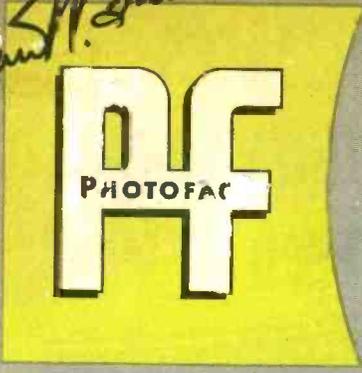


*W. J. Evans*



# INDEX

AND TECHNICAL DIGEST



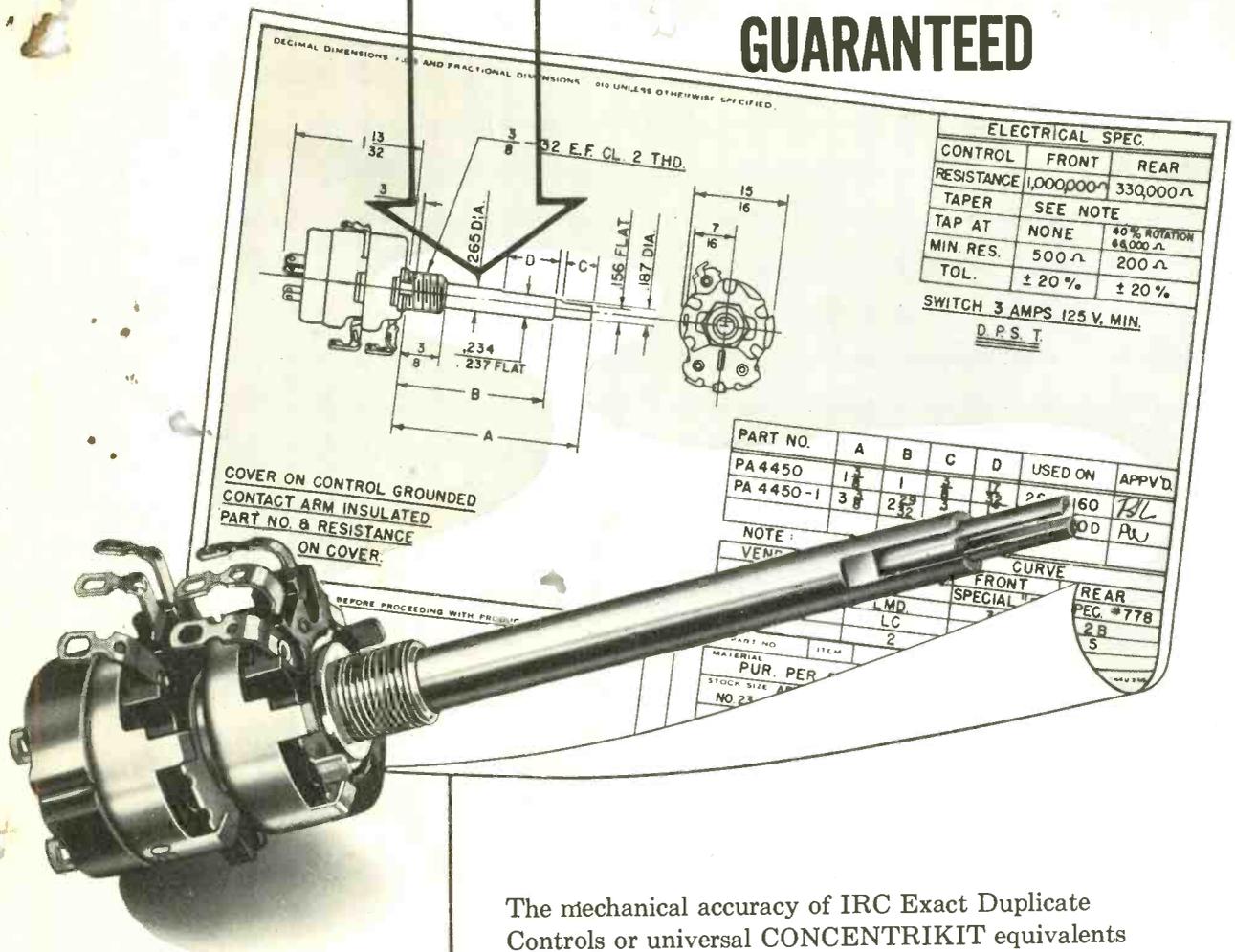
## TRANSISTORS

**The Transistor  
Story . . . See Page 10**

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**SEPT • OCT • 1953 • No. 40**

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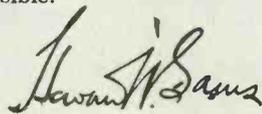
While we have absorbed these costs in the interests of bringing you more information and help, we have realized that, with increasing size, any deficit per issue increases proportionately, and that there had to come a time when we could no longer continue on such a basis.

Now we are doing what you have asked us to do. We are going to publish the Index every month, and try to make it more valuable than ever. We will continue to supply it to you through your distributor at twenty-five cents (25c) a copy beginning with the January 1954 issue. The November-December PF INDEX and Technical Digest will be the last of the bi-monthly issues.

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**AND TECHNICAL DIGEST**

VOL. 3 • NO. 5 SEPT.-OCT., 1953

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**CONTENTS**

Shop Talk	
Milton S. Kiver	5
Compatible Color TV	
C. P. Oliphant	9
The Transistor Story	
William E. Burke	10
Replacement Technique for Horizontal Output Transformers (Part II)	
Glen E. Slutz	15
Servicing with the Scope	
C. P. Oliphant	19
Examining Design Features	
Henry A. Carter	23
Record Changer Servicing	
Lester W. Caudell and Glen E. Slutz	27
UHF (Circuits and Equipment for UHF Reception)	
Merle E. Chaney and Glen E. Slutz	29
Adjustment Procedure for UHF Strips	
W. W. Hensler	37
In the Interest of Quicker Servicing	
Don R. Howe and Glen E. Slutz	41
Audio Facts	
Robert B. Dunham	45
Dollar and Sense Servicing	
John Markus	47
Photofact Cumulative Index	
No. 40 Covering Photofact Sets	
Nos. 1-218 Inclusive	49
Glossary of Transistor Terms	121
Status of TV Broadcast Operations	123
A Stock Guide for TV Tubes	124
+ More or Less—	126



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# WE'LL TELL THE WORLD!

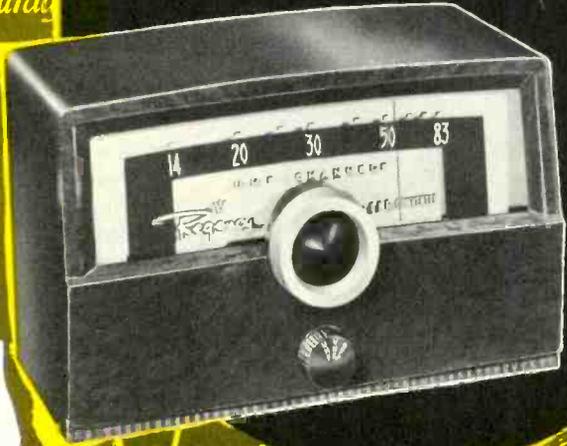
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# Shop Talk

MILTON S. KIVER

President, Television Communications Institute

In his every day work of servicing television receivers, the technician will, from time to time, find himself in circuits which are either completely new to him or about which he knows so little that he is not sure whether or not they are functioning properly.

In this predicament, many simply resign themselves to hazardous parts replacement hoping in that way to strike the defective one and fix the set. If the trouble has been correctly isolated to a fairly small section of the receiver, then this approach will yield results, although the location of the part may take several hours. However, if the preliminary diagnosis was incorrect then whatever time is spent here in parts replacement will be wasted.

Now, it is not necessary for the service man to rely wholly on Lady Luck when working on or around new or otherwise unfamiliar circuits. With a little thought and concentration, the operation of many circuits can be worked out. In the end you may not be totally familiar with every aspect of the circuits operation, but you will certainly have a better appreciation of many of its features, frequently enough to enable you to determine intelligently whether or not it is operating properly.

How do you go about determining how a circuit operates? There are no set rules for this and how well you succeed will depend on how much you know about circuit operation in general and about that receiver in particular. But if we assume that you are an average TV service man, then the following pointers should certainly prove of value.

1. First, take a schematic diagram of the set and see what name has been given to the unfamiliar

stage (or stages) as indicated on the schematic.

2. When the name is strange or ambiguous, try to determine the stage function by its position in the receiver. Note from which point it obtains its signal and to what point it feeds this signal.

To illustrate, in the DuMont Model RA-111A television receiver, there is a 6BA6 sync amplifier stage that taps into the video system just ahead of the second detector. See Figure 1. This is certainly an unusual place to find a sync amplifier and indicates an arrangement that differs from normal practice. Let us trace through this circuit.

At the point where the special 6BA6 amplifier taps into the video system it receives the full video signal at the IF frequency. The output of the 6BA6 then feeds a 6AL5 duo-diode and the latter, in turn, applies part of its output to the 1st sync clipper stage.

Now let us combine this information with the names assigned to the 6BA6 and its companion 6AL5. The schematic labels the 6BA6 as a sync amplifier and the 6AL5 as the sync detector and AGC stage. Hence what we apparently have here is a special system designed to obtain a portion of the IF signal from the 4th video IF stage, amplify it, and then detect it to obtain the video signal. This is then fed to a sync clipper where the sync pulses are separated from the rest of the signal. Furthermore, as a secondary function, the 6AL5 (V16) also provides AGC for the set.

By knowing this about the special circuit we can trace through it and detect trouble when it exists. At the 6AL5 output we would look for the detected video signal. Failing to

find this, we could, with an RF probe and a scope, check the signal at the input to the 6AL5, at the plate of V15, and at the grid of V15.

3. Compare any new circuits you find with those you already know. To this should be added whatever other knowledge you possess concerning electronic circuit operation. For example, diodes are basically rectifiers which convert AC voltages to pulsating DC voltages. They are used principally in power supplies and as detectors. Triodes and pentodes are most frequently employed as amplifiers while pentagrid tubes find wide usage as mixers. There are, of course, other functions which these tubes perform, but the foregoing are their principal applications.

4. Frequently helpful in determining how a stage operates are the voltages which are applied to the circuit, especially the tube. For example, high bias voltages which keep a tube cut-off for a portion of the time would exempt this tube from functioning as a Class-A amplifier. A keyed AGC tube operates in this fashion and passes current only when the plate and grid are simultaneously triggered. Clipper tubes are also subject to high grid bias and here, again, current is obtained only when the sync pulses are present.

Other common facts concerning tubes and their operating voltages are: (1) the grid is usually negative with respect to the cathode, and (2) the screen and plate elements are more positive than the cathode. Significant, too, are the voltage drops across plate, screen, and cathode resistors in a tube circuit. Absence of any voltage drop across these resistors generally indicates lack of current flow. Normally, current should flow although instances may be uncovered where not current flow is permissible.



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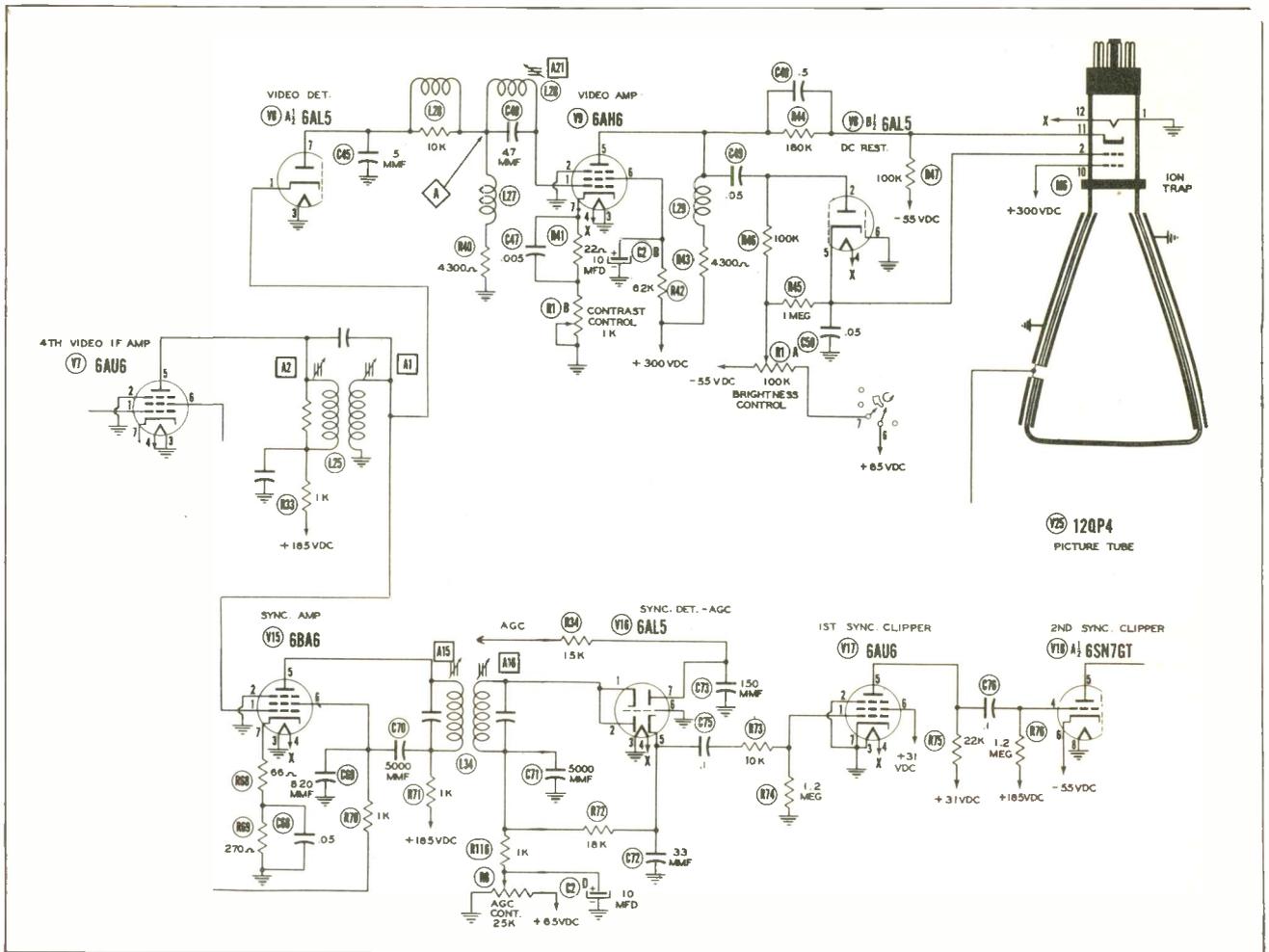


Figure 1. Sync Separator System in the DuMont RA-111A TV Receiver.

5. One final suggestion for un-tangling new circuits. Most amplifiers in television receivers operate Class A. That means that their bias values are nominal (see a tube manual), and are provided either by a cathode resistor or by a tap on a power supply bleeder resistor. Grid leak bias is out. So are high positive voltages fed to the cathode without a corresponding offset voltage to the grid. So, too, are small positive plate and screen voltages; small, that is, when measured with respect to the cathode. It should be noted that a low B+ plate voltage may still have the plate several hundred volts positive with respect to the cathode if the latter element is returned to a negative potential point. Voltages on tubes should always be measured with respect to those on other elements, not with respect to chassis ground.

Be careful about this or you may be led astray.

As a relatively simple start, consider the circuit of the vertical system in the General Electric Model 17C103 receiver. This is shown in

Figure 2. It contains a multivibrator and an amplifier. In addition, it also contains a tube labeled vertical blanking and this particular arrangement is unique to this receiver. Let us see if we can determine how it operates.

We note, first that the tube receives its signal from the plate of the vertical amplifier. This means that the tube receives the same voltage waveform that is fed to the vertical deflection coils. This is a sharply peaked wave possessing the form shown in Figure 3.

We see further that the cathode of the vertical blanking tube is grounded, while the grid itself is connected to a high-valued resistor (here 1 megohm). This arrangement plus the .01 mfd coupling capacitor is characteristic of grid-leak bias. This suspicion is further strengthened by the fact that the normal bias on this tube is given as -35 volts. A bias this high means that the tube conducts only for brief instants when the high negative voltage is overcome. At all other times, the tube is cut off.

The next step is to determine where the stage feeds its output signal. The plate lead, we see, ties into resistors R93, R94 & R95, with the top end of R93 connecting to grid No. 2 of the picture tube. The three resistors, then, are the load resistors for V14. The bottom end of R95 is tied into the damper circuit from which point it receives a positive B voltage. This is required by grid No. 2 of the picture tube for beam acceleration.

The operation of V14 can now be quite clearly figured out. Current will flow through the tube only when a strong positive pulse is applied to the grid. From the waveform which is obtained from the plate of V15, such a positive pulse appears during vertical retrace. At the plate of V14, the input pulse appears negative (due to tube inversion) and this must then reduce whatever positive voltage (DC in this case) is applied to grid No. 2 of the picture tube. The negative pulse from V14 is evidently sufficient in amplitude to remove the vertical retrace lines from the pic-

\* \* Please turn to page 85 \* \*

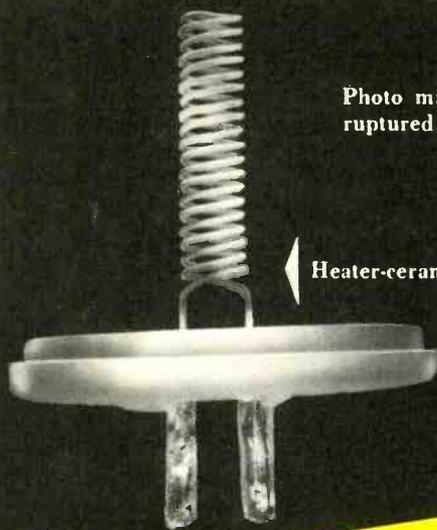
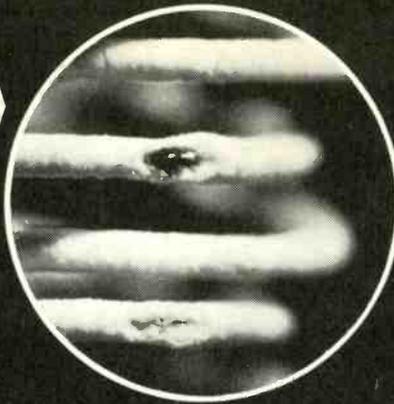


Photo micrograph of ruptured heater coating



Heater-ceramic assembly

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# COMPATIBLE

# COLOR TV

## Operation of the Black and White Receiver on the NTSC Color Signal

by C. P. Oliphant

Editor's Note: On July 23, 1953 the NTSC (National Television Systems Committee) petitioned the Federal Communications Commission to adopt color television standards set up by this committee. Prior to this time, on June 25, 1953, RCA and NBC jointly petitioned the FCC for adoption of the NTSC's color television standards. The Philco Corp.; Sylvania Electric Products, Inc.; General Electric Co.; and Motorola, Inc. have also petitioned for adoption of these standards. The following is a discussion of some of the specifications of the NTSC color television system. It should be understood that our discussion of these standards does not imply that this is the system which will ultimately be accepted by the commission. Rather it is intended to present information on the NTSC color system in order to keep the service technician abreast of the developments in the color television field.

### NTSC Color TV Synchronizing Signal -

It is desired by the public and the manufacturers of television receivers to have a color television system that will be compatible with present day monochrome receivers. A compatible color television system is one that will produce a black and white picture on the existing monochrome receivers, without modification of the receiver or additional adjustments, as well as producing a color picture on future color receivers. This objective has been undertaken by NTSC (National Television System Committee).

NTSC is a committee that has been authorized by the board of

directors of the Radio-Television Manufacturers' Association with members representing organizations in the electronics field who are interested in the research and development of television. Also, some members are qualified engineers who are not associated with a particular organization. All members are appointed by the Chairman of the Radio-Television Manufacturers' Association with the concurrence of the vice chairman.

Within the organization, panels are set up and certain projects are assigned to them. The members of each panel are selected from any company, association or organization regardless of affiliation. Each member of the panels is selected according to his recognized skill, ability, and interest in the particular project. Upon the completion of an assignment, the members of the panel submit a detailed report on their work and findings to the committee.

The first NTSC was formed in 1940 for the purpose of obtaining

a set of standards which could be used in the commercialization of monochrome television. The standards for monochrome television that we now have are the results of the first NTSC. Because of the approved work of the first NTSC, the present NTSC was organized.

After extensive research and field testing, standards for compatible color television have been set up by the committee and are being field-tested preparatory to being presented to the FCC for approval.

### Luminance and Chrominance -

The NTSC system of color television involves the simultaneous transmission of two different signals. These two signals are the monochrome signal that is now in use, and another signal for the transmission of color information. The portion of the signal that carries the color information is referred to as the chrominance signal and the portion that carries the monochrome information is called the luminance signal.

To have a compatible system, the committee realized that the present standards of black and white television had to be retained and that the addition of chrominance information must be accomplished without interrupting the operation of the monochrome receivers now in use. In order to accomplish this, band sharing of the luminance and the chrominance information in the band that is normally used for the transmission of luminance information must be done. This process is also referred to as interleaving the chrominance signal with the luminance signal.

### Band Sharing -

The NTSC method of band sharing is accomplished by adding

\* \* Please turn to page 91 \* \*

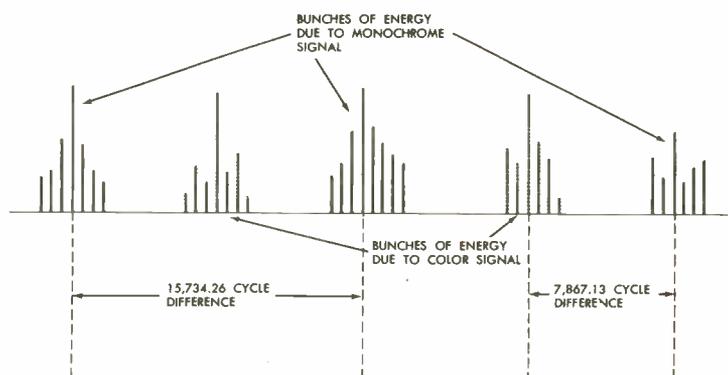
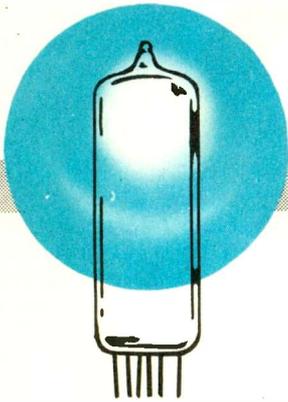


Figure 1. Concentration of Energies of the Interleaved Chrominance and Luminance Signals.

# The Transistor



## HOW THE POINT-CONTACT AND JUNCTION TRANSISTORS OPERATE; THEIR APPLICATION, LIMITATIONS, ADVANTAGES AND DISADVANTAGES.

The discovery of the transistor action, first announced in 1948, brought about extravagant claims about it and its subsequent inclusion into the electronics field. At the present time, however, many of the engineers' hopes for using transistors in commercial equipment have been considerably dampened. They have come to realize that the transistor is still in its infancy and in a rapidly changing state of development. Eventually, after more improved (and less expensive) units are available, the transistor will be employed in many applications where vacuum tubes are now used. With

this in mind, this data is presented with the hope that it will provide the service technician with the theory of operation of the transistor that will need to be known in order to service equipment incorporating these units.

The transistor, like the vacuum tube, was discovered somewhat accidentally as a result of research in another field. The transistor action theory was developed from facts that came from research work in the field of semi-conductors. These are materials that fall between insulators and conductors in their

capabilities for conduction or non-conduction of electrons. They do not pass current readily, as in a conductor, nor do they entirely oppose it, as an insulator does. For a feasible explanation of this action, it is necessary to review the basic principles of the properties of matter.

The smallest part of an element which will exhibit the physical properties of that element is called a molecule. A molecule is made up of atoms, which have an inner portion, a nucleus, and one or more layers of electrons around the nucleus. It is

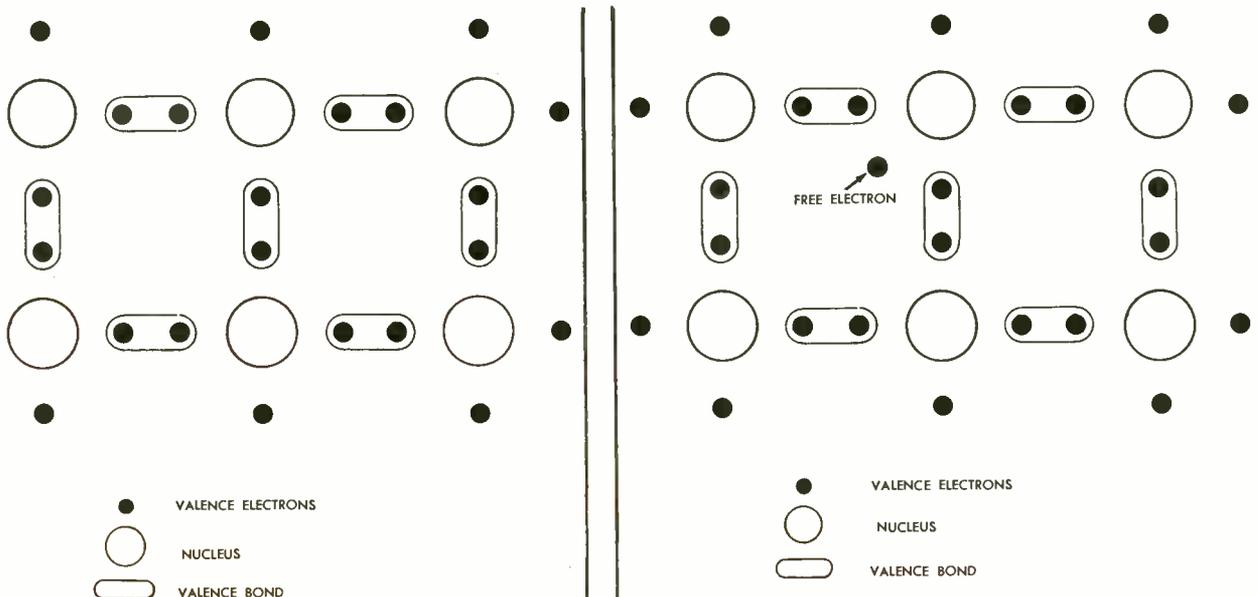
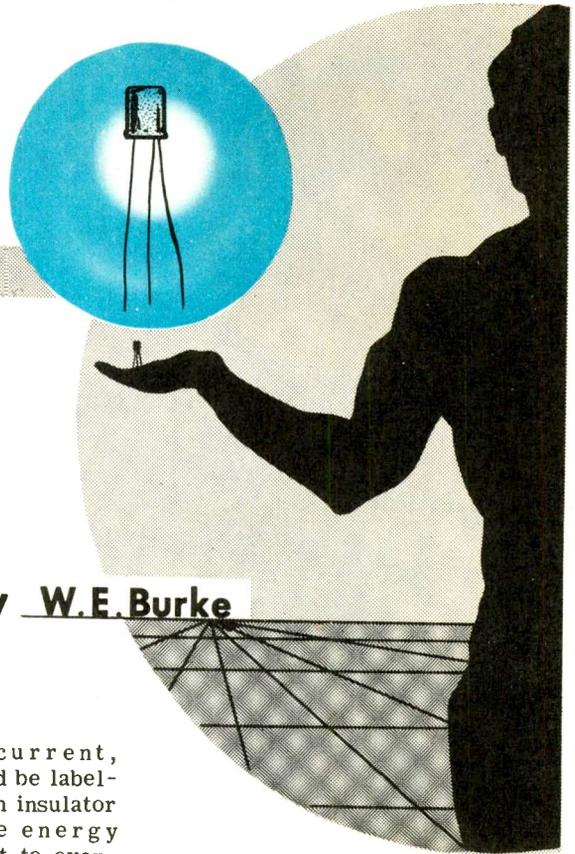


Figure 1. Normal Molecular Structure.

Figure 2. Substitution With One Atom Having Five Valence Electrons.

# Story



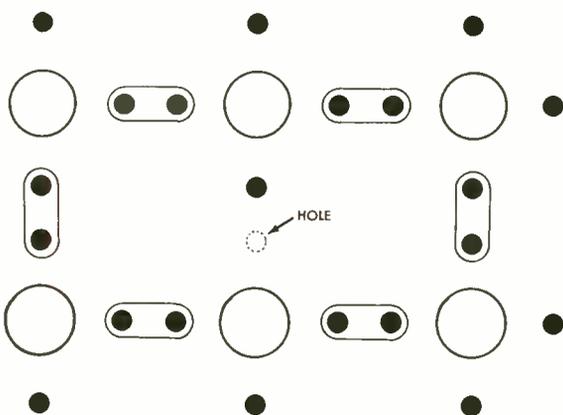
by W.E. Burke

the outer shell, the farthest from the nucleus, that we must consider in this explanation. This outer shell, or rather a portion of the electrons in this outer shell, constitutes the ingredients of an electric current. These are called valence electrons. In the normal molecular structure of an element the molecules are held together by a bonding or union of the valence electrons into pairs consisting of one electron from each of two atoms. The atoms are thus interwoven into a crystal-like structure as shown in Figure 1. If, as happens in many elements, an excess of electrons is present after all the valence bonds have been formed, these excess electrons (free electrons) are free to wander about in the molecular structure and are available to form an electric current when a suitable potential is applied. A material of this nature would be called a conductor.

In many other elements a condition exists in which all the valence electrons are combined into valence bonds. This leaves no excess of

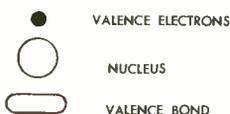
electrons to constitute a current, and such a material would be labeled as an insulator. If an insulator is heated, however, the energy applied may be sufficient to overcome the binding force of the valence bonds and to liberate free electrons. The heated insulator has now become what is known as a semi-conductor. The distinction between semi-conductors and insulators is not sharp. Some materials have valence bonds which can be broken easily, even at room temperature. These are called semi-conductors. Certain elements having four valence electrons, like germanium and silicon, fall

under this classification. (The number of valence electrons in an element can be determined by referring to a Periodic Table. A Periodic Table is an orderly arrangement of the elements into a chart consisting of eight vertical columns. The first column at the left contains all the elements with



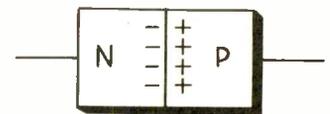
(Left)

Figure 3. Substitution With One Atom Having Three Valence Electrons.

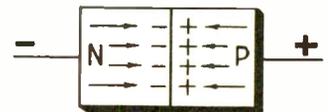


(Right)

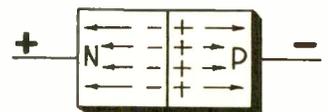
Figure 4. Junction Rectifiers Showing Carrier Action With (A) No Voltages Applied (B) Proper Polarity for Current Flow—Low Impedance Circuit (C) Wrong Polarity for Current Flow—High Impedance Circuit.



A

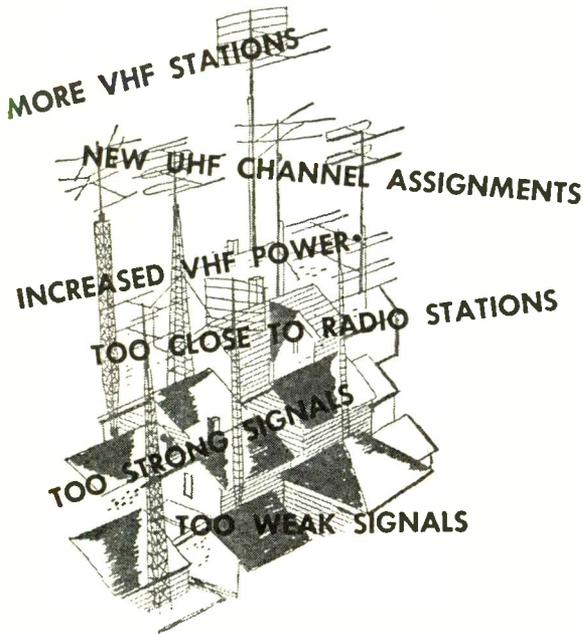


B



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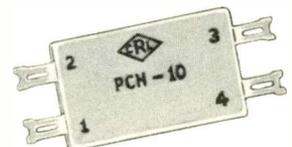
The switching arrangement makes it possible to attenuate each station as much or as little as necessary depending on daily conditions such as weather or existing interference, and allows for proper attenuation to balance two or more stations. It shows you the proper attenuation merely by turning a switch. You instantly match signal strength to requirements of receiver. Four different H-pads are mounted permanently to the at-

tractive metal case. All you do is hook up to the 300-ohm antenna twin lead and turn dial to the H-pad that gives you the proper attenuation. Then unhook leads and install the proper H-pad. Checking and installation takes only a few minutes.

If customers want permanent selective attenuation installation, this handy unit makes the job easier. And it's another sale for you!

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one valence electron, the second has those with two valence electrons and so on to the eighth column having the elements with eight valence electrons. Therefore, to determine the number of valence electrons held by any element, consult a Periodic Table, usually found in chemistry or physics handbooks. The number of the column in which that element is listed indicates the number of valence electrons.)

It was noted early in the study of semi-conductors that the presence of some impurities greatly changed the properties of the semi-conductor and the following two effects were recorded.

When an impurity element from the fifth column of the Periodic Table (those with five valence electrons) is added to germanium, atoms of the impurity replace atoms of germanium in the crystal structure. The germanium atoms, having only four valence electrons, will form valence bonds with only four of the five valence electrons of the impurity. As illustrated in Figure 2, this leaves one free electron (per each impurity atom) available for current flow. This combination is called an N-type (negative) semi-conductor and the impurity atoms are called "donors". An association for easy remembrance of these terms can be formed with the N's in N-type, negative, and donor.

Similarly, atoms of elements in the third column of the Periodic Table can be substituted for the atoms in the crystal. These atoms, with only three electrons in the outer ring, will form valence bonds with only three of the four electrons of the germanium, but will trap the fourth. This leaves a vacancy or hole in the germanium (See Figure 3) which, according to the latest transistor theory, can also contribute to current flow. A combination of this type is called a P-type (positive) semi-conductor and the impu-

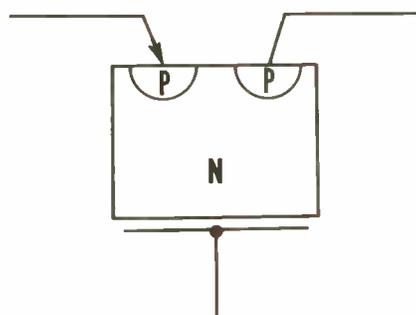


Figure 5. Point-Contact Transistor Construction.

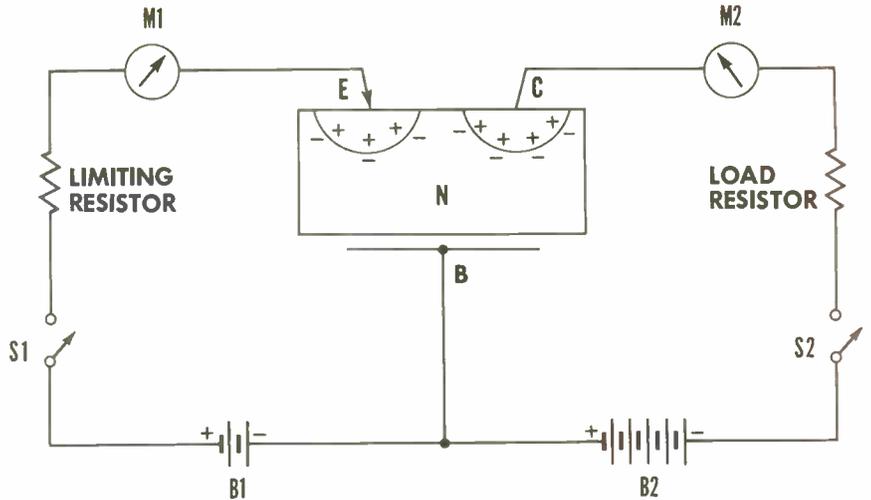


Figure 6. Basic Point-Contact Transistor Circuit.

rity atoms are now labeled as "acceptors". An association similar to that of the N-type can be formed with the P's in "P-type", "positive" and "acceptor".

The concept of holes, which was first formulated to help explain the transistor, can itself be explained by an experiment performed about 1889 by H.A. Rowland, a well known physicist. On an ebonite disk, he placed negative charges of static electricity, separated by raised portions of the disk. When this disk was rotated clockwise, a magnetic field was produced identical to what would have been expected if a flow of electrons had occurred in a loop of wire in the same direction of rotation. The negative charges were then removed and replaced by a set of positive charges and the disk was rotated counter-clockwise. An identical magnetic field was produced. Since our only indications of direction of current flow are based upon the direction of magnetic field produced, this illustrated that identical magnetic fields could be produced by positive and negative flows in opposite directions. In the study of transistors, the reader must bear in mind that both positive and negative flows can be and are present in the semi-conductor.

The first result of semi-conductor research was the junction rectifier. Consider a single crystal of germanium, one half of which is N-type and the other P-type as in Figure 4A. With no voltage potential applied, there will be only an extremely small current across the junction between the two types, and it will be caused by random re-combination of holes and electrons. With a voltage applied in a polarity such that the holes in the P-type region and the electrons in the N-type

region are both attracted toward the junction, considerable current will flow through the crystal. The holes which cross the junction to the N-type side will combine with electrons; and, likewise, the electrons which cross into the P-type region will combine with the holes. This is illustrated in Figure 4B, and results in a low impedance circuit.

Figure 4C illustrates the result of reversing the applied voltages. The holes and electrons are pulled back from the junction and the measurable current flow will cease. This imposes a high impedance in the circuit. As with most metallic rectifiers, there is a limit to the voltage that can be applied in this reverse connection. When this limit is exceeded, voltage breakdown occurs and the rectifier will be ruined.

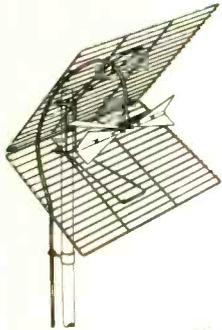
The first true transistor developed from this semi-conductor research was the point-contact type. This consists of a block of germanium, usually of the N-type, with two cat-whiskers mounted so that they exert a slight pressure on the crystal. This construction is shown in Figure 5. During manufacture, electric currents are passed through each whisker to form the areas of P-type material at the points. These points are usually separated by approximately .005 in.

The left-hand connection in Figure 6 is called the emitter (E) and the right one is the collector (C). The large connection to the crystal is the base (B). With S<sub>2</sub> closed (S<sub>1</sub> open) current will flow through the collector circuit, but only a small amount, as indicated on M<sub>2</sub>. By comparing the circuit, C to B, with Figure 4C, it can be seen that this

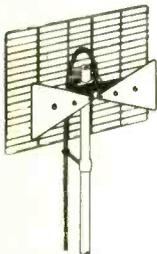
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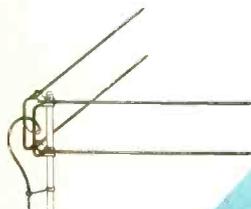
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**YAGI**



**RHOMBIC**

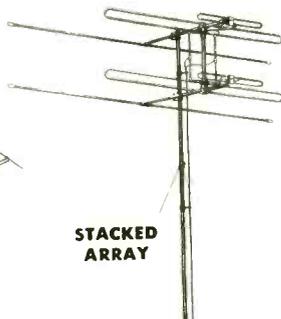


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# REPLACEMENT TECHNIQUE — for —

by Glen E. Slutz

## PART II

Part I of this series, having to do specifically with the replacement of horizontal output transformers of the isolated secondary type, appeared in the PF INDEX and Technical Digest of July-August, 1953. In that presentation a field experience in transformer replacement was described in some detail. The particular experience was selected not because it was typical of most such cases; actually, it was not, since the usual replacement job is not as involved as that one was. The experience was related because it did serve to illustrate a number of the possible complications which may at various times arise, and the remedies for these troubles.

Continuing in this vein, we now approach the subject of replacing transformers of the autotransformer variety. Autotransformers have been gaining increased usage in horizontal sweep systems, particularly in the newer television receivers employing large-sized picture tubes. Mindful of this, the replacement parts manufacturers have introduced transformer units designed to accommodate the requirements of these systems. A partial list of such units may be found in Chart 2. Photofact Folders on the various television receivers contain recommendations as to which replacement units are most applicable to each case. Also, instruction sheets packed with the replacement transformers help toward attaining satisfactory operation from these parts.

### THE REPLACEMENT PROCEDURE

A television receiver using a 21" metal picture tube and a 6BG6G horizontal output amplifier was found to have a defective horizontal output transformer. The portion of the circuit having to do with the horizontal sweep output and high voltage generation is reproduced in the schematic of Figure 7. A photograph of the original transformer and associated parts placement is shown in Figure

8. Note the fact that the width coil and fuse are included within the high voltage compartment. These components are very often found in this location.

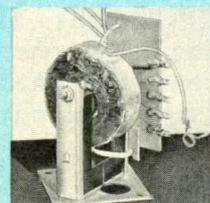
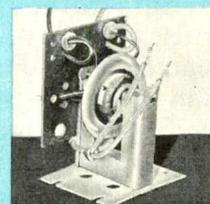
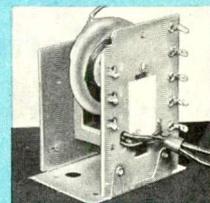
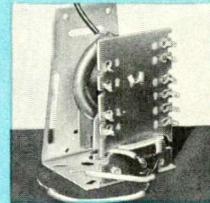
In choosing the replacement unit for the defective transformer, Photofact recommendations for the receiver were consulted. An RCA 232T1 autotransformer was selected from the listed recommendations because it happened to be in the technician's stock of parts. Since the RCA 232T1 requires a width coil with relatively high inductance, the original width coil was checked to determine whether it could be used in the new circuit. This was done by measuring the ohmic resistance of that portion of the original transformer across which the original width coil had been connected (terminals 1 and 2 in Figure 7). The DC resistance of this winding was found to be only 0.5 ohm, indicating that the original width coil had rather low inductance, which made it unsuitable for use with the RCA 232T1 transformer. Had the resistance measurement been 3 ohms or more, the original width coil would have had, in all probability, sufficient inductance to warrant its use in the new circuit. Since this was not the case, a new, high inductance width

CHART 2

Horizontal Output Transformers*	
Manufacturer	Transformer Part No.
Chicago	TFB-10
Merit	HVO-9
RCA	232T1
Stancor	A-8137
Triad	D-2

\*The listed units are dissimilar in several respects and for that reason should not be considered generally interchangeable.

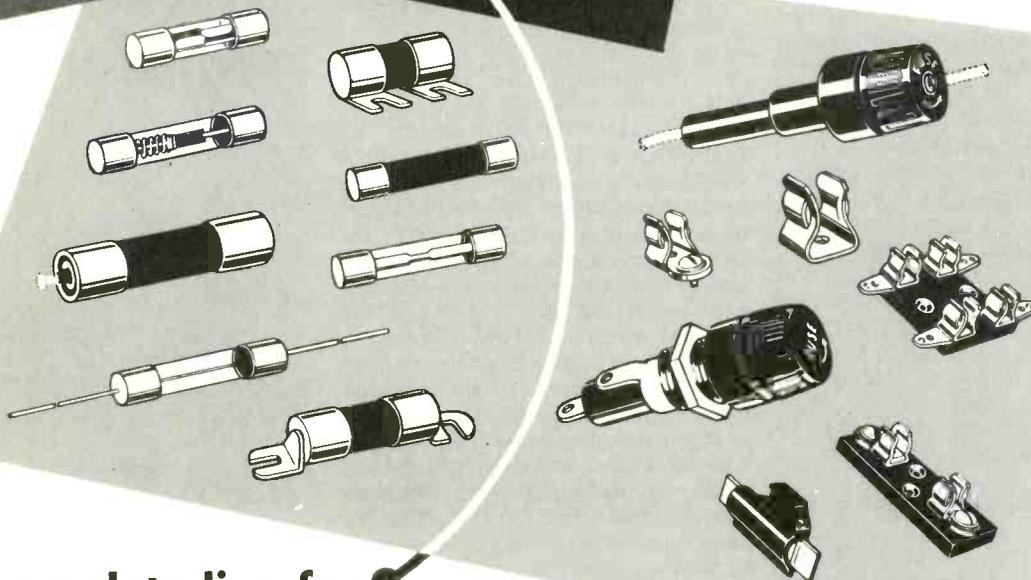
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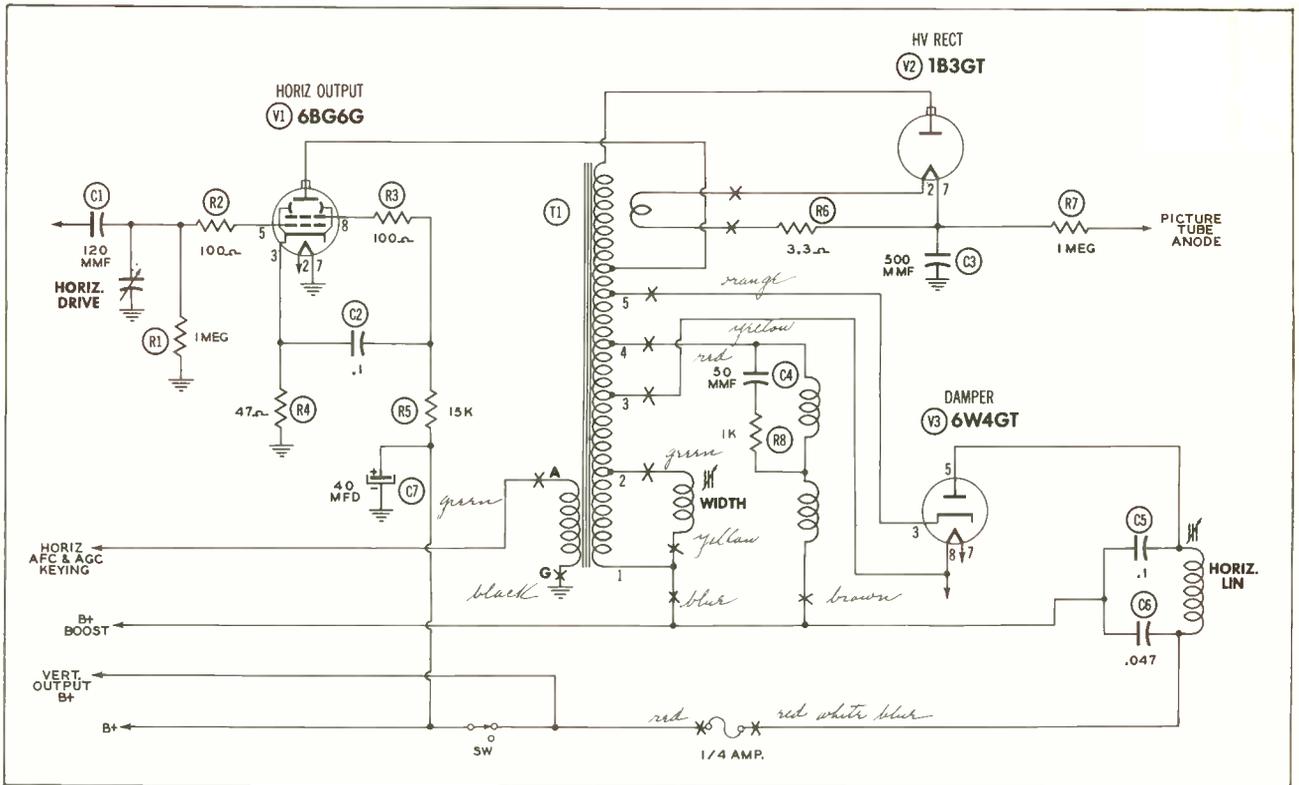


Figure 7. Schematic of Horizontal Deflection Output Section Before Transformer Replacement. (Script Notes Were Made by the Technician.)

coil was needed; and the technician chose the RCA 212R1 for this function.

The original transformer incorporated an isolated winding for horizontal AFC. The RCA 232R1 replacement unit also had this additional winding so that the acquisition of these control voltages posed no particular problem. Moreover, the instructions which accompanied the replacement unit directed that the width coil be placed across this second winding rather than across a portion of the multi-tapped coil as was true in the original circuit (See Figure 7). These were features which the technician made mental note of in preparation for the replacement task.

An important consideration in a replacement operation of this kind is the matching between transformer and yoke. If the matching is wrong, insufficient width and/or poor linearity will appear in the picture. Three or more alternative yoke connections are frequently given in the instructions with the various replacement transformers. It is up to the technician to decide which one to use. In some of the later Photofact folders this problem is solved by a series of notes which list the pre-

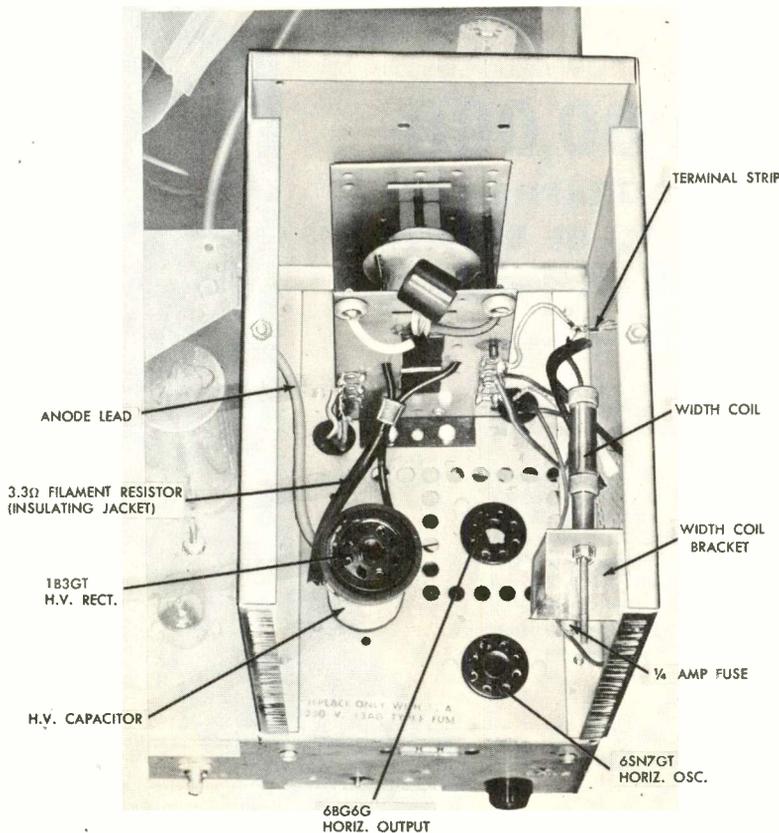


Figure 8. High Voltage Compartment Before Transformer Replacement.

\* \* Please turn to page 94 \* \*

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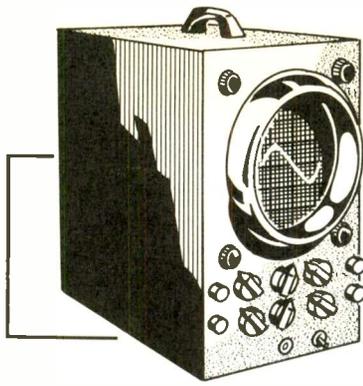


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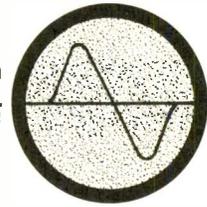


# SERVICING

## with the

# SCOPE

by C. P. Oliphant



### Using the scope as an indicating device for signal-tracing the FM receiver.

The article, "Servicing with the Scope," in the PF INDEX and Technical Digest No. 39, for July-August, 1953, described several procedures for using the scope to enable speedy, efficient radio servicing. The discussion covered the servicing of an AC-DC type receiver. It is intended to present in this discussion a procedure for servicing an FM receiver with the aid of the scope. Through the use of the scope, an FM receiver can be signal-traced to determine the stage in which the trouble is present. It is then a simpler matter to determine the exact part, or parts, that are defective.

The test equipment required to perform this trouble-shooting procedure is a scope and signal generator. The scope can be of the wide-band, high-sensitivity type which is normally used for television servicing. Since the frequency of the signal reproduced by the scope is around 400 cycles, however, it is not necessary that the scope be a wide-band type. The scope should have high sensitivity to enable circuit tracing at the head end of the receiver where the signal is quite low. The signal generator must be capable of producing a modulated signal in the FM band. Since many signal generators do not operate on the fundamental frequency in this range, it is possible to use harmonics successfully.

Starting with the assumption that the set to be checked is a weak or dead FM receiver, the recommended procedure for trouble-shooting is as follows:

The first step in checking any receiver, either an AM or an FM, is to test the audio stages. The conventional method of checking these stages, that is, the finger or screwdriver touch system, is quite satisfactory in most instances and

is considered to be the fastest method. By point-to-point probing through the audio section, an audible click or hum is heard in the speaker if the stages following the test point are functioning properly. If not, a quick voltage or resistance check should soon detect the defective component.

The above check of the audio section may not be necessary when the receiver is a combination AM-FM set. This would be true if the audio section is common for both AM and FM operation. If the receiver operates on AM, then the audio section is known to be functioning properly. After this has been determined, it is apparent that the trouble lies in the RF-IF portion of the receiver. The scope can then be used as a signal tracing device to locate the defective stage in the receiver.

Connect the output of the signal generator to the input of the receiver. Adjust the signal generator to provide a modulated 100 megacycle signal (fundamental or at a frequency whose harmonics produce the desired signal) and set the attenuator to provide a maximum output. Connect the ground terminal of the scope to ground or B- point of the receiver.

The FM circuit used in the presentation of this procedure is shown in Figures 1 and 2. Figure 1 shows the portion of the circuit from the plate of the third IF amplifier to the input of the audio section. Figure 2 shows the portion of the circuit from the input of the receiver to the input of the first limiter. The combination of these two schematics makes up the complete RF-IF portion of the receiver.

Test point 1, shown in Figure 1, is located at the input of the first limiter stage. Place the direct

probe of the scope at this point and rock the dial of the receiver back and forth around the 100 megacycle setting until a pattern appears on the scope as shown in Figure 3. By starting at this point in the circuit the receiver is effectively cut in half which will usually make the servicing procedure speedier. If a pattern is obtained at test point 1, the direct probe can then be used during almost all of the remaining trouble-shooting procedure, which will deal with the stages between this point and the audio section. When testing the discriminator stage it may be necessary to use the demodulator probe instead of the direct probe. The reason for this will be discussed later. If no signal is obtained at test point 1, the demodulator probe must be employed in order to obtain a signal on the scope from the stages between point 1 and the input of the receiver. In a number of cases, a lot of time is saved by starting at test point 1, since the presence of a signal at this point eliminates the need of tracing the preceding stages; therefore, it may not be necessary to connect the demodulator probe to the scope. This is the reason for presenting the circuit in two portions as shown in Figures 1 and 2, since each section requires a different signal tracing technique.

Assuming that a signal is received at test point 1, the circuit before this point can be considered to be operating normally, and the testing proceeds after this point. Using the direct probe of the scope, place it on the plate of the second limiter stage (test point 2). If the signal is absent at this point, move to the grid of the second limiter stage (test point 3). If the signal is present here, check for a bad second limiter tube or improper tube voltages. If no signal is present on the grid of the second limiter, move

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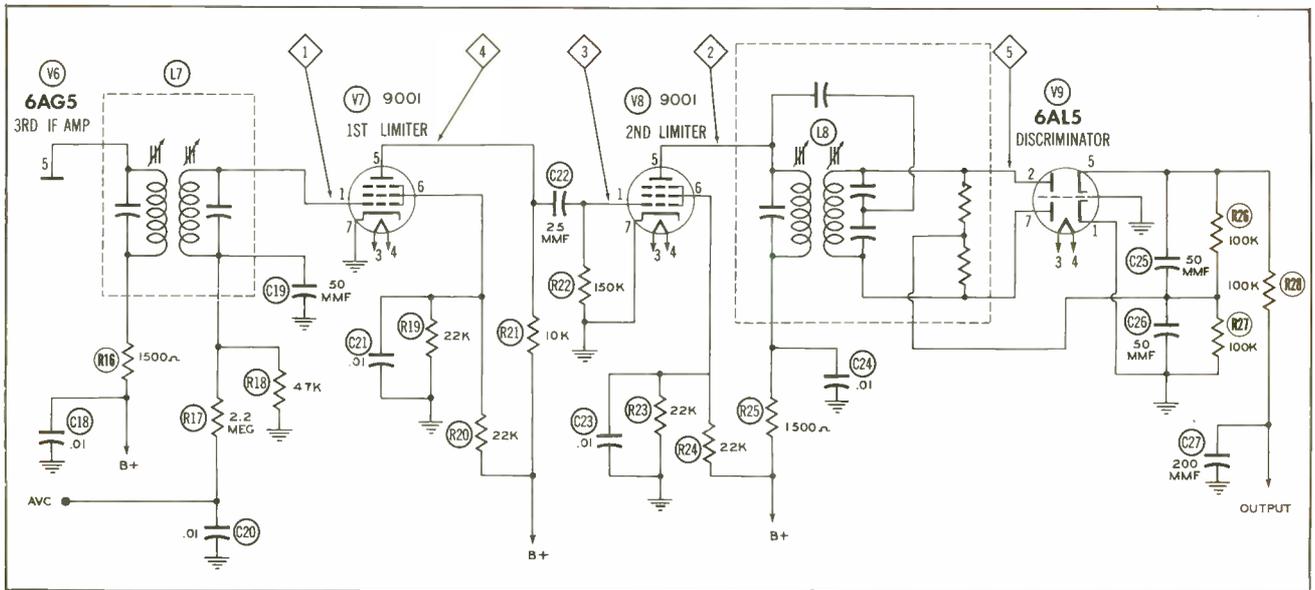


Figure 1. Partial Circuit of a Typical FM Receiver, Showing Test Points 1 to 5 Discussed in Text.

the probe to the plate of the first limiter (test point 4). If the signal is present at this test point, check for bad coupling between the two limiters. With the absence of a signal at test point 4, check for bad first limiter tube or improper voltages.

If no signal was received at test point 2, move the probe to the plates of the discriminator (test point 5). If no signal is present at this test point, disconnect the direct probe of the scope and connect the demodulator probe before checking any parts of the discriminator circuit. When using the direct probe at the plates of the discriminator, a pattern will not appear on the scope if this circuit is inoperative for any reason. If a sine wave pattern is present on the scope when using the demodulator probe at test point 5, the circuit between the plate of the second limiter and this test point is operating properly. The demodulator probe can be used for checking at the cathode of the discriminator. If no signal is present when using the demodulator probe during testing of the discriminator, check the circuit for a bad tube or component part.

This completes the procedure through the portion of the circuit from the input of the first limiter to the input of the audio section. Now, assuming that no signal was received at the input of the first limiter stage, the test procedure follows in the other direction. The reference circuit is that shown in Figure 2. The demodulator probe is to be employed now instead of

the direct probe of the scope. With the use of this type of probe, the signal will appear in the form of a sine wave, similar to that shown in Figure 3.

