Lead-In. That portion of an antenna system which completes the electrical connection between the elevated outdoor portion and the instruments or disconnecting switches inside the building.

Linear Detection. That form of detection in which the audio output voltage under consideration is substantially proportional to the modulation envelope throughout the useful range of the detecting device.

Loading Coil. An inductor inserted in a circuit to increase its inductance but not to provide coupling with any other circuit.

Loud Speaker. A telephone receiver designed to radiate acoustic power into a room or open air.

Magnetic Loud Speaker. One in which the mechanical forces result from magnetic reactions.

Magnetic Microphone. A microphone whose electrical output results from the motion of a coil or conductor in a magnetic field.

Master Oscillator. An oscillator of comparatively low power so arranged as to establish the carrier frequency of the output of an amplifier.

Megacycle. When used as a unit of frequency, is a million cycles per second.

Mercury-Vapor Rectifier. A mercury-vapor rectifier is a two-electrode, vacuum-tube rectifier which contains a small amount of mercury. During operation, the mercury is vaporized. A characteristic of mercury-vapor rectifiers is the low-voltage drop in the tube.

Mircophone. A microphone is an electro-acoustic transducer actuated by power in an acoustic system and delivering power to an electric system, the wave form in the electric system corresponding to the wave form in the acoustic system. This is also called a telephone transmitter.

Mixer Tube (generally in superheterodyne receivers.) A mixer tube is one in which a locally generated frequency is combined with the carrier-signal frequency to obtain a desired beat frequency.

Modulated Wave. A modulated wave is a wave of which either the amplitude, frequency, or phase is varied in accordance with a signal.

Modulation is the process in which the amplitude, frequency, or phase of a wave is varied in accordance with a signal, or the result of that process.

Modulator. A device which performs the process of modulation.

Monochromatic Sensitivity. The response of a phototube to light of a given color, or narrow frequency range.

Moving-Armature Speaker. A magnetic speaker whose operation involves the vibration of a portion of the ferromagnetic circuit. (This is sometimes called an electromagnetic or a magnetic speaker.)

Moving Coil Loud Speaker. A moving coil loud speaker is a magnetic loud speaker in which the mechanical forces are developed by the interaction of currents in a conductor and the polarizing field in which it is located. This is sometimes called an Electro-Dynamic or a Dynamic Loud Speaker.

Mu-Factor. A measure of the relative effect of the voltages on two electrodes upon the current in the circuit of any specified electrode. It is the ratio of the change in one electrode voltage to a change in the other electrode voltage, under the condition that a specified current remains unchanged.

Mutual Conductance. (See Grid-Plate Transconductance.)

Oscillator. A non-rotating device for producing alternating current, the output frequency of which is determined by the characteristics of the device.

Oscillatory Circuit. A circuit containing inductance and capacitance, such that a voltage impulse will produce a current which periodically reverses.

Pentode. A type of thermionic tube containing a plate, a cathode, and three additional electrodes. (Ordinarily the three additional electrodes are of the nature of grids.)

Percentage Modulation. The ratio of half the difference between the maximum and minimum amplitudes of a modulated wave to the average amplitude, expressed in per cent.

Phonograph Pickup. An electromechanical transducer actuated by a phonograph record and delivering power to an electrical system, the wave form in the electrical system corresponding to the wave form in the phonograph record.

Phototube. A vacuum tube in which electron emission is produced by the illumination of an electrode. (This has also been called photo-electric tube.)

Plate. A common name for the principal anode in a vacuum tube.

Power Amplification (of an amplifier). The ratio of the alternating-current power produced in the output circuit to the alternating-current power supplied to the input circuit.

Power Detection. That form of detection in which the power output of the detecting device is used to supply a substantial amount of power directly to a device such as a loud speaker or recorder.

Pulsating Current. A periodic current; that is, current passing through successive cycles, the algebraic average value of which is not zero. A pulsating current is equivalent to the sum of an alternating and a direct current.

Push-Pull Microphone. One which makes use of two functioning elements 180 degrees out of phase.

Radio Channel. A band of frequencies or wavelengths of a width sufficient to permit of its use for radio communication. The width of a channel depends upon the type of transmission. (See Band of Frequencies.)

Radio Compass. A direction finder used for navigational purposes.

Radio Frequency. A frequency higher than those corresponding to normally audible sound waves. (See Audio Frequency.)

Radio-Frequency Transformer. A transformer for use with radio-frequency currents.

Radio Receiver. A device for converting radio waves into perceptible signals.

Radio Transmission. The transmission of signals by means of radiated electromagnetic waves originating in a constructed circuit.

Radio Transmitter. A device for producing radio-frequency power, with means for producing a signal.

Rectifier. A device having an asymmetrical conduction characteristic which is used for the conversion of an alternating current into a pulsating current. Such devices include vacuum-tube rectifiers, gas rectifiers, oxide rectifiers, electrolytic rectifiers, etc.

Reflex Circuit Arrangement. A circuit arrangement in which the signal is amplified, both before and after detection, in the same amplifier tube or tubes.

Regeneration. The process by which a part of the output power of an amplifying device reacts upon the input circuit in such a manner as to reinforce the initial power, thereby increasing the amplification. (Sometimes called "feedback" or "reaction.")