Touch the demodulator probe to the plate of the second converter (test point 6). Rock the dial of the receiver back and forth around the 100 megacycle setting until a pattern appears on the scope. The presence or absence of a signal at test point 6 will determine if the trouble lies in the RF-Converter or IF section of the receiver. If the signal is present at this point, the trouble is in the IF section; however, if the signal is not present, the trouble is in the RF-Converter section. The direction in which the trouble-shooting procedure follows will be governed by the results of this test.

Let us first assume that the signal is present at test point 6. This means that the stages preceding this point are operating normally and the trouble is somewhere in the IF section of the receiver. The procedure to be followed now is to touch the probe to the plates of successive IF stages until the scope pattern is lost. These test points are shown in Figure 2 as being 7, 9, and 11. When it is determined at what point the signal is lost, the trouble must lie between this point and the plate of the preceding stage. As an example, suppose that the signal was not present at the output of the second IF amplifier (test point 9 in Figure 2). This means that the circuit to be checked is that portion between the plate of the first IF amplifier

(test point 7) and the plate of the second IF amplifier (test point 9). The points where the trouble might be located in this section of the circuit can be narrowed down by moving the probe to the input of the second IF amplifier (test point 10). If the signal is received at this test point, the stage is checked for a bad tube, defective transformer, or improper tube voltages. However, if the signal is not obtained at test point 10, a check of the coupling circuit to this stage is made.

If the signal was not present when testing at the plate of the second converter (test point 6), the trouble is in the RF-Converter section of the receiver. In this case, move the demodulator probe to the grid of the first converter (test point 13) and check for a signal. Rock the dial of the receiver back and forth around the 100 megacycle setting to see if a pattern appears on the scope. If the signal is not obtained, check the RF input circuit. It must be remembered that the signal at this point, if present, is very weak. The signal generator must be set for maximum output and the scope must be set for maximum vertical gain in order to obtain an indication on the scope.

If the signal is found to be present at the input of the first converter, move to the plate of this stage (test point 14). If the signal is not present at this point, a number of things could be causing the

\* \* Please turn to page 115 \* \*

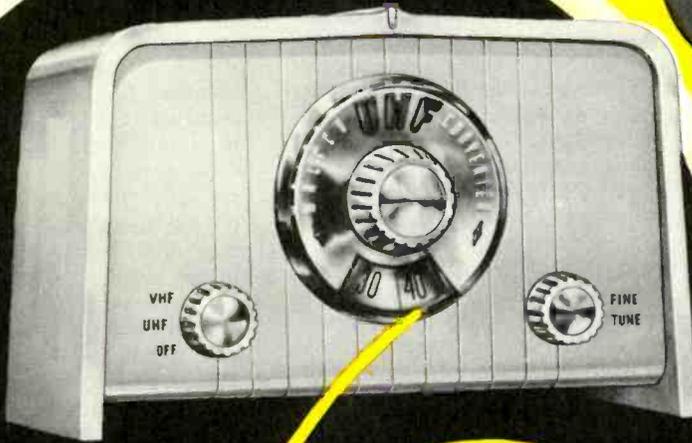
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# Examining

## DESIGN FEATURES

by HENRY A. CARTER

### CBS-COLUMBIA 22K38

The CBS-Columbia Model 22K38 TV receiver employs an interesting circuit for rendering the tuner and IF stages inoperative when using the radio. Instead of removing B+ from these tubes, the grids are simply driven to cut-off. Figure 1 is a partial schematic showing how this is accomplished. When the function switch is in radio position, voltage from the filament winding is rectified by one half of a type 6AL5 tube. This rectified voltage is applied to the AGC line, thereby, increasing the negative voltage on the RF and first two IF tubes to approximately 6 volts. This is sufficient voltage to succeed in cutting off current flow in these tubes.

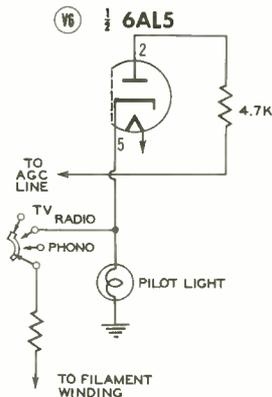


Figure 1. Partial Schematic from CBS-Columbia Showing System Used for Disabling Video IF When Using AM Radio.

The following voltages were recorded under normal operating conditions.

	With the switch in: Radio Position	TV Position
AGC Voltage at Tuner	6.3 volts	2 volts
$E_p$ 1st IF	185 volts	125 volts
$E_g$ 1st IF	6.3 volts	1.5 volts
$E_p$ 2nd IF	185 volts	125 volts
$E_g$ 2nd IF	6.3 volts	1.2 volts
$E_p$ 3rd IF	180 volts	125 volts

### KAYE HALBERT CHASSIS MODEL 263

#### Remote Control Unit

The Kaye Halbert 263 is designed and manufactured for custom installation. This receiver employs a simple but effective remote control unit for controlling the volume and selection of stations. The control head or "Robot" contains an On/Off switch, a volume control and a push button channel selector. Figure 2 shows a photo of the "Robot" and the twenty feet of cable that is supplied for connection to the main chassis. The schematic for the complete remote control system may be seen in Figure 3.

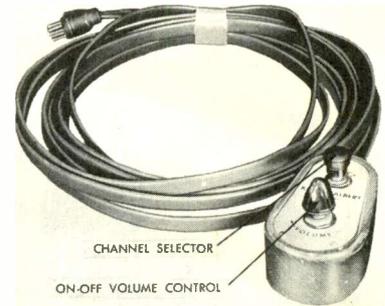


Figure 2. Remote Control Head or "Robot" used with Kaye Halbert 263.

the plug) between T2 and the power relay (M5), thus turning on the power to the set. The power relay (M5) is shown in Figure 4.

The transformer T2 (see Figure 3) which supplies power for the On/Off relay (M5), is always connected to the line while the set is plugged in. However, the transformer draws such a small current that practically no expense is involved in its operation and there is no danger of over heating.

The On/Off switch in the remote control head completes the circuit (through contacts 2 and 4 in

Power for the channel selector relay (M6 shown in Figure 4) is supplied by the filament winding of the power transformer T1. The channel selector button on the "Robot" completes the circuit (through contacts 2 and 3 in the plug) between the channel selector relay (M6) and the filament winding. When the channel selector button (M9) is depressed, power is applied to the relay (M6), closing the contacts. This action

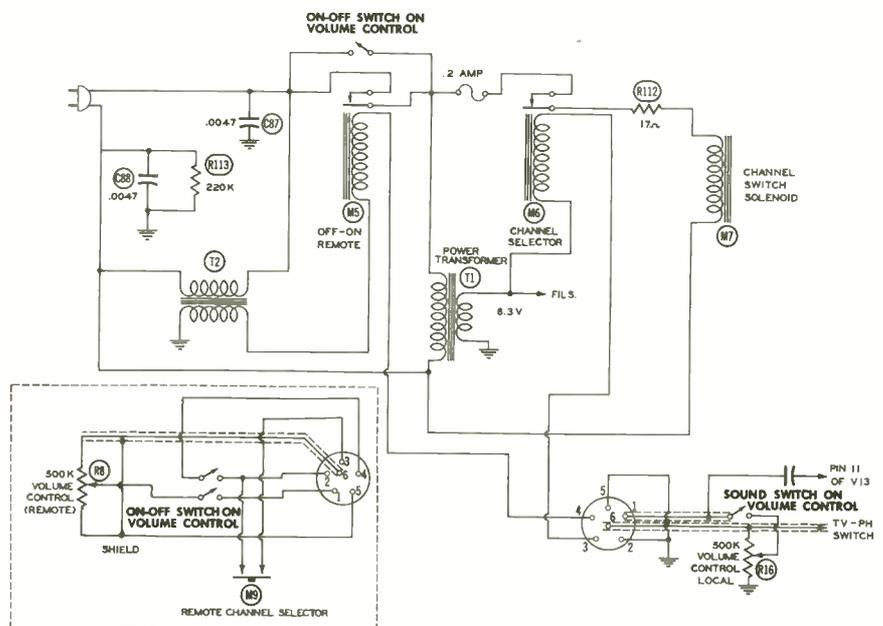


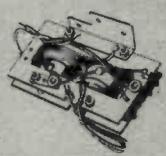
Figure 3. Schematic of Remote Control Head and Relay Circuit Used with Kaye Halbert 263.



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applies voltage to the solenoid (M7), which then rotates the ratchet mechanism in a counterclockwise direction. The ratchet slips while turning in this direction so that when the button is released, the return spring pulls the ratchet lever back in place, causing the tuner turret to rotate to the next channel. Figures 5 and 6 show photos of the channel selector solenoid and the ratchet mechanism respectively.

Due to the action of the ratchet mechanism, the channel selector knob on the set should never be forced to turn in a counterclockwise direction. To do so will result in damage to the mechanism.

It will be noted upon examination of Figure 3, that for best operation of the remote control unit, the receiver power switch should be in "OFF" position.

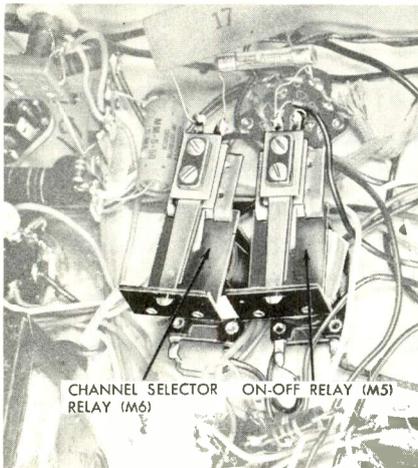


Figure 4. View of Power and Channel Selector Relays Mounted on Under Side of Chassis of Kaye Halbert 263.

**MAGNAVOX MODEL MV 310M-1 (107 SERIES)**

**Series Wired Stages**

Several manufacturers of television receivers are endeavoring to reduce the heavy drain on the low voltage power supplies. There are a number of ways they are accomplishing this. One is to place a number of video IF stages in parallel and in series with the audio output stage. Another is to place the video output and the audio output stages in series. The Magnavox Model MV310M-1 (107 Series) employs still another method. The 1st and 2nd video IF stages are connected in series as shown in Figure 7. The 4th video IF and 1st sound IF stages are also connected in series. Connecting stages in series reduces the drain on the power supplies by eliminating the necessity for a bleeder network

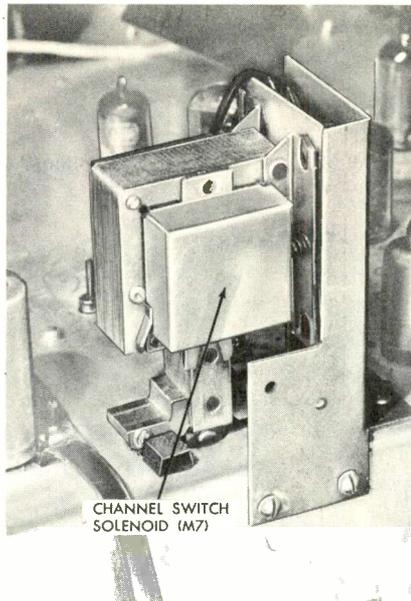


Figure 5. Channel Selector Solenoid for Changing Stations in Kaye Halbert 263.

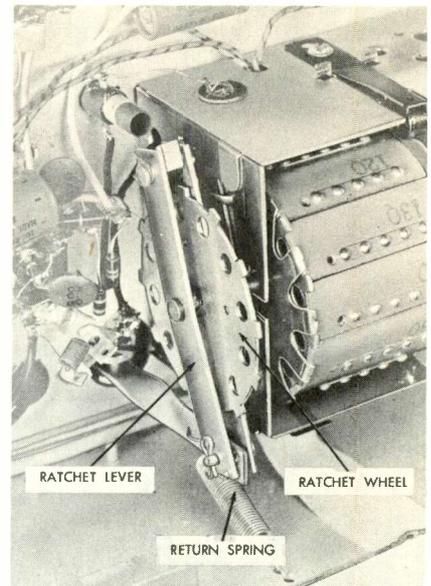


Figure 6. Ratchet Mechanism on Rear of Tuner in Kaye Halbert 263.

or large dropping resistor in each stage. The reduced drain on the power supply improves its voltage regulation and hence contributes to better AGC action in the receiver. Another advantage of stages in series is that fewer bleeder networks result in less heat produced during set operation.

been designed with the service technician in mind. Every service technician at one time or another has worked on a portable radio chassis that was so cramped that he had to remove several components in order to check others hidden beneath.

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Figure 8 is a photo of the chassis and the cabinet employed in the Trav-ler model 5300. It can readily be noted by looking at the photo that the flat chassis puts everything out in the open which makes for easy servicing. Due to the shape of the chassis, it remains

\* \* Please turn to page 113 \* \*

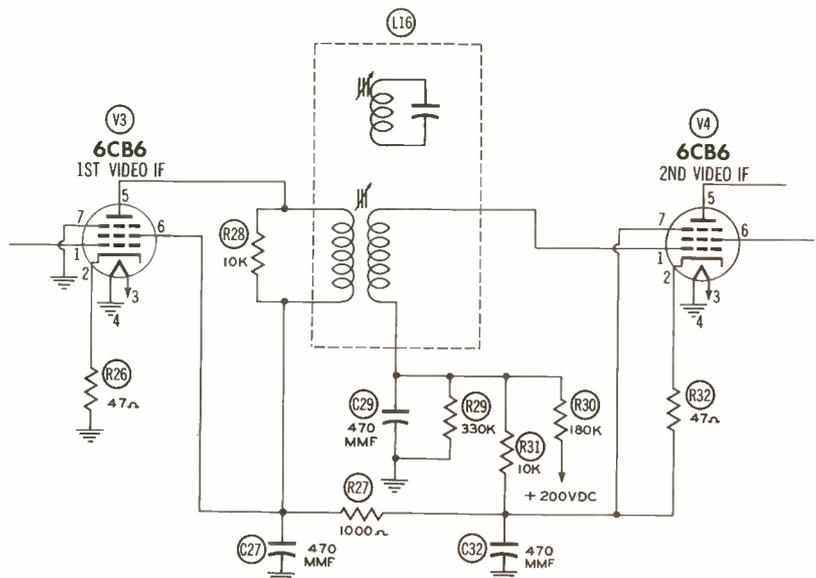


Figure 7. Partial Schematic of Magnavox MV310M-1 Showing 1st and 2nd Video IF Stages Connected in Series.

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# RECORD CHANGER SERVICING

by Lester W. Caudell and Glen E. Slutz

## Basic Requirements -

Contrary to popular belief, automatic record changer repair does not require that a person have an exceptional amount of mechanical aptitude. Some talent in this direction is, of course, helpful; but knowledge gained through experience and from available instructional manuals can go a long ways toward the development of skill in this field. Realizing that a discussion of the changer servicing business and its problems may be of interest, we have prepared a series of articles dealing with the general aspects of the subject together with specific information on several types of record changers, their operation, adjustments, and possible ills. We would like particularly to reach the technician who sees a need for changer repair service in his community and who is contemplating expansion of his business to include this field of work.

There are service technicians, many with backgrounds exclusively in TV and radio, who are making a profit from the repair of automatic record changers. Each has discovered that, altho the changer appears to be a tricky and complicated mechanism, it actually follows a pattern in design much in the same way as other manufactured products. Once this pattern is mastered by the technician, the way opens to rapid adjustments, repairs and hence to the growth of a profitable enterprise.

However, before launching into the new field each technician should give due consideration to the man-hours and shop space which he can allot to the additional work.

Parts stocking is somewhat of a problem in the changer servicing business. Exact manufacturers' replacements are very often required, and this means that a different set of parts may be needed for each make and model serviced. This constitutes a good reason for a shop possibly specializing in one or two popular makes of record changers. The parts problem may also be alleviated through close cooperation with the manufacturers' distributors in the locality. Then too, the manufacturers themselves may furnish advice on this problem if correspondence is directed to them.

Items of service literature containing exploded views of various record changer mechanisms contribute much toward an understanding of their operation. Several models of a particular make of changer may have a number of things in common; the set-down and tripping adjustments, the record ejection mechanism, and the automatic shut-off, if used, are a few examples. Differences between models of a given manufacturer may lie in the style of tone arm used, or the type of tripping mechanism employed, or possibly only the color of the changer. Therefore, if the mechanism of a particular changer is thoroughly understood, many models of that series or make may be adjusted or repaired using a similar servicing procedure.

The forthcoming parts of this discussion about automatic changer servicing will specifically cover several two and three speed changers. Models having adjustment points in common will be grouped so that similarities and differences may be clearly pointed out.

## Tools and Equipment -

As in radio and TV work, proper tools and equipment are a big factor in conducting an efficient changer servicing business. Since the average changer employs many small parts, various types of small tools are needed. The following is a basic list of useful tools:

1. Allen wrenches up to 1/4" size.
2. Several sizes of small screwdrivers. Jewelers' screwdrivers are also helpful at times.
3. Long nosed pliers.
4. Diagonal cutters.
5. Assorted sizes of small, open-end wrenches.
6. A set of small socket wrenches.

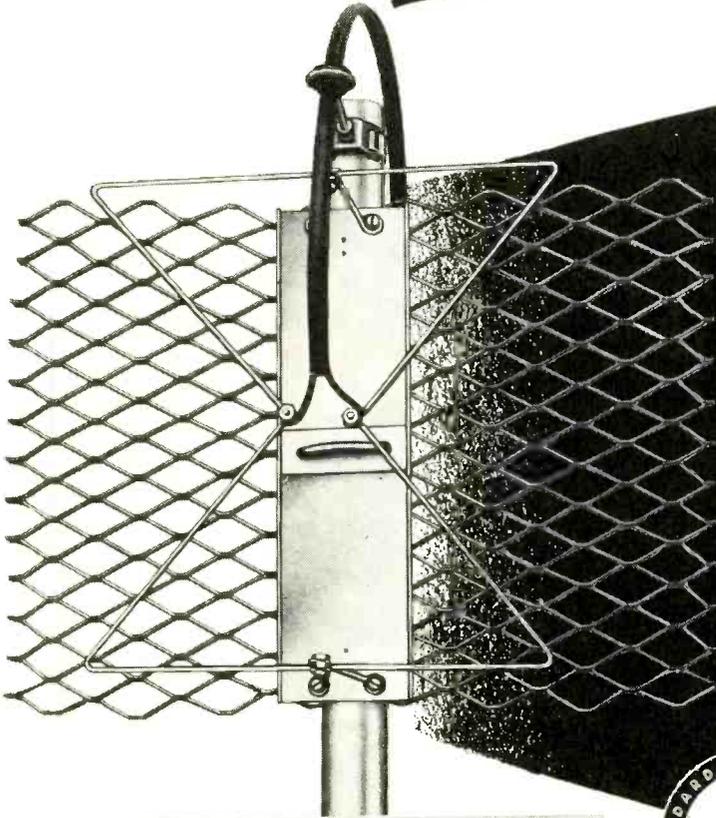
Besides the hand tools listed, a very handy device is a mounting rack or jig for holding the changer (see Figure 1). Such a rack allows the record changer to be turned over and positioned for easiest servicing.

If room is available, a special bench in the shop may be set aside as

\* \* Please turn to page 117 \* \*

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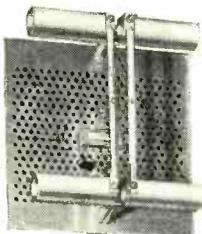


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## A description of circuits and equipment for Ultra High Frequency reception.

by MERLE E. CHANEY and GLEN E. SLUTZ

### Ampli-Verter, UHF Converter (Model BTU-1)

The Ampli-Verter Model BTU-1, a product of Blonder-Tongue Labs, Incorporated, (Figure 1) is a single-channel UHF converter designed to provide reception from any UHF station to which frequency the unit is pre-set at the time of installation. When connected to a television receiver, the converter output is accepted by the receiver when the VHF tuner is turned to channel 5 or 6.

Each Model BTU-1 is designed by the manufacturer for a specified UHF channel. Minor adjustments can be made when the unit is installed for best results.

Normally, the output of the converter is set at the frequency of channel 5. Where strong VHF signals are normally received at this frequency, it may be desirable to shift the output of the converter to channel 6. Shifting the output to this frequency may be readily performed to yield performance characteristics equivalent to that obtained on channel 5.

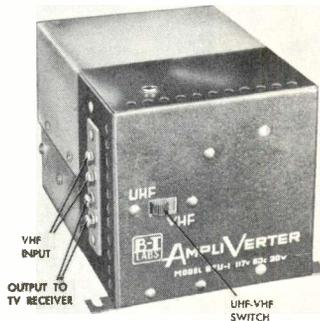


Figure 1. Ampli-Verter Model BTU-1 UHF Converter.

Physically, the Model BTU-1 is contained in a compact metal cabinet measuring 4" x 4" x 5-1/4". Three tubes are used in the unit. A 6AF4 functions as the oscillator tube, and a 6BK7A and 6CB6 are the IF amplifiers. A selenium rectifier is used in the power supply.

The Ampli-Verter is made up of two separate sections joined together to form a single converter device. One section contains the power supply (shown in Figure 2) and the other consists of the RF tuner and IF amplifier stages (shown

in Figure 3). Extensive shielding is employed in the tuner section. The RF tank and oscillator are each contained in a separate compartment to minimize radiation. The IF amplifier circuits also occupy a shielded compartment. Although two distinct chassis sections make up the BTU-1 converter, continuity between the units is provided by a plug and socket connection which plugs together when the sections are joined. When servicing of the unit is required, the sections may be readily disassembled, providing ready access to all components.

A feature of the Ampli-Verter is that only a single switch controls its operation. In addition, power to the unit is controlled by the On/Off switch of the television receiver. To operate the unit, the TV receiver is plugged into the receptacle on the side of the converter and the television set turned on. All the current applied to the TV receiver flows through a thermal type switch unit. As the current flows through the metallic element of the thermal unit, the metal becomes stressed which causes relay contact points to close. This turns on the converter power supply. Thus the operation of the

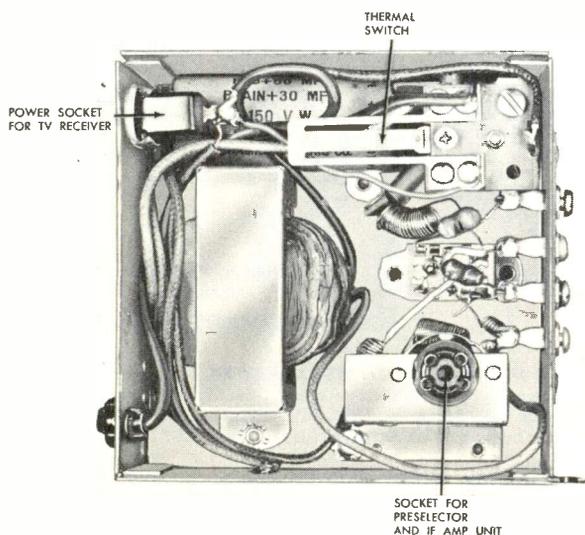


Figure 2. Rear View of Power Supply Section of Ampli-Verter.

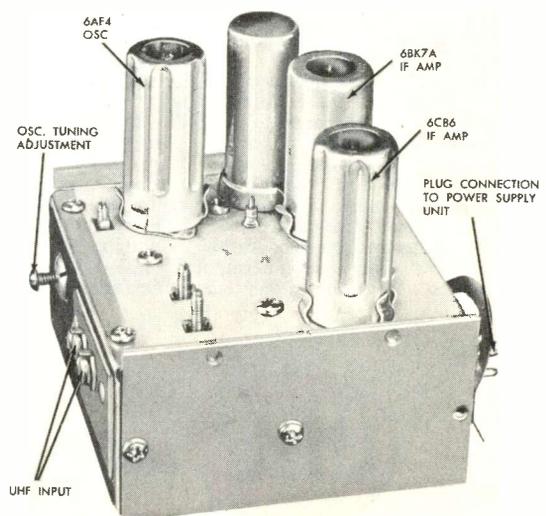


Figure 3. Preselector and IF Section of Ampli-Verter.



2N36

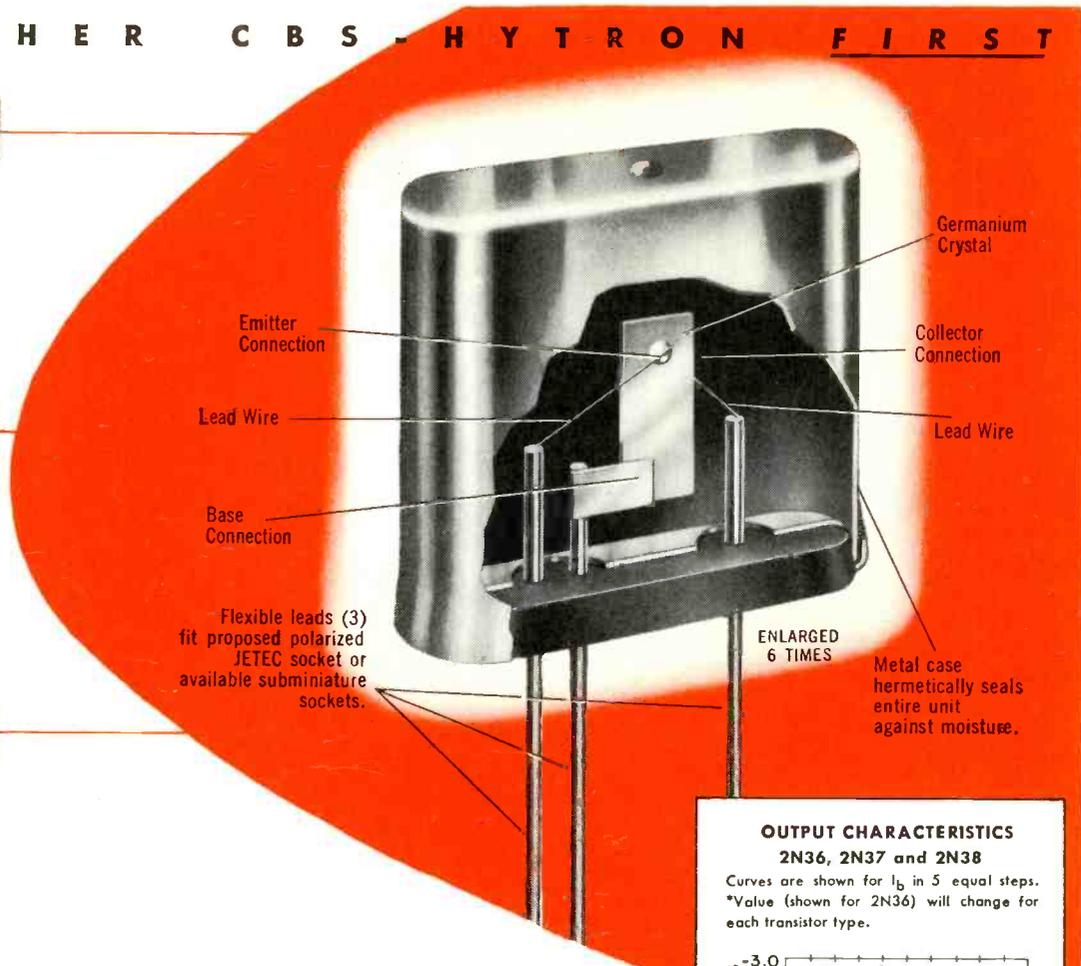
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2N37

(Actual size)

2N38

(Actual size)



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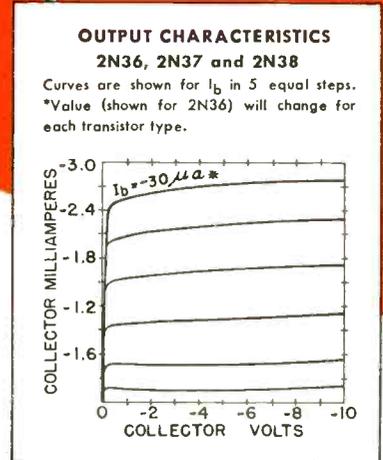
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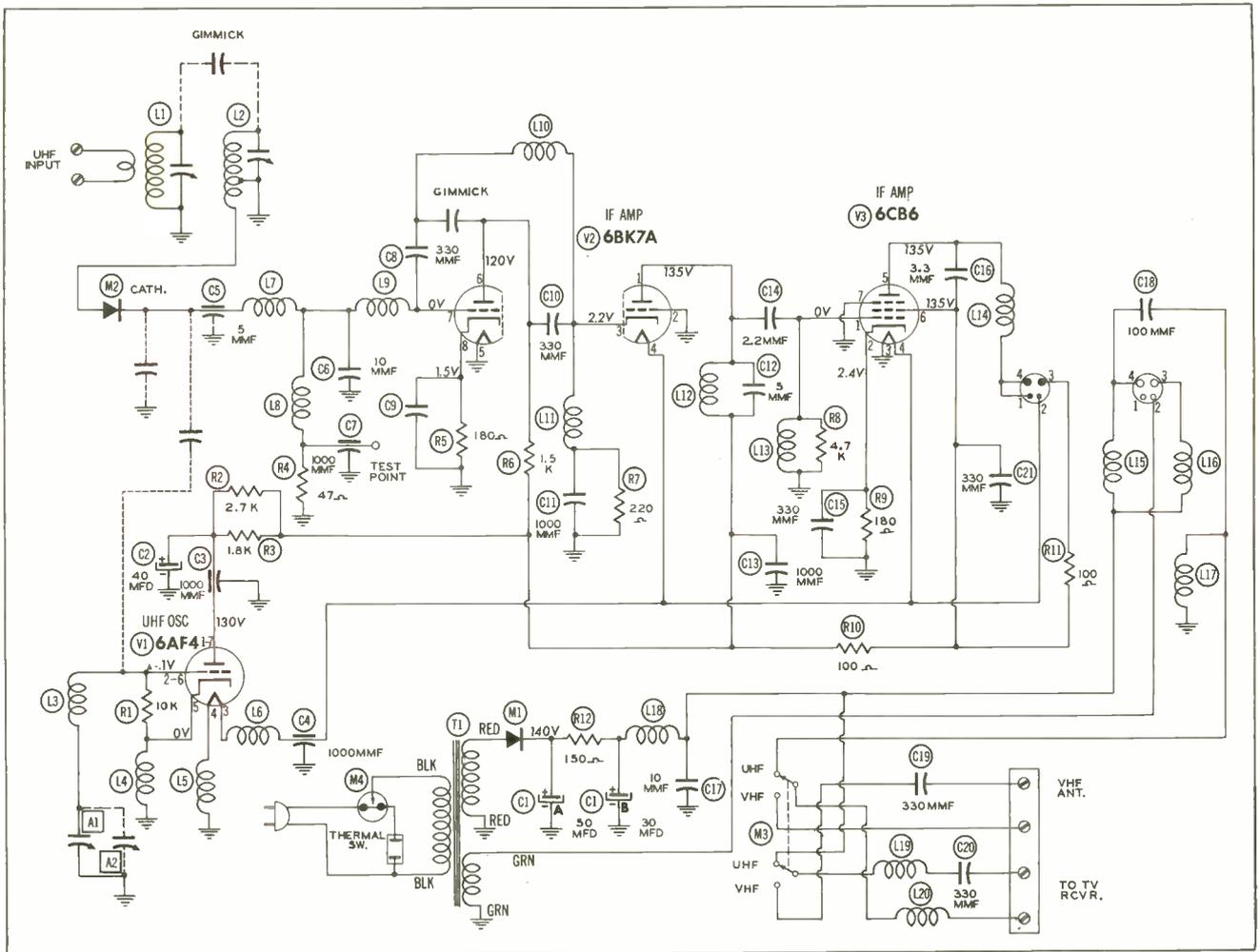


Figure 4. Schematic of Ampli-Verter Model BTU-1 UHF Converter.

unit is automatic with the turning on or off of the television receiver and switching to UHF position.

As previously stated, each converter is adjusted at the factory to operate for a specified UHF channel. Essentially, however, the basic circuitry for all the units is the same and a description of the unit supplied for analysis should serve for all the single channel BTU-1 converter units. A schematic of the unit is shown in Figure 4. Observe that it employs a double preselector, a 6AF4 oscillator, a cascode-coupled stage of IF amplification, followed by an additional 6CB6. Lumped circuits are used in this unit because of their economy and practicability for operation in a single channel converter. Adequate control over bandwidth, selectivity, and oscillator injection is provided through the use of a number of adjustable components. Should difficulties be suspected in the RF stages of the unit, which tube or crystal replacement does not correct, it is suggested that the entire unit be returned to the factory where proper equipment is

available for readily diagnosing troubles as well as providing the accuracy essential to correct alignment.

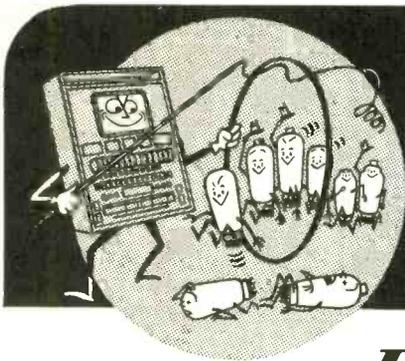
Tracing an incoming UHF signal through the converter unit, it is seen that the signal is transformer coupled to the 1st preselector tuned circuit. Mutual and stray coupling passes the tuned signal to the second preselector. Correct alignment of these two tuned circuits provides the desired selectivity while maintaining the required bandwidth.

From the double-tuned preselector, the signal is fed to the crystal mixer which is physically located half in the preselector compartment and half in the oscillator compartment. From the crystal mixer to the feed-thru capacitor into the IF compartment is a loop, formed in the connecting lead, which controls the amount of oscillator pickup or injection current. This loop is physically positioned at the time the unit is aligned so that optimum injection current and over-

all performance characteristics are obtained. Fine tuning of the oscillator, which is performed at the time the unit is installed for service, is accomplished with a metal screw extending through the rear of the chassis into the oscillator compartment and adjacent to the oscillator tank components (See Figure 3). Its function is to vary the stray capacitance associated with this circuit and thus provide an effective means for exactly establishing the oscillator frequency. Since this screw extends out from the rear of the chassis, care should be exercised to see that the unit is not placed in such a position that the screw is damaged, which might cause improper tuning.

The IF amplifier stages are designed to compensate for losses experienced in the crystal mixer. An additional stage of IF amplification is used to provide additional gain consistent with noise factor limitations.

Calling attention to a few points relative to maintenance of the unit

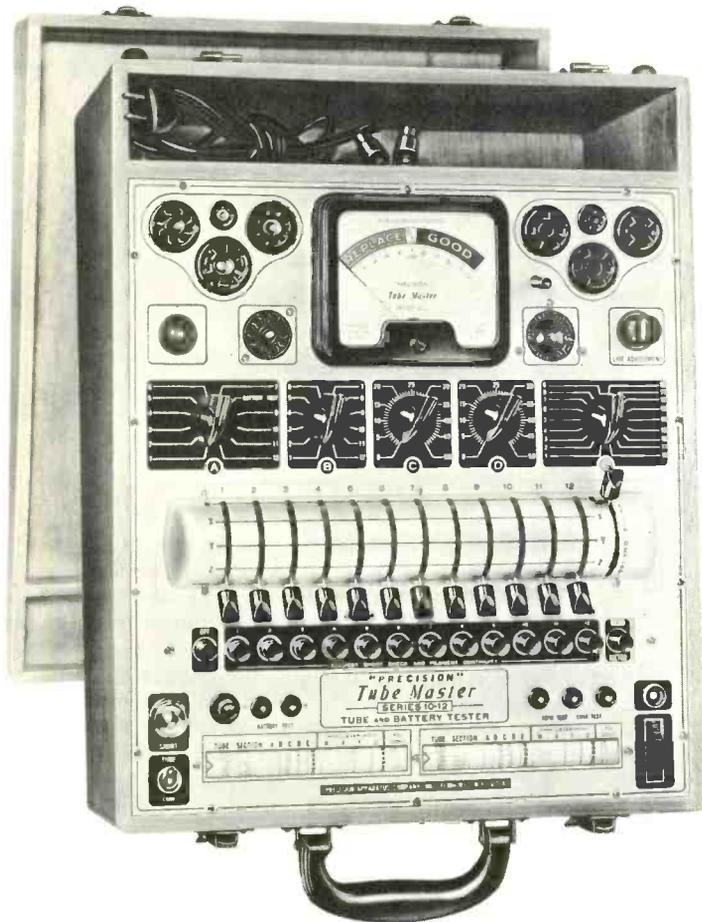


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may be helpful in the servicing of this instrument. As previously noted, the Ampli-Veter consists of two basic units, the tuned section and the power supply. However, the units are firmly held together with a number of metal screws which may be readily removed to expose the components and circuits for testing.

Since a thermal type On/Off switch is incorporated to turn power on for the unit, some means must be employed to close this switch. The easiest way is to place a jumper across the switch terminals being careful not to damage the switch mechanism.

### Bogen UHF Converter (Model UCT)

The Bogen Model UCT (Figure 5) is a UHF converter continuously tunable over the full UHF television band. It is contained in a small compact cabinet. On the front of the cabinet is the function switch, tuning control and channel indicator dial. When connected to a television receiver tuned to channel 5 or 6, available UHF stations may be received.

Two tubes are employed for its operation. Either a 6AF4 or 6T4 functions as the local oscillator, while the IF amplifier section uses either a 6BZ7 or 6BQ7 twin triode tube connected cascode. The crystal mixer may be a 1N72 or 1N82. (See Figure 6 for top chassis view).

Containing its own power supply, rectification is provided by a

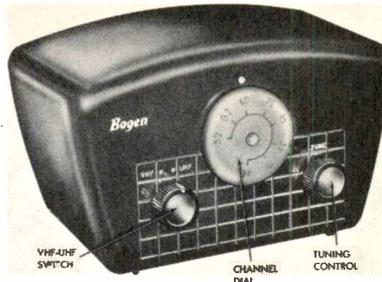


Figure 5. Bogen UHF Converter (Model UCT).

selenium rectifier and conventional RC filter arrangement. It is observed in the Model UCT that the function switch employs only two positions for the operation of the unit, VHF and UHF. In VHF position, power is turned off and the VHF antenna is connected through the switch to the television receiver input terminals. Rotating the switch to UHF position disconnects the VHF antenna input and connects the converter output to the input of the receiver. Thus, it is noted that provision is not incorporated to turn off the receiver power by the function switch of the converter. Therefore, no AC receptacle is provided at the back of this unit.

A feature of the Model UCT is that a two section tuning element is used. Thus, single tuned preselection provides the desired degree of RF selection and bandpass requirements.

A schematic for the Bogen converter is given in Figure 8, and a bottom chassis view showing the layout of parts is presented in Figure 7. With a UHF antenna connected to the appropriate terminals

on the back of the unit an available UHF station is tuned by the single stage preselection and then fed to the mixer circuit. The oscillator tuning element which is ganged to the RF tuning element automatically provides a heterodyning signal to the mixer circuit.

A resultant intermediate frequency is then obtained in the mixer circuit. Feeding this lower frequency to the cascode coupled stage provides signal amplification to compensate for losses occurring in the mixer circuit. Broad bandwidth characteristics are maintained in the IF amplifier stage such that either a channel 5 or 6 frequency signal is presented to the converter output.

Installation of this converter may be readily performed and should provide satisfactory service when proper antenna provisions are utilized. The design of this instrument is such that extensive servicing should not be necessary in the field. Maintenance, as required, consists mainly of tube or crystal replacement. Also components in the power supply section may be replaced as required as long as similar components are used as replacements. Should alignment be indicated or trouble be suspected in the tuner section, it is recommended that extreme care and suitable test equipment be employed in servicing this section.

A test that may be given the crystal diode is to unsolder the shorting connection to the chassis at Point A in Figure 8, and connect a 0 to 5 millimeter from that

\* \* Please turn to page 103 \* \*

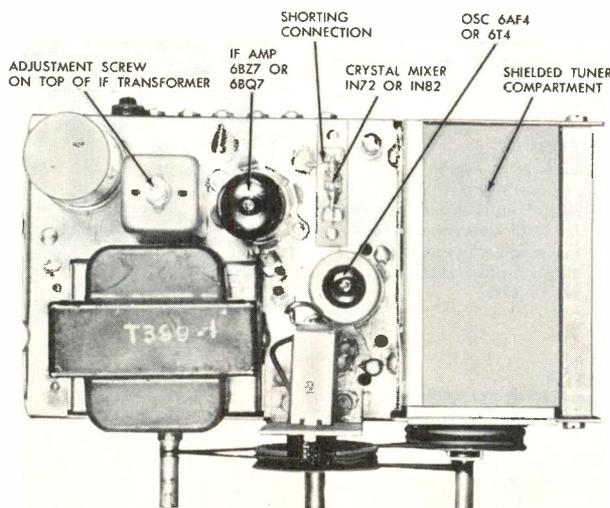


Figure 6. Top Chassis View of Bogen UHF Converter (Model UCT).

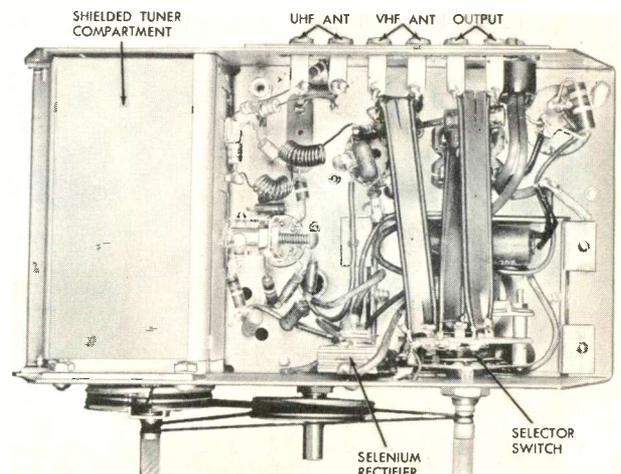
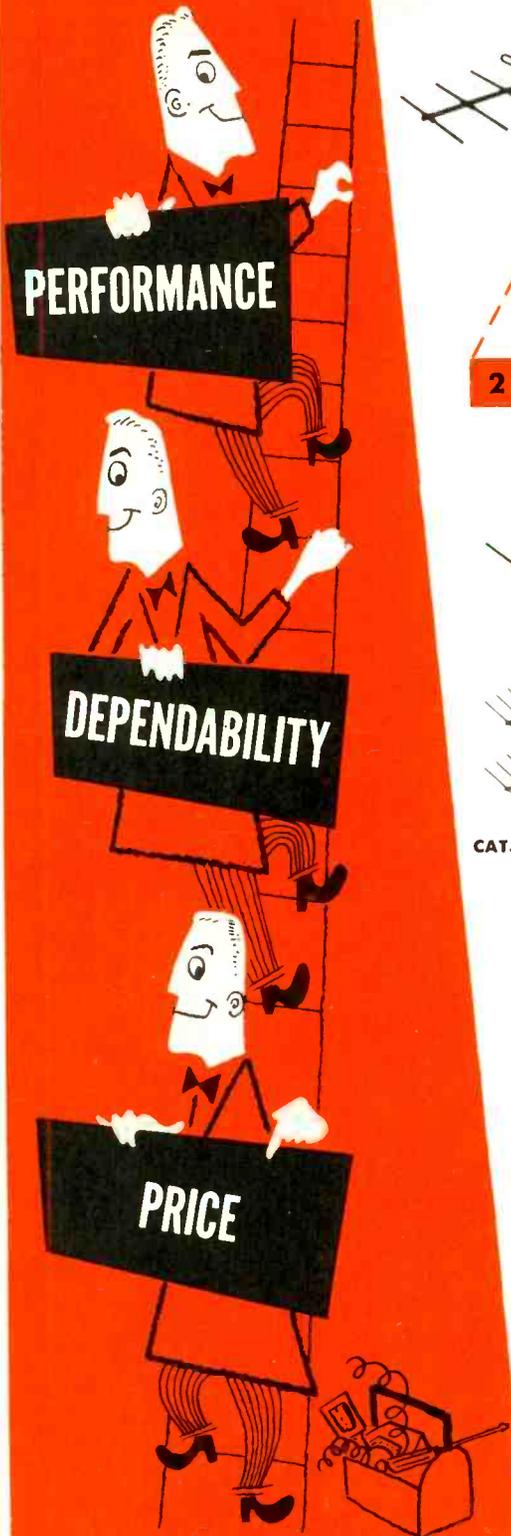
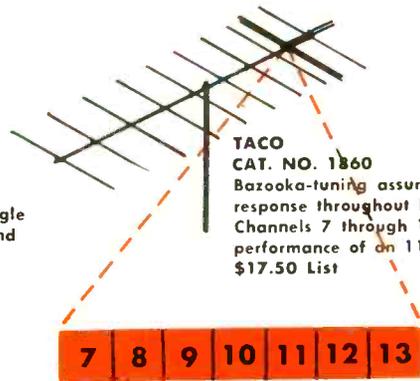


Figure 7. Bottom Chassis View of Bogen UHF Converter (Model UCT).

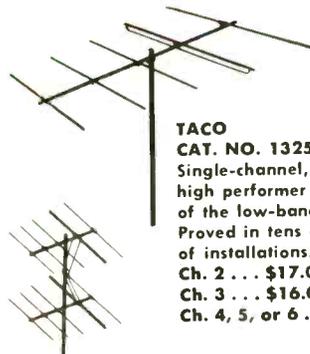
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Triple-Driven Yagi  
performance with a single  
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Channels 2 through 6.  
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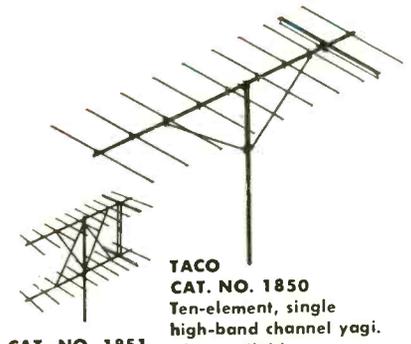


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CAT. NO. 1860**  
Bazooka-tuning assures flat  
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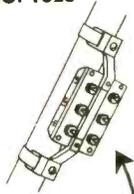


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Single-channel, low-cost,  
high performer for any one  
of the low-band Channels.  
Proved in tens of thousands  
of installations.  
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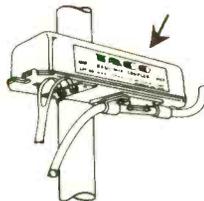


**TACO  
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Ten-element, single  
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Also available  
as stacked antenna.  
Sparkling performance  
in toughest locations.  
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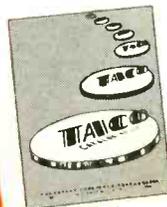


**TACO  
CAT. NO. 1425**  
Where the installation  
calls for both a low-band  
and a high-band antenna  
. . . mix the signals with  
this unit and feed through  
a single transmission  
line to receiver.  
\$4.95 List

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installations—combines signals  
for both antennas to feed  
the receiver through a  
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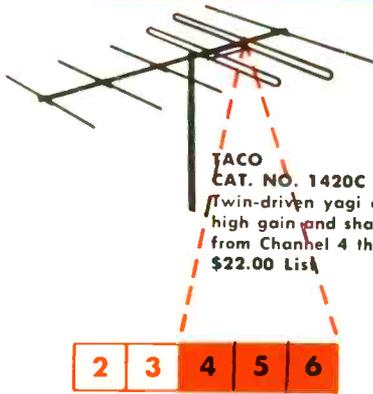


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facts and get them  
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headaches. Ask for your  
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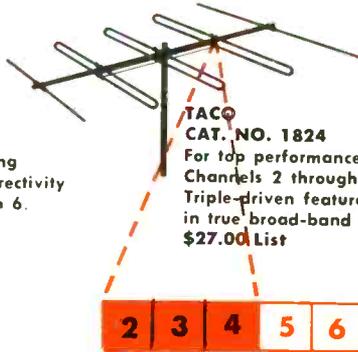


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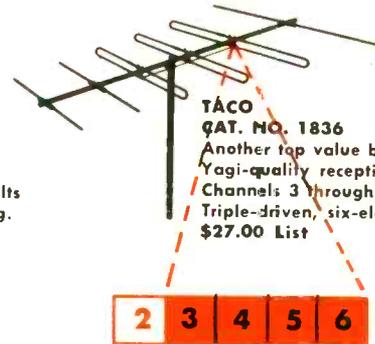
# GOOD ANTENNA



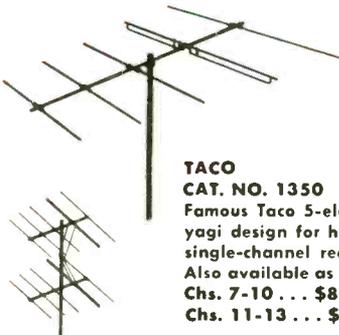
**TACO  
CAT. NO. 1420C**  
Twin-driven yagi offering high gain and sharp directivity from Channel 4 through 6.  
\$22.00 List



**TACO  
CAT. NO. 1824**  
For top performance on Channels 2 through 4. Triple-driven feature results in true broad-band tuning.  
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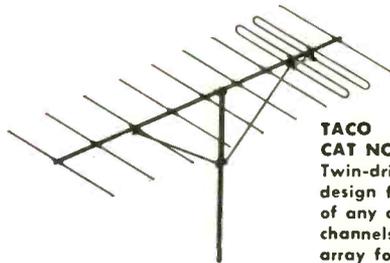


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CAT. NO. 1836**  
Another top value by Taco. Yagi-quality reception on Channels 3 through 6. Triple-driven, six-element design.  
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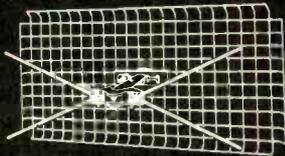


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Famous Taco 5-element yagi design for high-band single-channel reception. Also available as stacked antenna.  
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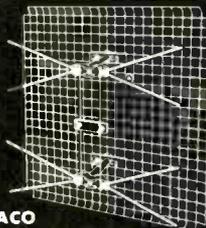
CAT. NO. 1351



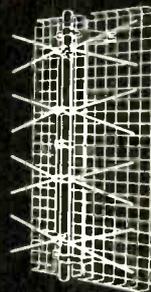
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Ch. 5 . . . \$33.00 List  
Ch. 6 . . . \$31.00 List



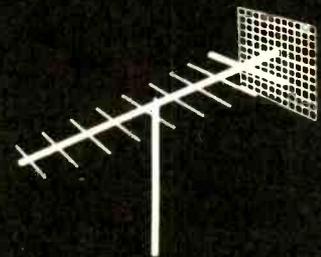
**TACO  
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Single bow tie antenna with screen reflector for improved front-to-back ratio in installations requiring elimination of ghosts.



**TACO  
CAT. NO. 3032**  
Stacked bow tie with screen reflector. Ideal for use in weaker signal areas. Combination of stacked antenna and reflector results in much higher signal-to-noise ratio.



**TACO  
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4 bow ties stacked for extra gain in the weakest signal areas. Screen reflector cancels out reflected signals.



**TACO  
UHF SCREEN-GRID YAGI**  
The most efficient UHF design ever offered. Yagi-gain combined with screen-grid reflector for maximum signal-to-noise ratio.

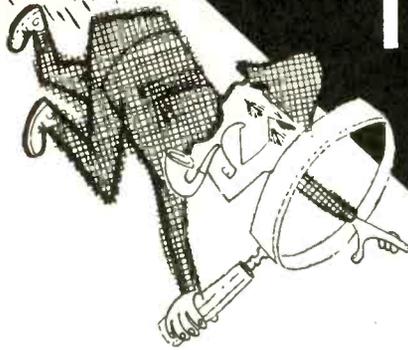
# TACO

TECHNICAL APPLIANCE CORPORATION • SHERBURNE, N. Y.

In Canada: Hackbusch Electronics, Toronto 4, Ont.

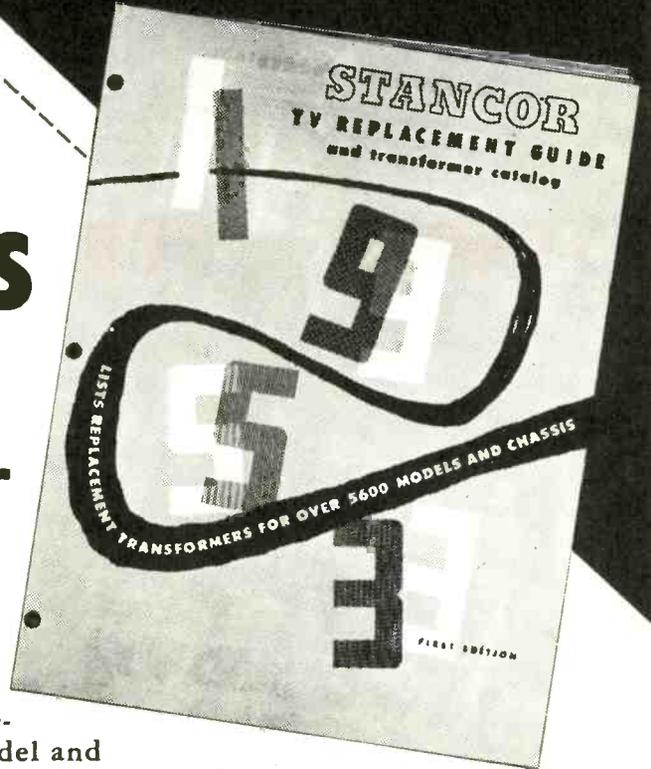
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Many of these units are the result of recommendations of the Stancor Servicemen Advisory board, composed of the top TV servicemen throughout the country.

**PLUS** A-8126, Universal vertical blocking-oscillator transformer for all Philco sets, including 1953 models.

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A-8222	Philco #32-8533 & #32-8534	38
A-8223	Philco #32-8572	15



## CHICAGO STANDARD TRANSFORMER CORPORATION

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**ADJUSTMENT**

**PROCEDURE**

**for UHF**

**STRIPS**

by **W. WILLIAM HENSLER**

A very popular method of converting the VHF receiver to UHF operation is provided through the use of Standard Coil UHF Strips in receivers having tuners of that manufacture. The conversion procedure consists of removing a pair of VHF strips of an unused channel, and replacing them with UHF strips designed to provide reception on the desired UHF channel.

If we consider the frequencies involved in the UHF spectrum, it is not difficult to see how proper adjustment of these UHF strips plays a very important part in their satisfactory operation. The frequency of the signals in the UHF spectrum are such that considerable attenuation is experienced. The first loss is encountered as the signal progresses from the transmitting antenna to the receiving antenna. Further losses are experienced in the lead-in system between the antenna and receiver. Thus, it is possible that the signal available at the termination of the lead-in is quite low in amplitude, and, therefore, will require considerable amplification in order to produce a usable picture. It is evident that any UHF tuning device must be properly adjusted to provide the best possible operation.

In a previous issue of the PF INDEX and Technical Digest (March-April, 1953) a complete description of the method of installation of these strips was given. It was also recommended in that article that no adjustment, other than the oscillator slug, should be made on these coils. It was pointed out that the selection of

frequencies at which each of the tuner circuits operate was critical, and that any attempt to make adjustments might result in unsatisfactory operation. Since that time, it has been found that considerable improvement can be obtained, in many instances, through adjustment of the UHF strips after they are installed in the receivers.

In the case of many new TV areas, the majority of initial sales are confined to the primary service area of the station. As time passes, more and more receivers are installed at points more remote from the transmitter until a practical limit is reached. In effect, this is what is happening in every new UHF area. Now, the greater the distance that the receiver location is from the transmitter, the weaker the signal will be. Under these conditions, a poorly adjusted UHF strip might not receive a satisfactory picture. The point to consider now is how can they be adjusted, as well as what

slugs should and should not be adjusted.

First of all, some criterion must be established in order to determine whether a UHF strip is providing optimum reception. This can best be done by comparing the performance of the receiver under test against one which is known to have good sensitivity. However, it is not very practical to carry a receiver along in all installations for comparative purposes. The next best thing is to make a sensitivity measurement of the available signal, using a field strength meter. The reading obtained should prove helpful in determining whether a usable signal is available. If it is felt that sufficient signal strength is available, and poor performance is noted on the receiver, it is probable that adjustment of the UHF strip should be made. If, on the other hand, the signal measuring device indicates that a very weak signal is present, it is probable that no amount of ad-

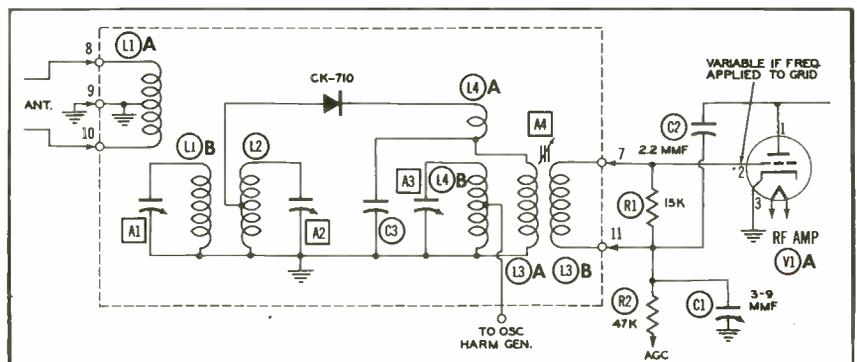


Figure 1. Input Circuit of the Standard Coil UHF Strip.

Your **BEST** antenna buy  
for channels 2 to 83!

# telrex "DUO-BAND" "CONICAL-V-BEAM"\*

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- ★ EXCELLENT DIRECTIVITY
- ★ AUTOMATIC TRANSITION FROM UHF TO VHF
- ★ HIGH SIGNAL-TO-NOISE RATIO
- ★ ALL ALUMINUM RUGGED CONSTRUCTION



\*REGISTERED TRADE MARK

Ask the DEALER!



INSTALL ONE ANTENNA, ONE TRANSMISSION LINE—Full UHF and VHF reception. The Telrex Duo-Band extends the famous "CONICAL-V-BEAM" principle. The addition of two supplementary V splines compacts and adds in-phase the higher frequency signals.

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Ask the SERVICE MAN!

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ONLY A SINGLE TRANSMISSION LINE IS REQUIRED — Duo-Band provides uniformly high gain with one major lobe, channels 2 to 83 and actually improves reception on channels 7 to 13.

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DUO-BAND features include all aluminum rugged design, light weight. Practical design can be used single bay or stacked for increased sensitivity.

60 Models Available to meet every Antenna Requirement. Write for Illustrated Catalog on the Complete TELREX Line.

"CONICAL-V-BEAMS" are produced under Re-issue Patent No. 23,346. Canadian and Foreign Patents Pending.



**SERVICE MEN!** Modify existing "CONICAL-V-BEAMS" with DUO-BAND! Existing antennas can be modified to operate efficiently on channels 2 to 83 by means of the new Telrex Modification Kit.

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Originators and Manufacturers of "CONICAL-V-BEAMS" — insist on the Original! Look for the Telrex Trademark.

PF INDEX - September-October, 1953

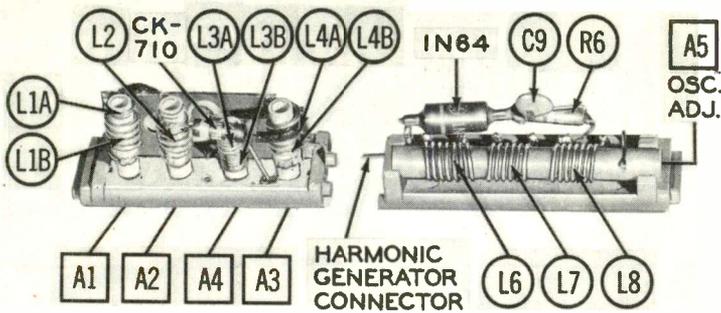


Figure 2. A Set of Standard Coil UHF Strips Showing Location of Components and Adjustment Points.

justment would help the situation. After a few installations are made the installer will have set up a minimum signal strength requirement, which will provide satisfactory performance. After this has been established, considerable time will be saved since it will be known that satisfactory reception is not possible at a particular location if the signal strength falls below the requirements.

Another method which allows the installer to make a comparative check on the operation of the UHF strip is provided through the use of an external converter. If, after making the installation, the UHF reception is not satisfactory, an external converter can be connected between the antenna and receiver. The quality of reception can then be checked. If the reception is still poor, it is probable that the signal available is weak and the poor reception was not caused by a misaligned UHF strip. Should the reception be decidedly better when using the converter, it is probable that some adjustment of the strip will improve the reception. It should be kept in mind however, that most external converters employ additional stages over those employed in the strip conversion method which might result in a little more gain when using the converter. After a

few tests the technician should be able to establish a basis for comparison of the two types of reception. It should then be possible to determine whether optimum performance is being obtained from the strip.

Instructions for adjustment of the oscillator slug are included in the instruction sheet packed with the UHF strips. This procedure is straightforward and needs no elaboration at this point. Let us consider the adjustments which can be made in order to be assured that maximum sensitivity is attained. Figure 1 is a schematic showing the input circuit of a Standard Coil UHF strip. The function of the input strip is to accept the desired television signal, convert it by means of the first converter circuit to an intermediate frequency, which is coupled to the IF amplifier stage (normally the RF stage) where further amplification is achieved. Please note that the IF referred to above, is not that of the IF employed in the television receiver chassis. The above mentioned IF is converted again in the mixer stage of the tuner to provide the desired IF. This point is very important, and must be borne in mind when adjusting the UHF strips.

The first adjustment required in any strip installation is that of adjusting the oscillator slug. This

may be required in a given receiver because of slight variations in a distributed capacitance in the oscillator circuit of the tuner, or due to the fact that the receiver may employ a different intermediate frequency which might not fall within range of the frequency limits of the oscillator. It is important to note that, even though the oscillator range is sufficient to allow tuning of the desired signal, adjustment of the input circuits may still be required. In order to see why this is the case, refer again to Figure 1 and let's consider the function of each of the circuits. L1B and A1 make up the first preselector circuit. Inductively coupled to this coil is L1A, which is the input coil. The resonance of the first preselector circuit is set so that it will accept the desired UHF station. The tuning of this particular circuit is quite broad, and since it is preset at the factory, it should not require any adjustment. Misadjustment of this circuit might affect the input impedance of the tuner, and thus result in poor reception.

L2 and A2 make up the second preselector circuit, the output of which is coupled to the first converter circuit. Although the tuning of this circuit is quite broad, there are conditions whereby its adjustment might be required. Since the cause for this readjustment is brought about by a change in some of the following circuits, it might be well to describe its adjustment at a later time. L4B and A3 comprise a circuit known as a harmonic generator. This circuit is tuned to resonance at the desired harmonic of the local oscillator. This signal is then coupled by means of L4A to the crystal in the first converter circuit. The output of the first converter stage is an intermediate frequency, which is coupled to the first RF stage by means of L3A and B. The adjustment slug A4 is employed to adjust the slope of the resonance curve of L3A and B. This circuit also is rather broad, and unless it is known to have been tampered with, it is advisable not to attempt any adjustment of A4.

Returning again to the harmonic oscillator circuit, maximum signal can be obtained across this circuit only if it is tuned to exact resonance of the desired harmonic. Thus, if it is necessary to adjust the local oscillator in the tuner, it will also be necessary to adjust the resonance of the harmonic generator. This then is the second step in

ALIGNMENT INSTRUCTIONS—READ CAREFULLY BEFORE ATTEMPTING ALIGNMENT					
Connect lead-in to receiver antenna terminals. Rotate turret so that UHF strip is engaged with the contact strip. Remove two VHF input strips opposite the UHF strip (See text). Connect VTVM to AGC line of receiver. Set range selector of VTVM to lowest voltage position (unless full scale deflection is obtained).					
DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	CHANNEL	CONNECT VTVM	ADJUST	REMARKS
Connect to UHF antenna	Use received UHF signal.	UHF. Set Fine tuning to mid-range.	Not Used	Osc. Slug	Adjust for proper tuning of UHF station.
Connect to UHF antenna	Use received UHF signal.	UHF.	DC probe to AGC line. Common to chassis.	A3	Adjust for maximum deflection.
Connect to UHF antenna	Use received UHF signal.	UHF.	DC probe to AGC line. Common to chassis.	A2	Adjust for maximum deflection.

Table 1. Alignment Chart of UHF Strips.

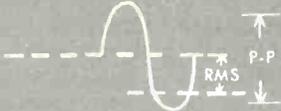
\* \* Please turn to page 111 \* \*

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## Model 655

### READS PEAK-TO-PEAK VOLTAGES DIRECTLY

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RMS or Peak-To-Peak... Useful and Necessary—Read Directly With Model 655



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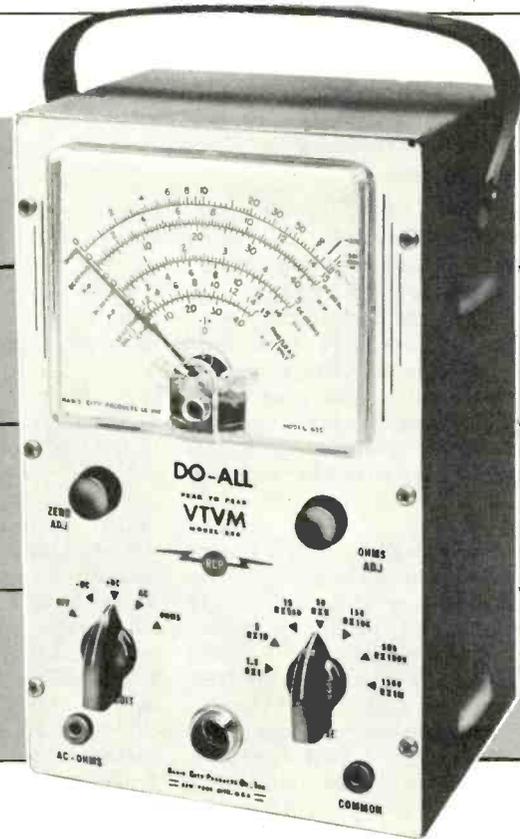
##### PULSE WAVE

TV Horizontal Deflection... Peak-To-Peak Measurements Needed—Read It Directly on the Scale—Model 655.



##### COMPOSITE VIDEO WAVE

Video Amplifier... Peak-To-Peak Measurements A Must—Do It Directly With The Model 655.



*Quickly... Accurately*

**DO-ALL Model 655.**

**ONLY \$59.50**

... gives a true reading measurement of complex and sinusoidal voltages with necessary peak-to-peak or RMS value read directly, for the analysis of waveforms in video, sync and deflection circuits.

Now TV efficiency is given greater effectiveness because sets can be serviced as the manufacturers say—the peak-to-peak way. The combination of this P. to P. meter and service notes to match, take the guesswork out of service and speed up your service operation.

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This handsome looking unit has a brushed aluminum panel, etched for durability and uses an attractive clear plastic meter. Comes complete with our new "RCP SOLDERLESS TEST LEADS" for operation on 105 to 125 V AC.

- FOR TELEVISION SERVICE AND INDUSTRIAL MAINTENANCE**
- PEAK-TO-PEAK AC measurements of from .2 V to 4200 V on 7 ranges.
  - AC RMS measurements of .1 V to 1500 V on 7 ranges.
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  - RESISTANCE measurements of from .2 ohms to 1000 Megohms on 7 ranges.

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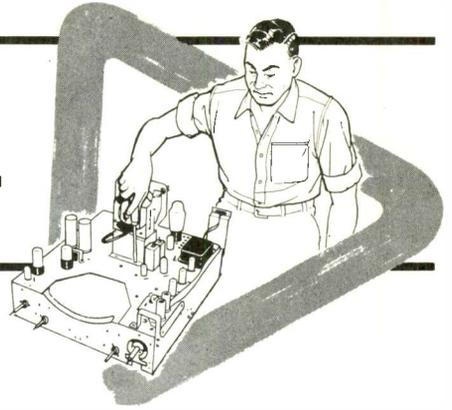
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In the Interest of . . .

# Quicker Servicing

by DON R. HOWE and GLEN E. SLUTZ



## Damage Caused by Lightning

An interesting case of visual and audio interference was recently brought to light on a routine service call. The set owner reported interference on all channels, but the interference was considerably worse on channel 10. This channel provided one of the weaker signals due to the distance of the television transmitter. The owner, not suspecting his set to be at fault, had invested in a signal booster and noise eliminator. This seemed to offer no apparent solution to his interference problem.

After eliminating the more probable causes, it was discovered that the antenna contacts on the turret tuner were badly burned, as evidenced by Figure 1. It was then found desirable to inspect the spring contacts of the tuner. This was done by removing one of the antenna coil sections of the turret,

rotating the turret five positions, and removing another section. A vacant section of the turret was then aligned with the spring contacts. By viewing through the remaining vacant section with the aid of a flashlight, the spring contacts were inspected and found to be severely burned.

The service technician was informed by the set owner that six months previously, lightning had struck a nearby tree and had jumped to the antenna used for channel 10. For lightning protection, the original installation employed a No. 14 wire running from the antenna mast to a water pipe. The lightning had burned this ground wire in two. The antenna lead-in then provided the most convenient path for dissipating the remaining charge built up by the lightning. Figure 2 shows the path followed by this charge. It may be noted by reference to Figure 1, that contact number 9 was more

severely damaged than contacts 8 or 10. This was brought about by the fact that 9 carried the combined current that flowed through contacts 8 and 10.

It is of special interest to note that the set continued to operate for a period of six months with the damaged tuner.

It is recommended that number 10 wire, or larger, or heavy braid be used for ground connections when installing lightning arrestor systems. A separate ground rod should be used when possible.

It might be well to keep in mind the above case when a problem of poor reception and interference is encountered. Inspection of the tuner contacts may reveal a condition similar to the one just described.

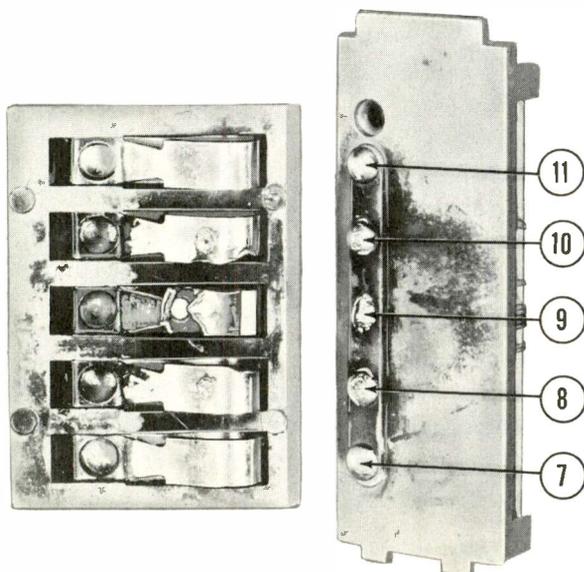


Figure 1. Damaged Contacts of the Turret Tuner.

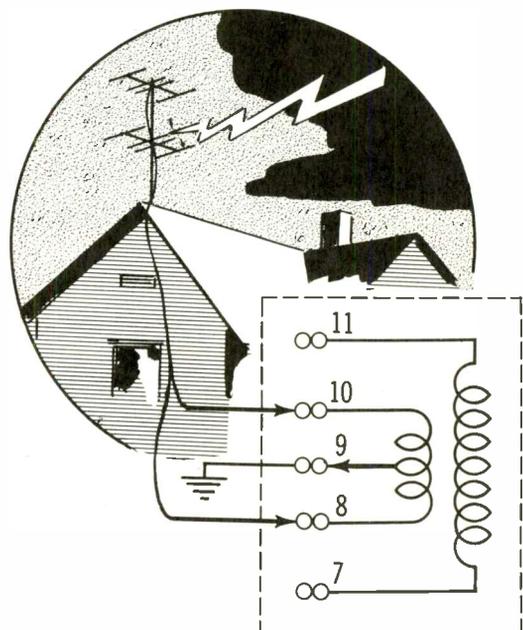


Figure 2. Path of Lightning Through the Turret Contacts.

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*Meet the  
Big Demand  
for Conversion*

with

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- Ease and simplicity of installation saves valuable time.
- Absolute, positive detent tuning—no fishing for channel. Tune UHF as easily, as perfectly as VHF.
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Over  
**9,000,000**  
Standard Tuners  
in operation—Each  
a prospect now  
or later for  
UHF Strips!

**Here's what an independent survey found out about Standard UHF strips:**

"Satisfactory results were obtained in every case. After making the necessary oscillator slug adjustment, no further adjustments were required. The units were very stable and any retuning which was required during warm-up was hardly noticeable."

IN TV IT'S STANDARD

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Send for this  
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Get facts on how to order  
UHF strips, how to install.  
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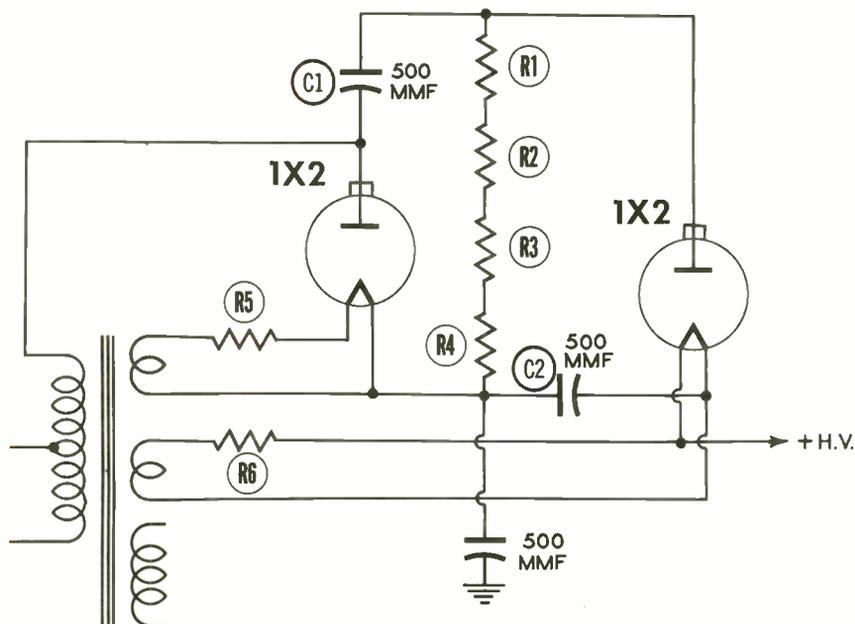


Figure 3. A Typical Voltage Multiplier Circuit.

### Internal Arcing of Capacitors

Arcing is not an uncommon problem, with the high voltages present in television sets. Arcing may often be detected by sight or sound. However, internal arcing of components presents an entirely different situation. Internal arcing is seldom visible, even in a darkened room. It is now possible to bring another physical sense into the picture - touch.

Let us look briefly at the thermal effects of arcing. Arcing produces heat, and this heat must be dissipated. If a component is arcing internally, the component itself must dissipate this heat. Naturally this will raise the temperature of the component, and this temperature rise can oftentimes be detected by touch.

An actual case of this happened in the voltage multiplier circuit of a television high voltage power supply. This circuit is illustrated in Figure 3. Arcing in the set could be heard and was severe enough to affect vertical synchronization of the picture. Interference, characteristic of arcing, was also noted in the picture. Observing the set operating in darkness revealed no visible signs of arcing. This presented a possible condition of internal arcing. This arcing was found to be in capacitor C1 and was detected by the following method.

1. The set was turned on and allowed to operate for a few minutes.

2. The set was turned off and the high voltage was shorted in order to bleed off any remaining charge.

3. Capacitors C1 and C2 were touched and C1 was found to be considerably warmer than C2. These capacitors performed a similar function and were mounted fairly close to each other, therefore, the temperature of the two should have been approximately the same.

The above method is only a preliminary check and the results may be verified by actual replacement of the component in question. This system of detection provides a very useful short-cut to the substitution method often required in a case of internal arcing.

This system of detection is not limited to capacitors, but may be used on nearly all components found in radio and television receivers. Resistors, controls, and leaky capacitors are examples of a few.

### The Tools of The Trade

The alignment of television and radio receivers is an exacting and often tedious undertaking, which is greatly simplified by the use of proper equipment in good working order. The alignment tool may seem to be an insignificant part of this equipment, but without it critical adjustments cannot be made correctly.

During one particular case requiring the alignment of an IF transformer, rotation of the alignment tool seemed to cause little effect. This condition is oftentimes significant of a broken slug in the transformer. Upon closer inspection it was found that the metallic insert inside the tool itself was loose and was not rotating as the tool was turned. The friction of the insert had allowed previous adjustments to be made but when an adjustment requiring greater force was encountered, the insert would not turn. In this case, discovery of this condition resulted in only a loss of time, but under a different situation it could have led to the disassembly and inspection of the component part:

A periodic inspection of tools found in the shop may lead to the prevention of a situation similar to the one described above. This inspection will not only result in a saving of time, but will allow the service technician to perform his duties in the efficient manner his capabilities allow.

Items frequently revealed by this inspection include: bent inserts on alignment tools, broken tips on screwdrivers, dull knives, and frayed cords on soldering irons. Some tools could possibly be repaired before the damage becomes great enough to require replacement.

### Preventing Shock

"Hot" chassis are frequently encountered in the servicing of permanent installations employing AC-DC systems; for example, inter-communication sets. This may cause a shock to the service technician or damage to his equipment. It is possible to alleviate this condition with a neon bulb.

Turn on the set in question, and hold one lead of the neon bulb in your hand, touch the other lead to the chassis. If a glow is observed, reverse the AC plug and repeat the test. If no glow of the neon bulb is apparent, the chassis may be considered safe to begin your repair work.

In selecting your neon bulb, be sure the igniting voltage is 60 volts or less. The commercially available pocket neon testers are quite suitable for this purpose.

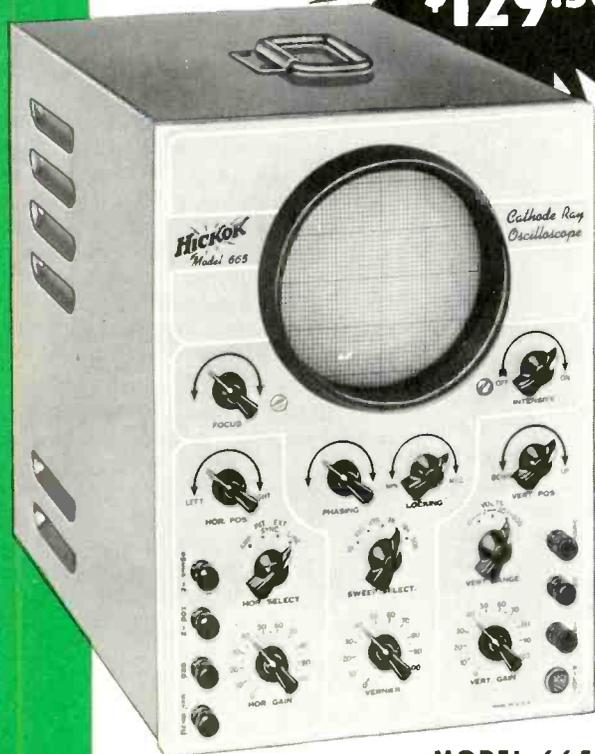
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*Oscilloscope*



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- 1 1V2 High Voltage Rectifier
- 1 6X4 Low Rectifier
- 3 12AT7 { (Vert. Cathode — Follower — 1st Amplifier  
(Vert. Push-Pull Output  
(Horiz. Push-Pull Output
- 1 6AB4 1st Horizontal Amplifier
- 1 6J6 Sweep Circuit Oscillator

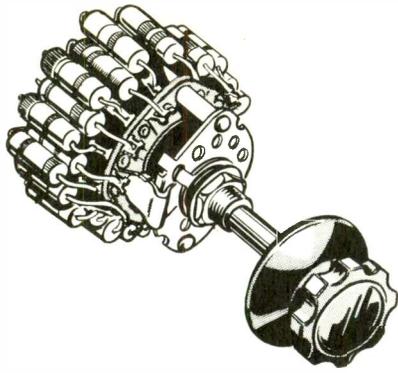
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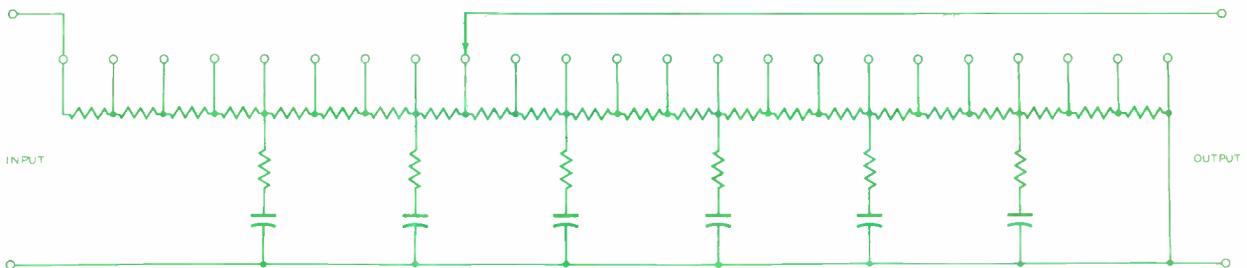
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# Loudness Controls for Better Listening

## Audio-Facts



by ROBERT B. DUNHAM

### Loudness Control -

With all the discussion of design and construction of high quality audio systems, it must be remembered that many of the developments can be applied to existing equipment in order to provide more satisfactory operation.

Of course radical changes and modifications can be made in a complete system, but at times the installation of a single item, such as a better speaker, output transformer or new phono cartridge will greatly improve the listening qualities. One component which can greatly aid in providing this desired effect is the loudness control.

As an example, a small record demonstration amplifier, marketed quite a few years ago by a well-known manufacturer, was made the subject of some experimenting. It performed very well by the standards of that time but a test revealed intermodulation distortion in excess of 40% when operated at a normal listening level. The removal of the tone control circuits and the application of some negative feedback reduced this distortion to less than 1%.

Replacing the volume control with a loudness control maintained

the tonal balance between highs and lows so well that the quality of reproduction was better than could be obtained with the tone controls.

This should not be taken to mean a loudness control is a cure-all for it is not, but rather as an example of how satisfactory such simple modifications can be.

Loudness controls have been the subject of much discussion, both pro and con, but some form of

compensated control is now employed in the majority of high quality outfits.

Until recently volume, gain or level control were the terms in general use. So there may be some question as to why the loudness control is being mentioned so often in connection with high quality audio equipment. Also, how and why does it differ from the ordinary volume control.

\* \* Please turn to page 108 \* \*

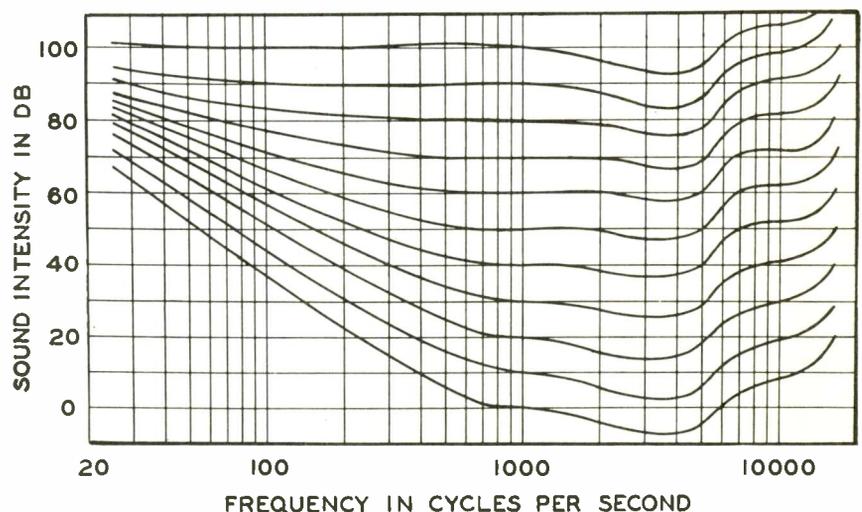


Figure 1. Fletcher-Munson Curves.

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# Dollar and Sense Servicing

by *John Markus*

*Editor-in-Chief, McGraw-Hill Radio Servicing Library*

**COUNTERMEASURES.** Around Jackson, Mississippi, highway patrolmen were for a time baffled by certain cars that whizzed past their radar speed-checking stations at around 75 mph without tripping the excess-speed indicator. On advice of electronic counsel, however, they started looking for motorists who had installed short-wave jamming transmitters in their cars, patterned after military radar countermeasure equipment.

What to do with the pranksters when caught is somewhat of a problem, as few, if any, city fathers or legislators have had the seeing-into-the-future vision to make use of jamming transmitters illegal. It looks as if the cops will either have to call on the FCC boys each time they catch one, or go back to the old-fashioned behind-the-billboard technique of catching these speeders.



**CABINETS.** Servicemen catering to demands of hi-fi enthusiasts for custom cabinet installations including a large loudspeaker will appreciate one unique feature of a newly announced all-in-one cabinet design. It uses eight industrial shock mounts to isolate the entire speaker enclosure acoustically from the phonograph and the rest of the audio equipment. This is claimed to solve the bugaboo of distortion caused by feedback of mechanical vibration from the speaker to the electronic units.

In ultramodern motif with choice of wood and finish, the net price of this cabinet is \$237 (without equipment) from Jeff Markell Associates, 108 W. 14th St., New York 11, New York. Less expensive ultramodern cabinets in the line, all with-

out speaker provisions, include three cocktail cabinets, two end tables, and a matching utility or record storage cabinet. An end-table cabinet in dignified traditional design is also available.



**ROBOT.** A new long-playing magnetic tape arrangement was scheduled to replace the 6 p. m. to midnight disk jockey at San Mateo, California's KEAR this past summer. The commercials and patter are recorded on one tape reel and the music on another. Special playback equipment developed by Apex Electric Corporation of Redwood City, California cuts in the announcements automatically one at a time in between the musical selections.

One way of achieving back-and-forth switching action between the two tape playback units is by recording an inaudible supersonic signal at each tape location where the other machine is supposed to take over. A filter circuit and small amplifier tuned to the supersonic frequency could then actuate a two-position stepper relay for switching the playback motors and audio lines. Cost of a pair of these announcer-replacing playback units is reported to be around \$1,000.



**BANKRUPTCY.** To help avoid business failure, check inventory every 30 days and see your banker and finance man every 90 days, says NARDA president Wallace Johnson of Memphis, Tenn. A television dealer should not carry more than 30 days supply of sets normally, it being the

distributor's function to carry the inventory to supply dealers in an area. Success in retailing depends largely on three things--knowing what to buy, how to buy, and what not to buy.

See your banker to learn all you can about retail trends in your locality and about the status of the local economy (whether industrial plants are laying off or hiring steadily, whether night shifts are bringing more money into town, and whether other income of potential customers is above or below normal). In even just a 15 minute conversation, you can glean a lot of ideas that may benefit your business.



**LATIN.** In the latest edition of a modern Latin dictionary it is "televisio", with "televisionis" as the genitive. Monsignor Antonio Bacci, official Latin expert of the Pope, defines the derivation of the word as "sight from afar".



**V-REELS.** Newly redesigned plastic reels for Scotch sound recording tape have V-shaped diagonal slots in the hub. These eliminate the need for threading the magnetic tape into the conventional slots in the drum of the reel. The user merely draws the tape outward between spokes, lets it drop into the V slot, then rotates the reel a few turns while holding the end of the tape so as to cinch the tape to the hub. The slot design permits doing this without having a bulky fold and eccentric winding.

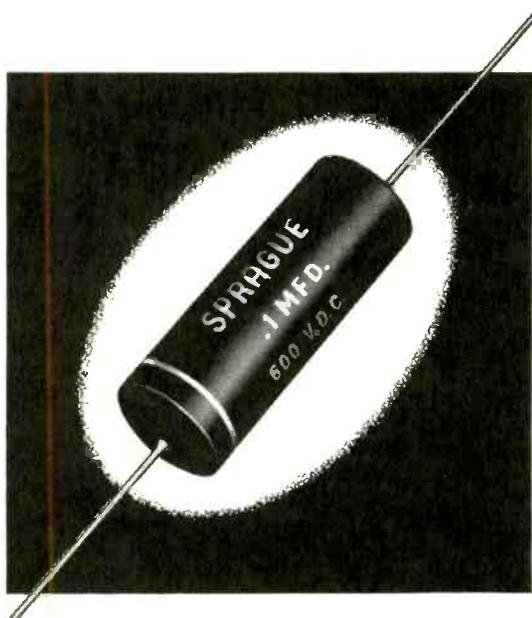
\* \* Please turn to page 121 \* \*

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RADIO AND TELEVISION SERVICE DATA FOLDERS

# No. 40

Covering Folder Sets Nos. 1 thru 218

## HOW TO USE THIS INDEX

To find the PHOTOFAC Folder you need, first look for the name of the receiver (listed alphabetically below), and then find the required model number. Opposite the model, you will find the number of the PHOTOFAC Set in which the required Folder appears, and the number of that Folder. The PHOTOFAC Set number is shown in bold-face type; the Folder number is in the regular light-face type.

**IMPORTANT—1.** The letter "A" following a Set number in the Index listing, indicates a "Preliminary Data Folder." These Folders are designed to provide you *immediately* with preliminary basic data on TV receivers pending their complete coverage in the standard, uniform PHOTOFAC Folder Set presentation.

**2.** Models marked by an asterisk (\*) have not yet been covered in a standard Folder. However, regular PHOTOFAC Subscribers may obtain Schematic, Alignment Data or other required information on these models without charge by supplying make, model or chassis number and serial number. (When requesting such data, mention the name of the Parts Distributor who supplies you with your PHOTOFAC Folder Sets.)

**3.** Production Change Bulletins contain data supplementary to certain models covered in previously issued PHOTOFAC Folders, and are listed in this Index immediately following the listing of the original coverage of the model or chassis. These Bulletins should be filed with the Folders covering the models to which the changes apply.

Set Folder No. No.	Set Folder No. No.	Set Folder No. No.	Set Folder No. No.	Set Folder No. No.
<b>ADAPTOR</b>	<b>ADMIRAL—Cont.</b>	<b>ADMIRAL—Cont.</b>	<b>ADMIRAL—Cont.</b>	<b>ADMIRAL—Cont.</b>
CT-1 ..... 48—1	Chassis 207I Tel. Rec. (Also see Prod. Chge. Bul. 15—Set 126-1 and Bul. 26—Set 146-1)..... 117—2	Chassis 24D1, 24E1, 24F1, 24G1, 24H1 Tel. Rec. (Also see Prod. Chge. Bul. 9—Set 114-1)..... 103—2	Chassis 4H167A, B, C, CN Tel. Rec. (See Ch. 208I)	Models 6RT41, 6RT42, 6RT43 (See Ch. 58I Phono)
<b>ADMIRAL (Also see Record Changer Listing)</b>	Chassis 20V Tel. Rec. (Also see Prod. Chge. Bul. 15—Set 126-1 and Prod. Chge. Bul. 26—Set 146-1)..... 117—2	Chassis 30A1 Tel. Rec. (See Ch. 30B1)	Models 4H167S, SN Tel. Rec. (See Ch. 30B1)	Model 6RT41A, 7RT42A, 6RT43A (See Ch. 58IA)
Chassis UL5K1 ..... 30—1	Chassis 20X1, 20Y1 Tel. Rec. (See Ch. 20Z1) (Also see Prod. Chge. Bul. 7—Set 110-1)..... 100—1	Chassis 30B1, 30C1, 30D1 Tel. Rec. (See Ch. 4T1)	Model 6RT44 (See Ch. 7B1)	Models 6S11, 6S12 (See Ch. 6S1)
Chassis UL7C1 ..... 25—2	Chassis 21A1 Tel. Rec. (Also see Prod. Chge. Bul. 23—Set 140-1)..... 77—1	Model 4D11, 4D12, 4D13 (See Ch. 4D1)	Model 6S11, 6S12 (See Ch. 6S1)	Model 6T01 ..... 1—19
Chassis 3A1 ..... 25—2	Chassis 21B1, 21C1, 21D1 Tel. Rec. (Also see Prod. Chge. Bul. 25—Set 144-1)..... 118—2	Models 4H15, 4H16, 4H17 (A or B) Tel. Rec. (See Ch. 20A1)	Model 6T02, 6T04 ..... 1—20	Model 6T05 ..... 1—19
Chassis 3C1 (Also See Prod. Chge. Bul. 15—Set 126-1)..... 117—2	Chassis 21E1 (See Chassis 21D1—Set 118-2 and Prod. Chge. Bul. 25—Set 144-1)..... 118—2	Models 4H15, 4H16, 4H17, 4H18, 4H19 (S or SN) Tel. Rec. (See Chassis 30B1)	Model 6T06, 6T07 (See Ch. 4A1)	Model 6T11 (See Ch. 4A1)
Chassis 4A1 ..... 3—31	Chassis 21F1, 21G1 Tel. Rec. (Also see Prod. Chge. Bul. 30—Set 156-2 and Prod. Chge. Bul. 46—Set 180-1)..... 135—2	Models 4H18, 4H19 (C or CN) Tel. Rec. (See Ch. 20B1)	Model 6T12 (See Ch. 4A1)	Model 6T14 (See Ch. 7B1)
Chassis 4B1 ..... 24—1	Chassis 21H1, 21J1 Tel. Rec. (Also see Prod. Chge. Bul. 25—Set 144-1)..... 118—2	Models 4H115, 4H116, 4H117 (S or SN) Tel. Rec. (See Ch. 30B1)	Models 6V11, 6V12 (See Ch. 6V1)	Models 6W11, 6W12 (See Chassis 6W1)
Chassis 4D1 ..... 49—1	Chassis 21K1, 21L1 Tel. Rec. (Also see Prod. Chge. Bul. 46—Set 180-1)..... 135—2	Models 4H126A, B, C, CN Tel. Rec. (See Ch. 21A1)	Model 6Y18, 6Y19 (See Chassis 6Y1)	Models 7C60W, 7C60M, 7C60V (See Ch. 6B1)
Chassis 4H1 ..... 71—2	Chassis 21M1, 21N1 Tel. Rec. (See Prod. Chge. Bul. 30—Set 156-2 and Prod. Chge. Bul. 46—Set 180-1)..... 135—2	Model 4H126 (S or SN) Tel. Rec. (See Ch. 30B1)	Models 7C61, 7C62, 7C62UL (See Ch. 6M1)	Model 7C62A (See Ch. 6M1)
Chassis 4J1, 4K1 ..... 77—7	Chassis 21P1, 21Q1 Tel. Rec. (Also see Prod. Chge. Bul. 30—Set 156-2 and Prod. Chge. Bul. 46—Set 180-1)..... 135—2	Model 4H137 (S or SN) Tel. Rec. (See Ch. 30B1)	Model 7C63, 7C63-UL (See Ch. 7C1)	Model 7C63A (See Ch. 7C1)
Chassis 4L1 ..... 100—1	Chassis 21R1, 21S1 Tel. Rec. (Also see Prod. Chge. Bul. 30—Set 156-2 and Prod. Chge. Bul. 46—Set 180-1)..... 135—2	Models 4H145A, B, C, CN Tel. Rec. (See Ch. 20B1)	Models 7C65, 7C65M, 7C65W (See Ch. 7E1)	Model 7C73 (See Ch. 9A1)
Chassis 4R1 ..... 108—3	Chassis 21T1, 21U1 Tel. Rec. (Also see Prod. Chge. Bul. 30—Set 156-2 and Prod. Chge. Bul. 46—Set 180-1)..... 135—2	Models 4H145A, B, C, CN Tel. Rec. (See Ch. 20B1)	Models 7G11, 7G12, 7G14, 7G15, 7G16 (See Ch. 7G1)	Models 7P32, 7P33, 7P34, 7P35 (See Ch. 5H1)
Chassis 4S1 ..... 100—1	Chassis 21V1 Tel. Rec. (See Ch. 20B1)	Models 4H146A, B, C, CN Tel. Rec. (See Ch. 20B1)	Models 7RT43 (See Ch. 6L1)	Models 7T01, 7T01M-UL, 7T04, 7T04-UL (See Ch. 5N1)
Chassis 4T1 ..... 143—2	Chassis 21W1 Tel. Rec. (See Ch. 20B1)	Models 4H146A, B, C, CN Tel. Rec. (See Ch. 20B1)	Model 7T06 (See Ch. 4B1)	Model 7T10 (See Ch. 5K1)
Chassis 5A3 ..... 191—2	Chassis 21X1, 21Y1 Tel. Rec. (See Prod. Chge. Bul. 62—Set 196-1 and Ch. 21W1—Set 177-2)	Models 4H146S, SN Tel. Rec. (See Ch. 30B1)	Model 7T12 (See Ch. 4B1)	Models 7T14, 7T15 (See Ch. 5K1)
Chassis 5B1 (See Model 6T02—Set 1-20)..... 4—24	Chassis 21Z1, 21Z1A Tel. Rec. (Also see Prod. Chge. Bul. 30—Set 156-2 and Prod. Chge. Bul. 46—Set 180-1)..... 135—2	Models 4H147A, B Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 8C11, 8C12, 8C13 Tel. Rec. (See Ch. 30A1 and Ch. 8C1)
Chassis 5B1A ..... 18—1	Chassis 22A1, 22A2A Tel. Rec. (See Ch. 20B1)	Models 4H147S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 8C14, 8C15, 8C16, 8C17 (See Ch. 8C1)
Chassis 5B2 ..... 100—1	Chassis 22C1, 22C2 Tel. Rec. (See Ch. 20B1)	Models 4H155A, B Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 8D15, 8D16 (See Ch. 8D1)
Chassis 5C3 ..... 197—2	Chassis 22E1 Tel. Rec. (See Ch. 20B1)	Models 4H155A, B Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Model 8R46 (See Chassis 3A1)
Chassis 5D2 ..... 119—2	Chassis 22F1 Tel. Rec. (See Ch. 20B1)	Models 4H156A, B Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 9B14, 9B15, 9B16 (See Ch. 9B1)
Chassis 5E2 ..... 139—2	Chassis 22G1 Tel. Rec. (See Ch. 20B1)	Models 4H156S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 9E15, 9E16, 9E17 (See Ch. 9E1)
Chassis 5F1 ..... 57—1	Chassis 22H1 Tel. Rec. (See Ch. 20B1)	Models 4H157A, B Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 12X11, 12X12 Tel. Rec. (See Ch. 20Z1)
Chassis 5G2 ..... 137—2	Chassis 22I1 Tel. Rec. (See Ch. 20B1)	Models 4H157S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 14R11, 14R12 Tel. Rec. (See Ch. 20T1)
Chassis 5H1 ..... 26—1	Chassis 22J1 Tel. Rec. (See Ch. 20B1)	Models 4H165A, B Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Model 15K21 Tel. Rec. (See Ch. 20T1)
Chassis 5J2 ..... 136—2	Chassis 22K1 Tel. Rec. (See Ch. 20B1)	Models 4H165S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	Model 16M12 Tel. Rec. (See Ch. 21X1)
Chassis 5K1 ..... 30—1	Chassis 22L1 Tel. Rec. (See Ch. 20B1)	Models 4H166A, B, C, CN Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 16R11, 16R12 Tel. Rec. (See Ch. 21B1)
Chassis 5L2 ..... 160—1	Chassis 22M1 Tel. Rec. (See Ch. 20B1)	Models 4H166S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	Model 17K16 Tel. Rec. (See Ch. 21F1)
Chassis 5M2 ..... 157—2	Chassis 22N1 Tel. Rec. (See Ch. 20B1)	Models 4H167A, B, C, CN Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 17D10, 17D11, 17D12 Tel. Rec. (See Ch. 19B1)
Chassis 5N1 ..... 31—1	Chassis 22O1 Tel. Rec. (See Ch. 20B1)	Models 4H167S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 17K11, 17K12 Tel. Rec. (See Ch. 21F1)
Chassis 5R1 ..... 59—1	Chassis 22P1 Tel. Rec. (See Ch. 20B1)	Models 4H168A, B, C, CN Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 17K21, 17K22 Tel. Rec. (See Ch. 21F1)
Chassis 5R2 ..... 165—3	Chassis 22Q1 Tel. Rec. (See Ch. 20B1)	Models 4H168S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 17M15, 17M16, 17M17 Tel. Rec. (See Ch. 21F1)
Chassis 5T1 ..... 68—1	Chassis 22R1 Tel. Rec. (See Ch. 20B1)	Models 4H169A, B, C, CN Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 19A115, SN, 19A125, SN Tel. Rec. (See Ch. 19A1)
Chassis 5W1 ..... 79—2	Chassis 22S1 Tel. Rec. (See Ch. 20B1)	Models 4H169S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 19A155, SN Tel. Rec. (See Ch. 19A1)
Chassis 5X1 ..... 76—3	Chassis 22T1 Tel. Rec. (See Ch. 20B1)	Models 4H170A, B, C, CN Tel. Rec. (See Ch. 20B1)	Models 7T14, 7T15 (See Ch. 5K1)	Models 20X11, 20X12 Tel. Rec. (See Ch. 20X1)
Chassis 5X2 ..... 204—2	Chassis 22U1 Tel. Rec. (See Ch. 20B1)	Models 4H170S, SN Tel. Rec. (See Ch. 30B1)	Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 5Y2 ..... 188—2	Chassis 22V1 Tel. Rec. (See Ch. 20B1)		Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6A1 (See Model 6T01—Set 1-19)..... 103—1	Chassis 22W1 Tel. Rec. (See Ch. 20B1)		Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6A2 ..... 103—1	Chassis 22X1, 22X2 (See Prod. Chge. Bul. 62—Set 196-1 and Ch. 21W1—Set 177-2)		Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6B1 ..... 48—2	Chassis 22Y1 Tel. Rec. (See Ch. 20B1)		Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6C1 ..... 53—1	Chassis 22Z1 Tel. Rec. (See Ch. 20B1)		Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6E1, 6E1N ..... 6—1	Chassis 23A1 Tel. Rec. (See Ch. 20B1)		Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6J2 ..... 140—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6L1 ..... 26—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6M1 ..... 25—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6M2 (See Ch. 6J2—Set 140-2)..... 78—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6Q1 ..... 54—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6R1 ..... 107—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6S1 ..... 62—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6V1 ..... 71—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6W1 ..... 75—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 6Y1 ..... 18—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 7B1 ..... 25—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 7C1 ..... 36—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 7E1 ..... 54—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 7G1 ..... 54—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 8C1 (See Ch. 8D1—Set 67-1)..... 67—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 8D1 ..... 32—1			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 9A1 ..... 49—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 9B1 ..... 68—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 9E1 ..... 3—30			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 10A1 ..... 59—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 19A1 Tel. Rec. (Also see Prod. Chge. Bul. 5—Set 106-1)..... 210—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 19B1, 19C1 Tel. Rec. (See Ch. 20T1)..... 210—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 19E1 Tel. Rec. (See Ch. 20T1)..... 210—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 19F1, 19F1A Tel. Rec. (See Ch. 20T1)..... 210—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 19G1 (See Ch. 19E1—Set 203-2)..... 210—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 19H1, 19K1 Tel. Rec. (See Ch. 20T1)..... 210—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 19N1 (See Ch. 19E1—Set 203-2)..... 210—2			Models 7T14, 7T15 (See Ch. 5K1)	
Chassis 20A1, 20B1 Tel. Rec. (Also see Prod. Chge. Bul. 23, Set 140-1)..... 77—1			Models 7T14, 7T15 (See Ch. 5K1)	

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Subject	Page No.
1. Explanation of letter "A," asterisk (*), and Prod. Changes	49
2. How to obtain a sample PHOTOFAC Folder	58
3. How to file PHOTOFAC Folders easily and quickly	63
4. How to obtain Service Data on Pre-War Models	67

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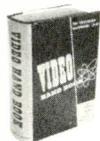
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 Model 26R37A Tel. Rec. (See Ch. 21B1)  
 Models 26X35, 26X36 Tel. Rec. (See Ch. 24D1)  
 Model 26X36AS, S Tel. Rec. (See Ch. 21E1)  
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 Models 27K25, A, B, 27K26, A, B, 27K27, A, B Tel. Rec. (See Ch. 21F1)  
 Models 27K35, A, B, 27K36, A, B, 27K37, A, B Tel. Rec. (See Ch. 21F1)  
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 27M35, 27M36 Tel. Rec. (See Ch. 21F1)  
 Models 29X15, 29X16, 29X17 Tel. Rec. (See Ch. 24F1)  
 Model 29X25 Tel. Rec. (See Ch. 24F1)  
 Model 29X25A Tel. Rec. (See Ch. 21H1)  
 Model 29X26 Tel. Rec. (See Ch. 24F1)  
 Model 29X26A Tel. Rec. (See Ch. 21H1)  
 Model 29X27 Tel. Rec. (See Ch. 24F1)  
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 Models 30A14, 30A15, 30A16 Tel. Rec. (See Ch. 30A1)  
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 Models 30F15, 30F16, A, 30F17, A Tel. Rec. (See Ch. 20A1)  
 Models 32X15, 32X16 Tel. Rec. (See Ch. 20Z1)  
 Models 32X26, 32X27 Tel. Rec. (See Ch. 20Z1)  
 Models 32X35, 32X36 Tel. Rec. (See Ch. 20Z1)

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 Model 36R37 Tel. Rec. (See Ch. 21C1)  
 Models 36R45, 36R46 Tel. Rec. (See Ch. 21C1)  
 Models 36X35, 36X36, 36X37 Tel. Rec. (See Ch. 24E1 and Ch. 5B2)  
 Models 36X35A, 37X36A, 36X37A Tel. Rec. (See Ch. 24E1 and Ch. 5D2)  
 Models 37F15, A, B, 37F16, A, B Tel. Rec. (See Ch. 21G1 or Ch. 21Q1 and Ch. 5D2)  
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 Models 47M35, 47M36, 47M37 Tel. Rec. (See Ch. 21Z1)  
 Models 52M15, 52M16, 52M17 Tel. Rec. (See Ch. 21Y1)  
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 Model 221DX15 Tel. Rec. (See Ch. 19C1)  
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 Model 221K28 Tel. Rec. (See Ch. 21K1)  
 Models 221K36, 221K36A, 221K37 Tel. Rec. (See Ch. 21K1)  
 Models 221K45, 221K46, 221K47 Tel. Rec. (See Ch. 21M1)  
 Models 221K45A, 221K46A, 221K47A Tel. Rec. (See Ch. 22M1)  
 Models 221M26, 221M27 Tel. Rec. (See Ch. 21K1)  
 Model 222DX15 Tel. Rec. (See Ch. 19H1)  
 Model 222DX15S Tel. Rec. (See Ch. 22C2)  
 Models 222DX16, 222DX17 Tel. Rec. (See Ch. 22C2)  
 Models 222DX26, 222DX27 Tel. Rec. (See Ch. 22C2)  
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 Models 321F35, 321F36 Tel. Rec. (See Ch. 21L1 and Ch. 5D2)  
 Models 321F46, 321F47 Tel. Rec. (See Ch. 21L1 and Ch. 5D2)  
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 Model 321K27 Tel. Rec. (See Ch. 21L1 and Ch. 3C1)  
 Model 321K35, 321K36 Tel. Rec. (See Ch. 21L1 and Ch. 3C1)  
 Models 321K46, 321K47 Tel. Rec. (See Ch. 21L1 and Ch. 3C1)  
 Model 321K49 Tel. Rec. (See Ch. 21L1 and Ch. 3C1)  
 Models 321K65, 321K66, 321K67 Tel. Rec. (See Ch. 21N1 and Ch. 3C1)  
 Models 321M25, 321M26, 321M27 Tel. Rec. (See Ch. 21Y1)  
 Models 321M25A, 321M26A, 321M27A Tel. Rec. (See Ch. 22Y1)  
 Model 322DX16 Tel. Rec. (See Ch. 22E2)  
 Models 421M15, 421M16 Tel. Rec. (See Ch. 21Y1)  
 Models 421M15A, 421M16A Tel. Rec. (See Ch. 22Y1)  
 Models 421M35, 421M36, 421M37 Tel. Rec. (See Ch. 22Y1)  
 Models 520M11, 520M12 Tel. Rec. (See Ch. 22A2)  
 Models 520M15, 520M16, 520M17 Tel. Rec. (See Ch. 22A2)  
 Models 521M15, 521M16, 521M17 Tel. Rec. (See Ch. 21Y1)  
 Models 521M15A, 521M16A, 521M17A Tel. Rec. (See Ch. 22Y1)

**AEROTIVE**

181-AD ..... 12-1  
**AERO (See Record Changer Listing)**  
**AIRCEE (See AMC)**  
**AIRADIO**  
 SU-41D ..... 11-1  
 SU-52A, B, C (Receiver) ..... 13-2  
 TRA-1A, B, C (Transmitter) ..... 13-1  
 3100 ..... 37-1

**AIRCATTLE**

C-300 ..... 136-3  
 DM-700 ..... 85-1  
 EV-740 ..... 85-1  
 G-516, G-518 ..... 48-3  
 G-521 ..... 54-3  
 G-724 ..... 52-25  
 G-725 ..... 50-1  
 K1 ..... 93-1  
 P-20 ..... 71-3  
 P-22 ..... 87-1  
 PAM-4 ..... 101-1  
 PC-8, PC-358 ..... 99-1  
 PM-78 ..... 100-2  
 PM-358 ..... 98-1  
 PX ..... 13-35  
 REV248 ..... 127-2  
 RZU248 (See Model 127-2)  
 SC-448 ..... 62-2  
 TD-6 ..... 103-3  
 WEU-262 ..... 91-1  
 WRA1-A ..... 47-1  
 WRA-4M ..... 60-1  
 XB702, XB703 Tel. Rec. ..... 93A-1  
 XL750, XP775 Tel. Rec. ..... 93A-1  
 OA-358-VM (See Model 358VM—Set 127-3)  
 O6-F, O6-L ..... 135-3  
 7B ..... 52-1  
 9 ..... 50-2  
 10C, 10T Tel. Rec. (See Model 14C—Set 140-3)  
 12C, 12T Tel. Rec. (See Model 14C—Set 140-3)  
 14C, 14T Tel. Rec. ..... 140-3  
 15 ..... 67-2  
 16C, 16T Tel. Rec. (See Model 14C—Set 140-3)  
 17C, 17T Tel. Rec. ..... 140-3  
 20XUT Tel. Rec. ..... 185-3  
 79A ..... 137-3  
 88, 88W ..... 142-2  
 101 ..... 86-1  
 102B ..... 98-2  
 105B ..... 13-3  
 150, 153 ..... 126-2  
 171, 172 ..... 96-1  
 198 ..... 83-1  
 200 ..... 139-3  
 201 ..... 81-1  
 211 ..... 65-1  
 212 ..... 68-3  
 213 ..... 63-1  
 2271, 227W ..... 84-1  
 312 Tel. Rec. (See Model 14C—Set 140-3)  
 316 Tel. Rec. (See Model 14C—Set 140-3)  
 3914 ..... 136-4  
 358VM ..... 127-3  
 412 Tel. Rec. (See Model 14C—Set 140-3)  
 416 Tel. Rec. (See Model 14C—Set 140-3)  
 472, JP24, 472, JP25 (See Model 472.MP25—Set 168-1)  
 472.MP24 (See Model 472.MP25—Set 168-1)  
 472.MP25 ..... 168-1  
 472.053VM ..... 163-2  
 472.17XUT, 472.17XUT.1, 472.XUT.2, 472.XUT.3 (Ch. 217B) Tel. Rec. (See Model 20XUT—Set 185-3)  
 472.20XUC (Ch. 220B) Tel. Rec. (See Model 20XUT—Set 185-3)  
 472.20XUT, 472.20XUT.1, 472.20XUT.2 (Ch. 220B) Tel. Rec. (See Model 20XUT—Set 185-3)  
 472.254 ..... 215-2  
 568 ..... 14-1  
 568.205 (See Model 200—Set 139-3) ..... 141-2  
 572 ..... 55-1  
 594-935 (See Model 935—Set 128-2) ..... 114-2  
 602-182144 ..... 133-2  
 603-PR-8.1 ..... 119-2  
 604 ..... 59-2  
 606-400WB ..... 177-3  
 607.299 ..... 122-2  
 607.314, 607.315 ..... 138-2  
 607.316, -1, 607.317, -1 ..... 174-2  
 610.C351 ..... 208-1  
 610.CLI52B, M ..... 142-3  
 610.F100 ..... 138-3  
 610.F151 ..... 172-2  
 610.H400 ..... 179-2  
 610.P-651.1 ..... 184-2  
 621 (Ch. F191) ..... 14-2  
 626 ..... 18-3  
 641 ..... 17-1  
 651 ..... 15-1  
 652.A25, 652.A35 ..... 205-2  
 652.6TIE, V ..... 210-3  
 652.3275A ..... 211-3  
 652.4875 ..... 168-2  
 652.505 ..... 167-2  
 659.511, 659.513 ..... 185-4  
 659.520E, I ..... 129-2  
 9151, W ..... 128-2  
 935 ..... 128-2  
 9651, W, 9651K, W (See Model 9511—Set 129-2)  
 1400C, 1400T Tel. Rec. ..... 140-3  
 1700C, 1700T Tel. Rec. ..... 140-3  
 2000C Tel. Rec. ..... 140-3  
 3170 Tel. Rec. (For TV Ch. See Set 140-3, For Radio Ch. See Model 150—Set 126-2)  
 4170 Tel. Rec. (For TV Ch. See Set 140-3, For Radio Ch. See Model 350—Set 136-4)  
 5000, 5001 ..... 16-2  
 5002 ..... 19-1  
 5003, 5004, 5005, 5006 ..... 20-1

**AIRCATTLE—Cont.**

5008, 5009 ..... 46-1  
 5010, 5011, 5012 ..... 13-4  
 5015, 1101 ..... 18-3  
 5020 ..... 16-3  
 5022 ..... 123-2  
 5024 ..... 45-1  
 5025 ..... 24-2  
 5027 ..... 49-3  
 5028 ..... 44-1  
 5029 ..... 51-1  
 5035 ..... 46-2  
 5036 ..... 72-2  
 5044 ..... 121-2  
 5050 ..... 48-4  
 5052 ..... 45-2  
 5056-A ..... 120-2  
 6042 ..... 61-1  
 6053 ..... 74-1  
 6054 ..... 97-1  
 6514 ..... 17-2  
 6541 ..... 17-2  
 6544 (See Model 6541—Set 17-2)  
 6547 ..... 17-2  
 6611, 6612, 6613, 6630, 6631, 6632, 6634, 6635 ..... 15-2  
 7000, 7001 ..... 14-3  
 7004 ..... 19-2  
 7014, 7015 ..... 57-3  
 7015 Early ..... 47-2  
 7553 ..... 99-2  
 9008I, 9008W ..... 97-2  
 9009I, 9009W ..... 97-2  
 9012I, 9012W ..... 94-1  
 10002 ..... 54-1  
 10003-1 ..... 46-2  
 10005 ..... 62-3  
 10021-1, 10022-1 ..... 59-3  
 10023 ..... 58-1  
 10024 ..... 58-2  
 108014, 108504 ..... 57-4  
 121104 ..... 73-1  
 12112 ..... 61-2  
 127084 ..... 60-2  
 131504 ..... 69-1  
 132564 ..... 54-3  
 138104 ..... 64-1  
 138124 ..... 64-1  
 139114 (See Model 139144—Set 59-4) ..... 56-3  
 149654 ..... 71-4  
 150084 ..... 71-4  
 159144 (See Model 159144—Set 59-4) ..... 18-4

**AIR CHIEF (See Firestone)**

**AIR KING**

A-400 (Ch. 470) ..... 23-1  
 A-403 ..... 20-2  
 A-410 ..... 34-1  
 A-410 (Revised) ..... 40-1  
 A-426 ..... 43-1  
 A-501, A-502 (Ch. 465-4) ..... 31-3  
 A-510 ..... 24-3  
 A-511, A-512 ..... 50-2  
 A-520 ..... 49-4  
 A-600 ..... 26-3  
 A-604 ..... 81-2  
 A-625 ..... 50-3  
 A-650 ..... 45-4  
 A-1000, 1001 Tel. Rec. ..... 58-3  
 AI001A Tel. Rec. ..... 75-2  
 AI016 Tel. Rec. ..... 91-2  
 A2000, A2001 Tel. Rec. ..... 75-2  
 A2002 Tel. Rec. (See Model A2000—Set 75-2)  
 A2010 Tel. Rec. ..... 75-2  
 A2012 Tel. Rec. (See Model AI001A—Set 75-2)  
 12C1 Tel. Rec. (See Model 16C1—Set 121-3)  
 12T1, 12T2 Tel. Rec. (See Model 16C1—Set 121-3)  
 14T1 Tel. Rec. (See Model 16C1—Set 121-3)  
 16C1, 16C2, 16C5 Tel. Rec. ..... 121-3  
 16M1 Tel. Rec. ..... 121-3  
 16T1 Tel. Rec. ..... 121-3  
 16T1B Tel. Rec. (See Model 16C1—Set 121-3)  
 17C2 (Ch. 700-96) ..... 151-2  
 Tel. Rec. ..... 151-2  
 17C5, B (Ch. 700-96) Tel. Rec. ..... 151-2  
 17C7 (Ch. 700-96) Tel. Rec. ..... 151-2  
 17K1 (Ch. 700-96) Tel. Rec. ..... 151-2  
 17K1C (Ch. 700.110, 700.130) Tel. Rec. ..... 150-2  
 17M1 (Ch. 700-96) Tel. Rec. ..... 151-2  
 17T1 (Ch. 700-96) Tel. Rec. ..... 151-2  
 19C1 Tel. Rec. ..... 121-3  
 20C1, 20C2 (Ch. 700-93) Tel. Rec. ..... 151-2  
 20K1 (Ch. 700-95) Tel. Rec. ..... 151-2  
 20M1 (Ch. 700-93) Tel. Rec. ..... 151-2  
 718R Tel. Rec. ..... 121-3  
 800 ..... 66-1  
 2017R Tel. Rec. ..... 111-2  
 4601 (See Model 4609—Set 11-2)  
 4603 ..... 3-26  
 4604 ..... 4-25  
 4704D (See Model 4604—Set 4-25)  
 4609, 4608 ..... 3-1  
 4609, 4610 (Early) (See Model 4607—Set 3-1)  
 4609, 4610 (Late) ..... 11-2  
 4625 ..... 13-8  
 4700 ..... 39-1  
 4704 ..... 12-2  
 4705, 4706 ..... 9-1  
 4708 (See Model 4704—Set 12-2)