Resistance Coupling. The association of one circuit with another by means of resistance common to both.

Resonance Frequency (of a reactive circuit). The frequency at which the supply current and supply voltage of the circuit are in phase.

Rheostat. A resistor which is provided with means for readily adjusting its resistance.

Screen Grid. A screen grid is a grid placed between a control grid and an anode, and maintained at a fixed positive potential, for the purpose of reducing the electrostatic influence of the anode in the space between the screen grid and the cathode.

Secondary Emission. Electron emission under the influence of electron or ion bombardment.

Selectivity. The degree to which a radio receiver is capable of differentiating between signals of different carrier frequencies.

Sensitivity. The degree to which a radio receiver responds to signals of the frequency to which it is tuned.

Sensitivity of a Phototube. The electrical current response of a phototube, with no impedance in its external circuit, to a specified amount and kind of light. It is usually expressed in terms of the current for a given radiant flux, or for a given luminous flux. In general the sensitivity depends upon the tube voltage, flux intensity, and spectral distribution of the flux.

Service Band. A band of frequencies allocated to a given class of radio communication service.

Side Bands. The bands of frequencies, one on either side of the carrier frequency, produced by the process of modulation.

Signal. The intelligence, message or effect conveyed in communication.

Single Side-Band Transmission. That method of operation in which one side band is transmitted, and the other side band is suppressed. The carrier wave may be either transmitted or suppressed.

Static. Strays produced by atmospheric conditions.

Static Sensitivity of a Phototube. The direct current response of a phototube to a light flux of specified value.

Stopping Condenser. A condenser used to introduce a comparatively high impedance in some branch of a circuit for the purpose of limiting the flow of low-frequency alternating current or direct current without materially affecting the flow of high frequency alternating current.

Strays. Electromagnetic disturbances in radio reception other than those produced by radio transmitting systems.

Superheterodyne Reception. Superheterodyne reception is a method of reception in which the received voltage is combined with the voltage from a local oscillator and converted into voltage of an intermediate frequency which is usually amplified and then detected to reproduce the original signal wave. (This is sometimes called double detection or supersonic reception.)

Swinging. The momentary variation in frequency of a received wave.

Telephone Receiver. An electro-acoustic transducer actuated by power from an electrical system and supplying power to an acoustic system, the wave form in the acoustic system corresponding to the wave form in the electrical system.

Television. The electrical transmission of a succession of images and their reception in such a way as to give a substantially continuous reproduction of the object or scene before the eye of a distant observer.

Tetrode. A type of thermionic tube containing a plate, a cathode, and two additional electrodes. (Ordinarily the two additional electrodes are of the nature of grids.)

Thermionic. Relating to electron emission under the influence of heat.

Thermionic Emission. Electron or ion emission under the influence of heat.

Thermionic Tube. An electron tube in which the electron emission is produced by the heating of an electrode.

Thermocouple Ammeter. An ammeter dependent for its indications on the change in thermo-electromotive force set up in a thermo-electric couple which is heated by the current to be measured.

Total Emission. The value of the current carried by electrons emitted from a cathode under the influence of a voltage such as will draw away all the electrons emitted.

Transconductance. The ratio of the change in the current in the circuit of an electrode to the change in the voltage on another electrode, under the condition that all other voltages remain unchanged.

Transducer. A device actuated by power from one system and supplying power to another system. These systems may be electrical, mechanical, or acoustic.

Transmission Unit. A unit expressing the logarithmic ratios of powers, voltages, or currents in a transmission system. (See Decibel.)

Triode. A type of thermionic tube containing an anode, a cathode, and a third electrode, in which the current flowing between the anode and the cathode may be controlled by the voltage between the third electrode and the cathode.

Tuned Transformer. A transformer whose associated circuit elements are adjusted as a whole to be resonant at the frequency of the alternating current supplied to the primary, thereby causing the secondary voltage to build up to higher values than would otherwise be obtained.

Tuning. The adjustment of a circuit or system to secure optimum performance in relation to a frequency; commonly, the adjustment of a circuit or circuits to resonance.

Vacuum Phototube. A type of phototube which is evacuated to such a degree that the residual gas plays a negligible part in its operation.

Vacuum Tube. A device consisting of a number of electrodes contained within an evacuated enclosure.

Vacuum Tube Transmitter. A radio transmitter in which vacuum tubes are utilized to convert the applied electric power into radio-frequency power.

Vacuum Tube Voltmeter. A device utilizing the characteristics of a vacuum tube for measuring alternating voltages.

Voltage Amplification. The ratio of the alternating voltage produced at the output terminals of an amplifier to the alternating voltage impressed at the input terminals.

Voltage Divider. A resistor provided with fixed or movable contacts and with two fixed terminal contacts; current is passed between the terminal contacts, and a desired voltage is obtained across a portion of the resistor. (The term potentiometer is often erroneously used for this device.)

Wave a. A propagated disturbance, usually periodic, as an electric wave or sound wave,
b. A single cycle of such a disturbance, or,
c. A periodic variation as represented by a graph.

Wavelength. The distance traveled in one period or cycle by a periodic disturbance.

-INDEX-