**AIR KNIGHT-ARIA**

**AIR KNIGHT (5KY KNIGHT)**

CA-500	17-4
CB-500P	17-31
N5-RD291	17-3

**AIRLINE**

05BR-3021B Tel. Rec.	150-3
05BR-3021C Tel. Rec.	150-3
05BR-3024B Tel. Rec.	150-3
05BR-3024C Tel. Rec.	150-3
05BR-3027A Tel. Rec.	150-3
05BR-3027B Tel. Rec.	150-3
05BR-3034A Tel. Rec.	*
05BR-3034A Tel. Rec.	*
05BR-3041A Tel. Rec.	145-1A
05BR-3044A Tel. Rec.	125-2
05GAA-992A	125-2
05GCB-1540A	131-2
05GCB-1541A	131-2
05GCB-3019A Tel. Rec.	116-2
05GCD-3658A	151-3
05GHH-934A	167-3
05GHH-1061A	133-3
05GSE-3020A, B, C Tel. Rec. (Also see Prod. Chge. Bul. 36—)	117-3
05GSE-3037A Tel. Rec. (Set 166-1)	117-3
05GSE-3042A Tel. Rec. (Also see Prod. Chge. Bul. 36—Set 166-1)	117-3
05WG-1811B (See Model 94WG-1811A—Set 99-4)	127-4
05WG-1813A	127-4
05WG-2748C, D, E (See Model 94WG-2748A—Set 90-1)	139-4
05WG-2748F	129-3
05WG-2749D	129-3
05WG-2752	100-3
05WG-3016A, B Tel. Rec. (See Set 100-2 and Model 94WG-3006A—Set 72-4)	119-3
05WG-3030A Tel. Rec.	148-2
05WG-3030C Tel. Rec.	148-2
05WG-3031A Tel. Rec.	109-1
05WG-3031B Tel. Rec.	*
05WG-3032B Tel. Rec.	*
05WG-3036A, B Tel. Rec.	148-2
05WG-3036C Tel. Rec.	*
05WG-3038A Tel. Rec.	129-4
05WG-3039A, B Tel. Rec.	148-2
05WG-3039C, D Tel. Rec.	*
05WG-3045A Tel. Rec.	129-4
15BR-1536B, 15BR-1537B	145-2
15BR-1543A, B	145-2
15BR-1544A, B	145-2
15BR-1547A, B	143-3
15BR-1548A, 15BR-1549A	191-3
15BR-2756B	148-3
15BR-2757A	148-3
15BR-3035A Tel. Rec.	155-2
15BR-3035A, B Tel. Rec.	149-2
15BR-3035A Tel. Rec.	149-2
15GAA-995A	168-3
15GHH-934A	167-3
15GHH-935	166-3
15GHH-936A	134-2
15GHH-937A	180-3
15GSE-2744A	165-4
15GSE-3043A Tel. Rec.	*
15GSE-3047A, B Tel. Rec.	*
15GSE-3047C Tel. Rec.	*
15GSE-3052A Tel. Rec.	*
15GSL-1564A, B, 15GSL-1565A, B, 15GSL-1566A, B, 15GSL-1567A, B	169-3
15WG-1545A, B	158-2
15WG-1546A, B	158-2
15WG-2745C	130-2
15WG-2749E, F	151-4
15WG-2752D, E	151-4
15WG-2758A (See Prod. Chge. Bul. 65—Set 202-1 and Model 15WG-2758A—Set 144-2)	144-2
15WG-2759A (See Prod. Chge. Bul. 65—Set 202-1 and Model 15WG-2758A—Set 144-2)	144-2
15WG-2761A (See Model 15WG-2758A—Set 144-2)	144-2
15WG-2765A (See Model 15WG-2745C—Set 130-2)	130-2
15WG-2765B, C (See Model 15WG-2758A—Set 144-2)	144-2
15WG-3046A, B, C Tel. Rec.	142-4
15WG-3049A, B Tel. Rec.	164-2
15WG-3050A, B Tel. Rec.	145-3
15WG-3051A, B, C Tel. Rec.	142-4
15WG-3059A Tel. Rec.	164-2
25BR-1542A	203-3
25BR-1548A, 25BR-1549B	191-3
25BR-3058B Tel. Rec.	200-1
25BR-3058A, B Tel. Rec.	200-1
25BR-3067A, B Tel. Rec.	200-1
25BR-3068A, B Tel. Rec.	200-1
25BR-3069A Tel. Rec.	200-1
25GAA-935B	181-2
25GAA-994B	170-3
25GAA-996A	182-2
25GCD-994A	167-4
25GSE-1555A	174-3
25GSE-1555B (See Model 25GSE-1555A—Set 174-3)	174-3
25GSE-1556A (See Model 25GSE-1555A—Set 174-3)	174-3
25GSE-1557B (See Model 25GSE-1556A—Set 174-3)	174-3
25GSE-3057A Tel. Rec.	*
25GSE-3062A, 25GSE-3063A Tel. Rec. (Also see Prod. Chge. Bul. 72—Set 212-1)	195-2
25GSE-3065A Tel. Rec.	193-2

**AIRLINE-Cont.**

25GSE-3081A Tel. Rec. (Also see Prod. Chge. Bul. 72—Set 212-1)	195-2
25GSE-3087A (See Model 25GSE-3062A—Set 195-2)	195-2
25GSL-1560A	189-2
25GSL-1814A	198-1
25GSL-2000A	199-1
25WG-1570A, B, C, 25WG-1571A, B, 25WG-1572A, B	177-4
25WG-1573A	196-2
25WG-2758B (See Prod. Chge. Bul. 65—Set 202-1 and Model 15WG-2758A—Set 144-2)	195-3
25WG-2758C, D	195-3
25WG-2761B (See Model 15WG-2758—Set 144-2)	195-3
25WG-2765B (See Model 15WG-2758A—Set 144-2)	195-3
25WG-2766A, B	195-3
25WG-3049B Tel. Rec. (See Model 15WG-3049A—Set 164-2)	192-2
25WG-3059A Tel. Rec. (See Model 15WG-3049A—Set 164-2)	192-2
25WG-3060A Tel. Rec.	212-2
25WG-3066A, B, C Tel. Rec.	206-2
25WG-3070A Tel. Rec.	212-2
25WG-3071A, B, C, 25WG-3072A, B, C, 25WG-3073A, B, C Tel. Rec.	206-2
25WG-3075A, B, C Tel. Rec.	206-2
25WG-3077A, B, C Tel. Rec.	206-2
25WG-3079A, B, C Tel. Rec.	206-2
35GSE-1555C (See Model 25GSE-1555A—Set 174-3)	174-3
35GSE-1556C (See Model 25GSE-1556A—Set 174-3)	174-3
35GSE-3074A Tel. Rec. (See Prod. Chge. Bul. 72—Set 212-1 and Model 25GSE-3063A—Set 195-2)	195-2
35GSE-3085A Tel. Rec. (See Prod. Chge. Bul. 72—Set 212-1 and Model 25GSE-3063A—Set 195-2)	195-2
35GSL-3064A, B Tel. Rec.	218-3
35GSL-3083A, B Tel. Rec.	218-3
35WG-1570B, C, 35WG-1571B, 35WG-1572B (See Model 25WG-1570A—Set 177-4)	2-26
54BR-1501A, 54BR-1502A	3-4
54BR-1503A, B, C	3-4
54BR-1504A, B, C	3-4
54BR-1505A, B	3-4
54BR-1506A, B	3-4
54KP-1209A, B	8-1
54WR-1801A, 54WG-1801B	4-33
54WG-2500A	4-15
54WG-2700A	3-34
64BR-916A	3-34
64BR-916B (See Model 74BR-916B—Set 17-5)	10-1
64BR-917A (See Model 64BR-917A—Set 10-1)	2-32
64BR-1051A	10-1
64BR-1051B (See Model 64BR-1051A—Set 2-32)	10-1
64BR-1205A, 64BR-1206A	10-3
64BR-1208A	16-4
64BR-1503B, 64BR-1504B (See Model 54BR-1503A—Set 3-4)	24-4
64BR-1513A, B	24-4
64BR-1514A, B	16-5
64BR-1808A	16-4
64BR-2200A	16-4
64BR-7000A	51-2
64BR-7100A, 64BR-7110A, 64BR-7120A	57-5
64BR-7300A, 64BR-7310A, 64BR-7320A	54-4
64BR-7810A, 64BR-7820A	53-3
64WG-1050A	10-2
64WG-1050B, C, D (See Model 64WG-1050A—Set 10-2)	9-2
64WG-1052A	9-2
64WG-1052B (See Model 64WG-1052A—Set 9-2)	18-5
64WG-1207B	18-5
64WG-1511A, 64WG-1511B, 64WG-1512A	5-5
64WG-1801C	4-33
64WG-1804A, B	4-27
64WG-1804C (See Model 64WG-1804A—Set 4-27)	5-4
64WG-1807A	5-4
64WG-1807B	5-4
64WG-1809A, B	5-4
64WG-2007A	5-6
64WG-2009A	6-2
64WG-2010B	18-6
64WG-2500A (See Model 54WG-2500A—Set 4-15)	28-1
64WG-2700A, B (See Model 54WG-2700A—Set 4-15)	28-1
64WG-2704A, C (See Model 74WG-2704A—Set 28-1)	18-7
64WG-2705A, B (See Model 74WG-2705A—Set 18-7)	26-5
64WG-2709A	26-5
64WG-2711A (See Model 74WG-2711A—Set 18-7)	55-3
64WG-2712A (See Model 84BR-1815B, 84BR-1816B	52-26
84GCB-1062A	51-3
84GDC-963B	51-3
84GDC-987A	53-4
84GHH-926B	55-4
84GSE-2731A	70-1
84GSE-3081A	82-1
84HA-1527A, 84HA-1528A (See Model 94HA-1527A—Set 67-3)	85-2
84HA-1529A, 84HA-1530A	85-2
84HA-1810A (See Model 84HA-1810C—Set 69-2)	69-2
84HA-3002A, 84HA-3002B Tel. Rec.	99-3
84HA-3010A, B, C Tel. Rec. (Also see Prod. Chge. Bul. 11—Set 118-1)	94-2
84KR-1521A	56-4
84KR-2511A	68-4
84WG-1060A	42-1
84WG-1060C (See Model 84WG-1060A—Set 42-1)	38-1
84WG-2015A	38-1
84WG-2505 (See Model 84WG-2721A—Set 46-3)	58-5
84WG-2506B	58-5
84WG-2712A	43-3
84WG-2712B (See Model 84WG-2712A—Set 43-3)	36-2
84WG-2714A	56-5
84WG-2714F, G, H, J	56-5
84WG-2718A, 84WG-2718B, 84WG-2720A	45-5
84WG-2721A, B	46-3
84WG-2724A	45-5
84WG-2728A (See Model 84WG-2718A—Set 45-5)	88-1
84WG-2732A, B (See Model 84WG-2712A—Set 43-3)	88-1
84WG-2734A (See Model 84WG-2718A—Set 45-5)	88-1
84WG-3006, 84WG-3008, 84WG-3009 Tel. Rec. (See Model 94WG-3006A—Set 72-4)	88-1
94BR-2740A	89-1
94BR-2741A, B	89-1
94BR3004A, C	91A-3
94BR3005, C Tel. Rec.	89-2
94BR-3017A Tel. Rec. (See Prod. Chge. Bul. 7—Set 110-1 and Model 94BR-3017A—Set 89-2)	91A-3
94BR-3021, 94BR-3024A Tel. Rec.	95-1
94GAA-3654A	96-2
94GCB-1064A	116-2
94GCB-3023A, B, C Tel. Rec.	116-2
94GHH-934A	167-3

**AIRLINE-Cont.**

74R-1812B	22-2
74BR-2001A (See Model 74BR-2001B—Set 23-2)	23-2
74BR-2001B	24-5
74BR-2701A (See Model 74BR-2702B—Set 23-3)	25-3
74BR-2702B	25-3
74GSG-8400A, 74GSG-8700A	60-3
74GSG-8810A, 74GSG-8820A	52-2
74HA-8200A	58-4
74R-1210A	41-1
74R-2706B	35-1
74R-2713A	43-2
74WG-925A	24-6
74WG-1050C, D (See Model 64WG-1050A—Set 10-2)	22-1
74WG-1052B (See Model 64WG-1052A, B—Set 9-2)	22-1
74WG-1054A	22-1
74WG-1054B (See Model 74WG-1054A—Set 22-1)	29-1
74WG-1057A	18-5
74WG-1207B	18-5
74WG-1509A, 74WG-1510A	27-1
74WG-1511B, 74WG-7512B (See Model 64WG-1511A—Set 5-5)	25-4
74WG-1052B (See Model 64WG-1052A, B—Set 9-2)	25-4
74WG-1803A (See Model 74WG-1802A—Set 25-4)	27-2
74WG-1804C (See Model 64WG-1804A—Set 4-27)	27-2
74WG-1807A, B (See Model 64WG-1807A—Set 5-4)	27-2
74WG-2004A	27-2
74WG-2007B, 74WG-2007C	5-6
74WG-2009B (See Model 64WG-2009A—Set 6-2)	26-4
74WG-2010A (See Model 74WG-2010B—Set 18-6)	26-4
74WG-2010B	18-6
74WG-2500A (See Model 54WG-2500A—Set 4-15)	18-6
74WG-2504A, C (See Model 74WG-2504B—Set 28-1)	28-1
74WG-2505A	18-7
74WG-2700A, B (See Model 54WG-2500A—Set 4-15)	18-7
74WG-2704A, C (See Model 74WG-2704A—Set 28-1)	28-1
74WG-2705A, B (See Model 74WG-2505A—Set 18-7)	28-1
74WG-2709A	26-5
74WG-2711A (See Model 74WG-2505A—Set 18-7)	26-5
84BR-1815B, 84BR-1816B	55-3
84GCB-1062A	52-26
84GDC-963B	51-3
84GDC-987A	53-4
84GHH-926B	55-4
84GSE-2731A	70-1
84GSE-3081A	82-1
84HA-1527A, 84HA-1528A (See Model 94HA-1527A—Set 67-3)	85-2
84HA-1529A, 84HA-1530A	85-2
84HA-1810A (See Model 84HA-1810C—Set 69-2)	69-2
84HA-3002A, 84HA-3002B Tel. Rec.	99-3
84HA-3010A, B, C Tel. Rec. (Also see Prod. Chge. Bul. 11—Set 118-1)	94-2
84KR-1521A	56-4
84KR-2511A	68-4
84WG-1060A	42-1
84WG-1060C (See Model 84WG-1060A—Set 42-1)	38-1
84WG-2015A	38-1
84WG-2505 (See Model 84WG-2721A—Set 46-3)	58-5
84WG-2506B	58-5
84WG-2712A	43-3
84WG-2712B (See Model 84WG-2712A—Set 43-3)	36-2
84WG-2714A	56-5
84WG-2714F, G, H, J	56-5
84WG-2718A, 84WG-2718B, 84WG-2720A	45-5
84WG-2721A, B	46-3
84WG-2724A	45-5
84WG-2728A (See Model 84WG-2718A—Set 45-5)	88-1
84WG-2732A, B (See Model 84WG-2712A—Set 43-3)	88-1
84WG-2734A (See Model 84WG-2718A—Set 45-5)	88-1
84WG-3006, 84WG-3008, 84WG-3009 Tel. Rec. (See Model 94WG-3006A—Set 72-4)	88-1
94BR-2740A	89-1
94BR-2741A, B	89-1
94BR3004A, C	91A-3
94BR3005, C Tel. Rec.	89-2
94BR-3017A Tel. Rec. (See Prod. Chge. Bul. 7—Set 110-1 and Model 94BR-3017A—Set 89-2)	91A-3
94BR-3021, 94BR-3024A Tel. Rec.	95-1
94GAA-3654A	96-2
94GCB-1064A	116-2
94GCB-3023A, B, C Tel. Rec.	116-2
94GHH-934A	167-3

**AIRLINE-Cont.**

94GSE-2735A	72-3
94GSE-2736A	72-3
94GSE-3011, B (See Model 84GSE-3011A—Set 83-1)	107-2
94GSE-3015A Tel. Rec.	93A-2
94HA-1527C, 94HA-1528C	67-3
94HA-1529A, 94HA-1530A	85-2
94WG-1059A	86-2
94WG-1804D	99-4
94WG-1811A	71-5
94WG-2742A, C, D	76-4
94WG-2745A	71-5
94WG-2746A, B	90-1
94WG-2747A	90-1
94WG-2748A	90-1
94WG-2748B (See Model 94WG-2748A—Set 90-1)	90-1
94WG-2749A	72-4
94WG-3008A Tel. Rec.	85-3
94WG-3008B, 94WG-3009A Tel. Rec.	72-4
94WG-3009B Tel. Rec.	85-3
94WG-3016A, B, C Tel. Rec. (See Set 110-2 and Model 94WG-9006A—Set 72-4)	85-3
94WG-3022 Tel. Rec.	85-3
94WG-3026A Tel. Rec.	85-3
94WG-3028A Tel. Rec. (See Model 94WG-3006A—Set 72-4)	85-3
94WG-3029A Tel. Rec.	85-3

**AMC-Cont.**

17T Tel. Rec. (Similar to Chassis)	126-8
17TG Tel. Rec. (Similar to Chassis)	149-13
17T20 Tel. Rec. (Similar to Chassis)	139-11
20C20A, -1 Tel. Rec. (Similar to Chassis)	149-13
20C20A, -1 Tel. Rec. (Similar to Chassis)	188-3
20C21 Tel. Rec. (Similar to Chassis)	149-13
20C22	

**ARLINGTON**

30T14A-056 Tel. Rec. (Similar to Chassis) 119-3  
 38T12A-058 Tel. Rec. (Similar to Chassis) 109-1  
 31773 Tel. Rec. (Similar to Chassis) 72-4  
 31874 Tel. Rec. (Similar to Chassis) 85-3  
 31874S Tel. Rec. (Similar to Chassis) 85-3  
 31874-872 Tel. Rec. (Similar to Chassis) 85-3  
 31876A Tel. Rec. (Similar to Chassis) 85-3  
 31876A-950 Tel. Rec. (Similar to Chassis) 85-3  
 31879A-900 Tel. Rec. (Similar to Chassis) 78-4  
 321MS31C Tel. Rec. (Similar to Chassis) 182-5  
 51876A Tel. Rec. (Similar to Chassis) 85-3  
 51879A-918 Tel. Rec. (Similar to Chassis) 78-4  
 518710A-916 Tel. Rec. (Similar to Chassis) 78-4  
 231876A-954 Tel. Rec. (Similar to Chassis) 85-3  
 231879A-912 Tel. Rec. (Similar to Chassis) 78-4

**ARTHUR ANSLEY**

LP-2, LP-3 62-4  
 LP-4A 82-2  
 LP-5 (See Model P-5—Set 108-4)  
 LP-6, LP-6S 136-5  
 LP-7 134-3  
 P-5 108-3  
 R-1 200-2  
 SP-1 60-4  
 TP-1 173-3

**ARTONE**

ARC21 Tel. Rec. 205-3  
 ARC71 Tel. Rec. 205-3  
 ARD21 Tel. Rec. 205-3  
 AR14L, AR17L Tel. Rec. 172-3  
 AR21 Tel. Rec. 205-3  
 AR71 Tel. Rec. 205-3  
 AR-23TV-1 Tel. Rec. 80-1  
 MST12, MST14 Tel. Rec. 170-4  
 14TR, 16TR Tel. Rec. 170-4  
 17CD (1st Prod.) Tel. Rec. 170-4  
 17CD (2nd Prod.) Tel. Rec. 172-3  
 17CRR (1st Prod.) Tel. Rec. 170-4  
 17CRR (2nd Prod.) Tel. Rec. 172-3  
 17ROG (1st Prod.) Tel. Rec. 170-4  
 17ROG (2nd Prod.) Tel. Rec. 172-3  
 20CD (1st Prod.) Tel. Rec. 170-4  
 20CD (2nd Prod.) Tel. Rec. 172-3  
 20TR Tel. Rec. 170-4  
 112X Tel. Rec. 170-4  
 203D (1st Prod.) Tel. Rec. 170-4  
 203D (2nd Prod.) Tel. Rec. 172-3  
 312 Tel. Rec. 170-4  
 524 Tel. Rec. 170-4  
 819 Tel. Rec. 170-4  
 1000, 1001 Tel. Rec. 172-3  
 3163CR Tel. Rec. 170-4  
 8163CR, 8193CM Tel. Rec. 170-4

**ARVIN**

140P (Ch. RE-209) 25-6  
 150-TC, 151-TC (Ch. RE-228) 25-7  
 150TC, 151TC (Ch. RE-228-1) Lote 39-2  
 152T (Ch. RE-233) 33-1  
 153T (See Model 152T—Set 33-1)  
 160T, 161T (Ch. RE-232) 49-5  
 182TFM (Ch. RE-237) 32-3  
 240-P (Ch. RE-243) 42-2  
 241P (Ch. RE-244, RE-24, RE-25, RE-256, RE-259) 47-3  
 242T, 243T (Ch. RE-251) 52-3  
 244P (Ch. RE-244, RE-254, RE-255, RE-256, RE-259) 47-3  
 250-P (Ch. RE-248) 43-4  
 253T, 254T, 255T, 256T (Ch. RE-245) 64-2  
 280TFM, 281TFM (Ch. RE-253) 44-2  
 341T (Ch. RE-274) 84-3  
 350P (Ch. RE-267) 69-3  
 350-PB (Ch. RE-267-1) 100-4  
 350-PL (Ch. RE-277-2) 100-4  
 351-PB (Ch. RE-267-1) 100-4  
 351-PL (Ch. RE-267-2) 100-4  
 352-PL, 353-PL (Ch. RE-267-2) 100-4  
 355T (Ch. RE-213) (See Model 355T—Set 78-2)  
 356T, 357T (Ch. RE-273) 78-2  
 358T (Ch. RE-233) (See Model 152T—Set 33-1)  
 360TFM, 361TFM (Ch. RE-260) 70-2  
 440T (Ch. RE-278) 96-3  
 441T (Ch. RE-278) (See Model 440T—Set 96-3)  
 442 (Ch. RE-91) 34-2  
 444, 444A (Ch. RE-200) 1-3  
 444AM, 444M (Ch. RE-200M) 23-3  
 446P (Ch. RE-280) 106-2  
 450T, 451T (Ch. RE-281) 110-3  
 460T, 461T (Ch. RE-284) 107-3  
 462-CB, 472-CM (Ch. RE-287-1) 116-3  
 480TFM, 481TFM (Ch. RE-277, RE-277-1) 107-4  
 482CFB, 482CFM (Ch. RE-288-1) 117-4  
 540T (Ch. RE-278) 143-4  
 542T (See Model 440T—Set 96-3)

**ARVIN—Cont.**

544, 544A (Ch. RE-201) 1-7  
 544AR, 544R (Ch. RE-201) (See Model 544—Set 1-7)  
 547A (Ch. RE-242) 42-3  
 551P (Ch. RE-297) 154-2  
 552AN, 552N (Ch. RE-231) 13-9  
 555, A (Ch. RE-202) 13-9  
 553 (Ch. RE-308) 159-4  
 554CCB, 554CCM (Ch. RE-306) 155-3  
 558 (Ch. RE-204) 3-16  
 580TFM (Ch. RE-313) 152-2  
 582CFB, 582CFM (Ch. RE-310) 156-4  
 652-P (Ch. RE-292) (See Model 650-P—Set 175-6)  
 654-P (Ch. RE-292) (See Model 650-P—Set 175-6)  
 650-P (Ch. RE-292) 175-6  
 655 SWT (Ch. RE-327) 187-2  
 657-T (Ch. RE-307) 168-5  
 664, 664A (Ch. RE-206-1) 3-23  
 664, 664A (Ch. RE-206-1) 29-2  
 665 (Ch. RE-229) 18-10  
 740T (Ch. RE-278) (See Model 540T—Set 143-4)  
 751TB (See Model 551T—Set 154-2)  
 2120CM (Ch. TE-289-2, TE-289-3) Tel. Rec. (Also See Prod. Chge. Bul. 20—Set 134-1) 120-3  
 212TM (Ch. TE-289-2, TE-289-3) Tel. Rec. (Also See Prod. Chge. Bul. 20—Set 134-1) 120-3  
 2122TM (Ch. TE-289-2, TE-289-3) Tel. Rec. (Also See Prod. Chge. Bul. 20—Set 134-1) 120-3  
 2124CAM (Ch. TE-289-2, TE-289-3) Tel. Rec. (Also See Prod. Chge. Bul. 20—Set 134-1) 120-3  
 2126CM (Ch. TE-289-2, TE-289-3) Tel. Rec. (Also See Prod. Chge. Bul. 20—Set 134-1) 120-3  
 2160, 2161, 2162, 2164 (Ch. TE-290) Tel. Rec. 126-3  
 2410P (Ch. RE-244, RE-254, RE-255, RE-256, RE-259) 47-3  
 3100TB, 3100TM, 3101CM, 3120TM, 3121TM (Ch. TE-272-1, TE-272-2) Tel. Rec. 80-2  
 3160CM (Ch. TE-276) Tel. Rec. 93-2  
 4080T (Ch. TE-282) Tel. Rec. 104-2  
 4081T Tel. Rec. (See Model 4080T—Set 104-2)  
 4162CM (Ch. TE-286) Tel. Rec. 130-3  
 5172C, CM, 5172M, 5172CB, CM (Ch. TE-302, -1, -2, -3, -4, -5A, -6) Tel. Rec. (Also See Prod. Chge. Bul. 50—Set 184-1) 142-5  
 5175, 5176 (Ch. TE-320) Tel. Rec. 179-3  
 520ACM, 520ACM (Ch. TE-300) Tel. Rec. 149-3  
 5210, 5211, 5212 (Ch. TE-315, -1, -2, -3, -4, -5) Tel. Rec. (Also See Prod. Chge. Bul. 37—Set 66-1 and Prod. Chge. Bul. 50—Set 184-1) 151-5  
 5213TM (Ch. TE-334) Tel. Rec. 191-5  
 6173TM (Ch. TE-313-3, -4) Tel. Rec. (See Prod. Chge. Bul. 66—Set 203-1 and Model 6175TM—Set 181-4)  
 6173TM-UHF (Ch. TE-332) Tel. Rec. 208-2  
 6175TM (Ch. TE-331, -1, -2, -3, -4) Tel. Rec. (Also See Prod. Chge. Bul. 66—Set 203-1) 181-4  
 6179TM (Ch. TE-331, -1, -2, -3, -4) Tel. Rec. (Also See Prod. Chge. Bul. 66—Set 203-1) 181-4  
 6213TB (Ch. TE-319, -1, -2) Tel. Rec. (See Prod. Chge. Bul. 67—Set 204-1 and Model 6213TM—Set 195-4)  
 6213TB-UHF (Ch. TE-330) Tel. Rec. 208-2  
 6213TM (Ch. TE-319, -1, -2) Tel. Rec. (Also See Prod. Chge. Bul. 67—Set 204-1) 195-4  
 6213 TA-UHF (Ch. TE-330) Tel. Rec. 208-2  
 6215CB (Ch. TE-319, -1, -2) Tel. Rec. (Also See Prod. Chge. Bul. 67—Set 204-1) 195-4  
 6215 CB-UHF (Ch. TE-330) Tel. Rec. 208-2  
 6215CM (Ch. TE-319, -1, -2) Tel. Rec. (Also See Prod. Chge. Bul. 67—Set 204-1) 195-4  
 6215CM-UHF (Ch. TE-330) Tel. Rec. 208-2  
 6640 (Ch. RE-206-2) 29-2  
 7210CB-UHF, 7210CM-UHF (Ch. TE-341, -2) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) 188-4

**ARVIN—Cont.**

7210CM, CR (Ch. TE-337-1) Tel. Rec. 189-3  
 7212CFP, MEA (Ch. TE-337, -1) Tel. Rec. (See Model 7210CM—Set 189-3)  
 7212CFP-UHF, 7212MEA-UHF (Ch. 341, -2) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) 188-4  
 7214CM (Ch. TE-337-1) Tel. Rec. 189-3  
 7214CM-UHF (Ch. TE-341, -2) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) 188-4  
 7216CB (Ch. TE-337-1) Tel. Rec. (See Model 7210CM—Set 189-3)  
 7216CB-UHF (Ch. TE-341, -2) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) 188-4  
 7218CB, CM (Ch. TE-337-1) Tel. Rec. 189-3  
 7218CB-UHF, 7218CM-UHF (Ch. TE-341, -2) Tel. Rec. (Also See Prod. Chge. Bul. 73—Set 197-1) 188-4  
 7219CM (Ch. TE-337-1) Tel. Rec. (See Model 7210CM—Set 189-3)  
 7219CM-UHF (Ch. TE-341, -2) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) 188-4  
 Ch. RE-91 (See Model 442)  
 Ch. RE-200 (See Model 444)  
 Ch. RE-200M (See Model 444M)  
 Ch. RE-201 (See Model 544)  
 Ch. RE-202 (See Model 555)  
 Ch. RE-204 (See Model 558)  
 Ch. RE-206 (See Model 664)  
 Ch. RE-206-1, 206-2 (See Model 664 Late)  
 Ch. RE-229 (See Model 140P)  
 Ch. RE-228 (See Model 150TC)  
 Ch. RE-228-1 (See Model 150TC Late)  
 Ch. RE-229 (See Model 665)  
 Ch. RE-231 (See Model 552AN)  
 Ch. RE-232 (See Model 160T)  
 Ch. RE-233 (See Model 152T)  
 Ch. RE-237 (See Model 182TFM)  
 Ch. RE-242 (See Model 547A)  
 Ch. RE-243 (See Model 240P)  
 Ch. RE-244 (See Model 241P)  
 Ch. RE-245 (See Model 250P)  
 Ch. RE-251 (See Model 242T)  
 Ch. RE-252 (See Model 253T)  
 Ch. RE-253 (See Model 280TFM)  
 Ch. RE-254, 255, 256, 259 (See Model 241P)  
 Ch. RE-260 (See Model 360TFM)  
 Ch. RE-265 (See Model 264T)  
 Ch. RE-267 (See Model 350P)  
 Ch. RE-267-1, RE-267-2 (See Model 350-PB)  
 Ch. RE-273 (See Model 356T)  
 Ch. RE-274 (See Model 341T)  
 Ch. RE-277, RE-277-1 (See Model 480TFM)  
 Ch. RE-278 (See Model 540T)  
 Ch. RE-280 (See Model 446P)  
 Ch. RE-281 (See Model 450T)  
 Ch. RE-284 (See Model 460T)  
 Ch. RE-287-1 (See Model 462-CB)  
 Ch. RE-288-1 (See Model 482CFB)  
 Ch. RE-292 (See Model 650-P)  
 Ch. RE-297 (See Model 551T)  
 Ch. RE-306 (See Model 554CCB)  
 Ch. RE-307 (See Model 657T)  
 Ch. RE-308 (See Model 553)  
 Ch. RE-310 (See Model 582CFB)  
 Ch. RE-313 (See Model 580TFM)  
 Ch. RE-327 (See Model 655SWT)  
 Ch. RE-272-1, -2 (See Model 3100TB)  
 Ch. RE-276 (See Model 4080T)  
 Ch. RE-286 (See Model 4162CM)  
 Ch. RE-289 (See Model 2122TM)  
 Ch. RE-289-2, TE-289-3 (See Model 2120CM)  
 Ch. RE-290 (See Model 2160)  
 Ch. TE-300 (See Model 520A)  
 Ch. TE-304 (See Model 520A)

**ARVIN—Cont.**

Ch. TE-302, -1, -2, -3, -4, -5, -5A, -6 (See Model 5170CB)  
 Ch. TE-315, -1, -2, -3, -4, -5, -5A, -6 (See Model 5210)  
 Ch. TE-319, -1, -2, -3, -4 (See Model 6213TM)  
 Ch. TE-320 (See Models 5175, 5176)  
 Ch. TE-330 (See Model 6213TB-UHF)  
 Ch. TE-331, -1, -2, -3, -4 (See Model 6175TM)  
 Ch. TE-332 (See Model 6173 TM-UHF)  
 Ch. TE-334 (See Model 5213TM)  
 Ch. TE-337-1 (See Model 7210CM)  
 Ch. TE-341, -2 (See Model 7210CB-UHF)  
**ASTORIA**  
 A-21, A-72, A-73L Tel. Rec. (Similar to Chassis) 182-3  
**ASTRONIC (Also see Pentron)**  
 T-3 121-4  
 748 53-6  
**ATLAS**  
 AB-45 14-5  
**AUDAR**  
 AV-77 166-6  
 MAS-4 "Bingo Amp." 26-6  
 P-1A 5-10  
 P-4A 19-3  
 P-5 5-11  
 P-7 44-3  
 PR-6 13-10  
 RE-6A 19-4  
 Telvar BM-25, BMF-25 62-5  
 Telvar FMC-12 35-2  
 Telvar RER-9 65-2  
 WC-77 166-6  
**AUDIO DEVELOPMENT (ADC)**  
 71-F 128-3  
**AUTOMATIC**  
 Tom Boy 27-4  
 Tom Thumb 53-7  
 Tom Thumb Camera-Radio 49-6  
 Tom Thumb Jr. 26-7  
 Tom Thumb Personal ATTP 23-4  
 B-44 60-5  
 C51 178-4  
 C-54 186-2  
 C-60 19-20  
 C-60X (See Model 24-10)  
 C300 102-1  
 C-351 148-4  
 CL-152B, M 192-3  
 CL-164B 192-3  
 D200 104-3  
 D-251 174-4  
 F-100 103-6  
 F-151 147-2  
 F-790 23-5  
 M-86 34-3  
 M-90 173-4  
 P-65 146-3  
 S-551 81-3  
 TV-P490 Tel. Rec. 81-3  
 TV-707, TV-709, TV-710 Tel. Rec. 60-6  
 TV-712 Tel. Rec. (See Model TV-707—Set 60-6)  
 TV-1205 Tel. Rec. (See Prod. Chge. Bul. 5—Set 106-1 and Model TV-1249—Set 103-5)  
 TV-1249, TV-1250 Tel. Rec. 103-5  
 TV-1294 Tel. Rec. (See Prod. Chge. Bul. 5—Set 106-1 and Model TV-1249—Set 103-5)  
 TV-1605 Tel. Rec. (See Model TV-1249—Set 103-5)  
 TV-1615 Tel. Rec. (See Model TV-1249—Set 103-5)  
 TV-1649, TV-1650, TV-1651 Tel. Rec. 143-5  
 TV-1654 Tel. Rec. (See Model TV-1249—Set 103-5)  
 TV-5006 Tel. Rec. 145-4  
 TV-5020 Tel. Rec. 134-4  
 TV-5061 Tel. Rec. 145-4  
 TV-5077 Tel. Rec. 145-4  
 TV-5118 Tel. Rec. 134-4  
 TV-5160 Tel. Rec. 134-4  
 TVX313 Tel. Rec. (See Model TV-707—Set 60-6)  
 TVX404 Tel. Rec. (See Model TV-707—Set 60-6)  
 601, 602 (Series A) 13-11  
 601, 602 (Series B) 22-5  
 612X 1-34  
 613X (See Model 612X—Set 1-34)  
 614X, 616X 8-2  
 620, Series B 12-3  
 640, 660, 662, 666 22-6  
 677 22-7  
 720 21-4  
**AVIOLA (Also see Record Changer Listing)**  
 509 7-3  
 601 15-3  
 612 16-4  
 613 15-3  
 618 16-6

**BELL-AIR**

PL17C Tel. Rec. (Similar to Chassis) 149-13  
 PL20C Tel. Rec. (Similar to Chassis) 149-13  
**BELL SOUND SYSTEMS**  
 B-23 75-4  
 RC-47 (RE-CORD-O-FONE) 30-3  
 RT-65 130-4  
 RT-65, B 171-3  
 350 148-5  
 352 149-4  
 3745S 151-6  
 420 150-4  
 440L, 440S "Bellphone" 25-9  
 2075 10-5  
 2122 77-3  
 2122A, 2122AR 153-1  
 2122B 199-1  
 2122R 76-7  
 2145, A 161-2  
 2200 207-2  
 3705 22-8  
 3725 22-9  
 3728M 24-11  
 3750 31-5

**BELTONE**

500 5-33  
**BELMONT (Also see Raytheon)**  
 A-60110 17-7  
 3AW7 10-7  
 4817 2-27  
 48112, 48113 (Series A) 10-6  
 5D110 22-10  
 5D128 (Series A) 9-4  
 5P19 (Series A) 9-5  
 5P113 "Boulevard" 28-2  
 6D120 2-33  
 6D120 24-12  
 8A59 6-4  
 21A21, 21A22, 21A23 93A-4  
 22A21, 22A22, 22A23 Tel. Rec. 55-5

**BENDIX**

C172 Tel. Rec. 134-5  
 C174 Tel. Rec. (See Model 2051—Set 111-3)  
 C176, B Tel. Rec. (See Model 2051—Set 111-3)  
 C182 Tel. Rec. (See Model C172—Set 134-5)  
 C192 Tel. Rec. (See Model C172—Set 134-5)  
 C200 Tel. Rec. 134-5  
 FB21C Tel. Rec. (See Model FB21CU—Set 213-2)  
 FB21CU Tel. Rec. 213-2  
 FB21C Tel. Rec. (See Model FB21CU—Set 213-2)  
 FB21CU Tel. Rec. 213-2  
 FM21C Tel. Rec. 213-2  
 FM21CU Tel. Rec. 213-2  
 FM27C (Ch. T14-3) Tel. Rec. 215-3  
 HB21C Tel. Rec. (See Model FB21CU—Set 213-2)  
 HB21CU Tel. Rec. 213-2  
 HB27C (Ch. T14-3) Tel. Rec. 215-3  
 HM21C Tel. Rec. (See Model FB21CU—Set 213-2)  
 HB21CU Tel. Rec. 213-2  
 KB21CU Tel. Rec. 213-2  
 KM17C Tel. Rec. (See Model OAK3—Set 183-2)  
 KM21CU Tel. Rec. 213-2  
 OAK3 Tel. Rec. 183-2  
 PAR 80 Tel. Rec. 39-3  
 TB21CU Tel. Rec. 213-2  
 TB24DS, DU (Ch. T14-10, -11) Tel. Rec. 215-3  
 TM17C Tel. Rec. (See Model OAK3—Set 183-2)  
 TM21CU Tel. Rec. 213-2  
 TM24DS, DU (Ch. T14-10, -11) Tel. Rec. 215-3  
 T170 Tel. Rec. (See Model 2051—Set 111-3)  
 T171 Tel. Rec. (See Model C172—Set 134-5)  
 T173 Tel. Rec. (See Model 2051—Set 111-3)  
 T190 Tel. Rec. (See Model 2051—Set 111-3)  
 0526A, 0526B, 0526C, 0526D, 0526E, 0526F, 1-22  
 17K2 Tel. Rec. (See Model C172—Set 134-5)  
 20K2, 20L2 Tel. Rec. (See Model C172—Set 134-5)  
 21KD Tel. Rec. 183-2  
 21K3 Tel. Rec. 183-2  
 21T3 Tel. Rec. 183-2  
 21X3 Tel. Rec. 183-2  
 55L2, 55L3, 55P2, 55P3 51-4  
 55X4 58-6  
 65P4 52-4  
 698B, 69M8, 69M9 63-3  
 75M5, 75M5, 75M8, 75P5, 75M5 59-5  
 7987, 75M5 66-3  
 95B3, 95M3, 95M9 60-7  
 110, 110W, 111, 111W, 112, 114, 115 41-3  
 235B1, 235M1 (Ch. Codes MA, MB, MC, MD) 69-4  
 300, 300W, 301, 302 40-2  
 416A 43-5  
 526MA, 526MB, 526MC 29-3  
 616 A (0626A) 12-4  
 636A, B, C 15-4  
 636D (See Model 636A—Set 15-4)  
 646A 2-28  
 656A 2-31  
 676B, 676C, 676D 5-23  
 687A 61-3  
 697A 26-8  
 736B 10-8  
 737F, M, W (Ch. C-19) 199-3

**BENDIX—CONRAC**

**BENDIX—Cont.**

847-B ..... 27-5  
 847-5 "Facto Meter" ..... 28-3  
 951, 951W ..... 136-6  
 1217, 1217B, 1217D ..... 29-4  
 1217D (L519, L524, 1525) ..... 46-5  
 1518, 1519, 1524, 1525 ..... 37-3  
 1521 ..... 42-4  
 1531, 1533 ..... 43-6  
 2001, 2002 Tel. Rec. .... 84-4  
 2020, 2021 Tel. Rec. .... 84-4  
 2025 Tel. Rec. .... 99-5  
 2051 Tel. Rec. (Also see Prod. Chge. Bul. 16—Set 126-1) ..... 111-3  
 2060 Tel. Rec. (Also see Prod. Chge. Bul. 16—Set 126-1) ..... 111-3  
 2070, 2071 Tel. Rec. (See Prod. Chge. Bul. 16—Set 126-1 and Model 2051—Set 111-3) ..... 84-4  
 3001, 3002 Tel. Rec. .... 84-4  
 3030, 3031 Tel. Rec. .... 84-4  
 3033 Tel. Rec. .... 99-5  
 3051 Tel. Rec. (Also see Prod. Chge. Bul. 16—Set 126-1) ..... 111-3  
 6001 Tel. Rec. (Also see Prod. Chge. Bul. 16—Set 126-1) ..... 111-3  
 6002 Tel. Rec. .... 99-5  
 6003 Tel. Rec. (Also see Prod. Chge. Bul. 16—Set 126-1) ..... 111-3  
 6090 Tel. Rec. .... 111-3  
 6099 Tel. Rec. .... 111-3  
 6100 Tel. Rec. (Also see Prod. Chge. Bul. 16—Set 126-1) ..... 111-3  
 6920 Tel. Rec. .... 111-3  
 6990 Tel. Rec. .... 111-3  
 7001 Tel. Rec. (See Prod. Chge. Bul. 16—Set 126-1 and Model 2051—Set 111-3) ..... 111-3  
 Ch. C-19 (See Model 753F) ..... 114-10  
 Ch. T14-3 (See Model FM27C) ..... 114-10  
 Ch. T14-10, T14-11 (See Model T824D5) ..... 114-10

**BOGEN (See David Bogen)**

**BREWSTER**

9-1084, 9-1085, 9-1086 ..... 2-13

**BROCINER**

A100P ..... 198-2  
 CA-2 ..... 200-3

**BROOK ELECTRONICS INC.**

38 (Issue 2), 3C ..... 184-4  
 10C ..... 41-4  
 10C2-A ..... 43-7  
 10C3 ..... 72-5  
 10D ..... 41-4  
 12A ..... 89-3  
 12A2, 12A3 (See Model 12A—Set 89-3 and Model 3C—Set 184-4) ..... 89-3

**BROOKS ELECTRONIC LABS.**

ST-14A ..... 183-3  
 ST-10 ..... 195-5

**BROWNING**

PF-12, RJ12 ..... 47-4  
 RJ-12A ..... 56-6  
 RJ-12B ..... 146-4  
 RJ-14A ..... 56-6  
 RJ-20 ..... 67-5  
 RJ-20A ..... 132-3  
 RJ-22 ..... 67-5  
 RV-10 ..... 46-6  
 RV-10A ..... 131-3  
 RV-11 ..... 46-6  
 RV31 ..... 198-3

**BRUNSWICK**

BJ-6836 "Tuscan" ..... 28-4  
 C-3300 "Darby" ..... 28-4  
 D-1030, D-1100 ..... 56-7  
 D-6876 "Buckingham" ..... 29-5  
 T-4000, T-4000½ ..... 29-5  
 "Buckingham" ..... 29-5  
 T-4400, T-4400½ ..... 61-4  
 T-6000, S, SS, SX, T-6000½ "Glasgow" (See Model T-4000—Set 29-5) ..... 56-7  
 T-9000 ..... 56-7  
 512, 513 Tel. Rec. .... 163-3  
 812, 816 Tel. Rec. .... 163-3  
 5000 ..... 42-5  
 5125 Tel. Rec. .... 163-3  
 6165 Tel. Rec. .... 163-3  
 8125, 8165 Tel. Rec. .... 163-3

**BRUSH SOUND MIRROR (See Recording Listing)**

**BRUSH MAIL-A-VOICE (See Recording Listing)**

**BUICK**

980690, 980733 ..... 18-9  
 980744, 980745 ..... 19-5  
 980782 ..... 62-6  
 980797, 980798 ..... 59-6  
 980868 ..... 104-4  
 980979 (See Model 980868—Set 104-4) ..... 217-2  
 981111 (See Model 980868—Set 104-4) ..... 217-2  
 981320 ..... 217-2

**BUTLER BROS. (See Air Knight or Sky Rover)**

**CADILLAC (Auto Radio)**

7241938 ..... \*  
 7253207 ..... \*  
 7256609 ..... 60-8  
 7258155 ..... \*  
 7258755 ..... 109-2  
 7260205 (See Model 7258755—Set 109-2) ..... 152-3  
 7260405 ..... 152-3  
 7260905 ..... 152-3

**CALLMASTER (See Lyman)**

**CAPEHART**

B-504-P16 Tel. Rec. (For TV Ch. See Model 461P—Set 87-2, For Radio Ch. See Model 35P7—Set 135-4) ..... 215-4  
 RF-152 ..... 132-4  
 TC-20 (Ch. C-297) ..... 192-4  
 TC-62 (Ch. CR-71) ..... 203-5  
 TC-100 (Ch. C-297) ..... 203-5  
 TC-101 (Ch. CR-36) ..... 141-3  
 T-30 ..... 209-1  
 T-522 (Ch. CR-76) ..... 187-3  
 1T17MX (Ch. CT27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 187-3  
 1T172M (Ch. CT-52) Tel. Rec. .... 187-3  
 2C172M (Ch. CT-52) Tel. Rec. .... 187-3  
 2T20MC (Ch. CT-38) Tel. Rec. (See Ch. CT-38—Set 160-2) ..... 99A-2  
 3C17MX (Ch. CT-27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 187-3  
 3C212B, M (Ch. CT-57) ..... 187-3  
 4H212B, M (Ch. CT-57) Tel. Rec. .... 187-3  
 5F212M (Ch. CT-57) Tel. Rec. .... 187-3  
 6F212B (Ch. CT-57) Tel. Rec. .... 187-3  
 7F212M (Ch. CT-57) Tel. Rec. .... 187-3  
 8F212B (Ch. CT-57) Tel. Rec. .... 187-3  
 9F212M (Ch. CT-57) Tel. Rec. .... 187-3  
 10 (Ch. C-312) ..... 166-7  
 10W212M (Ch. CTR68) Tel. Rec. (For TV Ch. only see Model 1T172M—Set 187-3) ..... 187-3  
 1T172M—Set 187-3) ..... 187-3  
 12F272M (Ch. CT-74) Tel. Rec. .... 212-3  
 19N4, 21P4, 24N4, 24P4, 26N4, 29P4, 30P4, 31N4, 31P4 ..... 65-3  
 32P9, 33P9 ..... 64-3  
 34P10 (See Model 32P9—Set 64-3) ..... 135-4  
 35P7 (Ch. P7) ..... 65-3  
 114N4 ..... 67-6  
 115P2 ..... 67-6  
 116N4, 116P4, 118P4 ..... 65-3  
 319BX, MX (Ch. CT-27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 320B, M (Ch. CX-331) Tel. Rec. (See Model 323M—Set 112-3, Prod. Chge. Bul. 13—Set 122-1 and Prod. Chge. Bul. 24—Set 142-1) ..... 112-3  
 320BX, MX (Ch. CT-27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 203-4  
 321ABX, AMX (Ch. CT-27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 203-4  
 321-B, -M, 322-B, -M (Ch. CX33) Tel. Rec. (See Model 323M—Set 112-3, Prod. Chge. Bul. 13—Set 122-1 and Prod. Chge. Bul. 24—Set 142-1) ..... 112-3  
 322RABX, RAMX (Ch. CT-27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 323M (Ch. CX-33F) Tel. Rec. (Also see Prod. Chge. Bul. 13—Set 122-1 and Bul. 24—Set 142-1) ..... 112-3  
 324BX (Ch. CT-27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 324M (Ch. CX33) Tel. Rec. (Also see Prod. Chge. Bul. 13—Set 122-1 and Prod. Chge. Bul. 24—Set 142-1) ..... 112-3  
 325AFX (Ch. CT-27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 325F (Ch. CX-33) Tel. Rec. (Also see Prod. Chge. Bul. 13—Set 122-1 and Prod. Chge. Bul. 24—Set 142-1) ..... 112-3  
 325M (Ch. CX-33) Tel. Rec. (See Model 325F—Set 112-3) ..... 326-M (Ch. CX33L) Tel. Rec. (See Model 323M—Set 112-3, Prod. Chge. Bul. 13—Set 122-1 and Prod. Chge. Bul. 24—Set 142-1) ..... 112-3  
 326MX (Ch. CT-27) Tel. Rec. (See Ch. CT-27—Set 160-2) ..... 331BX, MX (Ch. CT-38) Tel. Rec. (See Ch. CT-38—Set 160-2) ..... 332-B, -M, 334-M (Ch. CX-33F) Tel. Rec. (See Model 323M—Set 112-3, Prod. Chge. Bul. 13—Set 122-1 and Prod. Chge. Bul. 24—Set 142-1) ..... 335BX, MX, 336CX, FX (Ch. CT-38) Tel. Rec. (See Ch. CT-38—Set 160-2) ..... 338MX (Ch. CT-45) Tel. Rec. (See Ch. CT-45—Set 160-2) ..... 339MX (Ch. CT-38) Tel. Rec. (See Ch. CT-38—Set 160-2) ..... 340X, 341X (Ch. CT-45) Tel. Rec. (See Ch. CT-45—Set 160-2) ..... 413P, 414P ..... 67-6  
 461P, 462P12 Tel. Rec. .... 87-2  
 501P, 502P, 504P Tel. Rec. (For TV Ch. see Model 461P—Set 87-2, For Radio Ch. see Model 35P7—Set 135-4) ..... 610P, 651P, 661P Tel. Rec. 95A-1  
 1002F, 1003M, 1004B (Ch. F-8) ..... 135-4  
 1005B, M, W (Ch. C-296) 1006B, M, W (Ch. C-2870) ..... 132-5  
 1007AM (Ch. C-318) ..... 150-5  
 3001, 3002 (Ch. CX-30, A, Prod. C-272) Tel. Rec. 99A-1  
 3001, 3002 (Ch. CX-30A-2, Prod. C-272) Tel. Rec. 99A-2  
 3004-M (Ch. CX-31, Prod. C-268) Tel. Rec. (See Ch. CX-31—Set 93A-5) ..... 3005 (Ch. CX-32, Prod. C-279) Tel. Rec. (See Ch. CX-32—Set 93A-5) ..... 3006-M (Ch. CX-31, Prod. C-274) Tel. Rec. (See Ch. CX-31—Set 93A-5) ..... 3007 (Ch. CX-30, Prod. C-276) ..... 99A-2  
 3008 (Ch. CX-32, Prod. 278) Tel. Rec. (See Ch. CX-32—Set 93A-5) ..... 3011B, M, 3012B, M (Ch. CX-33) Tel. Rec. .... 112-3  
 4001-M (Ch. CX-31, Prod. C-274) Tel. Rec. (See Ch. CX-31—Set 93A-5) ..... 4002-M (Ch. CX-31, Prod. C-268) Tel. Rec. (See Ch. CX-31—Set 93A-5) ..... Ch. C-297 (See Model TC-100) ..... Ch. CR-36 (See Model TC-101) ..... Ch. C-312 (See Model 10) Ch. C-318 (See Model 1007AM) ..... (See Model TC-101) ..... Ch. CR71 (See Model TC-62) Ch. CR-76 (See Model T-522) Ch. CT-27 (Ch. Series CX-33DX) Tel. Rec. .... 160-2  
 Ch. CT-38 (Ch. Series CX-33DX) Tel. Rec. .... 160-2  
 Ch. CT-45 (Ch. Series CX-33DX) Tel. Rec. .... 160-2  
 Ch. CT-52 (Ch. Series CX-36) (See Model 1T172M) Ch. CT-57 (Ch. Series CX-36) (See Model 1T172M) Ch. CT-74 (See Model 12F272M) Ch. CT-75 (Ch. Series CX-37) Tel. Rec. .... 203-4  
 Ch. CT-77 (Ch. Series CX-37) Tel. Rec. .... 203-4  
 Ch. CT-81 (Ch. Series CX-37) Tel. Rec. .... 203-4  
 Ch. Series CX-30, A (See Model 3001) Ch. Series CX-30-A-2 (See Model 3001) Ch. Series CX-31 (See Model 3004-M) Ch. Series CX-32 (See Model 17C18) Ch. Series CX-33 (See Model 325F) Ch. Series CX-33F (See Model 323M) Ch. Series CX-33L (See Model 326-M) Ch. Series CX-33DX (See Ch. CT-27) Ch. Series CX-36 (See Model 1T172M) Ch. Series CX-37 (See Ch. CT-75)

**CAPITOL**

D-17 ..... 30-4  
 T-13 ..... 28-5  
 U-24 ..... 29-6

**CARDWELL, ALLEN D.**

CE-26 ..... 14-6

**CAVENDISH (See Bell Air)**

**CBS COLUMBIA (Also see Air King)**

17C18 (Ch. 817, -1) Tel. Rec. .... 188-5  
 17C18 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2) ..... 17M18 (Ch. 817, -1) Tel. Rec. .... 188-5  
 17M18 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2) ..... 17T18 (Ch. 817, -1) Tel. Rec. .... 188-5  
 17T18 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2) ..... 18C18 (Ch. 817-6) Tel. Rec. .... 214-2  
 18L18 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2) ..... 18L18 (Ch. 817-6) Tel. Rec. .... 214-2  
 18M08 (Ch. 817-6) Tel. Rec. .... 214-2  
 18M18 (Ch. 817-6) Tel. Rec. .... 214-2  
 18M28, 18M38 (Ch. 817-6) Tel. Rec. (See Model 18C18—Set 214-2) ..... 18T18 (Ch. 817-6) Tel. Rec. .... 214-2  
 18T28 (Ch. 817-6) Tel. Rec. (See Model 18C18—Set 214-2) ..... 20M18 (Ch. 820, -1) Tel. Rec. .... 188-5  
 20M18 (Ch. 820-2) Tel. Rec. (See Model 18C18—Set 214-2) ..... 20M28 (Ch. 820, -1) Tel. Rec. .... 188-5  
 20M28 (Ch. 820-2) Tel. Rec. (See Model 18C18—Set 214-2) ..... 20T18 (Ch. 820, -1) Tel. Rec. .... 188-5  
 20T18 (Ch. 820-2) Tel. Rec. (See Model 18C18—Set 214-2) ..... 21C11, B (Ch. 1021) Tel. Rec. .... 199-4  
 21C18 (Ch. 821) (See Model 17C18—Set 188-5) ..... 21C21 (Ch. 1021) Tel. Rec. .... 199-4  
 21C31B (Ch. 1021) Tel. Rec. .... 199-4  
 21C41 (Ch. 1021) Tel. Rec. .... 199-4  
 21T11 (Ch. 1021) Tel. Rec. .... 199-4  
 22C08 (Ch. 821-6, -6A) Tel. Rec. .... 214-2  
 22C11, B (Ch. 1021) Tel. Rec. (See Model 21C1—Set 199-4) ..... 22C18 (Ch. 821-6, -6A) Tel. Rec. .... 214-2  
 22C21 (Ch. 1021) Tel. Rec. (See Model 21C1—Set 199-4) ..... 22C28 (Ch. 821-6, -6A) Tel. Rec. .... 214-2  
 22C31B (Ch. 1021) Tel. Rec. (See Model 21C1—Set 199-4) ..... 22C38 (Ch. 821-3) Tel. Rec. (See Model 18C18—Set 214-2) ..... 22C41 (Ch. 1021) Tel. Rec. (See Model 21C1—Set 199-4) ..... 22C48, B, 22C78, 22C68, B, 22C78, B (Ch. 821-4) Tel. Rec. (See Model 18C18—Set 214-2) ..... 22L18 (Ch. 821-6, -6A) Tel. Rec. .... 214-2  
 22M08, 22M18 (Ch. 821-6, -6A) Tel. Rec. .... 214-2  
 22M28, 22M38 (Ch. 821-4) Tel. Rec. (See Model 18C18—Set 214-2) ..... 22T11 (Ch. 1021) Tel. Rec. (See Model 21C1—Set 199-4) ..... 22T18 (Ch. 821-6, -6A) Tel. Rec. .... 214-2  
 22T28, B (Ch. 821-4) Tel. Rec. (See Model 18C18—Set 214-2) ..... 540, 541 ..... 211-4  
 545, 546 (See Model 540—Set 211-4) ..... 2001 Tel. UHF Conv. .... 207-2  
 Ch. 817, -1 (See Model 17C18) Ch. 817-2 (See Model 17C18) Ch. 817-6 (See Model 18C18) Ch. 820, 820-1 (See Model 20M18) Ch. 821 (See Model 21C18) Ch. 821-3 (See Model 22C38) Ch. 821-4 (See Model 22C48) Ch. 821-6, -6A (See Model 22C08) Ch. 1021 (See Model 21C11) ..... 49-7  
 1-516, 1-517 ..... 49-7  
 1-601, 1-602, 1-603 (See Model 7G26C—Set 20-5) ..... 45-7  
 1-606 ..... 45-7  
 1-608 (See Model 6F26W—Set 19-10) ..... 6161W—Set 22-11) ..... 46-8  
 1-1201 ..... 55-7  
 2-105 (See Model 315W—Set 53-8) ..... 54-6  
 2-106 ..... 54-6  
 2-200, 2-201, 2-218, 2-219, 2-232, 2-235, 2-236, 2-237, 2-238, 2-239, 2-240 ..... 62-9  
 315W, 315WN ..... 53-8  
 325WL, 325WN (See Model 2-106—Set 54-6) ..... 10-M-36, 10-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) ..... 11-B-36, 12-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) ..... 13-B-36 (Ch. 36) Tel. Rec. (See Ch. 36) ..... 14-M-36, 14-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) ..... 985792 ..... 6-5  
 985793 ..... 19-6  
 985986 ..... \*

**CHALLENGER**

CC8 ..... 63-4  
 CC18 ..... 67-7  
 CC30 ..... 68-6  
 CC60 ..... 70-3  
 CC618 ..... 66-4  
 CD6 ..... 65-4  
 20R ..... 69-5  
 60R ..... 62-7  
 200 ..... 69-5  
 600 ..... 62-7

**CHANCELLOR (Also see Radionic)**

35P ..... 30-25

**CHEVROLET**

985792 ..... 6-5  
 985793 ..... 19-6  
 985986 ..... \*

**CHEVROLET—Cont.**

986067 ..... 90-2  
 986146 ..... 28-6  
 986240 ..... 75-5  
 986241 ..... 58-7  
 986398 ..... 104-5  
 987443 ..... 189-4  
 986515 ..... 149-5  
 986516 ..... 150-6

**CHRYSLER (See Mopar)**

**CISCO**

1A5 ..... 37-4  
 9A5 ..... 20-3

**CLARION**

C100 ..... 1-5  
 C101 ..... 5-9  
 C102 ..... 9-6  
 C103 ..... 6-6  
 C104 ..... 1-4  
 C105 (See Model C-104—Set 1-4) ..... 6-7  
 C105A (Ch. 101) ..... 5-8  
 1101 ..... 17-8  
 11305 ..... 18-11  
 11411-N ..... 30-5  
 11801 ..... 23-6  
 11802V-M (See Model 11801—Set 23-6) ..... 54-5  
 12310W ..... 31-6  
 12708 ..... 41-5  
 12801 ..... 61-5  
 13101 ..... 46-7  
 13201, 13203 ..... 62-8  
 14601 ..... 60-9  
 14965 ..... 66-5  
 16703 Tel. Rec. .... 102-2

**CLARK**

PA-10 ..... 12-6  
 PA-10A ..... 18-12  
 PA-20 ..... 13-12  
 PA-20A ..... 18-13  
 PA-30 ..... 19-7

**CLEARSONIC (See U. S. Television)**

**COLLINS AUDIO PRODUCTS**

FMA-6 ..... 99-6  
 45-D ..... 72-6

**COLLINS RADIO**

75A-1 ..... 34-4  
 75A-2 ..... 171-4

**COLUMBIA RECORDS**

360 Series "B" ..... 215-5

**COMMANDER INDUSTRIES**

Commander 3 Tube Record Player ..... 17-10  
 CD61P ..... 19-9

**CONCERTONE (See Recorder Listing)**

**CONCORD**

IN434, IN435, IN436 (Similar to Chassis) ..... 98-5  
 IN437 (Similar to Chassis) 121-2  
 IN549 (Similar to Chassis) 38-5  
 IN551 (Similar to Chassis) 38-6  
 IN551, IN555 (Similar to Chassis) ..... 55-10  
 IN556, IN557 (Similar to Chassis) ..... 109-7  
 IN559 (Similar to Chassis) 90-7  
 IN560 (Similar to Chassis) 109-7  
 IN561, IN562 (Similar to Chassis) ..... 97-8  
 IN563 (Similar to Chassis) 136-10  
 IN819 (Similar to Chassis) 69-7  
 6C51B ..... 19-8  
 6C51W ..... 19-8  
 6E51B ..... 10-10  
 6E3ARC ..... 21-7  
 6161W ..... 22-11  
 7G26C ..... 20-5  
 7R3APW ..... 21-7  
 1-402, 1-403 ..... 45-6  
 1-411 ..... 48-5  
 1-501 (See Model 6E51B—Set 20-4) ..... 55-6  
 1-504 ..... 55-6  
 1-509, 1-510 (See Model 6C51B—Set 19-8) ..... 49-7  
 1-516, 1-517 ..... 49-7  
 1-601, 1-602, 1-603 (See Model 7G26C—Set 20-5) ..... 45-7  
 1-606 ..... 45-7  
 1-608 (See Model 6F26W—Set 19-10) ..... 6161W—Set 22-11) ..... 46-8  
 1-1201 ..... 55-7  
 2-105 (See Model 315W—Set 53-8) ..... 54-6  
 2-106 ..... 54-6  
 2-200, 2-201, 2-218, 2-219, 2-232, 2-235, 2-236, 2-237, 2-238, 2-239, 2-240 ..... 62-9  
 315W, 315WN ..... 53-8  
 325WL, 325WN (See Model 2-106—Set 54-6) ..... 10-M-36, 10-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) ..... 11-B-36, 12-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) ..... 13-B-36 (Ch. 36) Tel. Rec. (See Ch. 36) ..... 14-M-36, 14-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) ..... 985792 ..... 6-5  
 985793 ..... 19-6  
 985986 ..... \*

CONRAC—Cont.

15-P-36 (Ch. 36) Tel. Rec. (See Ch. 36)  
 16-B-36 (Ch. 36) Tel. Rec. (See Ch. 36)  
 17-P-39 (Ch. 39) Tel. Rec. (See Ch. 39)  
 18-M-39, 18-W-39 (Ch. 39) Tel. Rec. (See Ch. 39)  
 20-M-39, 20-W-39 (Ch. 39) Tel. Rec. (See Ch. 39)  
 21-B-39 (Ch. 39) Tel. Rec. (See Ch. 39)  
 22-P-39 (Ch. 39) Tel. Rec. (See Ch. 39)  
 23-M-39, 23-W-39 (Ch. 39) Tel. Rec. (See Ch. 39)  
 24-M-36 (Ch. 36) Tel. Rec. (See Ch. 36)  
 25-W-36 (Ch. 36) Tel. Rec. (See Ch. 36)  
 26-B-36 (Ch. 36) Tel. Rec. (See Ch. 36)  
 27-M-40, 27-W-40 (Ch. 40) Tel. Rec. (See Ch. 40)  
 28-B-40 (Ch. 40) Tel. Rec. (See Ch. 40)  
 29-P-40 (Ch. 40) Tel. Rec. (See Ch. 40)  
 30-M-40, 30-W-40 (Ch. 40) Tel. Rec. (See Ch. 40)  
 31-P-40 (Ch. 40) Tel. Rec. (See Ch. 40)  
 32-M-44, 32-W-44 (Ch. 44) Tel. Rec. (See Ch. 44)  
 33-B-44 (Ch. 44) Tel. Rec. (See Ch. 44)  
 34-P-44 (Ch. 44) Tel. Rec. (See Ch. 44)  
 35-M-61, 35-W-61 (Ch. 61) Tel. Rec. (See Ch. 61)  
 36-B-61 (Ch. 61) Tel. Rec. (See Ch. 61)  
 37-P-61 (Ch. 61) Tel. Rec. (See Ch. 61)  
 38-B-61, 38-M-61 (Ch. 61) Tel. Rec. (See Ch. 61)  
 39-M-61 (Ch. 61) Tel. Rec. (See Ch. 61)  
 40-M-64, 40-W-64 (Ch. 64) Tel. Rec. (See Ch. 64)  
 41-B-64 (Ch. 64) Tel. Rec. (See Ch. 64)  
 42-P-64 (Ch. 64) Tel. Rec. (See Ch. 64)  
 43-B-64, 43-M-64 (Ch. 64) Ch. 36 Tel. Rec. 110-4  
 Ch. 39 Tel. Rec. 110-4  
 Ch. 40 Series Tel. Rec. 140-4  
 Ch. 44 Tel. Rec. (See Prod. Chge. Bul. 27-Set 140-3 and Ch. 40—Set 140-4)  
 Ch. 61, 64 Series Tel. Rec. 185-5

CONTINENTAL ELECTRONICS (See Skyweight)

CONVERSA-FONE

M5-5 (Master Station) ..... 16-7  
 SS-5 (Sub-Station) ..... 16-7

CO-OP

6AWC2, 6AWC3, 6A47WCR, 6A47WT, 6A47WTR ..... 56-8

CORONADO

FA43-8965 Tel. Rec. (See Model 43-8965—Set 86-3)  
 FA43-8966 Tel. Rec. \*  
 K-21 (43-9041) Tel. Rec. 182-3  
 K-72 (43-9031) Tel. Rec. 182-3  
 K-73L (43-9030) Tel. Rec. 182-3  
 TV43-8908 Tel. Rec. \*  
 TV43-8960 Tel. Rec. \*  
 OSRA1-43-7755A, OSRA1-43-7755B ..... 101-2  
 OSRA1-43-7901 ..... 115-2  
 OSRA2-43-8230A ..... 162-3  
 OSRA2-43-8515A ..... 110-5  
 OSRA4-43-9876A ..... 103-7  
 OSRA33-43-8120A ..... 110-6  
 OSRA37-43-8360A ..... 102-3  
 OSTV1-43-8925A Tel. Rec. 145-5  
 OSTV1-43-9005A, OSTV1-43-9006A Tel. Rec. 145-5  
 OSTV1-43-9014A Tel. Rec. 128-4  
 OSTV2-43-8950A Tel. Rec. 141-4  
 OSTV2-43-9010A Tel. Rec. 146-5  
 OSTV2-43-9010B Tel. Rec. 153-2  
 OSTV6-43-8925A Tel. Rec. \*  
 15RA1-43-7654A ..... 147-3  
 15RA1-43-7902A ..... 134-6  
 15RA2-43-8230A ..... 162-3  
 15RA33-43-8245A, 15RA33-43-8246A ..... 174-5  
 15RA33-43-8365 ..... 169-4  
 15RA37-43-9230A ..... 173-5  
 15TV1-43-8957A, B ..... 162-4  
 15TV1-43-8958A, B ..... 162-4  
 Tel. Rec. (Also see Prod. Chge. Bul. 34—Set 162-1) ..... 161-3  
 15TV1-43-9008A Tel. Rec. \*  
 15TV1-43-9015A, B, 15TV1-43-9016A, B ..... 162-4  
 15TV1-43-9020A ..... 162-4  
 15TV1-43-9021A, B Tel. Rec. (Also see Prod. Chge. Bul. 34—Set 162-1) ..... 161-3  
 15TV2-43-9012A, 15TV2-43-9013A Tel. Rec. \*  
 15TV2-43-9025A, B, 15TV2-43-9026A, B ..... 144-3  
 15TV2-43-9101A, 15TV2-43-9102A Tel. Rec. 152-4  
 15TV4-43-8948A, 15TV4-43-8949A Tel. Rec. 175-7  
 25TV2-43-9022A Tel. Rec. 183-4

CORONADO—Cont.

25TV2-43-9022B Tel. Rec. (See Prod. Chge. Bul. 65—Set 202-1 and Model 25TV2-43-9022A—Set 183-4)  
 25TV2-43-9022C Tel. Rec. (See Prod. Chge. Bul. 65—Set 202-1, Prod. Chge. Bul. 72—Set 212-1 and Model 25TV2-43-9022A—Set 183-4)  
 25TV2-43-9045A, B ..... 199-5  
 25TV2-43-9045C Tel. Rec. (See Prod. Chge. Bul. 68—Set 205-1 and Model 25TV2-43-9045A—Set 199-5)  
 25TV2-43-9060A Tel. Rec. 199-5  
 25TV2-43-9060B Tel. Rec. (See Prod. Chge. Bul. 68—Set 205-1 and Model 25TV2-43-9060A—Set 199-5)  
 35RA2-43-5101A ..... 214-3  
 35RA33-43-8125 ..... 217-5  
 35TV2-43-9022C Tel. Rec. (See Prod. Chge. Bul. 65—Set 202-1, Prod. Chge. Bul. 72—Set 212-1 and Model 25TV2-43-9022A—Set 183-4)  
 35TV2-43-9045D Tel. Rec. (See Prod. Chge. Bul. 68—Set 205-1, Prod. Chge. Bul. 71—Set 211-1 and Model 25TV2-43-9045B—Set 199-5)  
 35TV2-43-9060C Tel. Rec. (See Prod. Chge. Bul. 66—Set 205-1, Prod. Chge. Bul. 71—Set 211-1 and Model 25TV2-43-9060A—Set 199-5)  
 43-2027 ..... 11-3  
 43-5005 ..... 28-3  
 43-6300 ..... 7-4  
 43-6451 ..... 10-10  
 43-6485 ..... 46-9  
 43-6730 (See Model 43-8685—Set 11-4)  
 43-7601 (See Model 43-7601B—Set 10-11)  
 43-7601B ..... 10-11  
 43-7602 (See Model 43-7601B—Set 10-11)  
 43-7651 ..... 9-7  
 43-7652 (See Model 43-7651—Set 9-7)  
 43-7851 ..... 47-5  
 43-8101 (See Model 94RA31-43-8115A—Set 81-5)  
 43-8130C, 43-8131C (See Model 94RA33-43-8130C—Set 82-3)  
 43-8160 ..... 12-7  
 43-8177 (See Model 43-8178—Set 21-8)  
 43-8178 ..... 21-8  
 43-8180 ..... 10-12  
 43-8190 ..... 19-11  
 43-8201 (See Model 43-8178—Set 21-8)  
 43-8213 ..... 7-5  
 43-8240, 43-8241 ..... 12-8  
 43-8305 ..... 8-3  
 43-8312A ..... 8-4  
 43-8330 ..... 19-12  
 43-8331, 43-8332 ..... 12-9  
 43-8333, 43-8334 ..... 28-7  
 43-8420 ..... 24-13  
 43-8470 ..... 8-4  
 43-8471 ..... 8-4  
 43-8576B ..... 9-8  
 43-8685 ..... 11-4  
 43-8965 Tel. Rec. 86-3  
 43-9003 Tel. Rec. 182-3  
 43-9031 Tel. Rec. 182-3  
 43-9041 Tel. Rec. 182-3  
 43-9196 ..... 14-35  
 43-9201 ..... 24-14  
 94RA1-43-6945A ..... 69-6  
 94RA1-43-7605A ..... 65-5  
 94RA1-43-7656A ..... 73-2  
 94RA1-43-7657A ..... 87-3  
 94RA1-43-7751A ..... 87-3  
 94RA1-43-8510A, 94RA1-43-8511A ..... 71-7  
 94RA1-43-8510B, 94RA1-43-8511B ..... 75-6  
 94RA2-43-8230A ..... 162-3  
 94RA4-43-8129A, 94RA4-43-8130A, 94RA4-43-8131A, 94RA4-43-8131B ..... 62-10  
 94RA31-43-8115A, B, 94RA31-43-8116A ..... 81-5  
 94RA31-43-8117A ..... 79-3  
 94RA33-43-8131C ..... 82-3  
 94TV1-43-8940A Tel. Rec. \*  
 94TV1-43-9002A Tel. Rec. \*  
 94TV2-43-8970A, 94TV2-43-8971A, 94TV2-43-8972A, 94TV2-43-8973A, 94TV2-43-8974A, 94TV2-43-8975A, 94TV2-43-8976A, 94TV2-43-8977A, 94TV2-43-8978A, 94TV2-43-8979A, 94TV2-43-8980A, 94TV2-43-8981A ..... 78-4  
 94TV6-43-8953A Tel. Rec. 106-3  
 165 (See Model 94RA31-43-8115A—Set 81-5)  
 197, U (See Model 94RA31-43-8115A—Set 81-5)  
 2027 (See Model 43-2027—Set 11-3)  
 5005 (See Model 43-5005—Set 28-36)

CORONADO—Cont.

6301 (See Model 43-6301—Set 7-4)  
 6451 (See Model 43-6451—Set 10-10)  
 6485 (See Model 43-6485—Set 46-9)  
 6730 (See Model 43-8685—Set 11-4)  
 6945A (See Model 94RA1-43-6945A—Set 69-6)  
 7601, B, 7602 (See Model 43-7601B—Set 10-11)  
 7605A (See Model 94RA1-43-7605A—Set 65-5)  
 7651, 7652 (See Model 43-7651—Set 9-7)  
 7654A (See Model 15RA1-43-7654A—Set 147-3)  
 7656A, 7657A (See Model 94RA1-43-7656A—Set 73-2)  
 7751 (See Model 94RA1-43-7751A—Set 87-3)  
 7755A, B (See Model OSRA1-43-7755A—Set 101-2)  
 7851 (See Model 43-7851—Set 47-5)  
 7901A (See Model OSRA1-43-7901A—Set 115-2)  
 7902A (See Model 15RA1-43-7902A—Set 134-6)  
 8101 (See Model 94RA31-43-8101—Set 81-5)  
 8115A, B, 8116A (See Model 94RA31-43-8115A—Set 81-5)  
 8120A (See Model OSRA33-43-8120A—Set 110-6)  
 8129A, 8130A, B, 8131A, B (See Model OSRA4-43-8129A—Set 62-10)  
 8130C, 8131C (See Model 94RA33-43-8130C—Set 82-3)  
 8160 (See Model 43-8160—Set 12-7)  
 8177, 8178 (See Model 43-8177—Set 21-8)  
 8180 (See Model 43-8180—Set 10-12)  
 8190 (See Model 43-8190—Set 19-11)  
 8201 (See Model 43-8178—Set 21-8)  
 8213 (See Model 43-8213—Set 7-5)  
 8230A (See Model OSRA2-43-8230A—Set 162-3)  
 8240, 8241 (See Model 43-8240—Set 12-8)  
 8245A, 8246A (See Model 15RA33-43-8245A—Set 174-5)  
 8305 (See Model 43-8305—Set 8-3)  
 8312A (See Model 43-8312A—Set 8-4)  
 8330 (See Model 43-8330—Set 19-12)  
 8351, 8352 (See Model 43-8351—Set 12-9)  
 8353, 8354 (See Model 43-8353—Set 28-7)  
 8360A (See Model OSRA37-43-8360A—Set 102-3)  
 8365 (See Model 15RA33-43-8365—Set 169-4)  
 8420 (See Model 43-8420—Set 24-13)  
 8470 (See Model 43-8470—Set 8-3)  
 8371 (See Model 43-8312A—Set 8-4)  
 8510A, 8511A (See Model 94RA1-43-8510A—Set 71-7)  
 8510B, 8511B (See Model 94RA1-43-8510B—Set 75-6)  
 8576 (See Model 43-8576—Set 9-8)  
 8685 (See Model 43-8685—Set 11-4)  
 8960 Tel. Rec. \*  
 8940A Tel. Rec. \*  
 8945A Tel. Rec. (See Model OSTV1-43-8945A—Set 145-5)  
 8948A, 8949A Tel. Rec. (See Model 15TV4-43-8948A—Set 175-7)  
 8948A Tel. Rec. (See Model 15TV2-43-9010A—Set 146-5)  
 8954 Tel. Rec. (See Model 15TV1-43-8954—Set 162-4)  
 8957A Tel. Rec. (See Model 15TV1-43-8957A—Set 162-4)  
 8958A, B Tel. Rec. (See Prod. Chge. Bul. 34—Set 162-1 and Model 15TV1-43-8958A—Set 161-3)  
 8960 Tel. Rec. \*  
 8965 Tel. Rec. \*  
 8966 Tel. Rec. \*  
 8970A, 8971A, 8972A, 8973A Tel. Rec. (See Model 94TV2-43-8970A—Set 78-4)  
 8985A, 8986A, 8987A, 8988A, 8989A, 8990A, 8991A, 8992A, 8993A, 8994A, 8995A, 8996A, 8997A, 8998A, 8999A, 9000A Tel. Rec. \*  
 9002A Tel. Rec. \*

CORONADO—Cont.

9005A, 9006A Tel. Rec. (See Model OSTV1-43-8945A—Set 145-5)  
 9008A Tel. Rec. \*  
 9010A Tel. Rec. (See Model OSTV2-43-9010A—Set 146-5)  
 9010B Tel. Rec. (See Model OSTV2-43-9010B—Set 153-2)  
 9012A, 9013A Tel. Rec. \*  
 9014A Tel. Rec. (See Model OSTV1-43-9014A—Set 128-4)  
 9015A, B, 9016A, B Tel. Rec. (See Model 15TV1-43-8957A—Set 162-4)  
 9020A, B, 9021A, B Tel. Rec. (See Prod. Chge. Bul. 34—Set 162-1 and Model 15TV1-43-8958A—Set 161-3)  
 9022A Tel. Rec. (See Model 25TV2-43-9022A—Set 183-4)  
 9025A, B, 9026A, B Tel. Rec. (See Model 15TV2-43-9025A—Set 144-3)  
 9030 Tel. Rec. (See Model K-73L [43-9031]—Set 182-3)  
 9031 Tel. Rec. (See Model K-72 [43-9031]—Set 182-3)  
 9041 (See Model K-21 [43-9041]—Set 182-1)  
 9101A, 9102A Tel. Rec. (See Model 15TV2-43-9101A—Set 152-4)  
 9169 (See Model 43-9169—Set 14-35)  
 9201 (See Model 43-9201—Set 24-14)  
 9230A (See Model 15RA37-43-9230A—Set 173-5)  
 9841A (See Model 94RA31-43-9841A—Set 79-3)  
 9876A (See Model OSRA4-43-9876A—Set 103-7)

CROSLY—Cont.

EU-21COL, CDBL (Ch. 387) (See Prod. Chge. Bul. 73—Set 214-1 and Model EU-17COL—Set 193-3)  
 EU-21CDBL, CDLU (Ch. 394) Tel. Rec. (See Prod. Chge. Bul. 73—Set 214-1 and Model EU-17COL—Set 193-3)  
 EU-21CDM, CDN, COB, COMA (Ch. 381, 384) Tel. Rec. 186-3  
 EU-21COLBD (Ch. 386) Tel. Rec. (Also see Prod. Chge. Bul. 73—Set 214-1) ..... 193-3  
 EU-21COLBU (Ch. 394) Tel. Rec. (See Prod. Chge. Bul. 73—Set 214-1 and Model EU-17COL—Set 193-3)  
 EU-21COLBE (Ch. 387) Tel. Rec. (Also see Prod. Chge. Bul. 73—Set 214-1) ..... 193-3  
 EU-21COLC (Ch. 386) Tel. Rec. (Also see Prod. Chge. Bul. 73—Set 214-1) ..... 193-3  
 EU-21COLD (Ch. 387) Tel. Rec. (Also see Prod. Chge. Bul. 73—Set 214-1) ..... 193-3  
 EU-21COLI (Ch. 394) Tel. Rec. (See Prod. Chge. Bul. 73—Set 214-1 and Model EU-17COL—Set 193-3)  
 EU-21COMU, COBUA, CDMU, CDBU, CDNU, Tel. Rec. \*  
 EU-21COSB, COSU (Ch. 387) Tel. Rec. (See Prod. Chge. Bul. 73—Set 214-1 and Model EU-17COL—Set 193-3)  
 EU-21PDBU, EU-21PDMU (Ch. 392, UHF Ch. 391 and Radio Ch. 362-1) Tel. Rec. \*  
 EU-21TOL, TOLB (Ch. 386) Tel. Rec. (Also see Prod. Chge. Bul. 73—Set 214-1) ..... 193-3  
 EU-21TOLBU, TOLU (Ch. 393) Tel. Rec. (See Prod. Chge. Bul. 73—Set 214-1 and Model EU-17COL—Set 193-3)  
 E108E, CT, RD, WE (Ch. 10E, 10E, 11) ..... 203-6  
 E138E, CE, SL, TN, WE (Ch. 15-20E) ..... 201-3  
 E200G, GY, MN, TN (Ch. 15-20E) ..... 201-3  
 E308E, GN, MN, TN (Ch. 30E, 30E, 1) ..... 206-3  
 E-75, CE, GN, RD, TN (Ch. 75E) ..... 217-3  
 E-85, CE, GN, RD, TN (Ch. 85E) ..... 217-3  
 E-908K, CE, GY, RD, WE (Ch. 90E) ..... 217-4  
 F-1108E, BK, CE, GN, RD (Ch. 110F) ..... 218-4  
 S11-442MIU, S11-444MU, S11-453MU (Ch. 331-4F) ..... 153-3  
 S11-451MU (Ch. 321-4F) ..... 153-3  
 S11-472B1U, S11-474BU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472C1U, S11-474CU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472D1U, S11-474DU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472E1U, S11-474EU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472F1U, S11-474FU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472G1U, S11-474GU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472H1U, S11-474HU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472I1U, S11-474IU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472J1U, S11-474JU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472K1U, S11-474KU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472L1U, S11-474LU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472M1U, S11-474MU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472N1U, S11-474NU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472O1U, S11-474OU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472P1U, S11-474PU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472Q1U, S11-474QU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472R1U, S11-474RU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472S1U, S11-474SU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472T1U, S11-474TU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472U1U, S11-474U (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472V1U, S11-474V (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472W1U, S11-474W (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472X1U, S11-474X (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472Y1U, S11-474Y (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472Z1U, S11-474Z (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AA1U, S11-474AA (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AB1U, S11-474AB (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AC1U, S11-474AC (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AD1U, S11-474AD (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AE1U, S11-474AE (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AF1U, S11-474AF (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AG1U, S11-474AG (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AH1U, S11-474AH (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AI1U, S11-474AI (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AJ1U, S11-474AJ (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AK1U, S11-474AK (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AL1U, S11-474AL (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AM1U, S11-474AM (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AN1U, S11-474AN (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AO1U, S11-474AO (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AP1U, S11-474AP (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AQ1U, S11-474AQ (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AR1U, S11-474AR (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AS1U, S11-474AS (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AT1U, S11-474AT (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AU1U, S11-474AU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AV1U, S11-474AV (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AW1U, S11-474AW (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AX1U, S11-474AX (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AY1U, S11-474AY (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472AZ1U, S11-474AZ (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BA1U, S11-474BA (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BB1U, S11-474BB (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BC1U, S11-474BC (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BD1U, S11-474BD (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BE1U, S11-474BE (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BF1U, S11-474BF (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BG1U, S11-474BG (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BH1U, S11-474BH (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BI1U, S11-474BI (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BJ1U, S11-474BJ (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BK1U, S11-474BK (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BL1U, S11-474BL (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BM1U, S11-474BM (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BN1U, S11-474BN (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BO1U, S11-474BO (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BP1U, S11-474BP (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BQ1U, S11-474BQ (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BR1U, S11-474BR (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BS1U, S11-474BS (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BT1U, S11-474BT (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BU1U, S11-474BU (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BV1U, S11-474BV (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BW1U, S11-474BW (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BX1U, S11-474BX (Ch. 331-4F) Tel. Rec. 153-3  
 S11-472BY1U, S11-474BY (Ch. 331

**CROSLY-DUOSONIC**

**CROSLY-Cont.**

10-307M, 10-308, 10-309	80-4
10-401 Tel. Rec.	95-2
10-404MU, 10-404MIU	
Tel. Rec.	114-3
10-412MU Tel. Rec.	114-3
10-414MU Tel. Rec.	116-4
10-414M (Ch. 292) Tel. Rec. (See Model 10-414MU—Set 116-4)	
10-416MU Tel. Rec.	116-4
10-416M1, 10-416M-U (Ch. 292) Tel. Rec. (See Model 10-414MU—Set 116-4)	
10-418MU Tel. Rec.	114-3
10-419MU Tel. Rec.	104-6
10-420MU Tel. Rec.	114-3
10-421MU Tel. Rec.	106-4
10-427MU Tel. Rec.	125-1A
10-428MU Tel. Rec.	129-5
10-429M (Ch. 292) Tel. Rec. (See Model 10-414MU—Set 116-4)	
10-429MU Tel. Rec.	116-4
11-100U, 11-101U, 11-102U, 11-103U, 11-104U, 11-105U (Ch. 301)	127-5
11-106U, 11-107U, 11-108U, 11-109U (Ch. 302)	155-5
11-114U, 11-115U, 11-116U, 11-117U, 11-118U, 11-119U (Ch. 300)	135-5
11-126U, 11-127U, 11-128U, 11-129U (Ch. 312)	125-5
11-207MU, 11-208MU (Ch. 333)	142-6
11-301U, 11-302U, 11-303U, 11-304U, 11-305U (Ch. 303)	124-3
11-441MU (Ch. 320) Tel. Rec.	147-4
11-442MU (Ch. 331) Tel. Rec.	126-4
11-443MU Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 11-442—Set 126-4)	
11-445MU (Ch. 321, -1, -2) Tel. Rec.	126-4
11-446MU (Ch. 325) Tel. Rec.	126-4
11-447MU (Ch. 321, -1, -2) Tel. Rec.	126-4
11-453MU (Ch. 331) Tel. Rec.	126-4
11-459MU, MU (Ch. 321, -1, -2) Tel. Rec.	126-4
11-460MU (Ch. 331) Tel. Rec.	126-4
11-461 WU (Ch. 320) Tel. Rec.	147-4
11-465WU (Ch. 321, -1, -2) Tel. Rec.	126-4
11-470BU (Ch. 331) Tel. Rec.	126-4
11-471 BU (Ch. 320) Tel. Rec.	147-4
11-472BU (Ch. 331) Tel. Rec.	126-4
11-473BU Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 11-442—Set 126-4)	
11-475BU (Ch. 321, -1, -2) Tel. Rec.	126-4
11-476BU (Ch. 325) Tel. Rec.	126-4
11-477BU (Ch. 321, -1, -2) Tel. Rec.	126-4
11-483BU (Ch. 331) Tel. Rec.	126-4
11-550MU (Ch. 337)	139-5
11-560BU (Ch. 337)	139-5
17CDC1, 17CDC2, 17CDC3, 17CDC4 (Ch. 331, -1, -2) Tel. Rec. (See Model 11-442—Set 126-4)	
17COC1, 17COC2, 17COC3 (Ch. 331, 1) Tel. Rec. (See Model 11-442—Set 126-4)	
20CDC1, 20CDC2, 20CDC3 (Ch. 323-3, 323-4) Tel. Rec.	*
46FA, 46FB	15-5
56FA, 56FB, 56FC	31-7
56PA, 56PB	10-9
56TA-L, 56TC-L	4-9
56TD	21-9
56TG	4-3
56TJ	5-14
56TN-L, 56TW-L	4-9
56TP	8-5
56TZ	33-2
56TR, 56TS	17-11
56TU	10-13
57TQ (See Model 56TQ—Set 33-2)	
58TA	36-4
58TC (See Model 58TW—Set 38-2)	
58TK	34-5
58TL	36-4
58TW	38-2
66CA, CP, CQ (See Model 66CS—Set 18-14)	
66CS, 66CSM	18-14
66TA, 66TC, 66TW	5-15
68CP, 68CR	37-5
68TA, 68TW	40-4
86CR, 86CS	12-10
86CR, 86CS (Revised)	36-5
87CQ (See Model 88CQ—Set 36-5)	
88CQ	36-5
88TA, 88TC	38-3
88TA, 88TC (Revised) (See Set 43-8 and Model 88TA—Set 38-3)	
106CP, 106CS	7-6

**CROSLY-Cont.**

146CS	25-10
148CP, 148CQ	42-6
148CR (See Model 148CP—Set 42-6)	
307TA Tel. Rec.	*
348CP, 348CQ, 348CR, 348CQ	*
154927 Tel. UHF Conv.	211-5
Ch. 10E, 10E-1 (See Model E10BE)	
Ch. 15-20E (See Model E15BE)	
Ch. 30E, 30E-1 (See Model E30BE)	
Ch. 75E (See Model E-75)	
Ch. 85E (See Model E-85)	
Ch. 90E (See Model E-90BK)	
Ch. 110F (See Model F-110BE)	
Ch. 292 Tel. Rec. (See Model 10-414MU)	
Ch. 301 (See Model 11-100U)	
Ch. 302 (See Model 11-106U)	
Ch. 303 (See Model 11-301U)	
Ch. 311-1 (See Model D-25BE)	
Ch. 312 (See Model 11-126U)	
Ch. 320 (See Model 11-441MU)	
Ch. 321, 321-1, 321-2 (See Model 11-445MU)	
Ch. 321-4 Tel. Rec. (See Model 511-442MIU)	
Ch. 323 (See Model 11-443MU)	
Ch. 323-3, 323-4 (See Model 20CD1)	
Ch. 323-6 (See Model 520CDC1)	
Ch. 325 (See Model 11-446MU)	
Ch. 330 (See Model 11-114U)	
Ch. 331, -1, -2 (See Model 11-442)	
Ch. 331-4 Tel. Rec. (See Model 511-442MIU)	
Ch. 333 (See Model 11-207MU)	
Ch. 337 (See Model 11-550MU)	
Ch. 355-1 (See Model DU-17CDB)	
Ch. 356-3, -4 (See Model DU-17CDB)	
Ch. 357 Tel. Rec. (See Model DU-20CDM)	
Ch. 358-1 (See Model DU-21CDM1)	
Ch. 359 Tel. Rec. (See Model DU-17PDM)	
Ch. 360, 361 Tel. Rec. (See Model DU-17PDB)	
Ch. 380 (See Model EU-17COM)	
Ch. 381 (See Model EU-21CDB)	
Ch. 383 (See Model EU-17COM)	
Ch. 384 (See Model EU-21CDB)	
Ch. 385, 386, 387 (See Model EU-17COL)	
Ch. 386 (See Model EU-21COLBd)	
Ch. 387 (See Model EU-21COLBe)	
Ch. 390 Tel. Rec. (See Model EU-21COMUa)	
Ch. 392 (See Model EU-21PDBU)	
Ch. 393 (See Model EU-21TOLBU)	
Ch. 394 (See Model 21CDLBU)	
Ch. 396 (See Model EU-17CO-BU)	

**CROYDON**

C17FM Tel. Rec. (Also see Prod. Chge. Bul. 57—Set 191-1)	186-4
C21FM, C21FTM (Also see Prod. Chge. Bul. 57—Set 191-1)	186-4

**CRYSTAL PRODUCTS (See Coronet)**

DALBAR	
Barcomba Jr.	10-14
Barcomba Sr.	8-34
M8 "Tonomatic"	10-15
100-1000 Series	9-9

**DAVID BOGEN**

"Twin"	213-3
AM901	195-6
DB-10	102-4
DB10-1 (See Model DB-10—Set 102-4)	
DP-16	166-8
E66	85-4
E75	83-2
EX-326	76-9
FM801	198-4
G-50	30-6
GO-50	26-9
GO-125	22-12
GX50	25-11
H15	80-6
H30	79-5
H50, HL50, H2L50	78-6
H623	71-8
HE-10	154-3
H0H, H0L	80-5
H0I0	183-5
H0S0	84-5
H0I25	87-4
HX30	82-4
HX50	75-7

**DAVID BOGEN-Cont.**

HX-632	169-5
LOH, LOL	80-5
LP16	86-4
PH10	73-3
PH10-1 (See Model PH10—Set 69-5)	
PX10	183-5
PX15	68-5
PX15	72-7
R501	183-5
R602	33-3
R-604	67-8
UP16	86-4
2AR, 2RS	28-8
11D	77-5
11X	74-2
21D	77-5
21U	76-10
21X	74-2

**DEARBORN**

100	22-13
-----	-------

**DECCA**

DP11	24-15
DP29	19-13
PT-10	25-12

**DELCO**

R-705	42-7
R-1227, R-1228, R-1229	15-6
R-1230-A, R-1231-A, R-1232-A	14-33
R-1233	42-8
R-1234, R-1235	7-7
R-1236, R-1237	29-7
R-1238	38-4
R-1241	62-11
R-1242	31-8
R-1243	32-4
R-1244, R-1245, R-1246	52-6
R-1248, R-1249, R-1250	66-7
R-1251, R-1252	21-10
R-1253, R-1254, R-1255	47-7
R-1408, R-1409	15-7
TV-71, TV-71A Tel. Rec.	99A-3
TV-101 (See Model TV-102—Set 88-3)	
TV-102 Tel. Rec.	88-3
TV-160 Tel. Rec.	85-5
TV-201 Tel. Rec.	59-8

**DeSOTO (See Mopar)**

**DETROLA**

554-1-61A (See Aria Model 554-1-61A—Set 67-2)	
558-1-49A	7-8
568-1-221B	9-10
571, 571A, 571B, 571L, 571AL, 571BL	10-16
571X, 571AX, 571BX	9-11
572-220-226A	8-6
577-1-6A	8-7
579	7-9
579-2-58B (See Model 579—Set 7-9)	
582	19-14
610-A	55-8
611-A	50-6
626 Series	11-5
7156	48-6
7270	16-8

**DEWALD**

A500 (See Model A500—Set 4-22)	
A500U (See Model A500—Set 4-22)	
A501, A502, A503	4-22
A504, A505	16-9
A-507	26-10
A-509	31-9
A-514	27-6
A602, A605 (See Model A602—Set 16-10)	
B-400	35-3
B-401	34-6
B-402	45-8
B-403	52-7
B-504	43-9
B-506	38-5
B-510	34-7
B-512	35-4
B-515	63-6
B-612	42-9
B-614	56-9
BT-100, BT-101 Tel. Rec.	79-6
C-516	64-4
C-800	69-7
CT-101 Tel. Rec.	79-6
CT-102, CT-103, CT-104 Tel. Rec.	82-5
D-E517A	167-5
D-508	106-5
D-517	131-4
D-518	100-5
D519 (See Model B-506—Set 38-5)	
D-616	102-5
DT-120, DT-122 Tel. Rec.	100-6
DT-160 Tel. Rec.	82-5
DT-161 Tel. Rec.	100-6
DT-162, DT-163 Tel. Rec.	118-5
DT-162R, DT-163A, R Tel. Rec. (Also see Prod. Chge. Bul. 58—Set 192-1)	
DT-190 Tel. Rec.	118-5
DT-190D Tel. Rec. (Also see Prod. Chge. Bul. 58—Set 192-1)	
DT-1020, DT-1020A Tel. Rec.	100-6
DT-1030, DT-1030A Tel. Rec.	100-6
DT-X-160 Tel. Rec.	100-6
E-520	128-5
E-522	141-5
ET-140, ET-141 Tel. Rec.	118-5

**DEWALD-Cont.**

ET-140R, ET-141R Tel. Rec. (Also see Prod. Chge. Bul. 58—Set 192-1)	136-7
E-170, ET-171 Tel. Rec. (Also see Prod. Chge. Bul. 58—Set 192-1)	136-7
ET-171-20 Tel. Rec.	208-3
ET-172 Tel. Rec. (Also see Prod. Chge. Bul. 58—Set 192-1)	136-7
ET-190D (Revised) Tel. Rec.	208-3
FT-200 Tel. Rec. (See Prod. Chge. Bul. 58—Set 192-1 and Model DT-162R—Set 136-7)	
FT-200 (Revised) Tel. Rec.	208-3
FT-201 Tel. Rec. (See Prod. Chge. Bul. 58—Set 192-1 and Model DT-162R—Set 136-7)	
F-404	181-5
F-405	198-5
F-523	170-5
G-174 Tel. Rec.	208-3
G-201 Tel. Rec.	208-3
G-210, G-211 Tel. Rec.	208-3
511	71-9

**DODGE (See Mopar)**

**DORN'S (See Bell Air)**

DREXEL (Mutual Buying Syndicate) 17CG1, 17TW Tel. Rec. (Similar to Chassis)	149-13
-----------------------------------------------------------------------------	--------

**DUKANE**

1A45-A	184-5
1A300, 1B300	189-6
1U325	185-6
4A100	186-5
4B100 (See Model 4A100—Set 186-5)	
4C25 Flexiphone	187-4
4CT00	200-4

**DUMONT**

RA-101 Tel. Rec.	*
RA-102B1, RA-102B2, RA-102B3 Tel. Rec.	*
RA-103 Tel. Rec. (Also see Prod. Chge. Bul. 6—Set 103-1)	90-3
RA-103D Tel. Rec. (Also see Prod. Chge. Bul. 9—Set 114-1)	93-4
RA-104A Tel. Rec. (Also see Prod. Chge. Bul. 9—Set 114-1)	93-4
RA-105 Tel. Rec. (Also see Prod. Chge. Bul. 6—Set 108-1)	72-8
RA-105B Tel. Rec.	95-3
RA-106 Tel. Rec. (Supp. to RA-105, Set 72) (Also see Prod. Chge. Bul. 6—Set 108-1)	99A-4
RA-108A Tel. Rec.	95-3
RA-109A-FAS Tel. Rec. (See Prod. Chge. Bul. 54—Set 188-1 and Model RA-109—Set 110-7)	
RA-109-A1, -A2, -A3, -A5, -A6, -A7 Tel. Rec. (Also see Prod. Chge. Bul. 14—Set 124-1)	110-7
RA-110A Tel. Rec. (Also see Prod. Chge. Bul. 9—Set 114-1)	93-4
RA-111-A1, -A2, -A4, -A5, A1 Tel. Rec.	106-6
RA-112-A1, -A2, -A3, -A4, -A5, -A6 Tel. Rec. (Also see Prod. Chge. Bul. 38—Set 170-1)	119-5
RA-113-B1, -B2, -B3, -B4, -B5, -B6, -B7, -B8 Tel. Rec. (Also see Prod. Chge. Bul. 38—Set 170-1)	119-5
RA-116A Tel. Rec.	*
RA-117-A1, -A3, -A5, -A6, -A7 Tel. Rec.	131-5
RA-119A Tel. Rec.	156-5
RA-120 Tel. Rec. (See Prod. Chge. Bul. 51—Set 185-1 and Model RA-113—Set 119-5)	
RA-130A Tel. Rec. (See Prod. Chge. Bul. 54—Set 185-1 and Model RA-109—Set 110-7)	
RA-147A Tel. Rec. (See Prod. Chge. Bul. 49—Set 183-1 and Model RA-117A—Set 131-5)	
RA-160, -A1 Tel. Rec. (Also see Prod. Chge. Bul. 55—Set 189-1)	179-4
RA-162, -B1, -B4, -B5, -B6, -B7, -B21 through 26 Tel. Rec. (Also see Prod. Chge. Bul. 55—Set 189-1)	179-4
RA-164, -A1 Tel. Rec. (Also see Prod. Chge. Bul. 70—Set 194-1 and Prod. Chge. Bul. 69—Set 206-1)	189-7
RA-165, -B1, -B2, -B3, -B5, -B7, -B21 through B26 Tel. Rec. (Also see Prod. Chge. Bul. 60—Set 194-1 and Prod. Chge. Bul. 69—Set 206-1)	189-7
RA-166, RA-167, RA-168, RA-169, RA-170, RA-171 Tel. Rec.	216-2

**DUMONT-Cont.**

Andover Model RA-117-A6 (See Model RA-117A)	
Andover (See Model RA-147A)	
Armstrong Model RA-112-A1, -A4 (See Model RA-112A)	
Banbury Model RA-162-B4 (See Model RA-162)	
Banbury Model RA-162-B21 through B26 (See Model RA-162)	
Beverly Model RA-165-B2 (See Model RA-165)	
Bradford (See Model RA-108A)	
Brookville Model RA-113-B1, -B2 (See Model RA-113)	
Burlingame Model RA-113-B5, -B6 (See Model RA-113)	
Carlton Model RA-117-A3 (See Model RA-117A)	
Chatham (See Model RA-103)	
Chestnut (See Model RA-147A)	
Clifton (See Model RA-102)	
Clinton Model RA-164-A1 (See Model RA-164)	
Club 20 (See Model RA-106A)	
Colonel (See Model RA-105A)	
Devon Model RA-160-A1 (See Model RA-160)	
Devonshire (See Model RA-101)	
Dynasty (See Model RA-162)	
Fairfield (See Model RA-110A)	
Flanders Model RA-162-B5 (See Model RA-162)	
Guilford Model RA-111-A2, -A5 (See Model RA-111A)	
Hanover Model RA-109-A	

**DYNAVOX**

AP-514 (Ch. AT) 28-9  
 M-510 15-8  
 Swingmaster 27-7  
 3-P-801 36-3

**ECA**

101 (Ch. AA) 1-25  
 102 14-7  
 104 13-14  
 105 16-11  
 108 7-10  
 108 3-6  
 121 13-15  
 131 16-12  
 132 45-9  
 201 15-9  
 204 32-5

**ECHOPHONE**  
 (Also see Hallcrafters)

EC-1A \*  
 EC113 3-13  
 EC-306 14-8  
 EC-403, EC-404 22-14  
 TC-600 4-18  
 EX-102, EX-103 64-5  
 EX-306 (See Model  
 EC-306—Set 14-8)

**EDWARDS**

Fidaltuner 33-4

**EICOR**

(Also see Recorder Listing)

15 135-6

**EKOTAPE**

(See Recorder Listing)

**ELCAR**

602 5-19

**ELECTONE**

75TS3 12-34

**ELECTRO**

B20 14-9

**ELECTROMATIC**

APH301-A, APH301-C 7-11  
 606A, 607A 5-32

**ELECTRO-TONE**

555 13-17  
 706, 712 (See Model  
 555—Set 13-16)

**ELECTRONIC CORP. OF AMERICA**

(See ECA)

**ELECTRONIC SPECIALTY CO.**

(See Ranger)

**E/L (ELECTRONIC LABS.)**

75 (Sub-Station) 20-6  
 76E, K, M, W (See Model  
 2701—Set 4-28)  
 76RU ("Radio Utiliphone") 20-6  
 7108, 7109, 7107, 710W,  
 Orthosonic (Ch. 2875) 20-7  
 710PB, 710PC Orthosonic  
 (Ch. 2887) 24-16  
 2660 "Master Utiliphone" 8-8  
 2701 4-28  
 3000 Orthosonic 31-10

**EMERSON**

501, 502 (Ch. 120000,  
 120029) 2-1  
 503 (Ch. 120000, 120029) 1-18  
 504 (Ch. 120000, 120029) 2-1  
 505 (Ch. 120021) 8-9  
 505 (Ch. 120041) (See  
 Model 523—Set 5-27) 6-9  
 506 8-10  
 507 8-10  
 508 (Ch. 120008) 7-12  
 509 8-10  
 510, 510A  
 (Ch. 120000, 120029) 5-36  
 511 8-10  
 511 (Ch. 120010) (See  
 Model 541—Set 16-23) 9-12  
 512 (Ch. 120006) 26-11  
 512 (Ch. 120056) 27-8  
 514 (Ch. 120007) 27-8  
 515, 516 12-11  
 515, 516 (Ch. 120056) 26-11  
 517 (Ch. 120010) (See  
 Model 541—Set 16-13) 8-10  
 518 30-7  
 519 (Ch. 120030) 8-10  
 520 (Ch. 120000, 120029) 2-1  
 521 (Ch. 120011, 120031) 7-13  
 522 8-10  
 523 5-37  
 524 17-12  
 525 20-8  
 527 (Ch. 120019) Tel. Rec. 21-13  
 528 (Ch. 120038) 18-15  
 529, 529-9 (Ch. 120028) 18-15  
 530 (Ch. 120006,  
 Ch. 120056) 32-6  
 531, 532, 533 27-8  
 534 (Ch. 120007) 20-9  
 535 20-8  
 536 (Ch. 120036) 21-14  
 536A 24-17  
 537 23-7  
 538 (Ch. 120051) (See  
 Model 549—Set 26-12) 9-13  
 539 20-10  
 540 (Ch. 120042) 16-13  
 541 21-15  
 542 (See Model  
 521—Set 7-13) 19-30  
 543, 544 (Ch. 120046) 82  
 545 (Ch. 120047) Tel. Rec. 21-15  
 546 (Ch. 120049) 25-13  
 547A (Ch. 120050) 30-8  
 548 (Ch. 120051) 26-12  
 549 (Ch. 120051) 26-12  
 550 (Ch. 120066) (See  
 Model 512—Set 9-12)  
 550 (Ch. 120056) 26-11  
 551A 24-17

**EMERSON—Cont.**

552 20-8  
 553A 24-17  
 556, 557 (Ch. 120018B) 70-4  
 557B (Ch. 120048B) 43-10  
 558 (Ch. 120058) 31-11  
 559A (Ch. 120059) 31-12  
 560 (Ch. 120016) 25-14  
 561 (Ch. 120001B) 63-7  
 563 (Ch. 120038) 73-4  
 564 (Ch. 120027) (See  
 Model 540A—Set 20-10) 70-4  
 565 (Ch. 120018B) 70-4  
 566 (Ch. 120051) (See  
 Model 549—Set 26-12)  
 567 (Ch. 120016) (See  
 Model 560—Set 25-14)  
 567 (Ch. 120042) (See  
 Model 540A—Set 20-10) 58-9  
 568A (Ch. 120070A) 42-10  
 569A (Ch. 120062A) 42-10  
 570 (Ch. 120064) 97-3  
 571 (Ch. 120064) 46-25  
 571 (Ch. 120066B) \*  
 571 (Ch. 120086B) 76-11  
 572 (Ch. 120065) (See  
 Model 540A—Set 20-10) 42-11  
 573B (Ch. 120039B) 97-3  
 574 (Ch. 120064) 97-3  
 575 (Ch. 120068A,  
 120068B) 85-6  
 576A (Ch. 120079A) 40-5  
 577B (Ch. 120012B) 41-6  
 578 (Ch. 120050) (See  
 Model 547A—Set 25-13) 61-6  
 579A (Ch. 120034A) 61-6  
 580 (Ch. 120064) 97-3  
 581 (Ch. 120014A, B) 68-7  
 582 (See Model 548—  
 Set 30-8) \*  
 583 (See Model 573B—  
 Set 42-11) \*  
 584 (See Model 558—  
 Set 31-11) \*  
 585 (Ch. 120025B) 61-7  
 585 (Ch. 120088B,  
 120090B, 120090D) \*  
 586 (Ch. 120023B,  
 120083B) 72-9  
 587 (Ch. 120033A, B) 71-10  
 588 (See Model 547A—  
 Set 25-13) 69-8  
 590 (Ch. 120101A, B) 87-5  
 591 (Ch. 120055A) 67-9  
 593 (Ch. 120063B) 73-4  
 594, 595 (Ch. 120071A) 68-7  
 596 61-6  
 597 (Ch. 120073B) 90-5  
 599 (Ch. 120075B) 69-8  
 600 (Ch. 120103-B) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 9—Set 114-1) 87-6  
 601 (Ch. 120075B) 69-8  
 602 (Ch. 120072A,  
 120082A) 56-10  
 603 (Ch. 120063B) 73-4  
 604A (See Model 576A—  
 Set 40-5) \*  
 605 (Ch. 120076B) 66-8  
 606 (Ch. 120066) Tel. Rec. 46-25  
 606 (Ch. 120066B) \*  
 606 (Ch. 120086-D) 76-11  
 606 (Ch. 120086B) 76-11  
 607 (Ch. 120074A) 76-11  
 608A (Ch. 120089B) 84-6  
 609 (Ch. 120084-B) 90-6  
 610 (Ch. 120100A, B) 71-10  
 611, 612 (Ch. 120087B-D) 76-11  
 613A (Ch. 120085A, B) 79-7  
 614, B, BC, C (Ch. 120110,  
 B, BC, C) Tel. Rec. 97-4  
 614D (Ch. 120095-B) 95A-3  
 615 (Ch. 120001B) 63-7  
 616 (Ch. 120100A, B) 71-10  
 618 (Ch. 120090B, D) \*  
 619 (Ch. 120092D) 76-11  
 620 (Ch. 120091D-QD) 76-11  
 621 (Ch. 120098B) 108-5  
 622 (Ch. 120098P) 108-5  
 623 (Ch. 120101A, B) 87-5  
 624 (Ch. 120087B-D) 76-11  
 625 (Ch. 120105B) 103-8  
 626 (Ch. 120105B,  
 120104B) Tel. Rec. 84-6  
 627 (Ch. 120107B) 76-11  
 628 (Ch. 120098B) 108-5  
 629 (Ch. 120114B) Tel. Rec. (See Model 631—  
 Set 93A-6) 119-6  
 629B, 629C (Ch.  
 120120) Tel. Rec. 119-6  
 629D (Ch. 120124B) 116-5  
 630 (Ch. 120099B) 108-5  
 631 (Ch. 120109) 93A-6  
 632 (Ch. 120096B) 93A-7  
 633 (Ch. 120114) 93A-6  
 634B (Ch. 120097B) 111-4  
 635 (Ch. 120108) 92-1  
 636A (Ch. 120106A) 99-7  
 637, B, BC, C (Ch. 120110,  
 B, BC, C) Tel. Rec. 97-4

**EMERSON—Cont.**

637A (Ch. 120095-B) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 9—Set 114-1) 87-6  
 640 (Ch. 120112) 93-5  
 641B (Ch. 120125B) 120-5  
 642 (Ch. 120117A) 98-3  
 643A (Ch. 120111A) 91-4  
 644, B, BC, C (Ch. 120113,  
 B, BC, C) Tel. Rec. 97-4  
 645 (Ch. 120115) 94-4  
 646A (Ch. 120121A) 102-6  
 646B (Ch. 120121B) 102-6  
 647, B, BC, C (Ch. 120113,  
 B, BC, C) Tel. Rec. 97-4  
 648B (Ch. 120110E) 97-4  
 648B (Ch. 120134B, G, H) \*  
 Tel. Rec. (See Prod.  
 Chge. Bul. 48—Set  
 182-1 and Model  
 661B—Set 137-4) 106-7  
 649A (Ch. 120094A) 106-7  
 650 (Ch. 120118B) 113-2  
 650 (Ch. 120118B) Tel. Rec. (See Model 650—  
 Set 113-2) \*  
 650D (Ch. 120123-B) Tel. Rec. (Also see Prod.  
 Chge. Bul. 48—Set  
 182-1) 109-3  
 650F (Ch. 120138-B) 133-1A  
 651B (Ch. 120120) 119-6  
 651C (Ch. 12019) 93A-6  
 651C (Ch. 120124) 116-5  
 651D (Ch. 120124, B) 116-5  
 652 (Ch. 120032B) 98-3  
 653 (Ch. 120080B) 98-3  
 653B (Ch. 120136-B) 159-5  
 654 (Ch. 120118B) 113-2  
 654B (Ch. 120118B) Tel. Rec. (See Model 654—  
 Set 113-2) \*  
 654D (Ch. 120123B) Tel. Rec. (Also see Prod.  
 Chge. Bul. 48—Set  
 182-1) 109-3  
 654F (Ch. 120138-B) 133-1A  
 655B (Ch. 120123-B) 109-3  
 655D (Ch. 120123B) Tel. Rec. (Also see Model 650D—  
 Set 109-3) \*  
 655F (Ch. 120138-B) 133-1A  
 656B, 657B (Ch. 120122B) 111-5  
 658B (Ch. 120124, B) 116-5  
 658C (Ch. 120124) Tel. Rec. (See Model 629D—  
 Set 116-5) \*  
 658D (Ch. 120124B) \*  
 660B (Ch. 120133B) 131-6  
 661B (Ch. 120134B, G, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 48—Set  
 182-1 and Model  
 661B—Set 137-4) 137-4  
 662B (Ch. 120127-B) Tel. Rec. (Also see Prod.  
 Chge. Bul. 18—  
 Set 130-1) 125-6  
 663B (Ch. 120128-B) Tel. Rec. (Also see Prod.  
 Chge. Bul. 18—  
 Set 130-1) 125-6  
 664B (Ch. 120133-B) 131-6  
 665-B (Ch. 120131-B and  
 Radio Ch. 120130-B) 146-6  
 666B (Ch. 120135B, G, H  
 and Radio Ch. 120132B) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 27—  
 Set 148-1) 133-5  
 667B, 668B (Ch. 120134B,  
 G, H) Tel. Rec. (Also  
 see Prod. Chge. Bul.  
 48—Set 182-1) 137-4  
 669B (Ch. 120129B, D) Tel. Rec. (Also see Prod.  
 Chge. Bul. 24—Set  
 142-1 and Prod. Chge.  
 Bul. 47—Set 181-1) 126-5  
 669B (Ch. 120148-B) \*  
 Tel. Rec. (See Model 671B—  
 Set 118-6) 118-6  
 671D (Ch. 120137D) (See  
 Model 671B—Set 118-6) 131-7  
 672B (Ch. 120097-B) 131-7  
 673B (Ch. 120133-B) 131-6  
 674B (Ch. 120134B, G, H) \*  
 Tel. Rec. (Also see  
 Prod. Chge. Bul. 48—  
 Set 182-1) 137-4  
 675B (Ch. 120129B, D) \*  
 Tel. Rec. (Also see  
 Prod. Chge. Bul. 24—  
 Set 142-1 and Prod.  
 Chge. Bul. 47—  
 Set 181-1) 126-5  
 676B (Ch. 120140B) \*  
 Tel. Rec. 128-6

**EMERSON—Cont.**

676D (Ch. 120144B, G, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 48—  
 Set 182-1) 138-4  
 676F (Ch. 120143B) Tel. Rec. (Also see Prod. Chge.  
 Bul. 50—Set 184-1) 148-6  
 677B, 678B (Ch. 120134B,  
 G, H) Tel. Rec. (Also  
 see Prod. Chge. Bul.  
 48—Set 182-1) 137-4  
 679B (Ch. 130116-B) 142-7  
 680B (Ch. 120144-B, G, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 48—  
 Set 182-1) 138-4  
 680D (Ch. 120140B) \*  
 Tel. Rec. (See Prod.  
 Chge. Bul. 48—Set  
 182-1 and Model  
 674D—Set 138-4) 128-6  
 680D (Ch. 120144B, G, H) \*  
 Tel. Rec. (See Prod.  
 Chge. Bul. 48—Set  
 182-1 and Model  
 674D—Set 138-4) 128-6  
 681B (Ch. 120140B) \*  
 Tel. Rec. (See Prod. Chge. Bul. 48—Set  
 182-1) 128-6  
 681D (Ch. 120144B, G, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 48—  
 Set 182-1) 138-4  
 681F (Ch. 120143B, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 50—  
 Set 184-1) 148-6  
 683B (Ch. 120141-B) \*  
 Tel. Rec. (See Prod. Chge. Bul. 48—Set  
 182-1) 138-4  
 684B, 685B (Ch. 120134B,  
 G, H) Tel. Rec. 137-4  
 686B (Ch. 120144B, G, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 48—  
 Set 182-1) 138-4  
 686D (Ch. 120140B) \*  
 Tel. Rec. 128-6  
 686F (Ch. 120143B, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 50—  
 Set 184-1) 148-6  
 687A (Ch. 120142B) Tel. Rec. (Also see Prod.  
 Chge. Bul. 50—  
 Set 184-1) 148-6  
 687B (Ch. 120144B, G, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 48—  
 Set 182-1) 138-4  
 687D (Ch. 120140B) Tel. Rec. (See Model 676B—  
 Set 128-6) 138-4  
 687F (Ch. 120143B, H) \*  
 Tel. Rec. (Also see Prod.  
 Chge. Bul. 50—  
 Set 184-1) 148-6  
 687L (Ch. 120142B) Tel. Rec. (Also see Prod.  
 Chge. Bul. 50—  
 Set 184-1) 148-6  
 688B, 689B, 690B (Ch.  
 120129B) Tel. Rec. (Also  
 see Prod. Chge. Bul.  
 24—Set 142-1 and Prod.  
 Chge. Bul. 47—  
 Set 181-1) 126-5  
 691B (Ch. 120145-B) 160-3  
 692B, 693B, 694B (Ch.  
 120129B, D) Tel. Rec. (See Prod. Chge. Bul.  
 24—Set 142-1, Prod.  
 Chge. Bul. 47—Set  
 181-1 and Model  
 669B—Set 126-5) 162-5  
 695B (Ch. 120146-B) 162-5  
 696B (Ch. 120144B, G, H) \*  
 Tel. Rec. (See Prod. Chge. Bul. 48—Set  
 182-1 and Model  
 661B—Set 137-4) 137-4  
 696F (Ch. 120143B, H) Tel. Rec. (Also see Prod.  
 Chge. Bul. 50—  
 Set 184-1) 148-6  
 696L (Ch. 120142B) Tel. Rec. (Also see Prod.  
 Chge. Bul. 50—  
 Set 184-1) 148-6  
 697B (Ch. 120129B, D) Tel. Rec. (See Prod. Chge. Bul.  
 24—Set 142-1,  
 Prod. Chge. Bul. 47—  
 Set 181-1 and Model  
 669B—Set 126-5) 165-1A  
 698B (Ch. 120127B) Tel. Rec. (See Prod. Chge. Bul.  
 18—Set 130-1 and  
 Model 662B—Set 125-6) 169-6  
 699D (Ch. 120160-B) 169-6  
 700B (Ch. 120153-B) 169-6  
 700D (Ch. 120158-B) 169-6  
 701D (Ch. 120158-B) 169-6  
 701F (Ch. 120143B) Tel. Rec. (See Prod. Chge. Bul.  
 50—Set 184-1 and  
 Model 676F—Set 148-6) 169-6  
 702B (Ch. 120156-B) 159-5  
 703B (Ch. 120097-B) 160-4  
 704 (Ch. 120154-B) 184-6  
 705A, B (Ch. 120155A, B) 208-4  
 706B, 707B (Ch.  
 120156-B) 178-5  
 708B (Ch. 120165-B) (See  
 Model 706B—Set 178-5) 167-6  
 709A (Ch. 120162A) \*  
 Tel. Rec. (See Model 609) 167-6  
 710B (Ch. 120146-B) (See  
 Model 695B—Set 162-5) 183-6  
 711B (Ch. 120164-B) 183-6  
 711F (Ch. 120169-B) 206-4

**EMERSON—Cont.**

712B (Ch. 120164B) \*  
 Tel. Rec. 183-6  
 712F (Ch. 120169B) \*  
 Tel. Rec. 206-4  
 713B (Ch. 120156-B) (See  
 Model 706B—Set 178-5) 190-2  
 716D (Ch. 120163-D) \*  
 Tel. Rec. 190-2  
 716F (Ch. 120163-D) Tel. Rec. (See Prod. Chge. Bul.  
 61—Set 195-1, Prod.  
 Chge. Bul. 71—Set 211-1  
 and Model 716D—  
 Set 190-2) 190-2  
 717D (Ch. 120163-D) \*  
 Tel. Rec. 190-2  
 717F (Ch. 120168-D) Tel. Rec. (See Prod. Chge. Bul.  
 61—Set 195-1, Prod.  
 Chge. Bul. 71—Set 211-1  
 and Model 716D—  
 Set 190-2) 191-7  
 718B (Ch. 120150-B) 190-2  
 719D (Ch. 120163-D) \*  
 Tel. Rec. 190-2  
 719F (Ch. 120168-D) Tel. Rec. (See Prod. Chge. Bul.  
 61—Set 195-1,  
 Prod. Chge. Bul. 71—Set  
 211-1 and Model 716D—  
 Set 190-2) 197-5  
 720B (Ch. 120164-B) \*  
 Tel. Rec. 183-6  
 720D (Ch. 120169B) \*  
 Tel. Rec. 206-4  
 720F (Ch. 120169-D) \*  
 Tel. Rec. 206-4  
 721D (Ch. 120169-D) Tel. Rec. (Also See Prod.  
 Chge. Bul. 65—Set  
 202-1 and Prod. Chge.  
 Bul. 77—Set 218-1) 197-5  
 722D (Ch. 120163-D) \*  
 Tel. Rec. 190-2  
 724B (Ch. 120151B) 208-5  
 725A (Ch. 120169-B) 209-2  
 727D (Ch. 120168D) Tel. Rec. (See Prod. Chge. Bul.  
 61—Set 195-1, Prod.  
 Chge. Bul. 71—Set 211-1  
 and Model 716D—  
 Set 190-2) 206-4  
 728D (Ch. 120166-D) Tel. Rec. (Also See Prod.  
 Chge. Bul. 65—Set  
 202-1 and Prod. Chge.  
 Bul. 77—Set 218-1) 197-5  
 731D (Ch. 120167-D and  
 Radio Ch. 120152-B) \*  
 Tel. Rec. (See Prod.  
 Chge. Bul. 65—Set  
 202-1 and Model  
 721D—Set 197-5) 206-4  
 732B (Ch. 120169B) \*  
 Tel. Rec. 206-4  
 732D (Ch. 120164-B) Tel. Rec. (See Model  
 711B—Set 183-6) 209-2  
 733F (Ch. 120169F and  
 Radio Ch. 120152F) \*  
 Tel. Rec. 206-4  
 734B (Ch. 120169B) \*  
 Tel. Rec. 206-4  
 736B (Ch. 120171-B) Tel. Rec. (See Prod. Chge. Bul.  
 65—Set 202-1, Prod.  
 Chge. Bul. 77—Set  
 218-1 and Model  
 721D—  
 Set 197-5) 207-3  
 737A, B (Ch. 120172A, B) 207-3  
 738B (Ch. 120150-B) (See  
 Model 718B—Set 191-7) 740D (Ch. 120173-D) Tel. Rec. (See Prod. Chge. Bul.  
 65—Set 202-1,  
 Prod. Chge. Bul. 77—  
 Set 218-1 and Model  
 721D—Set 197-5) 741D (Ch. 120168-D) Tel. Rec. (See Prod. Chge. Bul.  
 61—Set 195-1, Prod.  
 Chge. Bul. 71—Set 211-1  
 and Model 716D—  
 Set 190-2) 206-4  
 742B (Ch. 120169B) \*  
 Tel. Rec. 206-4  
 743B (Ch. 120171-B) Tel. Rec. (See Prod. Chge. Bul.  
 65—Set 202-1,  
 Prod. Chge. Bul. 77—Set  
 218-1 and Model  
 721D—  
 Set 197-5) 750D (Ch. 120166-D) Tel. Rec. (See Prod. Chge.

**EMERSON-FORD**

**EMERSON-Cont.**

Ch. 120098B	
(See Model 608A)	
Ch. 120090B, D	
(See Model 585)	
Ch. 120091D-QD	
(See Model 620)	
Ch. 120092D	
(See Model 619)	
Ch. 120094A	
(See Model 649A)	
Ch. 120095-B	
(See Model 614D)	
Ch. 120096B	
(See Model 632)	
Ch. 120098B	
(See Model 621)	
Ch. 120098P	
(See Model 622)	
Ch. 120099B	
(See Model 630)	
Ch. 120103B	
(See Model 600)	
Ch. 120104B, B	
(See Model 626)	
Ch. 120107B	
(See Model 627B)	
Ch. 120109	
(See Model 631)	
Ch. 120110, B, BC, C (See	
Model 614, B, BC, C)	
Ch. 120110E	
(See Model 648B)	
Ch. 120113, B, BC, C (See	
Model 644, B, BC, C)	
Ch. 120114	
(See Model 633)	
Ch. 120114B	
(See Model 629)	
Ch. 120118B	
(See Model 650)	
Ch. 120120	
(See Model 629B, C)	
Ch. 120123B	
(See Model 650D)	
Ch. 120124	
(See Model 651C)	
Ch. 120124B	
(See Model 629D)	
Ch. 120127-B	
(See Model 622B)	
Ch. 120128-B	
(See Model 663B)	
Ch. 120129-B	
(See Model 669B)	
Ch. 120131-B	
(See Model 665B)	
Ch. 120133B	
(See Model 660B)	
Ch. 120134B, G, H	
(See Model 661B)	
Ch. 120135B, G, H	
(See Model 666B)	
Ch. 120136-B	
(See Model 653B)	
Ch. 120138-B	
(See Model 650F)	
Ch. 120140B	
(See Model 676B)	
Ch. 120141-B	
(See Model 683B)	
Ch. 120142B	
(See Model 686L)	
Ch. 120143B, H	
(See Model 676F)	
Ch. 120144B, G, H	
(See Model 676D)	
Ch. 120148-B	
(See Model 669B)	
Ch. 120149A (See Model	
725A)	
Ch. 120150-B	
(See Model 718B)	
Ch. 120151-B (See Model	
724B)	
Ch. 120152-B	
(See Model 731D)	
Ch. 120152-F	
(See Model 733F)	
Ch. 120153-B	
(See Model 700B)	
Ch. 120154-B	
(See Model 704)	
Ch. 120155A, B (See	
Model 705A, B)	
Ch. 120158-B	
(See Model 700D)	
Ch. 120160-B	
(See Model 699D)	
Ch. 120162-A	
(See Model 709A)	
Ch. 120163-D	
(See Model 716D)	
Ch. 120164-B	
(See Model 711B)	
Ch. 120166-D	
(See Model 721D)	
Ch. 120167-D	
(See Model 731D)	
Ch. 120168-D	
(See Model 716F)	
Ch. 120169-B	
(See Model 711F)	
Ch. 120169-D	
(See Model 720F)	
Ch. 120169F	
(See Model 733F)	
Ch. 120171-B	
(See Model 736B)	
Ch. 120172A, B (See	
Model 737A, B)	
Ch. 120173-D (See	
Model 740D)	

**EMPRESS**

55, 56	7-14
<b>ESPEY (Also see Philharmonic)</b>	
RR13, RR13L	13-17
7B	47-8
7C	153-4
18B	90-7
31	103-9
511C	174-6
512	68-8
512B	182-4

**ESPEY-Cont.**

513, 514	63-8
524	90-7
581	14-10
10-17	
641, 642	8-11
651	9-14
652, 653 (See Model	
651-Set 9-14)	
751	90-7
6511, -2, -S, 6514, 6516,	
6517, 6520, -2, 6521,	
6533 (Ch. FJ97) (See	
Model 651-Set 9-14)	
6540, 6541	8-12
6542 (Ch. FJ97 (See	
Model 651-Set 9-14)	
6545 (Ch. FJ97)	5-16
6546 (Ch. FJ97) (See	
Model 651-Set 9-14)	
6547	8-12
6560 (Ch. FJ97 (See	
Model 651-Set 9-14)	
6611, 6612, 6613, 6614,	
6615, 6630, 6631, 6632,	
6634, 6635 (Ch. 97A),	
7541 (Ch. FJ97) (See	
Model 651-Set 9-14)	
7552	90-7
<b>ESQUIRE</b>	
60-10, 65-4	14-11
511	157-3
517 (See Model 520- Set 163-5)	
520	163-5
550	177-6
<b>FADA</b>	
DL21T Tel. Rec.	200-5
G-925 Tel. Rec.	89-6
P80	27-9
P82	21-10
P100	27-10
P111	178-6
P130	135-7
R7C15, R7C23 Tel. Rec.	158-3
R-1025 Tel. Rec.	114-4
R-1050 Tel. Rec.	114-4
S4C20 Tel. Rec.	142-8
S4C40 Tel. Rec.	142-8
S4F15 Tel. Rec.	142-8
S4T30 Tel. Rec.	142-8
S6C55 Tel. Rec.	134-7
S6C70 Tel. Rec.	134-7
S6T65 Tel. Rec.	134-7
S7C20, S7C30 Tel. Rec.	
(See Model S6C55- Set 134-7)	
S7C70 Tel. Rec.	134-7
S7T65 Tel. Rec.	134-7
S9C10 Tel. Rec.	134-7
S20T20 Tel. Rec. (See	
Model S6C55-Set	
134-7)	
S1015 Tel. Rec.	109-4
S1020 Tel. Rec.	109-4
S1030 Tel. Rec.	109-4
S1055, S1055X Tel. Rec.	134-7
S1060 Tel. Rec.	134-7
S1065 Tel. Rec.	134-7
TV30 Tel. Rec.	74-3
7C42 Tel. Rec.	179-5
7C52 Tel. Rec.	179-5
7T32 Tel. Rec.	177-7
1776 Tel. Rec.	204-4
1779 Tel. Rec.	204-4
20C22 Tel. Rec.	180-3
20T12 Tel. Rec.	180-3
21C2 Tel. Rec.	200-5
21T Tel. Rec.	200-5
24T2 Tel. Rec.	200-5
24T10 Tel. Rec.	180-3
173T, 175C, 177CD	
Tel. Rec.	192-5
215C Tel. Rec.	200-5
602	14-12
605, 606 Series.	1-13
609, 610 Series.	1-15
633	17-13
637	17-14

**FADA-Cont.**

652 Series	1-23
700	32-7
711	28-10
721 Tel. Rec.	177-7
740	28-10
7751 Tel. Rec. (See Model	
7732-Set 177-7)	
790	64-6
795	36-7
799 Tel. Rec.	74-3
830	97-5
845	97-6
855	92-2
880 Tel. Rec.	95A-5
899 Tel. Rec.	74-3
925 Tel. Rec.	89-6
930, 940 Tel. Rec.	74-3
965 Tel. Rec.	89-6
1000 Series	1-17
1001	17-15
<b>FAIRMONT</b>	
30T14A-036 Tel. Rec.	119-3
(Similar to Chassis)	
38T12A-058 Tel. Rec.	109-1
(Similar to Chassis)	
317T3 Tel. Rec.	72-4
(Similar to Chassis)	
318T4 Tel. Rec.	85-3
(Similar to Chassis)	
318T5 Tel. Rec.	85-3
(Similar to Chassis)	
318T4-872 Tel. Rec.	85-3
(Similar to Chassis)	
318T6A Tel. Rec.	85-3
(Similar to Chassis)	
318T6A-950 Tel. Rec.	85-3
(Similar to Chassis)	
318T9-900 Tel. Rec.	78-4
(Similar to Chassis)	
518T6A Tel. Rec.	85-3
(Similar to Chassis)	
518T9A-918 Tel. ec.	78-4
(Similar to Chassis)	
518T10A-916 Tel. Rec.	78-4
(Similar to Chassis)	
2318T6A-954 Tel. Rec.	85-3
(Similar to Chassis)	
2318T9A-912 Tel. Rec.	78-4
(Similar to Chassis)	
<b>FARNSWORTH (Also see</b>	
<b>Record Changer Listing)</b>	
EC-260	7-15
EK-081, EK-092, EK-093,	
EK-262, EK-263BL,	
E-263WL, E-264BL,	
EK-264WL, EK-265	7-15
EK-681	26-13
ET-060, ET-061, ET-063	6-11
ET-064, ET-065, ET-066	4-2
GK-100, GK-102	
GK-103, GK-104	23-8
GK-111, GK-112	
GK-114, GK-115	60-11
GK-140, GK-141, GK-142,	
GK-143, GK-144	24-18
GT-050, GT-051, GT-052,	
GT-060, GT-061, GT-064,	
GT-065 (See Model	
K-267, K-669 (See Model	
EC-260-Set 7-15)	
Ch. 150	
(See Model ET-060)	
Ch. 152, 153	
(See Model EC-260)	
Ch. 156, 157	
(See Model EK-081)	
Ch. 158, 159	
(See Model ET-064)	
Ch. 162	
(See Model EC-260)	
Ch. 170	
(See Model GK-100)	
Ch. 193	
(See Model EK-081)	
Ch. 194, 201, 216	
(See Model GK-100)	

**FEDERAL MFG. CO.**

104 (Select-A-Call)	18-17
135 (Select-A-Call)	11-7
<b>FEDERAL TEL. &amp; RADIO CORP.</b>	
1021 (See Model 1030T- Set 8-13)	8-13
1030T	
1031, 1032 (See Model	
1030T-Set 8-13)	
1040T	23-9
1040TB (See Model	
1040T-Set 23-9)	
1540T	8-13
<b>FERRAR</b>	
C-81-B	17-16
T-61B	39-4
WR-11	15-10
<b>FIRESTONE (AIR CHIEF)</b>	
4-A-2 (Code	
No. 297-6-LMMU-143)	14-4
4-A-3 (Code	
No. 297-6-LMFU-134)	31-13
4-A-10 (Code	
No. 297-7-RN228)	28-11
4-A-11 (Code	
No. 182-B-4A11)	41-7
4-A-12 (Code	
No. 213-8-8370)	49-8
4-A-15 (Code 177-7-4A15)	36-7
4-A-17 (Code	
No. 213-7-7270)	35-7
4-A-20 (Code 5-5-9000-A)	15-11
4-A-21 (Code	
No. 5-5-9001A)	11-19
4-A-22X (Code	
No. 5-5-9001B)	11-19
4-A-23 (5-5-9003-A)	2-29
4-A-24 (Code 291-6-566)	13-5
4-A-25 (Code 291-6-572)	13-6
4-A-26 (Code	
307-6-9030-A)	33-5
4-A-27 (See Model	
28-12)	
4-A-31 (Code	
No. 177-5-4A31)	11-20
4-A-37 (Code 177-5-4A37)	13-7
4-A-41 (Code 291-7-576)	52-8
4-A-42 (Code	
No. 177-7-4A42)	30-9
4-A-60 (Code	
No. 307-8-9047A)	38-6
4-A-61 (Code	
No. 332-8-137J2T)	48-7
4-A-62, 4-A-63	67-10
4-A-64, 4-A-65	68-9
4-A-66 (Code	
No. 177-8-4A66)	74-4
4-A-68 (Code	
No. 332-8-143653)	53-11
4-A-69 (Code	
No. 155-8-B5)	61-8
4-A-70	136-8
4-A-71 (Code 291-8-628)	59-9
4-A-78, 4-A-79	117-5
4-A-85	118-7
4-A-86	129-6
4-A-86 (Late)	144-4
4-A-87	119-7
4-A-88	132-6
4-A-89	118-7
4-A-92	154-4
4-A-95	144-4
4-A-96 (See Model	
4-A-87-Set 119-7)	
4-A-97, 4-A-98	147-5
4-A-101, 4-A-102	181-7
4-A-108 (Code 297-2-361)	191-8
4-A-110	215-6
4-A-112 (See Model	
4-A-92-Set 154-4)	
4-B-1 (Code 7-6-PM15)	7-1
4-B-2 (Code 7-6-PM14)	18-18
4-B-6 (Code	
No. 177-7-PM18)	29-8
4-B-56	133-6
4-B-57	124-4
4-B-58	135-8
4-B-60	153-5
4-B-61	155-6

**FIRESTONE-Cont.**

4-B-62	152-6
4-B-67 (Code 120-2-F152)	187-6
4-C-3	19-17
4-C-5 (Code 291-7-574)	33-6
4-C-6	19-17
4-C-13 (Code	
332-8-140623)	66-9
4-C-16, 4-C-17	120-6
4-C-18	110-8
4-C-19, 4-C-20	170-7
4-C-21 (Code	
120-2-C51-U)	185-7
13-G-4 (Code	
347-9-249B) Tel. Rec.	73-5
13-G-5 (Code	
291-9-651) Tel. Rec.	83-3
13-G-33 Tel. Rec.	108-6
13-G-44, 13-G-45 Tel. Rec.	*
13-G-46, 13-G-47	
Tel. Rec.	140-5
13-G-48 Tel. Rec.	143-6
13-G-49, 13-G-50 Tel. Rec.	*
13-G-51, 13-G-52 (Code	
307-1-9202A, AA, B,	
BA) Tel. Rec.	193-4
13-G-53, 13-G-54,	
13-G-55 Tel. Rec.	*
13-G-56 Tel. Rec.	152-7
13-G-57 Tel. Rec.	158-4
13-G-58, 13-G-59	
Tel. Rec.	*
13-G-79 Tel. Rec.	*
13-G-107, 13-G-108 (Code	
105-2-700140) Tel. Rec.	197-6
13-G-109, A (Code	
105-2-700100, 105-2-	
700104) Tel. Rec.	197-6
13-G-110 (Code 334-2,	
MS31CA) Tel. Rec.	180-4
13-G-110A (Code 334-2,	
MS31CA) Tel. Rec. (Also	
See Prod. Chge. Bul.	
60-Set 194-1 and Prod.	
Chge. Bul. 76-Set	
217-1)	182-5
105-2-8170) (Ch. 817)	
Tel. Rec.	198-6
13-G-115, 13-G-116 (Code	
334-2-MS31CA) Tel. Rec.	
(Also See Prod. Chge.	
Bul. 60-Set 194-1 and	
Prod. Chge. Bul. 76-Set	
217-1)	182-5
13-G-117 (Code	
105-2-8170) Ch. 817)	
Tel. Rec.	198-6
13-G-119, 13-G-120 (Code	
334-2-MS31CA) Tel. Rec.	
(Also See Prod. Chge.	
Bul. 60-Set 194-1 and	
Prod. Chge. Bul. 76-Set	
217-1)	182-5
13-G-122 (Code	
105-2-700140) Tel. Rec.	197-6
13-G-124 (Code 334-2,	
MS31CA) Tel. Rec.	
(See Model 13-G-107- Set 197-6)	
13-G-125 (Code	
105-2-8170) Tel. Rec.	
(See Model 13-G-107- Set 197-6)	
13-G-127 (Code 334-3,	
MS31D) Tel. Rec. (See	
Prod. Chge. Bul. 60- Set 194-1, Prod. Chge.	
Bul. 76-Set 217-1 and	

**FORD-Cont.**

98F (8A-18805-A1) [See Model M-1—Set 46-4]  
 9DF (8A-18805-A2) [See Model 8072—Set 44-4]  
 9MF (8A-18805-A3) [See Model 8072—Set 44-4]  
 9ZF (8A-18805-B1) [See Model BMF983—Set 83-4]  
 7070 (51A-18805-B2) 45-10  
 8072 (8A-18805-A) 44-4  
**FREED EISEMAN**  
 46 11-8  
 54, 55, 56, 68 [Ch. 1620C] Tel. Rec. 113-1A

**GALVIN (See Motorola)**

**GAMBLE-SKOGMO (See Coronado)**

**GAROD (Also see Majestic)**

4A-1, 4A-2 29-9  
 4B-1 51-6  
 5A-1 22-15  
 5A-2 5-28  
 5A-3 44-5  
 5A-4 40-6  
 5AP1-Y "The Companion" 15-12  
 5D, 5D-2 12-12  
 5D-3, 5D-3A 22-16  
 5D-4, 5D-5 33-7  
 5R-C 36-8  
 6A-2 28-13  
 6AU-1 5-29  
 6BU-1A "The Senator" 13-18  
 6DPS, 6DPS-A 12-13  
 10T21, 10T22, 10T23, 10T24, 10T25 Tel. Rec. 60-12  
 10T20, 10T21, 10T22, 10T23 Tel. Rec. 95-4  
 11FMP Tel. Rec. 38-7  
 12T21, 12T22, 12T23, 12T24, 12T25, 12T26A, 12T27A, Tel. Rec. 60-12  
 12T20, 12T21, 12T22, 12T23 Tel. Rec. 95A-4  
 15T26, 15T27 Tel. Rec. 60-12  
 15T24, 15T25, 15T26, 15T27 Tel. Rec. 95A-4  
 16CT4, 16CT5 Tel. Rec. [See Majestic Model 16CT4—Set 133-8]  
 19C6, 19C7 Tel. Rec. [See Majestic Model 19C6—Set 133-8]  
 628 29-10  
 306 48-8  
 900TV, 910TV Tel. Rec. 50-7  
 1000TV, 1010TV Tel. Rec. 50-7  
 1042G, 1043G Tel. Rec. [See Majestic Model 12C4—Set 108-7]  
 1042T, 1043T Tel. Rec. 93A-7  
 1100TVP, 1110TVP Tel. Rec. 50-7  
 1200TVP, 1210TVP Tel. Rec. 50-7  
 1244G, 1245G Tel. Rec. [See Majestic Model 12C4—Set 108-7]  
 1244T, 1245T Tel. Rec. 93A-7  
 1546G, 1547G Tel. Rec. [See Majestic Model 12C4—Set 108-7]  
 1546T, 1547T Tel. Rec. 93A-7  
 1548G, 1549G Tel. Rec. [See Majestic Model 12C4—Set 108-7]  
 1671 (98 Series) Tel. Rec. 97A-3  
 1671, 1672, 1673, 1674 Tel. Rec. [See Majestic Model 1671—Set 133-8]  
 1974, 1975 Tel. Rec. [See Majestic Model 1974—Set 133-8]  
 2042T, 2043T Tel. Rec. 93A-7  
 2546T Tel. Rec. 93A-7  
 2549T Tel. Rec. 93A-7  
 3912 TVFMP, 3915 TVFMP Tel. Rec. 95A-6  
**GARRARD (See Record Changer Listings)**  
**GENERAL (Mutual Buying Syndicate)**  
 17CG1, 17TW Tel. Rec. [Similar to Chassis] 149-13  
**GENERAL ELECTRIC (Also see Record Changer Listings)**  
 UHF-103 Tel. UHF Conv. 209-5  
 YRB-60-1, YRB-60-2 33-8  
 YRC-101, 10C102 Tel. Rec. 96-4  
 10T1 Tel. Rec. 96-4  
 10T4, 10T5, 10T6 Tel. Rec. 96-4  
 12C101, 12C102, 12C105 Tel. Rec. 96-4  
 12C107, 12C107B, 12C108, 12C108B, 12C109, 12C109B Tel. Rec. 125-7  
 12K1 Tel. Rec. 95A-6  
 12T1 Tel. Rec. 96-4  
 12T3, 12T3B, 12T4, 12T4B Tel. Rec. 125-7  
 12T7 Tel. Rec. 99A-5  
 14 35-8  
 14C102, 14C103 Tel. Rec. 123-4  
 14T2, 14T3 Tel. Rec. 123-4  
 16C103 Tel. Rec. 123-4  
 16C110, 16C111 Tel. Rec. 123-4  
 16C113 Tel. Rec. 123-4  
 16C115, 16C116, 16C117 Tel. Rec. 123-4  
 16K1, 16K2 Tel. Rec. 161-1A  
 16T1, 16T2, 16T3, 16T4, 16T5 Tel. Rec. 123-4  
 16T4—Set 123-4  
 17C101, 17C102 Tel. Rec. 123-4

**GENERAL ELECTRIC-Cont.**

17C103, 17C104, 17C105 Tel. Rec. [Also see Prod. Chge. Bul. 32—Set 158-1] 141-6  
 17C107, 17C108, 17C109 Tel. Rec. [Also see Prod. Chge. Bul. 32—Set 158-1] 141-6  
 17C110, 17C111 (Early, "D" and "W" Versions) Tel. Rec. 180-5  
 17C112 Tel. Rec. [See Prod. Chge. Bul. 32—Set 158-1 and Model 17C103—Set 141-6]  
 17C113 Tel. Rec. 166-10  
 17C114 Tel. Rec. [See Prod. Chge. 32—Set 158-1 and Model 17C103—Set 141-6]  
 17C117 Tel. Rec. 166-10  
 17C117 Tel. Rec. [See Model 17C113—Set 166-10]  
 17C120 Tel. Rec. 166-10  
 17C125 Tel. Rec. [See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2]  
 17C125-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2]  
 17T1, 17T2, 17T3 Tel. Rec. [Also see Prod. Chge. Bul. 32—Set 158-1] 141-6  
 17T4, 17T5, 17T6 Tel. Rec. [See Prod. Chge. Bul. 32—Set 158-1 and Model 17C103—Set 141-6]  
 17T7 Tel. Rec. [See Model 17C113—Set 141-6]  
 17T10 Tel. Rec. 196-3  
 17T10-UHF Tel. Rec. [For TV Ch. See Model 17T10—Set 196-3, For UHF Conv. See Model UHF-103—Set 209-5]  
 17T11 Tel. Rec. [See Model 17T10—Set 196-3]  
 17T11-UHF Tel. Rec. [For TV Ch. See Model 17T10—Set 196-3, For UHF Conv. See Model UHF-103—Set 209-5]  
 17T12 Tel. Rec. [See Model 17T10—Set 196-3]  
 17T12-UHF Tel. Rec. [For TV Ch. See Model 17T10—Set 196-3, For UHF Conv. See Model UHF-103—Set 209-5]  
 19C101 Tel. Rec. 99A-6  
 20C105, 20C106, Tel. Rec. 176-3  
 20C107 Tel. Rec. [See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2]  
 20C107-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 20C150, 20C151 Tel. Rec. 153-6  
 20T2 Tel. Rec. 176-3  
 21C200 Tel. Rec. 176-3  
 21C201 Tel. Rec. [Also see Prod. Chge. Bul. 64—Set 201-1] 194-2  
 21C201-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21C202-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21C202 Tel. Rec. [Also See Prod. Chge. Bul. 64—Set 201-1] 194-2  
 21C202-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21C206 Tel. Rec. [Also See Prod. Chge. Bul. 64—Set 201-1] 194-2  
 21C206-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C206—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21C208 Tel. Rec. [Also See Prod. Chge. Bul. 64—Set 201-1] 194-2  
 21C208-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C208—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21C208U Tel. Rec. [See Prod. Chge. Bul. 64—Set 201-1 and Model 21C208—Set 194-2]

**GENERAL ELECTRIC-Cont.**

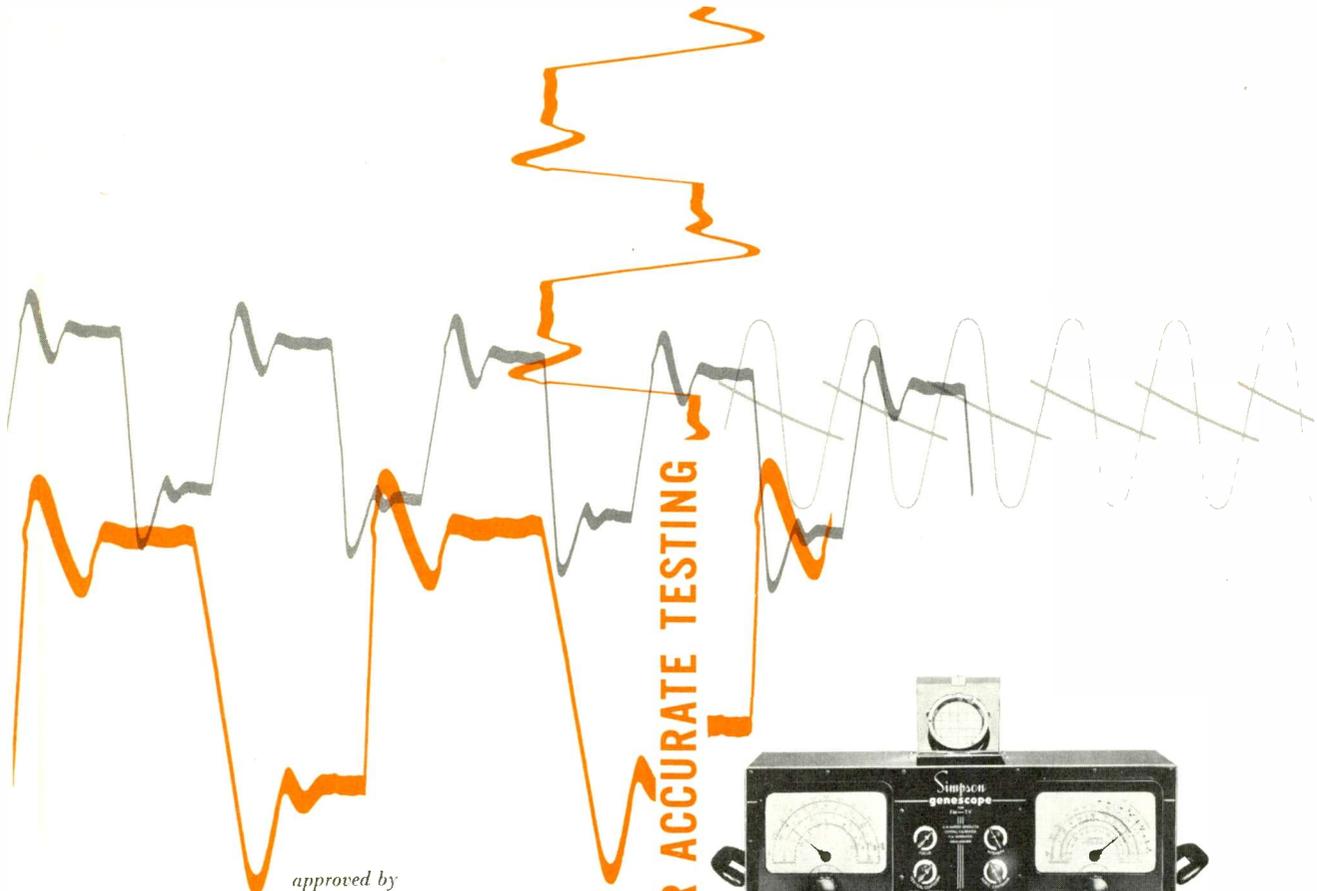
21C208U-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C208—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21C210 Tel. Rec. [See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2]  
 21C210-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C201—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21C214 Tel. Rec. [Also See Prod. Chge. Bul. 64—Set 201-1] 194-2  
 21C214-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21C214—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21T11 Tel. Rec. [Also See Prod. Chge. Bul. 64—Set 201-1] 194-2  
 21T11-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21T11—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 21T12 Tel. Rec. [See Model 21T11—Set 194-2]  
 21T3 Tel. Rec. [See Model 21T11—Set 194-2]  
 21T3-UHF Tel. Rec. [For TV Ch. See Prod. Chge. Bul. 64—Set 201-1 and Model 21T11—Set 194-2, For UHF Conv. See Model UHF-103—Set 209-5]  
 24C101 Tel. Rec. 152-8  
 41, 42, 43, 44, 45 32-8  
 50, 52 7-16  
 60, 62 36-9  
 64, 65 98-4  
 66, 67 76-12  
 100, 101 6-13  
 102, 102W 41-8  
 103, 105 6-13  
 106 8-14  
 107, 107W 41-8  
 113 51-7  
 114, 114W, 115, 115W 41-8  
 118, 119W, 119W 39-5  
 123, 124 97-7  
 131 [See Model 118—Set 39-5]  
 135, 136 81-8  
 140 30-10  
 143 75-9  
 145 60-13  
 150 56-11  
 160 56-12  
 165 89-7  
 180 11  
 186-4 57-7  
 200, 201, 202, 203, 205, 205M 8-15  
 210, 211, 212 51-8  
 218, 218 "H" 121-5  
 219, 220, 221 12-11  
 225 91-5  
 230 [See Kaiser-Frazer Model 200001—Set 35-13]  
 250 4-13  
 254 32-9  
 260 15-13  
 280 23-10  
 303 18-19  
 304 32-10  
 321 3-26  
 324 64-7  
 326, 327 30-11  
 328 64-7  
 329, 330 [See Model 324—Set 64-7]  
 354, 355 33-9  
 356, 357, 358 37-6  
 376, 377, 378 45-11  
 400, 401 118-8  
 404, 405 121-11  
 408 116-6  
 409 176-4  
 410 121-6  
 411 118-8  
 412 189-9  
 412F 211-6  
 414 175-11  
 414F 211-6  
 415 175-11  
 415F 211-6  
 416 175-11  
 416F 211-6  
 417 161-5  
 422, 423 154-5  
 431 175-11  
 500, 501 98-4

**GENERAL ELECTRIC-Cont.**

502 35-9  
 505, 506, 507, 508, 509 98-4  
 510, 511 120-7  
 510F, 511F, 512F, 513F 143-7  
 514 198-7  
 515F, 516F, 517F, 518F 143-7  
 521, 522 114-5  
 521F, 522F 143-7  
 530 98-4  
 535 151-7  
 542, 543 198-7  
 546, 547, 548, 549 191-9  
 551, 552 201-4  
 600 109-6  
 601, 603, 604 115-3  
 605, 606 145-6  
 607, 608 [See Model 605—Set 145-6]  
 610, 611 147-7  
 614, 615 199-6  
 650 101-3  
 741 157-6  
 752, 753 123-5  
 754 167-8  
 755 130-6  
 756 167-8  
 757 [See Model 755—Set 130-6]  
 800A, B, C, D Tel. Rec. [See Model 805—Set 78-7]  
 801 Tel. Rec. [Photofax Servicer] 78  
 802 Tel. Rec. 91A-7  
 803 Tel. Rec. 97A-4  
 805, 806, 807, 809 Series Tel. Rec. 78-7  
 810 Tel. Rec. 53-12  
 811 Tel. Rec. 63-9  
 814 Tel. Rec. 69-9  
 815 Tel. Rec. 97A-5  
 817 Tel. Rec. 78-7  
 818 Tel. Rec. 95A-7  
 820 Tel. Rec. \*  
 821 Tel. Rec. 78-7  
 830 Early, Tel. Rec. 81-9  
 835 Early, Tel. Rec. 81-9  
 840 Tel. Rec. 81-9  
 901 Tel. Rec. 97A-5  
 910 Tel. Rec. 97A-5  
**GENERAL IMPLEMENT**  
 9A5 37-7  
**GENERAL INDUSTRIES (See Changer and Recorder Listings)**  
**GENERAL INSTRUMENT (See Record Changer Listings)**  
**GENERAL MOTORS CORP. (GMC)**  
 2233029 93-6  
**GENERAL TELEVISION**  
 1A5, 2A5, 3A5, 5A5 (Ch. 1-1) 1-21  
 485 27-11  
 585G, 585Y 27-12  
 9A5 39-6  
 986P 36-10  
 1444F 3-21  
 15A5 (Ch. 1-1) 1-21  
 17A5 5-22  
 19A5 (Ch. 1-1) 1-21  
 21A4 12-14  
 22A5C 13-19  
 23A6 14-14  
 2486 37-8  
 2585 26-15  
 2685 29-11  
 27C5 36-11  
**GILFILLAN**  
 56A, 56B 1-27  
 56BC1, 56BCR [See Model 56A—Set 1-27] 1-27  
 56C, 56D 1-27  
 56E [See Model 56A—Set 1-27] 1-27  
 58M, 58W 45-12  
 66A, 66AM 8-16  
 66B "The Overland" 8-17  
 66D, 66DM 8-16  
 66P, 66PM 9-15  
 "The El Dorado" 9-15  
 68B-D 46-10  
 68F 46-11  
 68-48 61-10  
 86C, 86P, 86U (86 Series) 26-16  
 108-48 59-10  
**GLOBE**  
 58P1 18-20  
 6AP1 20-12  
 6D1 20-13  
 6P1 20-13  
 6U1 20-13  
 7CP-1 28-14  
 517 66PM 21-18  
 62C 19-19  
 85 49-9  
 454 41-9  
 456 40-7  
 457 39-7  
 500 21-18  
 517 21-17  
 551 16-16  
 552 27-13  
 553 28-15  
 559 50-8  
**GODFREY**  
 6AD 28-17  
 65M 28-17  
**GON-SET**  
 3-30 Meter Converter 61-11  
 10-11 Meter Converter 37-9  
**GOODELL**  
 ATB-3 70-5  
 NSA-20 73-6

**FORD-HALLICRAFTERS**

**B. F. GOODRICH (Also see Mantala)**  
 92-523, 92-524, 92-525, 92-526, 92-527, 92-528 148-7  
**GOTHAM**  
 319 Tel. Rec. 209-6  
**GRANCO**  
 CTU UHF Conv. 217-6  
**W. T. GRANT (See Grantline)**  
**GRANTLINE**  
 300 (Series B) 9-16  
 500, 501 (Series A) 9-17  
 501-7 35-10  
 504-7 21-19  
 508-7 34-8  
 510-A 24-19  
 605, 606 2-17  
 641 12-15  
 651 11-9  
 5610 35-11  
 6547 11-10  
**GROMMES**  
 LJ-2 194-3  
 50PG, 51PG 163-6  
 50PG2 206-6  
 100BA 189-10  
 117FS, 210PA 189-10  
 205PA 191-10  
 215BA 198-8  
**HALLICRAFTERS (Also see Echophone)**  
 A-84 (Run 1) 209-7  
 CA-2, CA-2A 30-12  
 CA-4 36-13  
 S-38 3-7  
 S-38B 121-7  
 S-38C (Run 2) 190-4  
 S-40 2-19  
 S-40A 33-10  
 S-40B 122-4  
 S-41G, S-41W 10-19  
 S-47 46-12  
 S-51 40-8  
 S-52 48-9  
 S-53 39-8  
 553A, AU 171-5  
 S-55, S-56 55-9  
 S-58 57-8  
 S-59 58-10  
 S-72 82-6  
 S-72L 173-6  
 S-76, S-76U 143-9  
 S-77 146-7  
 S-78 124-5  
 S-78A (Run 1) 80-6  
 S-80 162-6  
 S-81 166-11  
 S-82 167-9  
 ST-74 125-8  
 ST-83 218-5  
 SX-42 44-6  
 SX-43 45-13  
 SX-62 61-12  
 SX-71 111-6  
 T-54 (Early) Tel. Rec. 48-10  
 T-54 (Late) Tel. Rec. 91-6  
 T-60 Tel. Rec. 63-10  
 T-61, T-64, T-67 Tel. Rec. [Also see Prod. Chge. Bul. 32—Set 158-1] 65-7  
 T-68 (Tel. Rec.) 63-10  
 T-69 Tel. Rec. \*  
 5R10 130-7  
 5R10A (Run 1) 153-7  
 5R10A (Run 4) [See Model 5R10A (Run 1)—Set 153-7]  
 5R11, 5R12, 5R13, 5R14 129-7  
 5R18, 5R19, 5R20, 5R21, 5R22 [See Model 5R11—Set 129-7] 168-7  
 5R24 168-7  
 5R30, A, 5R31, A, 5R32, A, 5R33, A, 5R34, A, 170-8  
 5R50, 5R51, 5R52 179-6  
 5R100A (Run 4) [See Model 5R10A (Run 1)—Set 153-7]  
 5R100A (Run 1) 181-7  
 400, 406, 409, 410, 411, 412 52-9  
 505 (Early) Tel. Rec. 48-10  
 505 (Late) [See Model 505 (Early) Tel. Rec.] 48-10  
 506 (Early) Tel. Rec. [See Model 505 (Early) Tel. Rec.—Set 48-10]  
 506 (Late) Tel. Rec. 91-6  
 509, 510 Tel. Rec. [Also see Prod. Chge. Bul. 32—Set 158-1] 65-7  
 511 Tel. Rec. 96-5  
 512C, 513 T Tel. Rec. 80-7  
 514 Tel. Rec. 91-6  
 515 Tel. Rec. 80-7  
 518, 519, 520 Tel. Rec. 92-3  
 520E Tel. Rec. 80-7  
 521 Tel. Rec. 92-3  
 521E Tel. Rec. 80-7  
 524 Tel. Rec. 80-7  
 600, 601, 602, 603, 604 Tel. Rec. 92-3  
 605, 606 Tel. Rec. 107-5  
 680, 681 Tel. Rec. 113-3  
 690 Tel. Rec. 113-3  
 715, 716 Tel. Rec. 113-3  
 716 Tel. Rec. [See Model 680—Set 113-3]  
 730, 731 (Run 1) Tel. Rec. [See Model 680—Set 113-3]  
 732, 733 Tel. Rec. \*  
 740, 741 (Run 1) Tel. Rec. [See Model 680—Set 113-3]  
 745 Tel. Rec. 105-4  
 750, 751, Tel. Rec. 105-4  
 760, 761 Tel. Rec. 105-4  
 805, 806 Tel. Rec. 134-9  
 810 Tel. Rec. 134-9



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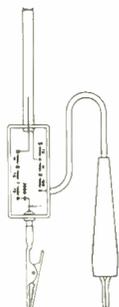
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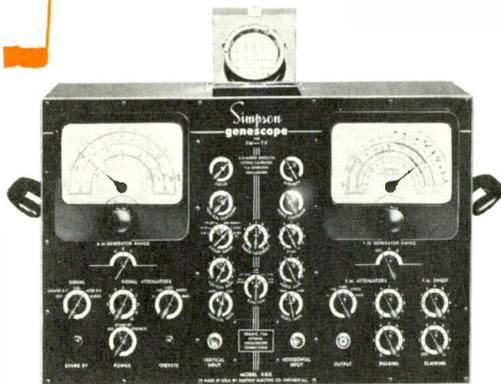
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**HALLICRAFTERS—Cont.**

810A, 811 Tel. Rec.	124-6
815 Tel. Rec.	124-6
818, 820 Tel. Rec.	124-6
821 Tel. Rec. (See Model 810A—Set 124-6)	
822 Tel. Rec.	124-6
832, 833 Tel. Rec.	121-1A
860, 861 Tel. Rec.	124-6
870, 871 Tel. Rec. (See Model 810A—Set 124-6)	
880 Tel. Rec. (See Model 810A—Set 124-6)	
1000 (Ch. W1000D)	180-7
1001 (Ch. F1100D) (See Model 1002—Set 169-7)	
1002, 1003, 1004 (Ch. F1100D) Tel. Rec.	169-7
1005, 1006 (Ch. A1100D)	
1007 (Ch. F1100D) Tel. Rec.	169-7
1008 (Ch. X1000D) Tel. Rec.	180-7
1010P (Ch. A-1200D, K1200D, W1200D)	
1010P (Ch. A-1200D, K1200D, W1200D) Tel. Rec.	188-6
1013C (Ch. F1200D)	
1013, 1016, 1017, 1018, 1019 (Ch. A1100D) Tel. Rec.	177-8
1019 (Ch. Z1000D)	
1021P (Ch. D1200D, L1200D, X1200D) Tel. Rec.	188-6
1022C (Ch. G1200D) Tel. Rec.	188-6
1025 (Ch. C1000D) Tel. Rec.	172-4
1026P (Ch. D1200D, L1200D, X1200D) Tel. Rec.	188-6
1027C (Ch. G1200D) Tel. Rec.	188-6
1050, A (Ch. A11200D) Tel. Rec.	211-7
1051P, 1052P (Ch. P1200D) Tel. Rec. (See Prod. Chge. Bul. 75—Set 216-1 and Model 1010P—Set 188-6)	
1053P, 1054P (Ch. R1200D) Tel. Rec. (See Prod. Chge. Bul. 75—Set 16-1 and Model 1010P—Set 188-6)	
1055C, 1056C (Ch. T1200D) Tel. Rec. (See Prod. Chge. Bul. 75—Set 216-1 and Model 1010P—Set 188-6)	
1060C, 1061C (Ch. T1200D) Tel. Rec. (See Prod. Chge. Bul. 75—Set 216-1 and Model 1010P—Set 188-6)	
1062C, 1063C (Ch. J1200D) Tel. Rec. (See Prod. Chge. Bul. 75—Set 216-1 and Model 1010P—Set 188-6)	
1072 (Ch. AG1200D) Tel. Rec.	211-7
1072A (Ch. A1200D) Tel. Rec.	211-7
1074 (Ch. AG1200D) Tel. Rec.	211-7
1074A (Ch. A1200D) Tel. Rec.	211-7
1074AT (Ch. AY1200D) Tel. Rec.	211-7
1075 (Ch. AG1200D) Tel. Rec.	211-7
1075A (Ch. A1200D) Tel. Rec.	211-7
1075AT (Ch. AY1200D) Tel. Rec.	211-7
1077 (Ch. AH1200D) Tel. Rec.	211-7
1078 (Ch. AG1200D) Tel. Rec.	211-7
1078A (Ch. A1200D) Tel. Rec.	211-7
1078AT (Ch. AY1200D) Tel. Rec.	211-7
1081, A (Ch. A1200D) Tel. Rec.	211-7
1085, A (Ch. A1200D) Tel. Rec.	211-7
1088, A (Ch. A1200D) Tel. Rec.	211-7
1111P (Ch. A1200D) Tel. Rec.	188-6
1113P (Ch. D1200D) Tel. Rec.	188-6
14808 (Ch. R900D) Tel. Rec.	167-10
17804C Tel. Rec.	155-8
17810M Tel. Rec.	152-9
17811-H Tel. Rec.	156-6
17812, 17813, 17814, 17815-H Tel. Rec.	155-8
17816, 17817 Tel. Rec.	156-6
17819 Tel. Rec.	155-8
17824 Tel. Rec.	155-8
17824-A Tel. Rec.	165-6
17829 (Ch. F1100D) Tel. Rec. (See Model 1002—Set 169-7)	
17838 Tel. Rec.	155-8
17848, 17849, 17850 Tel. Rec.	155-8
17860-H, 17861-H Tel. Rec.	156-6
17905 Tel. Rec. (See Model 17810-M—Set 152-9)	
17906 Tel. Rec.	165-6
17930, 17931, 17932, 17933, 17934 Tel. Rec.	165-6

**HALLICRAFTERS—Cont.**

20823 (Ch. M900D) Tel. Rec.	167-10
20823B (Ch. L900D) Tel. Rec.	167-10
20823C Tel. Rec.	165-6
20827 Tel. Rec.	155-8
20882 Tel. Rec.	155-8
20990, 20990S, 20994 Tel. Rec.	154-6
21923 Tel. Rec.	165-6
21928 Tel. Rec.	165-6
21940 Tel. Rec.	165-6
21980 Tel. Rec.	165-6
Ch. A1100D (See Model 1005)	
Ch. A1200D (See Model 1010P)	
Ch. AG1200D (See Model 1072)	
Ch. AH1200D (See Model 1077)	
Ch. AJ1200D (See Model 1081)	
Ch. AL1200D (See Model 1050)	
Ch. AR1200D (See Model 1072A)	
Ch. AT1200D (See Model 1074AT)	
Ch. D1200D (See Model 1021P)	
Ch. F1200D (See Model 1013C)	
Ch. G1200D (See Model 1022C)	
Ch. J1200D (See Model 1062C)	
Ch. K1200D (See Model 1010P)	
Ch. L1200D (See Model 1021P)	
Ch. P1200D (See Model 1051P)	
Ch. R1200D (See Model 1053P)	
Ch. T1200D (See Model 1055C)	
Ch. W1000D (See Model 1000)	
Ch. W1200D (See Model 1010P)	
Ch. X1000D (See Model 1008)	
Ch. X1200D (See Model 1021P)	
Ch. Z1000D (See Model 1019)	

**HAMILTON ELECTRONICS**

H-15-5	16-17
H-50-2S	16-18

**HAMILTON RADIO CORP. (See Olympic)**

**HAMMARLUND**

HQ-129-X	8-18
SP-400-X	10-20

**HARVEY-WELLS**

AT-38-6, AT-38-12	32-11
ATR-3-6, ATR-3-12	36-14

**HEATH**

HBR-5	24-20
-------	-------

**HOFFMAN**

A-200 (Ch. 103)	4-23
A-202 (Ch. 119)	11-11
A-300	4-41
A-309 (Ch. 119)	11-11
A-403 (Ch. 102)	11-12
A-500 (Ch. 107)	4-34
A-501 (Ch. 108ST)	3-35
A-700 (Ch. 110S)	12-16
B-400	17-17
B-1000	20-14
C-501	48-11
C-502	51-9
C-503	50-9
C-504, (Ch. 123)	47-10
C-506, C-507	49-10
C-511	48-11
C-512	51-9
C-513	50-9
C-519 (Ch. 120)	47-10
C-518	61-13
C710, (Ch. 133)	*
CI006, CI007	54-9
CT-800, CT-801, CT-900, CT-901 (Tel. Rec.)	63-11
7B104 (Ch. 190, B)	201-5
7B113 (Ch. 202) Tel. Rec.	205-5
7B113B (Ch. 212, M) Tel. Rec.	194-4
7B128 (Ch. 212) Tel. Rec. (See Model 7B113B—Set 194-4)	
7B303 (Ch. 190, B) Tel. Rec.	201-5
7M103 (Ch. 190, B) Tel. Rec.	201-5
7M109 (Ch. 200) Tel. Rec.	205-5
7M109B (Ch. 210, M) Tel. Rec.	205-5
7M112 (Ch. 202) Tel. Rec.	205-5
7M112B (Ch. 212, M) Tel. Rec.	194-4
7M127 (Ch. 212) Tel. Rec. (See Model 7B113B—Set 194-4)	
7M302 (Ch. 190, B) Tel. Rec.	201-5
7P105 (Ch. 190, B) Tel. Rec.	201-5
7P111B (Ch. 210, M) Tel. Rec.	205-5
7P114B (Ch. 212, M) Tel. Rec. (See Model 7B113B—Set 194-4)	
7P304 (Ch. 190, B) Tel. Rec.	201-5
20B102 (Ch. 183T) Tel. Rec.	168-8

**HOFFMAN—Cont.**

20B102F (Ch. 194) Tel. Rec.	201-5
20B501 (Ch. 183T) Tel. Rec.	168-8
20M101 (Ch. 183T) Tel. Rec.	168-8
20M101F (Ch. 194) Tel. Rec.	201-5
20M500 (Ch. 183T) Tel. Rec.	168-8
20P502 (Ch. 183T) Tel. Rec.	168-8
21B107 (Ch. 191, B) Tel. Rec.	201-5
21B116 (Ch. 196, M) Tel. Rec.	195-8
21B122 (Ch. 211, M) Tel. Rec.	194-4
21B134 (Ch. 211) Tel. Rec. (See Model 1077)	
21B122—Set 194-4	
21B137 (Ch. 196) Tel. Rec. (See Model 1081)	
21B136—Set 195-8	
21B301 (Ch. 191, B) Tel. Rec.	201-5
21B306B (Ch. 211, M) Tel. Rec.	194-4
21B309 (Ch. 196M, T) Tel. Rec.	195-8
21B315 (Ch. 211T) Tel. Rec. (See Model 21B122—Set 194-4)	
21B504 (Ch. 191, B) Tel. Rec.	201-5
21B507 (Ch. 211, M) Tel. Rec.	194-4
21B510, T (Ch. 196) Tel. Rec. (See Model 21B116—Set 195-8)	
21B701 (Ch. 191, B) Tel. Rec.	201-5
21B701 (Ch. 196M, T) Tel. Rec.	195-8
21B716 (Ch. 211T) Tel. Rec. (See Model 21B122—Set 194-4)	
21B901 (Ch. 192) Tel. Rec. (TV Ch. only)	201-5
21B904 (Ch. 213, M) Tel. Rec.	211-8
21M106 (Ch. 191, B) Tel. Rec.	201-5
21M115 (Ch. 196, M) Tel. Rec.	195-8
21M121 (Ch. 211, M) Tel. Rec.	194-4
21M133 (Ch. 211) Tel. Rec. (See Model 21B122—Set 194-4)	
21M136 (Ch. 196) Tel. Rec. (See Model 21B116—Set 195-8)	
21M300 (Ch. 191, B) Tel. Rec.	201-5
21M305 (Ch. 201) Tel. Rec.	205-5
21M305B (Ch. 211, M) Tel. Rec.	194-4
21M308 (Ch. 196M, T) Tel. Rec.	195-8
21M314 (Ch. 211T) Tel. Rec. (See Model A200)	
21B122—Set 194-4	
21M503 (Ch. 191, B) Tel. Rec.	201-5
21M504 (Ch. 211, M) Tel. Rec.	194-4
21M509 (Ch. 196) Tel. Rec. (See Model 902)	
21B116—Set 195-8	
21M700 (Ch. 191, B) Tel. Rec.	201-5
21M700 (Ch. 196M, T) Tel. Rec.	195-8
21M715 (Ch. 211T) Tel. Rec. (See Model 902)	
21B122—Set 194-4	
21M900 (Ch. 192) Tel. Rec. (TV Ch. only)	201-5
21M903 (Ch. 213, M) Tel. Rec.	211-8
21P108 (Ch. 191, B) Tel. Rec.	201-5
21P117 (Ch. 196, M) Tel. Rec.	195-8
21P123 (Ch. 211, M) Tel. Rec.	194-4
21P307B (Ch. 211, M) Tel. Rec.	194-4
21P310 (Ch. 196M, T) Tel. Rec.	195-8
21P505 (Ch. 191, B) Tel. Rec.	201-5
21P508 (Ch. 211, M) Tel. Rec.	194-4
21P511 (Ch. 196) Tel. Rec. (See Model 21B116—Set 195-8)	
21P702 (Ch. 191, B) Tel. Rec.	201-5
21P702 (Ch. 196M, T) Tel. Rec.	195-8
21P717 (Ch. 211) Tel. Rec. (See Model 21B122—Set 194-4)	
21P902 (Ch. 192) Tel. Rec. (TV Ch. only)	201-5
21P905 (Ch. 213, M) Tel. Rec.	211-8
24B707 (Ch. 187, B, C) Tel. Rec.	159-6
24M708 (Ch. 187, B, C) Tel. Rec.	159-6
600 (Ch. 154) Tel. Rec.	95A-8
601 (Ch. 155) Tel. Rec.	95A-8
610 (Ch. 140) Tel. Rec.	97A-6
612 (Ch. 142) Tel. Rec.	97A-6
613 (Ch. 149) Tel. Rec.	97A-6
630, 631 (Ch. 159) Tel. Rec.	*
630, 631 (Ch. 170) Tel. Rec.	150-7

**HOFFMAN—Cont.**

632, 633 (Ch. 160) Tel. Rec.	*
632, 633, 634, 635 (Ch. 171) Tel. Rec.	150-7
634A, 635A (Ch. 173) Tel. Rec.	150-7
636, 637, (Ch. 183) Tel. Rec.	141-7
636B, 637B (Ch. 183 B) Tel. Rec.	168-8
638, 639 (Ch. 180) Tel. Rec.	144-5
816, 817 (Ch. 145) Tel. Rec.	*
820, 821, 822 (Ch. 146) Tel. Rec.	*
826, 827, 828 (Ch. 143) Tel. Rec.	95A-8
830, 831 (Ch. 151) Tel. Rec.	97A-6
832 (Ch. 151) Tel. Rec. (See Model 830—Set 97A-6)	
836, 837 (Ch. 153) Tel. Rec.	93A-8
840 (Ch. 153) Tel. Rec.	93A-8
846 (Ch. 151) Tel. Rec. (See Model 830—Set 97A-6)	
847, 848, 849 (Ch. 156) Tel. Rec.	97A-7
860, 861, 862 (Ch. 157) Tel. Rec.	97A-7
866, A, 867, A, 868, A (Ch. 173) Tel. Rec.	150-7
870, 871, 872 (Ch. 170) Tel. Rec.	150-7
876, 877, 878 (Ch. 171) Tel. Rec.	150-7
876A, 877A, 878A (Ch. 173) Tel. Rec.	150-7
880, 881, 882, 883, 884, 885, 886, 887 (Ch. 183) Tel. Rec.	141-7
886B, 887B, (Ch. 183B) Tel. Rec.	168-8
890, 891, 892 (Ch. 175) Tel. Rec.	150-7
893, 894, 895, 896, 897 (Ch. 185) Tel. Rec.	141-7
896B, 897B (Ch. 183T) Tel. Rec.	168-8
902 (Ch. 141, Radio Ch. 137) Tel. Rec.	*
912, 913 (Ch. 147) Tel. Rec.	95A-8
914, 915 (Ch. 150) Tel. Rec.	97A-6
917, 918 (Ch. 152) Tel. Rec.	97A-6
920 (Ch. 152) Tel. Rec. (See Model 830—Set 97A-6)	
946, 947, 948 (Ch. 164) Tel. Rec.	97A-7
950, 951, 952 (Ch. 172), 950A, 951A, 952A (Ch. 174) Tel. Rec.	127-6
953, 954, 955 (Ch. 184) Tel. Rec.	141-7
960, 961, 962, (Ch. 176) Tel. Rec.	127-6
963, 964, 965 (Ch. 186) Tel. Rec.	141-7
Ch. 102 (See Model A401)	
Ch. 103 (See Model A200)	
Ch. 107 (See Model A500)	
Ch. 108ST (See Model A501)	
Ch. 1105 (See Model A700)	
Ch. 114 (See Model B1000)	
Ch. 119 (See Model A202)	
Ch. 123 (See Model C504)	
Ch. 137 (See Model 902)	
Ch. 140 (See Model 610)	
Ch. 141 (See Model 902)	
Ch. 142 (See Model 612)	
Ch. 143 (See Model 826)	
Ch. 146 (See Model 820)	
Ch. 147 (See Model 826)	
Ch. 149 (See Model 613)	
Ch. 150 (See Model 914)	
Ch. 151 (See Model 917)	
Ch. 152 (See Model 917)	
Ch. 153 (See Model 836)	
Ch. 154 (See Model 600)	
Ch. 155 (See Model 601)	
Ch. 156 (See Model 847)	
Ch. 157 (See Model 860)	
Ch. 164 (See Model 946)	
Ch. 170, 171 (See Model 630)	
Ch. 172 (See Model 950)	
Ch. 173 (See Model 634A)	
Ch. 174 (See Model 950A)	
Ch. 175 (See Model 890)	
Ch. 176 (See Model 946)	
Ch. 183 (See Model 636)	
Ch. 183B, 183M, 183T (See Model 636B)	
Ch. 186 (See Model 963)	
Ch. 187, B, C (See Model 24B707)	
Ch. 190, B (See Model 7B104)	
Ch. 191, B (See Model 21B107)	
Ch. 192 (See Model 21B901)	
Ch. 194 (See Model 20B102F)	
Ch. 196, M (See Model 21B116)	
Ch. 196T (See Model 21B701)	
Ch. 200 (See Model 7B110B)	
Ch. 201 (See Model 21M305)	
Ch. 202 (See Model 7B113)	
Ch. 210, M (See Model 7M109B)	
Ch. 211, M (See Model 21B122)	
Ch. 211T (See Model 21B315)	
Ch. 212, M (See Model 7B113B)	
Ch. 213, M (See Model 21B904)	

**HOWARD**

472AC, 472AF, 472C, 472F	31-14
474, 475	32-12
475TV Tel. Rec.	84
Photofact Servicer	84

**HOWARD—Cont.**

481B, 481C, 481M	67-11
482, 482A	68-12
901A-E, -H, -I, -M, -W (See Model 901A Series—Set 1-8)	
901A Series	1-8
901A	10-21
906, 906C	17-18
909M	25-15
920	5-7

**HUDSON (Auto Radio)**

DB47 (Fact. No. 6MH089)	25-16
DB48 (Fact. No. 6MH889)	39-9
22590A (Early)	149-6
22590B (Early)	149-6
(Ch. 749-1)	167-11
229403 (Ch. 749-2)	167-11
236476 (SH759)	215-8
236486 (SH758)	214-4
238060 (SH758)	214-4

**HUDSON (Dept. Stores)**

30T14A-056 Tel. Rec. (Similar to Chassis)	119-3
38T12A-058 Tel. Rec. (Similar to Chassis)	109-1
31773 Tel. Rec. (Similar to Chassis)	72-4
31874 Tel. Rec. (Similar to Chassis)	85-3
31874S Tel. Rec. (Similar to Chassis)	85-3
31874-872 Tel. Rec. (Similar to Chassis)	85-3
31876A Tel. Rec. (Similar to Chassis)	85-3
31879A-900 Tel. Rec. (Similar to Chassis)	85-3
31879A-900 Tel. Rec. (Similar to Chassis)	78-4
321M531C-A Tel. Rec. (Similar to Chassis)	182-5

**JACKSON—MAJESTIC**

**JACKSON—Cont.**

254 ..... 173-8  
 255 ..... 179-7  
 312 Tel. Rec. .... 132-8  
 316 Tel. Rec. .... 132-8  
 350 ..... 131-9  
 412 Tel. Rec. .... 132-8  
 416 Tel. Rec. .... 132-8  
 1400T Tel. Rec. (See Model 10C—Set 132-8)  
 1700, T Tel. Rec. (See Model 10C—Set 132-8)  
 2000C Tel. Rec. (See Model 10C—Set 132-1)  
 5000, 5050 Tel. Rec. .... 88-5  
 5200, 5250 Tel. Rec. .... 88-5  
 5600, 5650 Tel. Rec. .... 88-5  
 Ch. 114H Tel. Rec. .... 162-7  
 Ch. 116H, 117H ..... 162-7  
 Tel. Rec. .... 162-7  
 Ch. 120H Tel. Rec. .... 162-7  
 Ch. 317A, 320A, 321A, 324A, Tel. Rec. .... \*

**JEFFERSON-TRAVIS**

MR-28 ..... 10-22  
 MR3 ..... 17-19

**JEWEL**

17CP, 17T9, 17W7 ..... 187-7  
 Tel. Rec. .... 187-7  
 21CP, 21T9 Tel. Rec. .... 23-11  
 300 ..... 35-12  
 304 ..... 35-12  
 500A, B, C, 501A, B, C, 502A, B, C, 503A, B, C, 504A, B, C, 505A, B, C, 15-14  
 505 "Pin-Up" ..... 18-21  
 801 (Trixie) ..... 45-14  
 814 ..... 51-10  
 910 ..... 99-8  
 915 ..... 99-8  
 920A ..... 55-10  
 921 (See Model 920—Set 55-10)  
 935, 936 (See Model 920—Set 55-10) ..... 105-5  
 949 ..... 98-5  
 955 ..... 144-6  
 956 ..... 97-8  
 960 ..... 97-8  
 960U, 961 (See Model 960—Set 97-8) ..... 99-8  
 985 ..... 183-7  
 5007 ..... 111-7  
 5010 ..... 136-10  
 5020U (See Model 5020—Set 136-10) ..... 160-5  
 5040 ..... 128-7  
 5050 ..... 109-7  
 5057U ..... 159-7  
 5100, E, U ..... 217-7  
 5125U ..... 194-6  
 5200 ..... 196-4  
 5205 ..... 206-7  
 5250 ..... 206-7

**KAISER-FRAZER**

100170 ..... 128-8  
 100205 ..... 139-6  
 200001 ..... 35-13  
 200002 ..... 56-13

**KAPPLER**

1027 ..... 54-10

**KARADIO**

80C ..... 66-10  
 1275, 1275A ..... 85-7  
 1276 ..... 115-4

**KAYE-HALBERT**

012 (Ch. 243) Tel. Rec. .... 169-9  
 014 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 024 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 033, 034, 035, 036, 037 (Ch. 242) Tel. Rec. .... 139-7  
 044, 045, 046 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 074, 076, 077 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 114DX (Ch. 253DX) Tel. Rec. (Also See Prod. Chge. Bul. 45—Set 179-1 and Model 114DX—Set 170-9)  
 122 (Ch. 243) Tel. Rec. (See Model 012—Set 169-9)  
 146 (Ch. 253) Tel. Rec. (See Model 014—Set 146-8)  
 146 (Ch. 253DX) Tel. Rec. (See Prod. Chge. Bul. 45—Set 179-1 and Model 114DX—Set 170-9)  
 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241 (Ch. 231 or 242) Tel. Rec. .... 139-7  
 424, 425, 426 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 425, 426 (Ch. 253DX) Tel. Rec. (See Prod. Chge. Bul. 45—Set 179-1 and Model 114DX—Set 170-9)  
 428 (Ch. 253DX) Tel. Rec. (See Prod. Chge. Bul. 45—Set 179-1 and Model 114DX—Set 170-9)  
 714 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 724 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 731, 733 (Ch. 231 or 242) Tel. Rec. .... 139-7

**KAYE-HALBERT—Cont.**

734, 735, 736, 737 (Ch. 242) Tel. Rec. .... 139-7  
 744, 745 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 777 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 914 (Ch. 253) Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) ..... 146-8  
 Ch. 231 (See Model 231)  
 Ch. 242 (See Model 033)  
 Ch. 243 (See Model 012)  
 Ch. 253 (See Model 014)  
 Ch. 253DX (See Model 114DX)  
 Ch. 263 Tel. Rec. .... 217-8

**KAY MUSICAL INSTRUMENT CO.**

77 ..... 42-13

**KITCHENAIRE**

5 Tube Radio ..... 6-14

**KNIGHT (Also see Recorder Listing)**

4D-450 ..... 40-9  
 4G-420 ..... 88-6  
 5A150, 5A152, 5A154 ..... 12-17  
 5A-190 ..... 14-15  
 5B-160 ..... 20-15  
 5B-175, 5B-176 ..... 20-16  
 5B-177 ..... 20-17  
 5C-290 ..... 30-13  
 5D-250, 5D-251 ..... 55-11  
 5D-455 ..... 34-9  
 5E-250, 5E-251 ..... 36-25  
 (Similar to Chassis) ..... 53-23  
 5F-52 ..... 5F-526 ..... 52-13  
 5F-565 ..... 55-12  
 5G-563 (Similar to Chassis) ..... 97-1  
 5H-570 ..... 143-10  
 5H-571 (See Model 5H-570—Set 143-10) ..... 131-10  
 5H-605 ..... 5H-608 ..... 97-15  
 (Similar to Chassis) ..... 109-7  
 5H-678, 5H-679 ..... 123-7  
 (Similar to Chassis) ..... 174-8  
 5J-705 ..... 215-9  
 5K-175 ..... 9-19  
 6A-122 ..... 16-19  
 6A-127 ..... 16-19  
 6A-195 ..... 16-19  
 6B-122 (See Model 6A-122—Set 9-18) ..... 6B-127 (See Model 6A-127—Set 9-19) ..... 30-14  
 6C-225 ..... 6D-225, 6D-226 (See Model 6C-225—Set 30-14) ..... 54-11  
 6D-235 ..... 39-10  
 6D-360 ..... 39-10  
 6G-400 (See Model 449—Set 93-5) ..... 126-7  
 6H-580 ..... 217-9  
 6K-718 ..... 27-14  
 7B-220 ..... 39-11  
 7D-405 ..... 20-17  
 8B-210 ..... 46-13  
 8D-340 ..... 128-9  
 8G-200, 8G-201 ..... 78-8  
 9V-101 Tel. Rec. .... 42-14  
 10B-249 ..... 29-12  
 11C-300 ..... 57-9  
 11D-302 ..... 176-5  
 12H-610 ..... 63-12  
 14F-490, 14F-495, 14F-496 ..... 125-9  
 15H-609 (See Model 511B—Set 125-9) ..... 58-11  
 19F497, 19F498 ..... 164-4  
 20H611 ..... 31-15  
 93-017 ..... 32-13  
 93-024 ..... 31-16  
 93-103 ..... 36-15  
 93-146 ..... 37-10  
 93-155 ..... 38-8  
 93-191 ..... 74-5  
 93-320 ..... 99-9  
 93-330 ..... 76-13  
 93-350 ..... 79-9  
 93-360 ..... 75-10  
 93-370 ..... 90-8  
 93-380 ..... 167-12  
 93-431 ..... 16-6  
 96-276 ..... 137-5  
 96-326 ..... 139-15  
 96-354 ..... 78-9  
 97-870 ..... 83-5  
 449 ..... 125-9  
 511B ..... 15-15  
 15-15  
 J62, J62C ..... 14-16  
 MC10B, MC10Y ..... 28-18  
 MC11 ..... 27-15  
 MC12 ..... 15-16  
 MC16 ..... 27-16  
 P564 (Similar to Chassis) ..... 38-5  
 IN434, IN435, IN436 (Similar to Chassis) ..... 98-5  
 IN437 (Similar to Chassis) ..... 121-2  
 IN549 (Similar to Chassis) ..... 38-5  
 IN551 (Similar to Chassis) ..... 38-6  
 IN554, IN555 (Similar to Chassis) ..... 55-10  
 IN556, IN557 (Similar to Chassis) ..... 109-7  
 IN559 (Similar to Chassis) ..... 90-7  
 IN560 (Similar to Chassis) ..... 109-7  
 IN561, IN562 (Similar to Chassis) ..... 97-8  
 IN819 (Similar to Chassis) ..... 69-7  
 IP184 Tel. Rec. (Similar to Chassis) ..... 149-13  
 IP185, IP186 Tel. Rec. (Similar to Chassis) ..... 149-13

**LAFAYETTE—Cont.**

178M1 Tel. Rec. (Similar to Chassis) ..... 149-13  
 20CP Tel. Rec. (Similar to Chassis) ..... 149-13  
 278M1 Tel. Rec. (Similar to Chassis) ..... 149-13

**LAMCO**

1000 ..... 16-20

**LEAK**

TL/12 ..... 166-12  
 RC/PA/U ..... 166-12

**LEAR (See Record Changer Listing)**

**LEARADIO**

Chassis R-971 ..... 51-11  
 RM-402C (Leavarian) ..... 42-15  
 561, 562, 563 ..... 1-26  
 563, 565BL, 566, 567, 568 ..... 9-20  
 1281-PC (Ch. 57) ..... 49-11  
 6610PC, 6611PC, 6612PC ..... 9-21  
 6614, 6615, 6616, 6619 ..... 3-18  
 6617PC ..... 16-22

**LEE (See Royal)**

**LEE TONE**

AP-100 ..... 16-23

**LEWYT**

615A ..... 11-13  
 711 ..... 42-16

**LEXINGTON**

6545 ..... 13-20

**LIBERTY**

A6K, A6P, 6K ..... 20-18  
 507A ..... 20-19

**LINCOLN (Auto Radio)**

1CH748 (1H-18805) ..... 158-5  
 (See Ford Model 1CF743—Set 133-7) ..... 167-7  
 3SH-756 (FAG-18805-A) ..... 214-5  
 7ML080 (5EH-18805-A) ..... 66-11  
 7ML081 (5EH-18805-B) ..... 66-11  
 8ML882 (8H-18805-A) ..... 44-7  
 (Ch. 8E82) ..... 8ML985 (8L-18805-A) ..... 83-4  
 8ML985E (8L-18805-B) ..... 83-4

**LINCOLN**

513L-B ..... 2-10

**LINCOLN (Allied Radio Corp.)**

5A-110 ..... 5-34

**LINEX CORP. (See Swank)**

**LIPLEX (See Supreme)**

**LULABY (See Mitchell)**

**LYMAN**

CM10, CM20 ..... 44-8

**LYRIC (Also see Randol)**

546T, 546TY, 546TW ..... 7-17

**MAGIC TONE**

500, 501 ..... 5-40  
 504 (Bottle Receiver) ..... 22-18  
 505 (Keg Radio) ..... 52-10  
 510 ..... 38-9  
 510 ..... 38-9

**MAGNAVOX**

104 Series (Ch. CT30) thru CT314 Tel. Rec. .... 161-4  
 Chassis AMP-101A ..... 43-12  
 AMP-101B ..... 41-10  
 Chassis AMP-108A ..... 41-10  
 Chassis AMP-111A, B, C ..... 68-10  
 Chassis CR-188 (155B Regency Symphony) ..... 18-22  
 Chassis CR-190A, CR-190B ..... 16-14  
 Chassis CR-192A, CR-192B ..... 41-11  
 Chassis CR-197C ..... 37-11  
 Chassis CR-198A, B, C (Hepplewhite, Modern Symphony) ..... 17-20  
 Chassis CR-199 ..... 63-13  
 Chassis CR-200A, B, C, D, E, F ..... 44-9  
 Chassis CR-207A, B, C, 41-12  
 Chassis CR-208A, CR-208B ..... 43-13  
 Chassis Models CR-210A, CR-210B ..... 52-11  
 Chassis CR-211A, B ..... 68-10  
 Chassis CT-214, CT-218, CT-219 ..... 62-13  
 Chassis CT-219, CT-220 ..... 82-7  
 Chassis CT-221 Tel. Rec. .... 62-13  
 Chassis CT-222 Tel. Rec. .... 82-7  
 Chassis CT-224 Tel. Rec. .... 97A-8  
 Chassis CT-232 Tel. Rec. .... 93A-9  
 Chassis CT-235 Tel. Rec. .... 97A-8  
 Chassis CT-236 Tel. Rec. .... 93A-9  
 Chassis CT237, CT-238 Tel. Rec. (See Set 95A-9 and Ch. CT219—Set 82-7) ..... 93A-9  
 Chassis CT244, CT245, CT246 Tel. Rec. .... 93A-9  
 Chassis CT247, CT248, CT249 Tel. Rec. .... \*  
 Chassis CT250, CT251 ..... 135-1A  
 Chassis CT252, CT253 ..... 95A-9  
 Chassis CT255 Tel. Rec. .... 97A-8  
 Chassis CT257, CT258 ..... 119-1A  
 Chassis CT262, CT263, CT264, CT265 Tel. Rec. .... 155-10  
 Chassis CT266, CT267, CT269 Tel. Rec. .... 131-1A

**MAGNAVOX—Cont.**

Chassis CT-270, CT-271, CT-272, CT-273, CT-274, CT-275, CT-276, CT-277, CT-278, CT-279, CT-280, CT-281, CT-282 ..... 148-8  
 Chassis CT283 Tel. Rec. .... 155-10  
 Chassis CT284, CT285 Tel. Rec. .... 131-1A  
 Chassis CT286 Tel. Rec. .... 155-10  
 Chassis CT287, CT-288 Tel. Rec. .... 131-1A  
 Chassis CT289 Tel. Rec. .... 155-10  
 Chassis CT290 Tel. Rec. .... 131-1A  
 Chassis CT291, CT293 ..... 155-10  
 Chassis CT294 Tel. Rec. .... 131-1A  
 Chassis CT295, CT296 ..... \*  
 Chassis CT297 Tel. Rec. .... 155-10  
 Chassis CT301 thru CT314 ..... 161-4  
 Chassis CT331 thru CT349 (105 Series) Tel. Rec. .... 168-10  
 Chassis CT358 (107 Series) Tel. Rec. .... \*  
 Chassis CT362, CT363 (105L, M, N Series) Tel. Rec. .... 205-6  
 Chassis CT372, CT373 (105L, M, N Series) Tel. Rec. .... 205-6  
 Chassis MCT228 Tel. Rec. .... 95A-9

**MAGNECORD (See Recorder Listing)**

**MAGUIRE (Also see Record Changer Listing)**

500B1, 500BW, 500D1, 500DW ..... 6-15  
 561B1, 561BW, 561D1, 561DW ..... 6-16  
 571 ..... 44-10  
 661, 661A ..... 12-18  
 700A ..... 7-18  
 700E ..... 15-17

**MAJESTIC**

G-414 Tel. Rec. .... 133-8  
 G-614 Tel. Rec. .... 133-8  
 G-624 Tel. Rec. .... 133-8  
 G-914 Tel. Rec. .... 133-8  
 5A410 (Ch. 4501) ..... 1-30  
 5A430 (Ch. 4504) ..... 23-12  
 5A445, 5A445R ..... 27-17  
 5AK711 ..... 28-19  
 (Ch. 5B05A) ..... 169-10  
 5C-2, 5C-3 ..... 130-9  
 5LA7, 5LA8 ..... 132-9  
 6FM714 (Ch. 6802D) ..... 50-10  
 6FM773 (Ch. 6811D) ..... 57-10  
 7BK758 (See Model 71777R—Set 27-18) ..... 14-17  
 7C447 (Ch. 4706) See Model 7C432—Set 14-17) ..... 56-14  
 7FM877, 7FM888 (Ch. 7C11D) ..... 27-18  
 7J1866 (Ch. 7C23A) ..... 60-14  
 7P420 (Ch. 4705) ..... 26-17  
 7S433, 7S450, 7470 (Ch. 4702, 4703) ..... 22-19  
 7TV850, 7TV852 (Ch. 18C90, 18C91) Tel. Rec. .... \*  
 7YR752 (Ch. 7B04A) ..... 29-13  
 7YR753 (Ch. 7B09A1), 7YR772 (Ch. 7B09A) ..... 42-17  
 8FM744 (Ch. 8B04D) ..... 30-15  
 8FM775 (Ch. 8B08D) ..... 29-14  
 8FM776 (Ch. 8B07D) ..... 54-12  
 8FM889 (Ch. 8C07D) ..... 47-11  
 8S452, 8S473 (Ch. 4810) ..... 8-19  
 10FM891 (Ch. 10C23E) (See Model 10FM891—Set 65-8)  
 12C4, 12C5 Tel. Rec. .... 108-7  
 12FM475, 12FM778, 12FM779 (Ch. 41201) ..... 28-20  
 12FM895 (Ch. 12C22E) ..... 59-11  
 12T2, 12T3 Tel. Rec. .... 108-7  
 12T6 Tel. Rec. (See Model 12C4—Set 108-7) ..... 14C4 Tel. Rec. (See Model 12C4—Set 108-7) ..... 133-8  
 14T2 Tel. Rec. (See Model 12C4—Set 108-7) ..... 108-7  
 16C4, 16C5 Tel. Rec. .... 108-7  
 16C7A, 16C7B Tel. Rec. .... 108-7  
 16T2, 16T3 Tel. Rec. .... 108-7  
 17C62, 17C64, 17C65 (Series 106) Tel. Rec. (See Prod. Chge. Bul. 43—Set 177-1 and Model 70—Set 153-8) ..... 170A (Ch. 101) Tel. Rec. .... 127-7  
 17CA, 17H (Ch. 101) Tel. Rec. .... 127-7  
 17T6A1, 17T6B1 (Series 106) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 1762 (Series 106) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 20FP88, 20FP89 (Series 109) Tel. Rec. .... 170-10  
 20F82, 20F83 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 20F85, 20F86, 20F87 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 20F81 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 20T82, 20T83, 20T84 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 20T8A1 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21D50, 21D51 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21F86, 21F87 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21F88, 21F89 (Series 108.5) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21T20, 21T21 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 22 Thru 35 (Series 106.5) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 70, 72, 73 (Series 106) Tel. Rec. (Also see Prod. Chge. Bul. 43—Set 177-1) ..... 102, 121, 121B (Ch. 99) Tel. Rec. (Also See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7) ..... 160, 160B, 162, 163 (Ch. 101) Tel. Rec. .... 127-7  
 170 (Ch. 101) Tel. Rec. .... 127-7  
 173 Tel. Rec. (See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7) ..... 700, 701 (Series 106) Tel. Rec. (Also See Prod. Chge. Bul. 43—Set 177-1) ..... 153-8  
 712, 715, 717, 718, 719 (Series 106) Tel. Rec. (Also See Prod. Chge. Bul. 43—Set 177-1) ..... 153-8  
 800, 801, 802, 803, 804 (Series 108) Tel. Rec. (Also See Prod. Chge. Bul. 43—Set 177-1) ..... 153-8  
 902, 903 (Ch. 103) Tel. Rec. .... 127-7  
 910, 911 (Ch. 103) Tel. Rec. .... 127-7  
 1042, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1043, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1142, 1143 Tel. Rec. (See Model 12C4—Set 108-7) ..... 1244, G, GU, T, TX Tel. Rec. (See Model 12C4—Set 108-7) ..... 1245, G, GU, T, TX Tel. Rec. (See Model 12C4—Set 108-7) ..... 1348 Tel. Rec. (See Model 12C4—Set 108-7) ..... 1400, B (Ch. 100) Tel. Rec. .... 127-5  
 1401 (Ch. 105) Tel. Rec. (Also See Prod. Chge. Bul. 37—Set 166-2) ..... 127-7  
 1546, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1547, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1548, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1549, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1600, 1600B (Ch. 101) Tel. Rec. .... 127-7  
 1605, 1605B (Ch. 102) Tel. Rec. .... 127-7  
 1610, 1610B (Ch. 102) Tel. Rec. .... 127-7  
 1646, 1647, 1648, 1649 Tel. Rec. (See Model 12C4—Set 108-7) ..... 1671, 1672, 1673, 1674, 1675 Tel. Rec. .... 133-8  
 1700C Tel. Rec. (See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7) ..... 1710 (Ch. 101) Tel. Rec. .... 127-7  
 1710C (Ch. 101) Tel. Rec. (See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7) ..... 1710C (Ch. 101) Tel. Rec. .... 127-7

**MAJESTIC—Cont.**

20F81 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 20T8A1 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 20T82, 20T83, 20T84 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21C30, 20C31 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21D40, 21D41 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21D50, 21D51 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21F86, 21F87 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21F88, 21F89 (Series 108.5) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 21T20, 21T21 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 22 Thru 35 (Series 106.5) Tel. Rec. (See Model 70—Set 153-8 and Prod. Chge. Bul. 43—Set 177-1) ..... 70, 72, 73 (Series 106) Tel. Rec. (Also see Prod. Chge. Bul. 43—Set 177-1) ..... 102, 121, 121B (Ch. 99) Tel. Rec. (Also See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7) ..... 160, 160B, 162, 163 (Ch. 101) Tel. Rec. .... 127-7  
 170 (Ch. 101) Tel. Rec. .... 127-7  
 173 Tel. Rec. (See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7) ..... 700, 701 (Series 106) Tel. Rec. (Also See Prod. Chge. Bul. 43—Set 177-1) ..... 153-8  
 712, 715, 717, 718, 719 (Series 106) Tel. Rec. (Also See Prod. Chge. Bul. 43—Set 177-1) ..... 153-8  
 800, 801, 802, 803, 804 (Series 108) Tel. Rec. (Also See Prod. Chge. Bul. 43—Set 177-1) ..... 153-8  
 902, 903 (Ch. 103) Tel. Rec. .... 127-7  
 910, 911 (Ch. 103) Tel. Rec. .... 127-7  
 1042, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1043, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1142, 1143 Tel. Rec. (See Model 12C4—Set 108-7) ..... 1244, G, GU, T, TX Tel. Rec. (See Model 12C4—Set 108-7) ..... 1245, G, GU, T, TX Tel. Rec. (See Model 12C4—Set 108-7) ..... 1348 Tel. Rec. (See Model 12C4—Set 108-7) ..... 1400, B (Ch. 100) Tel. Rec. .... 127-5  
 1401 (Ch. 105) Tel. Rec. (Also See Prod. Chge. Bul. 37—Set 166-2) ..... 127-7  
 1546, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1547, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1548, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1549, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7) ..... 1600, 1600B (Ch. 101) Tel. Rec. .... 127-7  
 1605, 1605B (Ch. 102) Tel. Rec. .... 127-7  
 1610, 1610B (Ch. 102) Tel. Rec. .... 127-7  
 1646, 1647, 1648, 1649 Tel. Rec. (See Model 12C4—Set 108-7) ..... 1671, 1672, 1673, 1674, 1675 Tel. Rec. .... 133-8  
 1700C Tel. Rec. (See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7) ..... 1710 (Ch. 101) Tel. Rec. .... 127-7  
 1710C (Ch. 101) Tel. Rec. (See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7) ..... 1710C (Ch. 101) Tel. Rec. .... 127-7

**MAJESTIC—Cont.**

1720, 1721 Tel. Rec. (See Prod. Chge. Bul. 37—Set 166-2 and Model 17DA—Set 127-7)

1900 Tel. Rec. (See Model 95A-10)

1974, 1975 Tel. Rec. 133-8

2042T, 2043T Tel. Rec. (See Model 12C4—Set 108-7)

2546T, 2547T, 2549T Tel. Rec. (See Model 12C4—Set 108-7)

Ch. 5801A (See Model 5AK711)

Ch. 5805A (See Model 5AK731)

Ch. 6802D (See Model 6FM714)

Ch. 6811D (See Model 6FM773)

Ch. 7804A (See Model 7YR752)

Ch. 7809A (See Model 7YR772)

Ch. 7809A1 (See Model 7YR753)

Ch. 7C11D (See Model 7FM887)

Ch. 7C25A (See Model 7JL866)

Ch. 8806D (See Model 8FM744)

Ch. 8807D (See Model 8FM776)

Ch. 8808D (See Model 8FM775)

Ch. 8C07D (See Model 8FM889)

Ch. 10C23E (See Model 10FM891)

Ch. 12826E (See Model 12FM475)

Ch. 12C22E (See Model 12FM895)

Ch. 18C90, 18C91 (See Model 17V850)

Ch. 4501 (See Model 5A410)

Ch. 4504 (See Model 5A430)

Ch. 4506 (See Model 5A445)

Ch. 4702, 4703 (See Model 75433)

Ch. 4705 (See Model 7P420)

Ch. 4706 (See Model 7C432)

Ch. 4707 (See Model 7C447)

Ch. 4708R (See Model 7JK777R)

Ch. 4810 (See Model 85452)

Ch. 4810B (See Model 8JL885)

Ch. 41201 (See Model 12FM475)

**MALLORY**

TV-101 (Below Serial No. 200,000) Tel. UHF Conv. 194-7

TV-101 (Serial No. 200,000 and Above) Tel. UHF Conv. 194-8

**MANTOLA (B. F. Goodrich Co.)**

R630-RP 3-22

R643-PM (See Model R643W—Set 4-29)

R643W 4-29

R652, R652N 9-22

R654 PM, R654-PV 3-5

R655W (Ch. No. 501APH) 8-20

R662, R662N 3-33

R664, R664-PV, R664-W 23-13

R-743-W (See Model R643W—Set 4-29)

R-7543 18-23

R-75143 39-12

R-75152 38-10

R-75343 39-12

R-76143 (See Model 2486—Set 25-17)

R-76162 (Fact. No. R76262) 40-10

R-76162 (Fact. No. 7160-17) 51-12

R-78162 43-11

2486 25-17

92-502 (See Model R643W—Set 4-29)

92-503, 92-504 (See Model R654PM—Set 3-5)

92-505, 92-506 (See Model R664PM—Set 23-13)

92-520, 92-521, 92-522 68-11

92-529 150-8

**MARKEL** (See Record Changer Listing)

**MARK SIMPSON** (See Masco)

**MASCO** (Also see Recorder Listing)

CM-20 218-6

EMM-6 216-3

IM-5 41-13

IM-10 186-8

JMR 31-17

JM-5 (Master Station), JR (Sub-Station) 42-18

JM-10 187-8

JMP-6 147-7

JMP-12 147-7

MA-8N 119-8

MA-10HF 112-4

MA-10EX 113-4

MA-12HF 51-13

MA-17 14-32

MA-17N 50-11

MA-17P 14-32

MA-17PN 50-11

MA-20HF 28-21

**MASCO—Cont.**

MA-25 16-24

MA-25EX 60-15

MA-25HF 54-13

MA-25NF 43-14

MA-25NR 49-12

MA-25P 16-24

MA-25PN (See Model MA-25N—Set 43-14)

MA-35 21-20

MA-35N 44-11

MA-35RC 21-20

MA-50 30-16

MA-50N (See Model MA-50N—Set 45-15)

MA-50NR 53-14

MA-60 119-9

MA-75 28-22

MA-75N 52-27

MA-77, MA-77R 190-7

MA-121 24-21

MA-125 188-8

MA-808 26-18

MAP-15 26-19

MAP-18 59-12

MAP-105 25-18

MAP-105N 52-12

MAP-120 21-21

MAP-120N 46-15

MB-8N 196-5

MB-50N 58-12

MB-60 127-8

MB-60 (Lote) 148-10

MB-75 61-15

MB-77 206-8

MB-125 211-9

MC-10 47-12

MC-25, MC-25P 17-21

MC-25N, MC-25PC, MC-25PN, MC-25RC 57-11

MC-126, MC-126P 111-8

MCR-5 15-18

ME-8 152-10

ME-18, ME-18P 151-8

ME-27 135-11

ME-36, ME-36R 154-7

ME-52 149-7

MHP-110 114-6

MHP-110X 115-5

Midgetalk 116-7

MM-27P 153-9

MFA-3, MPT-4 16-25

MSD-16 150-9

MU-5 117-6

MU-17 185-8

PR-1 218-6

RK-5 (Early) 33-11

RK-5, RK-5L, RK-5M, RK-5ML, RK-5SL 168-11

RK-5SLR 177-9

T-16 123-8

TD-16 120-8

TP-16A 30-17

WF-1A 209-8

76, 711 20-20

86, 811 2021

**MASON**

45-1A 14-18

45-1B, 45-1P, 45-3, 45-4, 45-5 (See Model 45-1A—Set 14-18)

**MATTISON**

630-6A Tel. Rec. 218-7

630-6AB Tel. Rec. 218-7

**MAYFAIR**

510, 510W, 520, 520W, 530, 530W 25-20

550, 550W 24-22

**MCGOHAN (Don)**

MG-7 195-7

MG-10B 190-8

MG-18B 191-6

MG-20-B 189-5

MG-30-B 188-9

**MCGRADE**

M-100 16-27

**MECK (Trail Blazer-Plymouth)**

CD-500 (PX-5CS-EW-19) 33-12

CE-500 (5CS-P12) 34-10

CM-500 (5D7-W18) 34-11

CR-500 48-11

CW-500 48-13

CK-500 48-13

DA601, D86021 81-10

EC720 85-8

EF-730, EG-731 (Ch. 10003) 89-8

EV-760 104-7

JM717C, CU, TU (Ch. 9021), JM720C, CU, TU (Ch. 9021), JM721C, CU (Ch. 9032) Tel. Rec. (See Model 148-11)

JM-717C, T, JM-720C, T, JM-721C, CD (Ch. 9032) Tel. Rec. 186-9

MM510T, MM512T, MM516C, MM516T, Tel. Rec. 110-9

MM614C, T (Ch. 9018) Tel. Rec. (Also See Prod. Chge. Bul. 12—Set 120-1) 117-8

MM616C, T (Ch. 9018) Tel. Rec. (Also See Prod. Chge. Bul. 12—Set 120-1) 117-8

MM-617C, T (Ch. 9032) Tel. Rec. (See Model JM-717C—Set 186-9)

MM619C (Ch. 9018) Tel. Rec. (Also See Prod. Chge. Bul. 12—Set 120-1) 117-8

MM-620C, T (Ch. 9032) Tel. Rec. (See Model JM-717C—Set 186-9)

M616C, T (Ch. 9023) Tel. Rec. (See Model JM717C—Set 148-11)

M620C, T (Ch. 9023) Tel. Rec. (See Model JM717C—Set 148-11)

**MECK—Cont.**

PM-5CS-DW10 2-4

PM-5CS-PW10 12-19

RC-5CS-P 1-9

RC-6A7-P6 31-19

SA-10, SA-20 101-9

XA-701 Tel. Rec. 61-16

XE-705 (See Model XA-701—Set 61-16)

XF-777 Tel. Rec. 101-5

XL750 Tel. Rec. 76-14

XN-752 Tel. Rec. 101-5

XOB Tel. Rec. 110-9

XP-775 Tel. Rec. 101-5

XQA Tel. Rec. 110-9

XQA-776 Tel. Rec. 101-5

XQR Tel. Rec. 110-9

XQ-776 Tel. Rec. 101-5

XRA, XRPT Tel. Rec. 110-9

XR-778 Tel. Rec. 110-9

XSA Tel. Rec. 110-9

XSB (Ch. 9018) Tel. Rec. (Also See Prod. Chge. Bul. 12—Set 120-1) 117-8

XSC, XSD (Ch. 9018) Tel. Rec. (See Model MM614C—Set 117-8 and Prod. Chge. Bul. 12—Set 120-1) 110-9

XSPT Tel. Rec. 110-9

XS-786 Tel. Rec. 101-5

XTA, XTR Tel. Rec. 110-9

XT-785 Tel. Rec. 101-5

XX900 Tel. Rec. 110-9

487 35-14

5A7-P11, 5A7-P811 31-18

5D7-WL18 21-22

6A6-W4 16-26

514C, T (Ch. 9018) Tel. Rec. (See Model MM614C—Set 117-8 and Prod. Chge. Bul. 12—Set 120-1) 614C, 614TL (Ch. 9022) Tel. Rec. (See Model JM717C—Set 148-11) 616C, T (Ch. 9018) Tel. Rec. (See Model MM614C—Set 117-8 and Prod. Chge. Bul. 12—Set 120-1) 617C, 617TL (Ch. 9022) Tel. Rec. (See Model JM717C—Set 148-11) 619C, T (Ch. 9018) Tel. Rec. (See Model MM614C—Set 117-8 and Prod. Chge. Bul. 12—Set 120-1)

**MEDCO (See Telesonic)**

**MEISSNER**

TV-1 (Ch. 24TV) Tel. Rec. 56-15

4E (See Model 172-5)

5A (See Maguire Model 571—Set 44-10)

6H (See Maguire Model 661—Set 12-18)

8BT 161-5

**MEISSNER—Cont.**

8C 37-12

9AJ 123-9

9-1065 3-15

9-1091A, 9-1091B 35-15

9-1091C 116-8

9-1093 55-13

16A 105-6

24TV Tel. Rec. (See Model TV1—Set 56-15)

574 (See Maguire Model 571—Set 44-10)

661 (See Maguire Model 661—Set 12-18)

2961 Series 27-19

**MERCURY (Automobile)**

GM891 (OM-18805-A) (See Ford Model GF890—Set 109-5)

GM-757 (FAF-18805-A) 214-5

1CM47 (1M-18805) (See Ford Model 1CF743—Set 133-7)

1CM747-1 (1M-18805) 158-5

2CM752 (FAB-18805-A) 167-7

6MM790 62-12

8MM890 (Ch. BE90) (8M-18805-B) 49-13

8MM990 (8M-18805-B) 69-10

8MM991 (8M-18805-B) 83-4

8MM991-E (8M-18805) 83-4

**MERCURY (Pacific-Mercury)**

2013 (Ch. 150-2) Tel. Rec. (Also See Prod. Chge. Bul. 57—Set 190-1) 172-6

2080 (Ch. 150-2) Tel. Rec. (See Prod. Chge. Bul. 57—Set 190-1 and Model 2013—Set 172-6)

2081 (Ch. 150-4 and Radio Ch. 155) Tel. Rec. (Also see Prod. Chge. Bul. 57—Set 190-1) 172-6

2118, 2115 (Ch. 150-11, -81) Tel. Rec. (Also see Prod. Chge. Bul. 57—Set 190-1) 172-6

2118, 2117 (Ch. 150-81) Tel. Rec. (Also See Prod. Chge. Bul. 57—Set 190-1 and Model 2013—Set 172-6)

2181 (Ch. 150-31, -61 and Radio Ch. 155) Tel. Rec. 198-11

2192 (Ch. 150-10 and Radio Ch. 160) \*

2217, 2218, X (Ch. 200-11) Tel. Rec. 216-8

2224 (Ch. 200-11) Tel. Rec. 216-8

2284 (Ch. 200-11) Tel. Rec. 216-8

2401 (Ch. 150-5, -51) Tel. Rec. (Also see Prod. Chge. Bul. 57—Set 191-1) 172-6

4120 (Ch. 150-2) Tel. Rec. (Also See Prod. Chge. Bul. 57—Set 190-1) 172-6

4220 (Ch. 150) Tel. Rec. (Also see Prod. Chge. Bul. 57—Set 190-1) 172-6

4317 (Ch. 150-7, -12) Tel. Rec. \*

4317 (Ch. 150-9) Tel. Rec. 172-6

4320 (Ch. 150-2, -15) Tel. Rec. (Also see Prod. Chge. Bul. 57—Set 191-1) 172-6

4421 (Ch. 150-81) Tel. Rec. (See Model 2013—Set 172-6 and Prod. Chge. Bul. 57—Set 191-1)

4721 (Ch. 150-10 and Radio Ch. 160) \*

Ch. 150-2 (See Model 2013)

Ch. 150-4 (See Model 2081)

Ch. 150-5 (See Model 2401)

Ch. 150-7 (See Model 4317)

Ch. 150-9 (See Model 4317)

Ch. 150-11 (See Model 2113)

Ch. 150-12 (See Model 4317)

Ch. 150-15 (See Model 4320)

Ch. 150-31 (See Model 2181)

Ch. 150-51 (See Model 2401)

Ch. 150-61 (See Model 2181)

Ch. 150-81 (See Model 2113)

Ch. 155 (See Model 2081)

Ch. 200-11 (See Model 2217)

**MIDLAND**

M68 2-30

**MIDWEST**

P6, PB-6 14-19

R-12, RG-12, RT-12 (Ch. RGL-12) 44-12

R-12, RG-12, RT-12 (Ch. RGT-12) 44-13

R-16, RG-16, RT-16 (Ch. RGT-16) 45-16

SB, ST-8 (Ch. STM-8) 15-19

S-12, SG-12, ST-12 (Ch. SGT-12) 21-23

S-16, SG-16, ST-16 (Ch. SGT-16) 21-24

TM-8 (Ch. STM-8) 15-19

716, A (See Model S-16—Set 21-24)

**IMPORTANT**

**Quick, Easy PHOTOFAC Filing Method**

The preferred 30-Second method for filing PHOTOFAC Folders

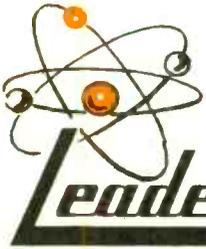
Your PHOTOFAC Folder Sets come to you in convenient envelopes. When you remove a Set from its envelope, you will find the Folders already arranged in proper filing order, and preceded by an Index Separator. This Separator lists each receiver covered in the Set, and has an index tab showing the Set number. To file, here's all you do:

1. Remove the Index Separator and the Folders from the envelope. The Folders and manila TV Jackets are already arranged in proper numerical filing order except the TV folders, which are placed last in the Set.
2. Open your binder and place the entire contents, taken from the envelope, behind the preceding Set of folders, laying aside the TV folders.
3. Now, insert the TV folders in their respective manila jackets and your filing is complete.

To locate the folder you want, refer to instructions on the first page of this index listing.

**ALWAYS REFER TO THE PHOTOFAC INDEX**

# Revolutionary Superotor®



**Leader Design gives you**

## **FIVE FIRSTS** - Five exclusive sales features

Now! — a new name, and a great new standard of quality and performance in antenna rotators! With FIVE major advances, SUPEROTOR overnight has shot years ahead of the entire field! For the consumer, SUPEROTOR means superb new control and recep-

tion. For the serviceman — a remarkable new ease in servicing. And for the distributor — the "plus" business that comes from handling a unit that wins cheers all the way down the line. SUPEROTOR will be available in your area soon. Don't miss it!

### 5 DYNAMIC NEW ENGINEERING FEATURES . . .

**1**

#### **QUICK DETACHABLE DRIVE UNIT**

Complete drive unit can be replaced in five minutes — by one man, without dismantling antenna. When necessary antenna can be locked in any desired direction with drive unit removed.

A **Leader** First!

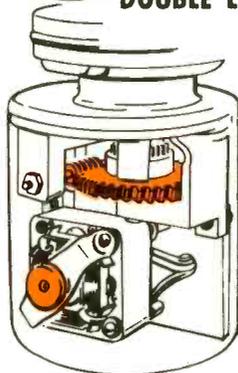


**2**

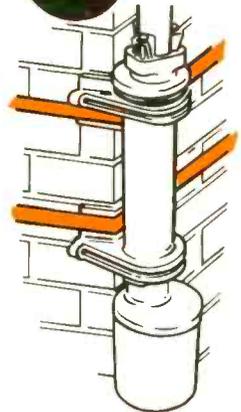
#### **DOUBLE LOCK STOP PREVENTS DRIFT AND COAST**

Worm gear lock positively maintains antenna in desired position — no drift. Motor brake prevents transfer of motor inertia to antenna — no coast. Permits smallest increment movement of antenna for precision tuning.

A **Leader** First!



**3**



### Plus These Other Outstanding Features

- Antenna position readable without rotating antenna
- Operates at upwards of 350 feet from control point
- Dependable high-torque motor
- Wide-span double ball bearing supports



2925 EAST 55TH ST., CLEVELAND 27, OHIO

LEADING THE WAY TO BETTER PRODUCTS

New

# Hits TV Industry

Years ahead  
of Anything  
on the market

## BUILT-IN CHIMNEY MOUNT DESIGN

Eliminates need for  
stub mast assembly.  
Mounts directly on  
chimney, and below  
chimney crown, pro-  
tecting drive unit  
from soot and cor-  
rosive fumes.

A **Leader** First!

Patent  
Applied for

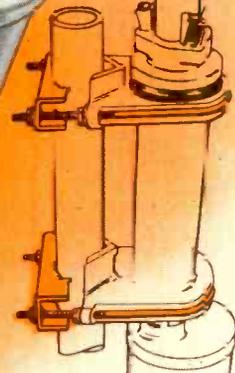


4

## STEEL REINFORCED CONSTRUCTION

Entire aluminum ro-  
tator housing and  
antenna supports are  
maintained in com-  
pression with steel.  
Thus, strength of  
steel is combined  
with lightness of  
aluminum.

A **Leader** First!



5

## VP TUNING

Only the Superrotor with double lock stop, per-  
mits "finger tip" Vernier Precision tuning.

A **Leader** First!

MILWAUKEE ERWOOD—MOTOROLA

MILWAUKEE ERWOOD  
(See Record Changer Listing)

**MINERVA**  
L-702 ..... 12-20  
L-728 ..... 11-15  
W-117, Tropic Master ..... 6-17  
W-117-3 ..... 11-14  
W-702B ..... 12-20  
W710, W710A (W119) ..... 5-25  
W-728 ..... 11-15  
410, 411 ..... 41-14  
702H, 702H-1 ..... 30-18  
729 (Portopal) ..... 23-14

**MIRRORTONE (Also see Meck)**

A-17C, T (Ch. 9040) ..... 216-4  
Tel. Rec. (See Model 1474—Set 158-8)  
A-21C, CB, T, TB, X, Z (Ch. 9040) Tel. Rec. .... 216-4  
14M4TS Tel. Rec. .... 163-7  
16MC, MT, 17MC, MT, MZ-C, MZ-T Tel. Rec. .... 163-7  
17PC (Ch. 9025) (Series "P") Tel. Rec. (See Model 20PC—Set 175-12) ..... 17-12  
17PCSB, 17PCW Tel. Rec. 204-5  
17PT (Ch. 9025) (Series "P") Tel. Rec. (See Model 20PC—Set 175-12) ..... 17-12  
17PTE Tel. Rec. .... 204-5  
20MC, MT, MZ-C, MZ-T Tel. Rec. .... 163-7  
20PC Tel. Rec. .... 175-12  
20PCSB, 20PCW Tel. Rec. 204-5  
20PT Tel. Rec. (See Model 20PC—Set 175-12) ..... 17-12  
20PTE, 20PTS, 20PTSB, 20PTW Tel. Rec. .... 204-5  
20TPRSB Tel. Rec. .... 204-5  
21PCS Tel. Rec. .... 204-5  
21DCCS Tel. Rec. .... 204-5  
24DCCS Tel. Rec. .... 204-5  
Ch. 9040 (See Model A-17C)

**MITCHELL**

T16-B, -M, T16-2KB, T16-2KA, T17-B, -M Tel. Rec. .... 154-8  
T172B, T172M Tel. Rec. 189-11  
T121-B, -M Tel. Rec. .... 190-9  
1250, 1251 ..... 55-14  
1252, 1253 ..... 155-12  
1254, 1255 ..... 159-8  
1256 ..... 136-8  
1267 ..... 158-7  
1268R ..... 127-9

**MOLDED INSULATION CO.**  
(Also see Viz)

MR-6 (Wiretone) ..... 41-15

**MONITOR**

M-403 (Fact. No. 470-2) ..... 22-20  
M-500 (Fact. No. 473) ..... 28-23  
M-510 (Fact. No. 472) ..... 23-15  
M-3070 ..... 29-15  
RA-50 ..... 24-23  
TA56M, TW56M ..... 6-18

**MONITORADIO (Radio Apparatus)**

AR-1 ..... 164-5  
AR-3 ..... 175-13  
M-51A ..... 162-8  
M-101 ..... 159-9

**MONTGOMERY WARD (See Airline)**

**MOPAR**

602 (671A) ..... 19-20  
603 ..... 65-9  
604 ..... 106-9  
606 ..... 133-9  
607 ..... 171-11  
608 ..... 207-4  
609 ..... 201-6  
802 (C-4608) ..... 18-24  
802 (C-4608) (Revised) ..... 42-19  
803 (PD-4908) ..... 66-12  
804 ..... 67-12  
805 (C-4908) ..... 71-11  
806, 807 (See Model 803—Set 66-12) ..... 107-6  
809 (C-5009) (See Model 805—Set 71-11) ..... 810 (C-5010) (See Model 805—Set 71-11) ..... 139-8  
812 (P-5106) ..... 139-8  
813 (D5107) ..... 139-8  
814 ..... 137-7  
815 (C-5109) ..... 139-8  
816 (C-5110) ..... 139-8  
817 (C-5111) ..... 139-8  
819, 820 ..... 22-3  
821 ..... 204-6  
824 ..... 202-3

**MOTOROLA (Also see Record Changer Listing)**

AR-96-23 (M-5) ..... 11-16  
AKO-A (See Ch. 10A—Set 106-10) ..... 82-8  
BK2A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
BK2M (Ch. 2M and P7-2 or P8-2) ..... 197-7  
BK-6 ..... 10-23  
BK8, X (Ch. 8A—Set 46-16) ..... 20-24  
CR-6 ..... 25-21  
CTO (See Model CT-9—Set 82-8) ..... 134-8  
CT1 (See Ch. 1A—Set 134-8) ..... 143-11  
CT1M (Ch. 2A and P6-2 or P8-2) ..... 197-7  
CT2M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
CT-6 ..... 8-21

**MOTOROLA—Cont.**

CT8 (See Ch. 8A—Set 46-16) ..... 82-8  
CT8-A (See Ch. 10A—Set 106-10) ..... 82-8  
CT9 ..... 82-8  
FD-6 ..... 7-20  
FD7 (See Model FD-6—Set 106-10) ..... 82-8  
FD8 (See Ch. 8A—Set 46-16) ..... 82-8  
GMOT (See Ch. 10A—Set 106-10) ..... 82-8  
GM72A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
GM72M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
GM9T (See Ch. 8A—Set 46-16) ..... 82-8  
GM9T-A (See Ch. 10A—Set 160-10) ..... 82-8  
HJ2A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
HJ2M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
HNO (See Ch. 10A—Set 106-10) ..... 82-8  
HN2A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
HN2M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
HN8, HN9 (See Ch. 8A—Set 46-16) ..... 82-8  
ILOT (See Ch. 10A—Set 106-10) ..... 82-8  
IL2TC (See Ch. 1A—Set 134-8) ..... 82-8  
IL2TS (See Ch. 1A—Set 134-8) ..... 82-8  
KRI (See Ch. 1A—Set 134-8) ..... 82-8  
KR2A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
KR2M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
KR8, KR9 (See Ch. 8A—Set 46-16) ..... 82-8  
KR9A (See Ch. 10A—Set 106-10) ..... 82-8  
NH3C ..... 139-9  
NH2AC (See Nash Model AC-152—Set 184-9) ..... 82-8  
NH3C (See Nash Model NH3C—Set 216-6) ..... 82-8  
NH6 ..... 9-24  
NH8 (See Ch. 8A—Set 46-16) ..... 82-8  
OEO (See Ch. 10A—Set 106-10) ..... 82-8  
OE2 (See Ch. 8A—Set 46-16) ..... 82-8  
OE2A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
OE2M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
OE6 ..... 8-21  
OEB, OEF (See Ch. 8A—Set 46-16) ..... 82-8  
PCO (See Ch. 10A—Set 106-10) ..... 82-8  
PC2 (See Ch. 8A—Set 16-16) ..... 82-8  
PC2A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
PC2M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
PC6 ..... 8-21  
PC8, PC9 (See Ch. 8A—Set 46-16) ..... 82-8  
PC9-A (See Ch. 10A—Set 106-10) ..... 82-8  
PD2A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
PD2M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
SROB (Ch. 2M and P7-2 or P8-2) ..... 105-7  
SR1B (See Ch. 1B—Set 136-11) ..... 82-8  
SR2A (Ch. 2A and P6-2 or P8-2) ..... 197-7  
SR2M (Ch. 2M and P6-2 or P8-2) ..... 197-7  
SR6, SR8, SR9 (See Ch. 8A—Set 46-16) ..... 82-8  
SR9A (See Ch. 10A—Set 106-10) ..... 82-8  
TC-101, B Tel. UHF Conv. ..... 196-6  
TK-17M, Tel. UHF Conv. ..... 193-5  
TK-19M, Tel. UHF Conv. ..... 193-5  
TK-19ME Tel. UHF Conv. (See Model TK17M—Set 193-5) ..... 193-5  
TK-20M Tel. UHF Conv. ..... 193-5  
TK-22M Tel. UHF Conv. ..... 193-5  
TK-23M Tel. UHF Conv. ..... 193-5  
TK-24M Tel. UHF Conv. ..... 193-5  
TK-24ME Tel. UHF Conv. (See Model TK17M—Set 193-5) ..... 193-5  
TK-31M Tel. UHF Conv. (See Model TK17M—Set 193-5) ..... 193-5  
TK-33M Tel. UHF Conv. (See Model TK17M—Set 193-5) ..... 193-5  
VF102, A, C (Ch. TS-7 and Radio Ch. HS-317) Tel. Rec. .... 51-14  
VF103, VF103M (Ch. TS-8) Tel. Rec. .... 73-8  
VK101, B, M (Ch. TS-5 and Radio Ch. HS-108) Tel. Rec. .... 51-14  
VK106, B (Ch. TS-9D) Tel. Rec. Photofact Servicer ..... 82  
VK106, B, M (Ch. TS-9, A, B, C) Tel. Rec. .... 67-13  
VK106, VK107 (Ch. TS-9E, TS-9E1) Tel. Rec. .... 77-6  
VTK-17M, ME Tel. UHF Conv. (See Model TK17M—Set 193-5) ..... 193-5  
VT71B, M-A (Ch. 4A through J) Tel. Rec. .... 55-16

**MOTOROLA—Cont.**

VT-73, VT-73A (Chassis TS-4) Late Tel. Rec. .... 71-12  
VT101 (Ch. TS-3) Tel. Rec. 51-14  
VT105 (Ch. TS-9D) Tel. Rec. Photofact Servicer. 82  
VT105, VT105M (Ch. TS-9, TS-9A, TS-9B, TS-9C) Tel. Rec. .... 67-13  
VT107 (Ch. TS-9D) Tel. Rec. Photofact Servicer. 82  
VT107, B, M (Ch. TS-9, A, B, C) Tel. Rec. .... 67-13  
VT121 (Ch. TS-15) Tel. Rec. .... 91A-9  
WR6 (Ch. HS-18) ..... 5-2  
WR6, WR8 (See Model WR6—Set 5-2) ..... 5-2  
WS1C (See Willlys Model 677012—Set 156-14) ..... 156-14  
WS2C (See Willlys Model 679737—Set 77-12) ..... 77-12  
2M (See Ford Model 2MF—Set 175-10) ..... 175-10  
3MF (See Ford Model 3MF—Set 206-5) ..... 206-5  
3MT (See Ford Model 3MT—Set 215-7) ..... 215-7  
5A1 (Ch. HS-6) ..... 2-11  
5A2 (Ch. HS-6) ..... 3-11  
5A7 (Ch. HS-62) ..... 29-16  
5A7A (Ch. HS-62A) ..... 29-16  
5C1 (Ch. HS-228) ..... 116-9  
5C2 (Ch. HS-258) ..... 116-9  
5C3 (Ch. HS-262) ..... 116-9  
5C4 (Ch. HS-270) ..... 116-9  
5C5 (Ch. HS-270) ..... 116-9  
Model 5C1—Set 116-9 ..... 116-9  
5C6 (Ch. HS-272) (See Model 5C1—Set 116-9) ..... 116-9  
5H11U, 5H12U, 5H13U (Ch. HS-224) ..... 117-9  
5J1 (Ch. HS-250) ..... 100-7  
5J2 (Ch. HS-250) (See Model 5J1—Set 100-7) ..... 100-7  
5J2U (Ch. HS-252) (See Model 5J1—Set 100-7) ..... 100-7  
5L1 (Ch. HS-250) ..... 100-7  
5L2 (Ch. HS-250) (See Model 5J1—Set 100-7) ..... 100-7  
5L2U (Ch. HS-224) (See Model 5J1—Set 100-7) ..... 100-7  
5M1, 5M1U, 5M2, 5M2U (Ch. HS-249, HS-223) ..... 101-7  
5R11A, 5R12A, 5R13A, 5R14A, 5R15A, 5R16A (Ch. HS-280) (See Model 5R11U—Set 115-6) ..... 115-6  
5R11U, 5R12U, 5R13U, 5R14U, 5R15U, 5R16U (Ch. HS-246) ..... 115-6  
5X11U, 5X12U, 5X13U (Ch. HS-224) ..... 114-7  
5X21U, 5X22U, 5X23U (Ch. HS-259) ..... 120-9  
6F11, 6F11B (Ch. HS-264) ..... 117-10  
6L1, 6L2 (Ch. HS-226) ..... 102-7  
6X11U, 6X12U (Ch. HS-245) ..... 112-5  
7F11, 7F11B (Ch. HS-265) ..... 113-5  
7VT1, 7VT2, 7VT5 (Ch. TS-18) Tel. Rec. .... 83-6  
8FDT (See Ch. 8A—Set 46-16) ..... 82-8  
8FM21, 8FM21B (Ch. HS-247) ..... 121-9  
8GMT (See Ch. 8A—Set 46-16) ..... 82-8  
9FM21, 9FM21B (Ch. HS-246) ..... 114-8  
9T1 (Ch. TS-18, A) Tel. Rec. (See Model 7VT1—Set 83-6) ..... 83-6  
9VT1, 9VT5 (Ch. TS-18, A) Tel. Rec. .... 83-6  
10T2 (Ch. TS-14B) Tel. Rec. .... 92-4  
10VK9 (Ch. TS-9E, TS-9E1) Tel. Rec. (Also Prod. Chge. Bul. 5—Set 106-1) ..... 93-7  
10VK12 (Ch. TS14, A, B) Tel. Rec. .... 92-4  
10VK22 (Ch. TS14, A, B) Tel. Rec. .... 92-4  
10VT3 (Ch. TS-9E, TS-9E1) Tel. Rec. .... 77-6  
10VT10 (Ch. TS14, A, B) Tel. Rec. .... 92-4  
10VT24 (Ch. TS14, A, B) Tel. Rec. .... 92-4  
12K1, B (Ch. TS23B) Tel. Rec. .... 92-4  
12K2, B (Ch. TS-23B) Tel. Rec. .... 92-4  
12K2 (Ch. TS-53) Tel. Rec. .... 115-7  
12T1, B (Ch. TS-23B) Tel. Rec. .... 92-4  
12T3 (Ch. TS-53) Tel. Rec. .... 115-7  
12VF4B, R, R-C (Ch. TS-23, A and Radio Ch. HS-190) Tel. Rec. .... 92-4  
12VF26B, B-C, R, R-C (Ch. TS-23A, B and Radio Ch. HS-190A) Tel. Rec. .... 92-4  
12VK11 (Ch. TS-23, A, B) Tel. Rec. .... 92-4  
12VK15 (Ch. TS-30, A) Tel. Rec. (Also Prod. Chge. Bul. 5—Set 106-1) ..... 93-7  
12VK18B, 12VK18R (Ch. TS-15C, TS-15C1) Tel. Rec. .... 77-6  
12VT13 (Ch. TS-23, A, B) Tel. Rec. .... 92-4  
12VT16, 12VT16B, A, B, C (Ch. TS-15C, TS-15C1) Tel. Rec. .... 77-6  
14K1, B (Ch. TS-88) Tel. Rec. .... 112-6  
14K1BH, 14K1H (Ch. TS-115) Tel. Rec. .... 121-10

**MOTOROLA—Cont.**

14P1B (Ch. TS-216) Tel. Rec. (See Model 1474—Set 158-8) ..... 174-9  
14P2, 14P2U (Ch. TS-275) Tel. Rec. .... 174-9  
14T1, B (Ch. TS-88) Tel. Rec. .... 112-6  
14T3 (Ch. TS-114) Tel. Rec. .... 121-10  
14T3X1 (Ch. TS-114A) (See Model 14T3—Set 121-10) ..... 158-8  
14T4, B (Ch. TS-216) Tel. Rec. .... 158-8  
16F1 (Ch. TS-89) ..... 102-8  
16F1BH, 16F1H (Ch. TS-89 and Radio Ch. HS-324) Tel. Rec. (For TV Ch. see Set 121-10, For Radio Ch. see Model 16F1—Set 102-8) ..... 102-8  
16K2L, L-B (Ch. TS-52) Tel. Rec. .... 93A-10  
16K2 (Ch. TS-74) Tel. Rec. 102-8  
16K2BH, 16K2H (Ch. TS-94) Tel. Rec. .... 121-10  
16T1 (Ch. TS-60) Tel. Rec. 102-8  
16T1BH, 16T1H (Ch. TS-89) Tel. Rec. .... 121-10  
16V9B, B (Ch. TS-16, A and Radio Ch. HS-211) Tel. Rec. (For TV Ch. see Set 93-7, For Radio Ch. see Model 99FM21R—Set 80-10) ..... 93A-10  
16VK1 (Ch. TS-52) Tel. Rec. .... 93A-10  
16VK7 (Ch. TS-16, A) Tel. Rec. (Also Prod. Chge. Bul. 5—Set 106-1) ..... 93-7  
17F1 (Ch. TS-118 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F1A (Ch. TS-59 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F1B (Ch. TS-118 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F1BA (Ch. TS-89 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F2W (Ch. TS-118 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F2WA (Ch. TS-89 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F3, B (Ch. TS-118 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F3BA (Ch. TS-89 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F4 (Ch. TS-118 and Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) ..... 121-10  
17F4A (Ch. TS-89 and Radio Ch. HS-253) Tel. Rec. .... 121-10  
17F5 (Ch. TS-118 and Radio Ch. HS-261) Tel. Rec. (See Model 14K1BH) ..... 121-10  
17F5A, 17F5BA (Ch. TS-89 and Radio Ch. HS-261) Tel. Rec. .... 121-10  
17F5B (Ch. TS-118 and Radio Ch. HS-261) Tel. Rec. .... 121-10  
17F6, B (Ch. TS-118 and Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17F6B, C (Ch. TS-174 and Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17F7B (Ch. TS-18) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17F7BC (Ch. TS-174 and Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17F7B, B (Ch. TS-118) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17F7C (Ch. TS-174) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17F7D (Ch. TS-401) Tel. Rec. (For TV Ch. Only see Prod. Chge. Bul. 49—Set 183-1 and Model 21F1—Set 173-9) ..... 173-9  
17F13, B (Ch. TS-395A, 02 and Radio Ch. HS-319) (For TV Ch. see Set 192-6, For Radio Ch. see Model 17F12—Set 171-8) ..... 171-8  
17F13BC (Ch. TS-408A and Radio Ch. HS-319) Tel. Rec. For TV Ch. see Model 21C1—Set 191-13, For Radio Ch. see Model 17F12—Set 171-8) ..... 171-8  
17F13D (Ch. TS-401) Tel. Rec. (For TV Ch. Only see Prod. Chge. Bul. 49—Set 183-1 and Model 21F1—Set 173-9) ..... 173-9  
17F13, B (Ch. TS-395A, 02 and Radio Ch. HS-319) (For TV Ch. see Set 192-6, For Radio Ch. see Model 17F12—Set 171-8) ..... 171-8  
17F13BC (Ch. TS-408A and Radio Ch. HS-319) Tel. Rec. For TV Ch. see Model 21C1—Set 191-13, For Radio Ch. see Model 17F12—Set 171-8) ..... 171-8

**MOTOROLA—Cont.**

17F13C (Ch. TS-408A and Radio Ch. HS-319) Tel. Rec. (For TV Ch. see Model 21C1—Set 191-13, For Radio Ch. see Model 17F12—Set 171-8) ..... 171-8  
17K1A, 17K1BA (Ch. TS-95) Tel. Rec. .... 121-10  
17K1BE, E (Ch. TS-172) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K2BE, E (Ch. TS-172) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K3, 17K3B (Ch. TS-118) Tel. Rec. .... 121-10  
17K3A, 17K3BA (Ch. TS-89) Tel. Rec. .... 121-10  
17K4A (Ch. TS-95) Tel. Rec. .... 121-10  
17K4E (Ch. TS-172) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K5 (Ch. TS-118) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K5C (Ch. TS-174) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K5E (Ch. TS-221A) Tel. Rec. .... 159-10  
17K6 (Ch. TS-118) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K6C (Ch. TS-174) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K7, B (Ch. TS-118) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K7C (Ch. TS-174) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K8, B (Ch. TS-236) Tel. Rec. .... 152-4A  
17K8A, BA (Ch. TS-228) Tel. Rec. .... 165-7  
17K9, B (Ch. TS-220) ..... 159-10  
17K9A, BA (Ch. TS-228) Tel. Rec. .... 165-7  
17K9C (Ch. TS-221, -A) Tel. Rec. .... 159-10  
17K10A (Ch. TS-174) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K10E (Ch. TS-314A, B) Tel. Rec. .... 167-13  
17K11, B, C (Ch. TS-236) Tel. Rec. .... 152-4A  
17K11A, BA (Ch. TS-228) Tel. Rec. .... 165-7  
17K12, A, B, BA, W, WA (Ch. TS-325, A, B, C, TS-326, A) Tel. Rec. .... 171-8  
17K13A (Ch. TS-326, B) Tel. Rec. (See Model 17F12—Set 171-8) ..... 171-8  
17K13D (Ch. TS-401) Tel. Rec. (See Prod. Chge. Bul. 49—Set 183-1 & Model 21F1—Set 173-9) ..... 173-9  
17K14, A, B (Ch. TS-395, -02) Tel. Rec. .... 192-6  
17K14BC (Ch. TS-408A) Tel. Rec. (See Model 21C1—Set 191-13) ..... 191-13  
17K14C (Ch. TS-408A) Tel. Rec. (See Model 21C1—Set 191-13) ..... 191-13  
17K14W (Ch. TS-395, -02) Tel. Rec. .... 192-6  
17K14WC (Ch. TS-408A) Tel. Rec. (See Model 21C1—Set 191-13) ..... 191-13  
17K15, B (Ch. TS-395A, -02) Tel. Rec. .... 192-6  
17K16C (Ch. TS-408A) Tel. Rec. (See Model 21C1—Set 191-13) ..... 191-13  
17K17, 17K17A (Ch. TS-89) Tel. Rec. .... 121-10  
17K17A, 17K17BA (Ch. TS-89) Tel. Rec. .... 121-10  
17K17C, 17K17D (Ch. TS-118) Tel. Rec. .... 121-10  
17K18 (Ch. TS-118) Tel. Rec. .... 121-10  
17K18A (Ch. TS-89) Tel. Rec. .... 121-10  
17K18B (Ch. TS-118A, B) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18C (Ch. TS-118) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18D (Ch. TS-118) Tel. Rec. .... 121-10  
17K18E (Ch. TS-118) Tel. Rec. .... 121-10  
17K18F (Ch. TS-118) Tel. Rec. .... 121-10  
17K18G (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18H (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18I (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18J (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18K (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18L (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18M (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18N (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18O (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18P (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18Q (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18R (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18S (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18T (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18U (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18V (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18W (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18X (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18Y (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10  
17K18Z (Ch. TS-221, -A) Tel. Rec. (See Model 14K1BH—Set 121-10) ..... 121-10



**MOTOROLA-OLYMPIC**

**MOTOROLA-Cont.**

405 (See Model 408—Set 38-12) ..... 215—10  
 412 ..... 98—7  
 500 ..... 138—10  
 501 ..... 148—12  
 501A ..... 4—37  
 505 (Ch. AS-14) ..... 39—13  
 508 ..... 509 (See Model 508—Set 39-13) ..... 97—10  
 600 (See Mopar Model 603—Set 65-9) ..... 5—1  
 604 (See Mopar Model 704—Set 106-9) ..... 5—1  
 605 (Ch. AS-15) ..... 606 (See Mopar Model 606—Set 133-9) ..... 607 (See Mopar Model 607—Set 170-11) ..... 39—14  
 608 (Mopar) (See Mopar Model 608—Set 207-4) ..... 609 (See Model 608—Set 39-14) ..... 100—8  
 700 ..... 137—8  
 701 (Ch. BT-2 and P6-2) ..... 197—7  
 705 (Ch. AS-16) ..... 7—19  
 708 ..... 40—12  
 709 (See Model 708—Set 40-12) ..... 103—10  
 801 ..... 138—6  
 802 (Ch. BT-2 and P8-2) ..... 197—7  
 804 (See Mopar Model 804—Set 67-12) ..... 808 (See Mopar Model 808—Set 107-6) ..... 814 (See Mopar Model 814—Set 137-7) ..... Ch. AS-13 (See Model 405) ..... Ch. AS-14 (See Model 505) ..... Ch. AS-15 (See Model 605) ..... Ch. AS-16 (See Model 705) ..... Ch. AS-22 (See Model BK-6) ..... Ch. BT-2 ..... 197—7  
 Ch. HS-2 (See Model 65X11A) ..... Ch. HS-6 (See Model 5A1) ..... Ch. HS-7 (See Model 65L11) ..... Ch. HS-8 (See Model 45B12) ..... Ch. HS-15 (See Model 5A5) ..... Ch. HS-18 (See Model WR6) ..... Ch. HS-22 (See Model 85F21) ..... Ch. HS-26 (See Model 65F21) ..... Ch. HS-30 (See Model 55F11) ..... Ch. HS-31 (See Model 65F11) ..... Ch. HS-32 (See Model 65T21) ..... Ch. HS-36 (See Model 75F31) ..... Ch. HS-36A (See Model 75F31A) ..... Ch. HS-38 (See Model 95F33) ..... Ch. HS-39 (See Model 95F31) ..... Ch. HS-50 (See Model 55X11A) ..... Ch. HS-52 (See Model 85K21) ..... Ch. HS-58 (See Model 67X11) ..... Ch. HS-59 (See Model 67L11) ..... Ch. HS-60 (See Model 57X11) ..... Ch. HS-62 (See Model 5A7) ..... Ch. HS-62A (See Model 5A7A) ..... Ch. HS-63 (See Model 67F11) ..... Ch. HS-64 (See Model 67XM21) ..... Ch. HS-69 (See Model 67F18N) ..... Ch. HS-72 (See Model 47B11) ..... Ch. HS-87 (See Model 107F31) ..... Ch. HS-89 (See Model 77FM21) ..... Ch. HS-91 (See Model 75F21) ..... Ch. HS-94 (See Model 56X11) ..... Ch. HS-97 (See Model 77FM22) ..... Ch. HS-98 (See Model 76F31) ..... Ch. HS-102 (See Model 77XM21) ..... Ch. HS-108 (See Model VK-101) ..... Ch. HS-113 (See Model 48L11) ..... Ch. HS-114 (See Model 58L11) ..... Ch. HS-116 (See Model 58R11) ..... Ch. HS-119 (See Model 68L11) ..... Ch. HS-122 (See Model 67F14) ..... Ch. HS-124 (See Model 78F11) ..... Ch. HS-125 (See Model 58X11) ..... Ch. HS-127 (See Model 68X11) ..... Ch. HS-127A (See Model 68X11A) ..... Ch. HS-128 (See Model 78FM22M) ..... Ch. HS-132 (See Model 78FM21)

**MOTOROLA-Cont.**

Ch. HS-133 (See Model 88FM21) ..... Ch. HS-137 (See Model V102) ..... Ch. HS-144 (See Model 68T11) ..... Ch. HS-150 (See Model 78F11) ..... Ch. HS-155 (See Model 78F12M) ..... Ch. HS-158 (See Model 58A11) ..... Ch. HS-160 (See Model 58G11) ..... Ch. HS-167 (See Model 59R11) ..... Ch. HS-168 (See Model 79M21) ..... Ch. HS-170 (See Model 99FM21R) ..... Ch. HS-175 (See Model 69L11) ..... Ch. HS-178 (See Model 79FM21) ..... Ch. HS-180 (See Model 59K11) ..... Ch. HS-181 (See Model 69X11) ..... Ch. HS-183 (See Model 49L11Q) ..... Ch. HS-184 (See Model 59L11A) ..... Ch. HS-187 (See Model 59L11Q) ..... Ch. HS-188 (See Model 59F11) ..... Ch. HS-192 (See Model 59X21U) ..... Ch. HS-210 (See Model 59H11U) ..... Ch. HS-223 (See Model 5M1) ..... Ch. HS-224 (See Model 5J11U) ..... Ch. HS-226 (See Model 6L1) ..... Ch. HS-228 (See Model 5C1) ..... Ch. HS-230 (See Model 19F11) ..... Ch. HS-234 (See Model 16F11) ..... Ch. HS-242 (See Model 5R11A) ..... Ch. HS-243 (See Model 5X11U) ..... Ch. HS-244 (See Model 5H11U) ..... Ch. HS-245 (See Model 6X11U) ..... Ch. HS-246 (See Model 9FM21) ..... Ch. HS-247 (See Model 8FM21) ..... Ch. HS-249 (See Model 5M1) ..... Ch. HS-250 (See Model 5J1) ..... Ch. HS-253 (See Model 17F11) ..... Ch. HS-258 (See Model 5C2) ..... Ch. HS-259 (See Model 5X21U) ..... Ch. HS-261 (See Model 17F5) ..... Ch. HS-262 (See Model 5C3) ..... Ch. HS-264 (See Model 6F11) ..... Ch. HS-265 (See Model 7F11) ..... Ch. HS-270 (See Model 5C4) ..... Ch. HS-271 (See Model 5C5) ..... Ch. HS-272 (See Model 5C6) ..... Ch. HS-283 (See Model 51M1U) ..... Ch. HS-289, A (See Model 52R11) ..... Ch. HS-299 (See Model 62C1) ..... Ch. HS-300 (See Model 52M1U) ..... Ch. HS-302 (See Model 17F11) ..... Ch. HS-303 (See Model 62X11U) ..... Ch. HS-305 (See Model 52B1U) ..... Ch. HS-306 (See Model 42B1) ..... Ch. HS-308 (See Model 62L1U) ..... Ch. HS-309 (See Model 52C1) ..... Ch. HS-310 (See Model 52C6) ..... Ch. HS-313 (See Model 52H11U) ..... Ch. HS-314 (See Model 62X11U) ..... Ch. HS-315 (See Model 52R11U) ..... Ch. HS-316 (See Model 21F1) ..... Ch. HS-317 (See Model 52R11A) ..... Ch. HS-319 (See Model 17F12) ..... Ch. HS-324 (See Model 62CW1) ..... Ch. HS-327 (See Model 52L1) ..... Ch. HS-329 (See Model 52CW1) ..... Ch. HS-347 (See Model 53LC1) ..... Ch. HS-357 (See Model 52L1) ..... Ch. M-5 (See Model AR96-23) ..... Ch. OB (See Model SROB)

**MOTOROLA-Cont.**

Ch. P6-2 ..... 197—7  
 Ch. P8-2 ..... 197—7  
 Ch. TS-3 (See Model VT-101) ..... Ch. TS-48 Thru J (See Model VT-71) ..... Ch. TS-4J Late (See Model VT-73) ..... Ch. TS-5 (See Model VK101) ..... Ch. TS-7 (See Model VF-102) ..... Ch. TS-8 (See Model VF103) ..... Ch. TS-9, TS-9A, TS-9B, TS-9C (See Model VT105) ..... Ch. TS-9D (See Model VT105) ..... Ch. TS-9E, TS-9E1 (See Model VK106) ..... Ch. TS-1A, A, B (See Model 10VK12) ..... Ch. TS-15 (See Model VT121) ..... Ch. TS-15C, TS-15C1 (See Model 12VK18B) ..... Ch. TS-16, A (See Model 16VF8B) ..... Ch. TS-18, A (See Model 7VT1) ..... Ch. TS-23, A, B (See Model 12VK11) ..... Ch. TS-30, A (See Model 12VK15) ..... Ch. TS-52 (See Model 16K2L) ..... Ch. TS-53 (See Model 12K2) ..... Ch. TS-60 (See Model 16F1) ..... Ch. TS-67 (See Model 19F1) ..... Ch. TS-74 (See Model 16K2) ..... Ch. TS-88 (See Model 14K1) ..... Ch. TS-89 (See Model 16F1BH) ..... Ch. TS-94 (See Model 16K2BH) ..... Ch. TS-95 (See Model 17K1A) ..... Ch. TS-101 (See Model 19K2) ..... Ch. TS-114 (See Model 14T3) ..... Ch. TS-114A (See Model 14T3X1) ..... Ch. TS-115 (See Model 14K1BH) ..... Ch. TS-118 (See Model 17F1) ..... Ch. TS-118A, B (See Model 17T3X1) ..... Ch. TS-119, A (See Model 19K2E) ..... Ch. TS-119B (See Model 20F2) ..... Ch. TS-119C, C1, D (See Model 20K3) ..... Ch. TS-172 (See Model 17K1BE) ..... Ch. TS-174 (See Model 17F6BC) ..... Ch. TS-214 (See Model 17T5A) ..... Ch. TS-216 (See Model 14T4) ..... Ch. TS-220 (See Model 17K9) ..... Ch. TS-221, -A, (See Model 17K5E) ..... Ch. TS-228 (See Model 17F11) ..... Ch. TS-236 (See Model 17K8) ..... Ch. TS-275 (See Model 14P2) ..... Ch. TS-292A, B, C (See Model 21C1) ..... Ch. TS-292AY, BY, CY (See Model 21C1Y) ..... Ch. TS-307 (See Model 20K6) ..... Ch. TS-314A, B, TS-315A, B (See Model 17K10E) ..... Ch. TS-324, A, B (See Model 21T4A) ..... Ch. TS-324AY, BY (See Models 21T4A and TK-19M) ..... Ch. TS-325, A, TS-326, A (See Model 17F12) ..... Ch. TS-326Y (See Models 17F12 and VTK-17M) ..... Ch. TS-351, A, B (See Model 21F11) ..... Ch. TS-395, -O2 (See Model 17F13) ..... Ch. TS-400A (See Model 17T1E) ..... Ch. TS-401 (See Model 17F12D) ..... Ch. TS-408A (See Model 17F13C) ..... Ch. TS-408Y (See Models 17F13C and TK-19M) ..... Ch. TS-410A (See Model 17T13) ..... Ch. TS-410Y (See Model 17T13Y) ..... Ch. TS-501A (See Model 21T3) ..... Ch. TS-501Y (See Models 21T3 and TK-24M) ..... Ch. VTS-292A, AY, B, BY, C, CY (See Model 21K10, Y) ..... Ch. VTS-410 (See Model 17T14) ..... Ch. VTS-410Y (See Model 17T14Y) ..... Ch. VTS-292A, AY, B, BY, C, CY (See Model 21C1BD, BDY)

**MOTOROLA-Cont.**

Ch. 1A ..... 134—8  
 Ch. 1B ..... 136—11  
 Ch. 2A ..... 197—7  
 Ch. 2M ..... 197—7  
 Ch. 8A ..... 46—16  
 Ch. 10A ..... 106—10  
**MUNTZ**  
 M30 (Ch. TV-16A1) Tel. Rec. (See Model M32) ..... 108—8  
 M31 (Ch. TV-16A2) Tel. Rec. (See Model M32) ..... 108—8  
 M31 (Ch. TV17A2) Tel. Rec. (See Model M32) ..... 116—10  
 M31R (Ch. TV17A3) Tel. Rec. (See Model M32) (Ch. TV17A3)—Set 116-10) ..... 108—8  
 M32 (Ch. TV17A2) Tel. Rec. (See Model M32) ..... 116—10  
 M32 (Ch. TV17A3) Tel. Rec. (See Model M32) (Ch. TV17A3)—Set 116-10) ..... 116—10  
 M33 (Ch. TV17A4) Tel. Rec. (See Model M33) ..... 116—10  
 M34 (Ch. TV17A4) Tel. Rec. (For TV Ch. only Set Model M33—Set 116-10) ..... M41, M42 (Ch. TV17A3A) Tel. Rec. (See Model 175) ..... M46 (Ch. TV17A7) Tel. Rec. (See Model 2053) ..... M49 (Ch. TV17A7) Tel. Rec. (See Model 2053) ..... M-158 Tel. Rec. ..... 97A-10  
 M-159 Tel. Rec. ..... 97A-10  
 M-159A, B Tel. Rec. ..... 97A-10  
 M-169 Tel. Rec. ..... 96—6  
 1750, 1751, 1752 (Ch. 17A3A) Tel. Rec. (See Prod. Chge. Bul. 33—Set 159-3 and Model M31—Set 116-10) ..... 2053 (Ch. 17A7) Tel. Rec. (See Prod. Chge. Bul. 33—Set 159-3 and Model M31—Set 116-10) ..... 2053-A (Ch. 17B1, 17B2) Tel. Rec. (See Ch. 17B1—Set 163-8) ..... 2054 (Ch. 17A7) Tel. Rec. (See Prod. Chge. Bul. 33—Set 159-3 and Model M31—Set 116-10) ..... 2054-A (Ch. 17B1, 17B2) Tel. Rec. (For TV Ch. only See Ch. 17B1—Set 163-8) ..... 2055 (Ch. 17A7) Tel. Rec. (See Prod. Chge. Bul. 33—Set 159-3 and Model M31—Set 116-10) ..... 2055 (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. .... 207—5  
 2055-A (Ch. 17B1, 17B2) Tel. Rec. (See Ch. 17B1—Set 163-8) ..... 2055A, AU (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619200) Tel. Rec. .... 207—5  
 2055-B (Ch. 17B2) Tel. Rec. (See Ch. 17B2—Set 163-8) ..... 2055B (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. .... 207—5  
 2056 (Ch. 17A7) Tel. Rec. (See Prod. Chge. Bul. 33—Set 159-3 and Model M31—Set 116-10) ..... 2056-A (Ch. 17B1, 17B2) Tel. Rec. (See Ch. 17B1—Set 163-8) ..... 2060 Tel. Rec. .... 164—6  
 2066 (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. .... 207—5  
 2158A (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. .... 207—5  
 2158-A (Ch. 17B5, 17B6) Tel. Rec. (See Ch. 17B5—Set 163-8) ..... 2159A (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. .... 207—5  
 2159-A (Ch. 17B5, 17B6) Tel. Rec. (See Ch. 17B5—Set 163-8) ..... 2162 (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. .... 207—5  
 2162-A (Ch. 17B5, 17B6) Tel. Rec. (See Ch. 17B5—Set 163-8) ..... 2457-A (Ch. 17B3, 17B4) Tel. Rec. (See Ch. 17B3—Set 163-8) ..... 2461-A (Ch. 17B3, 17B4) Tel. Rec. (See Ch. 17B3—Set 163-8) ..... 2763A, 2764A, 2765A (Ch. 17B8, Above Serial No. 374500) Tel. Rec. .... 208—7  
 Ch. 17B1, 17B2, Tel. Rec. 163—8  
 Ch. 17B2 (Above Serial No. 369500) [See Model 2055]

**MUNTZ-Cont.**

Ch. 17B3, 17B4, 17B5, 17B6 Tel. Rec. .... 163—8  
 Ch. 17B6 (Above Serial No. 3619500) (Above Serial 2055) ..... Ch. 17B8 (Above Serial No. 374500) (See Model 2763A) ..... **MURPHY**  
 113 ..... 122 (See Model 112—Set 2-15) ..... **MUSITRON**  
 PT-10 ..... 15—20  
 PX ..... 16—28  
 SRC-3 ..... 13—21  
 101 "Piccolo" ..... 13—21  
 103 "Piccolo" ..... 15—21  
 105 ..... 21—26  
 202 ..... 21—27  
**MUTUAL BUYING SYNDICATE (See Drexel or General)**  
**NASH**  
 AC-152 (NH2AC) ..... 184—9  
 NH3C ..... 216—6  
 6MNH82 ..... 9—25  
**NATIONAL CO.**  
 HFS ..... 62—14  
 HRO-7R, HRO-7T ..... 50—12  
 HRO-50R1, HRO-50T1 ..... 112—7  
 HRO-60 ..... 169—11  
 HRO-60 ..... 202—4  
 NC-TV7, NC-TV7M, NC-TV7W Tel. Rec. .... 67—14  
 NC-TV-10C, T, W Tel. Rec. (Also See Prod. Chge. Bul. 1—Set 103-19) ..... 94—5  
 NC-TV-12C, W Tel. Rec. (Also See Prod. Chge. Bul. 1—Set 103-19) ..... 94—5  
 NC-TV-1001 Tel. Rec. (Also See Prod. Chge. Bul. 1—Set 103-19) ..... 94—5  
 NC-TV-1025 Tel. Rec. (Also See Prod. Chge. Bul. 1—Set 103-19) ..... 94—5  
 NC-TV-1201, NC-TV-1202 Tel. Rec. (Also See Prod. Chge. Bul. 1—Set 103-19) ..... 94—5  
 NC-TV-1225, NC-TV-1226 Tel. Rec. (Also See Prod. Chge. Bul. 1—Set 103-19) ..... 94—5  
 NC-2-400R, NC-2-400T ..... 41—16  
 NC-33 ..... 47—14  
 NC-46 ..... 9—26  
 NC-57 ..... 48—14  
 NC-108R, NC-108T ..... 47—15  
 NC-125 ..... 139—10  
 NC-173R, NC-173T ..... 40—13  
 NC-183R, NC-183T ..... 49—15  
 SW-54 ..... 141—9  
 TV-1201 Tel. Rec. .... 119—10  
 TV-1226 Tel. Rec. .... 119—10  
 TV-1601 Tel. Rec. .... 119—10  
 TV-1625 Tel. Rec. .... 119—10  
 TV-1701, TV-1702 Tel. Rec. .... 145—7  
 TV-1725, TV-1727 Tel. Rec. .... 145—7  
 TV-1729, TV-1730, TV-1731, TV-1732 Tel. Rec. .... 145—7  
 TV-2029, TV-2030 Tel. Rec. .... 145—7  
**NATIONAL UNION**  
 G-613 "Commuter" ..... 19—23  
 G-619 ..... 11—35  
 571, 571A, 571B ..... 17—22  
**NEWCOMB**  
 A-104R ..... 196—8  
 H-10 ..... 14—20  
 H-14 ..... 15—22  
 KX-30 ..... 15—23  
**NOBLITT SPARKS (See Arvin)**  
**NORELCO**  
 PT200, PT300 Tel. Rec. .... 155—13  
 588A Tel. Rec. .... 164—7  
 1200A Tel. Rec. (See Model 588A—Set 164-7) ..... **OAK (See Record Changer Listing)**  
**OLDSMOBILE**  
 982375 ..... 20—25  
 982376 ..... 59—14  
 982399 ..... 57—12  
 982420 ..... 87—7  
 982454 ..... 60—16  
 982455 ..... \*  
 982543 ..... 157—7  
 982544, 982573 ..... 96—7  
 982579 ..... 157—7  
 982697, 982698 (See Model 982544—Set 96-7) ..... 982699, 982700 ..... 150—10  
**OLYMPIC**  
 DX-214, DX-215, DX-216 Tel. Rec. .... 106—11  
 DX-619, DX-620, DX-621, DX-622 Tel. Rec. .... 106—11  
 DX-931, DX-932 Tel. Rec. .... 106—11  
 DX-950 Tel. Rec. .... 106—11  
 RTU-3H (Dupliator) ..... 62—15  
 TV-104, TV-105 Tel. Rec. .... 67—15  
 TV-106, TV-107, TV-108 Tel. Rec. (See Model TV-104—Set 67-15) ..... TV-922 Tel. Rec. .... 58—14  
 TV-922L Tel. Rec. .... 67—15





RCA VICTOR-Cont.

MI-12224, MI-12224A .. 81-12
MI-12236, -A, -B, -C,
MI-12237, -A,
MI-12238, -A,
MI-12239, -A .. 78-13
MI-12287, MI-12288 .. 89-12
MI-12289, MI-12290 .. 80-12
MI-12291, MI-12292 .. 86-8
MI-12293, MI-12294 .. 86-8
MI-12295 .. 89-12
MI-12296, MI-12298 .. 80-12
MI-12299 .. 89-12
MI-13159 .. 10-26
MI-13167 .. 26-19
PX600 (Ch. RC1110) .. 108-12
RV151 (Ch. RK121C,
RS-123D) .. 61-17
S1000 (Ch. KCS31-1,
RC6178) Tel. Rec. .. 91A-11
T100 (Ch. KCS-38) .. 93-9
T120, T121 (KCS34C) .. 93-9
T164 (Ch. KCS40) .. 109-11
TA-128 (Ch. KCS41 and
Radio Ch. RK135D) Tel.
Rec. (For TV Ch. See Set
110-11, For Radio Ch. See
Model TA-169—Set 108-10)
TA-129 (Ch. KCS41A-1 and
Radio Ch. RK135D) Tel.
Rec. (For TV Ch. See Set
110-11, For Radio Ch. See
Model TA-179—Set 108-10)
TA169 (Ch. KCS43 and Radio
Ch. RK135D) .. 108-10
TC124, TC125, TC127
(Ch. KCS34B) Tel. Rec. .. 93-9
TC165, TC166, TC167,
TC168 (Ch. KCS40A) .. 109-11
U1A (Ch. KRK-19) .. 190-12
U18 (Ch. KRK-19A) .. 190-12
U2 (Ch. KCS79) .. 191-15
U70 (Ch. KCS70) .. 192-7
X551, X552 (Ch.
1089B, C) .. 129-9
X711 (Ch. RC-1070A) .. 133-11
1R81 (Ch. RC-1102,
A, B, C) [Also see
Prod. Chge. Bul.
54-Set 138-1] .. 136-10
1X51, 1X52, 1X53, 1X54,
1X55, 1X56, 1X57
(Ch. RC-1104, A, B,
C, D, E) [Also see
Prod. Chge. Bul.
51-Set 185-1] .. 172-8
1X591, 1X592 (Ch.
RC1079K, L) .. 159-12
2B400, 2B401, 2B402,
2B403, 2B404, 2B405,
(Ch. RC-1114) .. 181-10
2B863 (Ch. RC-1115) .. 193-7
2C511, 2C512, 2C513,
2C514 (Ch. RC1118,
A, B, C) .. 195-10
2C521, 2C522, 2C527
(Ch. RC-1120A) .. 194-11
2E53 (Ch. RS-142) .. 205-7
2E531 (Ch. RS-142) .. 205-7
2E538 (Ch. RS-142) .. 205-7
2R51, 2R52 (Ch. RC1119) 196-13
2S10 (Ch. RC1111 and
Audio Ch. RS141) .. 210-5
2T51 (Ch. KCS45A)
Tel. Rec. (Also See
Prod. Chge. Bul. 11
Set 118-1) .. 111-11
2T60 (Ch. KCS45A) Tel.
Rec. (Also See Prod.
Chge. Bul. 11—Set
118-1) .. 111-11
2T81 (Ch. KCS46 and Radio
Ch. RC1090) Tel. Rec.
(For TV Ch. See Model
2T51—Set 111-11, For
Radio Ch. See Model
4T141—Set 139-12)
2U57 (Ch. RC-1117A, C) 182-8
2X61 (Ch. RC-1080C) .. 197-8
2X62 (Ch. RC-1080D) .. 197-8
2XF91 (Ch. RC-1121) .. 206-9
2XF931, 2XF932, 2XF933,
2XF934 (Ch. RC1121A) 209-9
2X621 (Ch. RC-1085B) .. 199-9
4T101 (Ch. KCS-61)
Tel. Rec. .. 139-12
4T141 (Ch. KCS62 and
Radio Ch. RC1090)
Tel. Rec. .. 139-12
6T53 (Ch. KCS47, T) Tel.
Rec. (See Prod. Chge. Bul.
12—Set 120-1 and Model
6T54—Set 113-7)
6T54 (Ch. KCS47, T) Tel.
Rec. (Also See Prod.
Chge. Bul. 12—Set
120-1) .. 113-7
6T64, 6T65 (Ch. KCS47A,
AT) Tel. Rec. (Also See
Prod. Chge. Bul. 12—
Set 120-1) .. 113-7
6T71 (Ch. KCS47A, AT)
Tel. Rec. (Also See
Prod. Chge. Bul. 12—
Set 120-1) .. 113-7
6T72 (Ch. KCS40B) Tel.
Rec. .. 109-11
6T74, 6T75, 6T76 (Ch.
KCS47A, AT) Tel. Rec.
(Also See Prod. Chge.
Bul. 12—Set 120-1) .. 113-7

RCA VICTOR-Cont.

6T84 (Ch. KCS 48, T and
Radio Ch. RC-1090) Tel.
Rec. (For TV Ch. See
Prod. Chge. Bul. 12—Set
120-1 and Model 6T54—
Set 113-7, For Radio
Ch. See Model 4T141—
Set 139-12) .. 134-9
6T86, 6T87 (Ch. KCS 48, T
and Radio Ch. RC-1092)
Tel. Rec. (For TV Ch. See
Prod. Chge. Bul. 12—Set
120-1 and Model 6T54—
Set 113-7, For Radio Ch.
See Model 9T89—Set 122-8)
7T103, 7T104 (Ch.
KCS47B) Tel. Rec. .. 134-9
7T103B, 7T104B (Ch. KCS 47F)
Tel. Rec. (See Prod. Chge.
Bul. 26—Set 146-1 and
Model 7T103—Set 134-9)
7T111B (Ch. KCS47GF-2) .. 156-11
7T112 (Ch. KCS47B) .. 134-9
7T112B (Ch. KCS 47G) Tel.
Rec. (See Prod. Chge. Bul.
26—Set 146-1 and Model
7T112—Set 134-9)
7T112B (Ch. KCS 47G-2)
Tel. Rec. (See Model
7T111B—Set 156-11)
7T122, 7T123 (Ch.
KCS 47C) Tel. Rec. .. 134-9
7T122B, 7T123B (Ch.
KCS 47G) Tel. Rec.
(See Prod. Chge. Bul.
26—Set 146-1 and Model
7T122—Set 134-9)
7T122B, 7T123B (Ch.
KCS 47G-2) Tel. Rec.
(See Model 7T111B—
Set 156-11)
7T124, 7T125 (Ch. KCS 47G)
Tel. Rec. .. 134-9
7T124B, 7T125B (Ch.
KCS 47G) Tel. Rec. (See
Prod. Chge. Bul. 26—Set
146-1 and Model 7T124
—Set 134-9)
7T132 (Ch. KCS47D) .. 143-12
7T143 (Ch. KCS 48A and
Radio Ch. RC1092) Tel.
Rec. (For TV Ch. See Set
134-9, For Radio Ch. See
Model 9T89—Set 122-8)
8B41 (Ch. RC-1069),
8B42 (Ch. RC-1069A),
8B43 (Ch. RC-1069B) .. 76-16
8B46 (Ch. RC-1069C) [See
Model 8B41—Set 76-16]
8B85 (Ch. RC-1059) .. 46-20
8B86 (Ch. RC-1040C) .. 44-18
8B85A, 8B85S (See Model
8B85—Set 46-20)
8B86S (See Model 8B86—
Set 44-18)
8F43 (Ch. RC-1037B) .. 97-13
8PCS41, B, C (Ch.
KCS24B-1, KR520A-1,
KRK1A-1, KCS24C-1,
KRK4, KRK2A, KR521A-1,
RS123C) Tel. Rec. .. 90-9
8R71 (Ch. RC-1060),
8R72 (Ch. RC-1060A) .. 53-20
8R74, 8R75, 8R76 (Ch.
RC-1060, A) .. 53-20
8T241, 8T243, 8T244 .. 74-8
8T245 (Ch. KCS28) Tel. Rec. .. 74-8
8T270 (Ch. KCS29,
KCS29A) Tel. Rec. .. 85-13
8T270, 8T271 (Ch.
KCS29, KCS29A)
Tel. Rec. .. 85-13
8TK29 (Ch. KCS32A, C and
Radio Ch. RK135, A) .. 88-9
8TK320 (Ch. KCS33A-1)
(Radio Ch. RK-135A-1)
Tel. Rec. .. 85-13
8TR29 (Ch. KCS32, B and
Radio Ch. RK135, A)
Tel. Rec. .. 88-9
8TS30 (Ch. KCS20J-1)
Tel. Rec. .. 54-18
8TV41 (Ch. KCS25D-1,
KCS25E-2, RK117A,
RS-123A) Tel. Rec. ..
8TV321, B, 8TV323, B (Ch.
KCS30-1 and Radio Ch.
RC-616B, C, J, K)
Tel. Rec. .. 74-8
8V7 (Ch. RC-615) [See
Model 7T71—Set 38-18]
8V90 (Ch. RC-618,
RC-618A), 8V91 (Ch.
RC-616A, RC-616H) .. 56-20
8V111, 8V112 (Ch. RC-616) 58-18
8V151 .. 61-17
8X53 (Ch. RC-1064) .. 39-17
8X71, 8X72 (RG-1070) .. 63-15
8X521 (RC-1064) .. 52-17
8X522 (RC-1066A) .. 52-17
8X541, 8X542
(Ch. RC-1065, RC-1065A) 59-16
8X544, 8X545, 8X546 (See
Model 8X541—Set 59-16)
8X547, 8X548 .. 59-16
8X681, 8X682 (Ch.
RC-1061) .. 65-10
9B8X (Ch. RC-1059B, C)
(See Model 8B8X—Set 46-20)
9B8X56 (Ch. RC-1068) .. 79-13
9EY3 (Ch. RS-132) .. 158-10
9EY31, 9EY32 (Ch.
9PC4A, B, C (Ch.
KCS24C-1, D, KRK-4,
KRS20B-1, KR521A-1,
RS-123A) Tel. Rec. .. 90-9
9T57 (Ch. KCS49, A)
Tel. Rec. .. 122-8
9T77 (Ch. KCS49A,
AT) Tel. Rec. .. 122-8

RCA VICTOR-Cont.

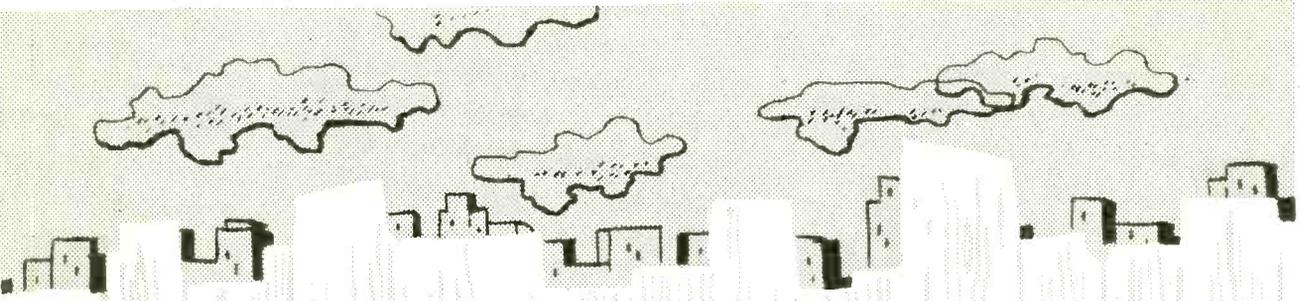
9T79 (Ch. KCS49, A,
AT, T) Tel. Rec. .. 122-8
9T89 (Ch. KCS60, T and
Radio Ch. RC1092)
Tel. Rec. .. 122-8
9T105 (Ch. KCS49B) Tel.
Rec. .. 134-9
9T126 (Ch. KCS49C) Tel.
Rec. .. 134-9
9T128 (Ch. KCS49C) Tel.
Rec. .. 134-9
9T147 (Ch. KCS 60A and
Radio Ch. RC1092) Tel.
Rec. (For TV Ch. See Set
134-9, For Radio Ch. See
Model 9T89—Set 122-8)
9T240 (Ch. KCS28, A)
Tel. Rec. .. 74-8
9T246 (Ch. KCS28C) .. 74-8
9T246 (Ch. KCS38) .. 93-9
9T256 (Ch. KCS38B) .. 93-9
9T270 (Ch. KCS29) .. 85-13
9T240 (Ch. KCS28B)
Tel. Rec. .. 74-8
9T245 (Ch. KCS34B)
and Radio Ch. RK135C)
Tel. Rec. (For TV Ch. See
Model TA-129—
Set 110-11, For Radio Ch.
See Set 95A-11)
9T247 (Ch. KCS34, B) .. 93-9
9T249 (Ch. KCS34, B) .. 93-9
9T272, 9T275 (Ch.
KCS29C) Tel. Rec. .. 85-13
9TW309 (Ch. KCS41-1
and Radio Ch. RK135C)
Tel. Rec. (For TV Ch. See
Model TA-129—
Set 110-11, For Radio Ch.
See Set 95A-11)
9TW333 (Ch. KCS30-1,
Radio Ch. RC616N)
Tel. Rec. .. 74-8
9TW390 (Ch. KCS31-1,
RC617A) Tel. Rec. .. 91A-11
9W101, 9W102, 9W103
(Ch. RC-618B), 9W105
(Ch. RC-618C) .. 73-10
9X061 (Ch. RC-622) .. 97-12
9X056 (Ch. RC-1079B) .. 101-9
9X552 (Ch. RC-1079C) .. 101-9
9X571 (Ch. RC-1079) .. 107-7
9X572 (Ch. RC-1079A) 107-7
9X641 (Ch. RC-1080),
9X642 (Ch. RC-1080A) 87-9
9X651 (Ch. RC-1085),
9X652 (Ch. RC-1085A) 104-9
9Y7 (Ch. RC-1059) .. 75-13
9Y51 (Ch. RC-1077) .. 98-11
9Y510 (Ch. RC1077A),
9Y511 (Ch. RC1077B) .. 131-13
16T152 (Ch. KCS47E)
Tel. Rec. .. 160-10
17T150, 17T151 (Ch.
KCS56C) Tel. Rec. .. 169-13
17T153 (Ch. KCS56)
Tel. Rec. .. 158-11
17T154 (Ch. KCS56) Tel.
Rec. (See Model 17T153—
Set 158-11)
17T155 (Ch. KCS56)
Tel. Rec. .. 158-11
17T160 (Ch. KCS56)
Tel. Rec. .. 158-11
17T162 (Ch. KCS56) Tel.
Rec. (See Model
17T153—Set 158-11)
17T163 (Ch. KCS56C)
Tel. Rec. .. 169-13
17T172, 17T173 (Ch.
KCS5A) Tel. Rec. (See
Model 17T153—Set 158-11)
17T172K, 17T173K,
17T174K (Ch. KCS66D)
Tel. Rec. .. 169-13
17T174 (Ch. KCS66A)
Tel. Rec. .. 158-11
17T200, 17T202 (Ch.
KCS72) Tel. Rec.
(Also See Prod. Chge.
Bul. 59—Set 193-1) .. 184-12
17T211 (Ch. KCS72) Tel.
Rec. (Also See Prod.
Chge. Bul. 59—Set
193-1) .. 184-12
17T220 (Ch. KCS72)
Tel. Rec. (Also See Prod.
Chge. Bul. 59—Set
193-1) .. 184-12
17T250DE (Ch. KCS74)
Tel. Rec. .. 193-8
17T250DE (Ch. KCS74M1)
Tel. Rec. (See Model
17T250DE—Set 193-8)
17T261DE (Ch. KCS74)
Tel. Rec. .. 193-8
17T261DE (Ch. KCS74M1)
Tel. Rec. (See Model
17T250DE—Set 193-8)
17T302, U
(Ch. KCS78, B) .. 206-10
17T310, U (Ch. KCS78, B)
Tel. Rec. .. 206-10
21D305, U (Ch. KCS81, B)
Tel. Rec. .. 208-8
21D317, U (Ch. KCS81, B)
Tel. Rec. .. 208-8
21D326, U, 21D327, U,
21D328, U, 21D329, U,
21D330, U (Ch.
KCS81, B) Tel. Rec. .. 208-8
21T159 (Ch. KCS68C, E)
Tel. Rec. (See Prod. Chge.
Bul. 56—Set 190-1 and
Model 21T176—Set 157-8)
21T159DE (Ch. KCS68F)
Tel. Rec. .. 197-9
21T165 (Ch. KCS68C, E)
Tel. Rec. (See Prod. Chge.
Bul. 56—Set 190-1 and
Model 21T176—Set 157-8)

RCA VICTOR-Cont.

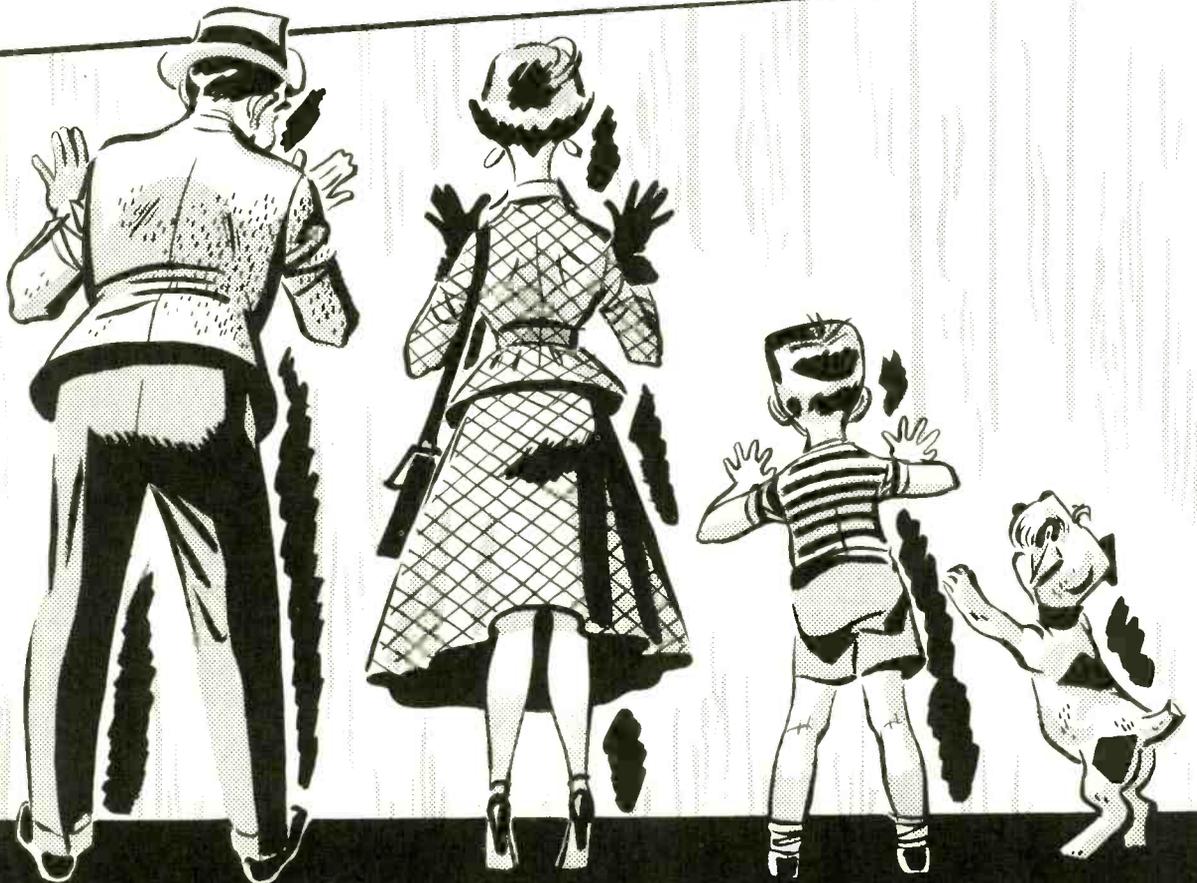
21T166DE (Ch. KCS68F)
Tel. Rec. (See Model
21T159DE—Set 197-9)
21T174DE (Ch. KCS68F)
Tel. Rec. .. 197-9
21T175DE (Ch. KCS68F)
Tel. Rec. (See Model
21T159DE—Set 197-9)
21T176, 21T177, 21T178,
21T179 (Ch. KCS68C)
Tel. Rec. (Also See
Prod. Chge. Bul. 56—
Set 190-1) .. 157-8
21T178DE (Ch. KCS68F)
Tel. Rec. .. 197-9
21T179 (Ch. KCS68C, U)
Tel. Rec. (Also See Prod.
Chge. Bul. 56—Set
190-1) .. 157-8
21T179DE (Ch. KCS68F)
Tel. Rec. .. 197-9
21T197DE (Ch. KCS68A,
U) Tel. Rec. (See Similar
Model 730T1—Set 70-7)
21T207, G (Ch. KCS72A)
Tel. Rec. (See Prod.
Chge. Bul. 59—Set 193-1
and Model 17T200—
Set 193-1)
21T208 (Ch. KCS72A) Tel.
Rec. (Also See Prod.
Chge. Bul. 59—Set
193-1) .. 184-12
21T217, 21T218 (Ch.
KCS72A) Tel. Rec. (Also
See Prod. Chge. Bul. 59—
Set 193-1) .. 184-12
21T242 (Ch. KCS72D-1 and
Radio Ch. RC117B)
Tel. Rec. .. 202-6
21T244 (Ch. KCS72D-2,
Radio Ch. RC1118B, and
Audio Ch. RS141C)
Tel. Rec. .. 202-6
21T303, U (Ch. KCS82, B)
Tel. Rec. .. 207-7
21T313, U, 21T316, U
(Ch. KCS82, B) Tel. Rec. 207-7
21T322, U, 21T323, U,
21T324, U (Ch. KCS82,
B) Tel. Rec. .. 207-7
45EY1 (Ch. RS-132F) .. 135-11
45-EY-2 (Ch. RS-138,
A, H) .. 165-9
45-EY-3 .. 126-11
45-EY-4 (Ch. RS140) .. 173-11
45EY15 (Ch. RS-132H) .. 135-11
45-EY-26 (Ch.
RS-138L, M) .. 197-10
45-W-10 (Ch. RC1096A) 138-8
54B1, 54B1-N, 54B2,
54B3 (Ch. RC589) .. 7-22
54B5 (Ch. RC1047) .. 17-25
55AU (Ch. RC1017) .. 2-16
55U (Ch. RC1017) .. 2-16
55F (Ch. RC-1004E) .. 4-6
55FA (See Model 55F—
Set 4-6)
56X, 56X2, 56X3
(Ch. RC-1011) .. 1-16
56X5 (See Model 56X10—
Set 1-16)
56X10 (Ch. RC-1023B) .. 1-12
58AV, 58V (Ch. RC-604) .. 1-32
59AV1, 59V1 (Ch. RC-605) 6-25
63E (Ch. RS-127) .. 28-28
64F7, 64F2 (Ch. RC1037),
64F3 (Ch. RC1037A) .. 4-16
65BR9 (Ch. RC-1045) .. 23-16
65F (See Model 55F—
Set 4-6)
65AU, 65U (Ch. RC-1017A) 14-23
65U-1 (See Model 65AU—
Set 14-23)
65X1, 65X2 (Ch. RC-1034) 4-30
65X1, 65X2 (Ch. RC-1064) 31-26
65X8, 65X9 (See Model
65X1—Set 4-30)
66BX (Ch. RC-1040,
RC-1040A) .. 14-24
66E (Ch. RS-126) .. 17-26
66X1, 66X2, 67X3, 66X4
66X7, 66X8 (See Model
66X1—Set 7-23)
66X9 .. 7-23
66X12 (Ch. RC-1046A),
66X12 (Ch. RC-1046),
66X13, 66X14, 66X15
(Ch. RC-1046B) .. 27-20
67V1, 67AV1
(Ch. RC-606) .. 9-27
68R1, 68R2, 68R3, 68R4
(Ch. RC-608) .. 23-17
75X11, 75X12
(Ch. RC-1050) .. 33-21
75X14, 75X15 (Ch. RC-1050)
(See Model 75X11—Set
33-21)
75X16, 75X17, 75X18,
75X19 (Ch. RC-1050B)
(See Model 75X11—
Set 33-21)
77U (Ch. RC-1057A) .. 38-17
77V1 (Ch. RC-615) .. 38-18
77V2 (Ch. RC-606-C) .. 39-18
610V1 (Ch. RC-610C)
(See Model 4T101)
Ch. KCS61
610V2 (Ch. RC-610) .. 31-27
612V1, 612V2, 612V3
(Ch. RK-121, RS-123) .. 17-27
612V4 (See Model
612V1—Set 17-27)
621TS (Ch. KCS21-1)
Tel. Rec. (Servicer) .. 78
630TCS (Ch. KCS20B)
Tel. Rec. .. 54-18
630TS (Ch. KCS20A)
Tel. Rec. .. 54-18

RCA VICTOR-Cont.

641TV (Ch. KCS25A1-1,
KCS25C-2, RK17A,
RS-123A) Tel. Rec. .. 91A-11
648PTK (Ch. KCS24-1,
KPK1-1, KR520-1,
KR521A-1, RK-121A,
RS-123A) Tel. Rec. .. 90-9
648PV (Ch. KCS24A-1,
KRK-1A, KR520-1,
KR521A-1, RK-121A,
RS-123B) Tel. Rec. .. 90-9
710V2 (Ch. RC-613A) .. 40-15
711V1 (See Model 711V2—
Set 22-24)
711V2, 711V3 (Ch.
RK-117 and RS-123) .. 22-24
711V3 (See Model 711V2—
Set 22-24)
721TCS (Ch. KCS26A-1, -2)
Tel. Rec. (See Similar
Model 730T1—Set 70-7)
721TS (Ch. KCS26-1, -2)
Tel. Rec. (See Similar
Model 730T1—Set 70-7)
730TV1 (Ch. KCS27-1, -2
and Radio Ch. RC610A)
Tel. Rec. (See Prod.
Chge. Bul. 59—Set 193-1
and Radio Ch. RC610B)
730TV2 (Ch. KCS27-1, -2
and Radio Ch. RC610B)
741PCS (Ch. KCS24B-1,
KRK1A-1, KR520A-1,
KR521A-1, RS-123C)
Tel. Rec. .. 90-9
Ch. KCS20A
(See Model 630TS)
Ch. KCS20B-1
(See Model 630TCS)
Ch. KCS201-1
(See Model 8T530)
Ch. KCS21-1
(See Model 621TS)
Ch. KCS24-1
(See Model 648PTK)
Ch. KCS24A-1
(See Model 648PV)
Ch. KCS24B-1
(See Model 8PCS41)
Ch. KCS24C-1
(See Model 8PCS41)
Ch. KCS24D
(See Model 9PC41A)
Ch. KCS25A-1
(See Model 641TV)
Ch. KCS25C-2
(See Model 641TV)
Ch. KCS25D-1
(See Model 8TV41)
Ch. KCS25E-2
(See Model 8TV41)
Ch. KCS26-1, -2
(See Model 721TS)
Ch. KCS27
(See Model 730TV1)
Ch. KCS28, A, B, C
(See Model 8T241)
Ch. KCS29, KCS29A
(See Model 8T270)
Ch. KCS29C
(See Model 9T272)
Ch. KCS30-1
(See Model 8TV241)
Ch. KCS31-1
(See Model S1000)
Ch. KCS32, KCS32A,
KCS32B, KCS32C
(See Model 8TK29)
Ch. KCS33A-1
(See Model 8TK320)
Ch. KCS34, B, C
(See Model T120)
Ch. KCS-38-C
(See Model T100)
Ch. KCS40, A, B
(See Model T164)
Ch. KCS41A-1
(See Model TA-129)
Ch. KCS42A
(See Model TA-128)
Ch. KCS43
(See Model TA169)
Ch. KCS45, A
(See Model 2T51)
Ch. KCS45
(See Model 2T81)
Ch. KCS47, A, AT, T
(See Model 6T54)
Ch. KCS47B, C
(See Model 7T103)
Ch. KCS47D
(See Model 7T132)
Ch. KCS47E
(See Model 16T152)
Ch. KCS47GF-2
(See Model 7T111B)
Ch. KCS48
(See Model 6T84)
Ch. KCS48A
(See Model 7T143)
Ch. KCS49, A, AT, T
(See Model 9T57)
Ch. KCS49B, C
(See Model 9T105)
Ch. KCS49BF
(See Model 9T105)
Ch. KCS49CF
(See Model 9T105)
Ch. KCS50, T
(See Model 9T89)
Ch. KCS60A
(See Model 9T147)
Ch. KCS61
(See Model 4T101)
Ch. KCS62
(See Model 4T141)
Ch. KCS65, A
(See Model 17T153)
Ch. KCS66C
(See Model 17T150)
Ch. KCS66D
(See Model 17T172K)
Ch. KCS68A (See Model
21T197DE)



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**RCA VICTOR—Cont.**

Ch. KCS58C, CB  
 [See Model 21T176]  
 Ch. KCS58E  
 [See Model 21T159]  
 Ch. KCS58F  
 [See Model 21T159DE]  
 Ch. KCS70  
 [See Model U70]  
 Ch. KCS72  
 [See Model 17T200]  
 Ch. KCS72A  
 [See Model 21T208]  
 Ch. KCS72D-1  
 [See Model 21T242]  
 Ch. KCS72D-2  
 [See Model 21T244]  
 Ch. KCS74, KCS74M1  
 [See Model 17T250DE]  
 Ch. KCS7B, B  
 [See Model 17T301, U]  
 Ch. KCS79  
 [See Model U2]  
 Ch. KCS81, B [See Model  
 21D305, U]  
 Ch. KCS82, B [See Model  
 21T303, U]  
 Ch. KRK-1A  
 [See Model 648PV]  
 Ch. KRK1-1  
 [See Model 648PTK]  
 Ch. KRK1A-1  
 [See Model 8PCS41]  
 Ch. KRK4  
 [See Model 9PC41A]  
 Ch. KRK-19, A  
 [See Model U1A]  
 Ch. KR520-1  
 [See Model 628PTK]  
 Ch. KR520A-1  
 [See Model 8PCS41]  
 Ch. KR520B-1  
 [See Model 9PC41A]  
 Ch. KR521A-1  
 [See Model 8PCS41]  
 Ch. RC-58P  
 [See Model 54B1]  
 Ch. RC-604  
 [See Model 58AV]  
 Ch. RC-605  
 [See Model 59AV1]  
 Ch. RC-606  
 [See Model 67V1]  
 Ch. RC-606C  
 [See Model 77V2]  
 Ch. RC-608  
 [See Model 68R1]  
 Ch. RC-610  
 [See Model 610V1]  
 Ch. RC610A, RC610B  
 [See Model 730TV1]  
 Ch. RC610C  
 [See Model 610V1]  
 Ch. RC-613A  
 [See Model 710V2]  
 Ch. RC-615  
 [See Model 77V1]  
 Ch. RC-616  
 [See Model 8V111]  
 Ch. RC-616A, RC-616H  
 [See Model 8V91]  
 Ch. RC616B, C, J, K  
 [See Model 9T321]  
 Ch. RC-616N  
 [See Model 9TW333]  
 Ch. RC617A, B  
 [See Model S1000]  
 Ch. RC-618, RC-618A  
 [See Model 8V90]  
 Ch. RC-618, B, C  
 [See Model 9W101]  
 Ch. RC-622  
 [See Model A106]  
 Ch. RC-1004E  
 [See Model 55F]  
 Ch. RC-1011  
 [See Model 56X]  
 Ch. RC-1017  
 [See Model 55AU]  
 Ch. RC-1017A  
 [See Model 65AU]  
 Ch. RC-1023B  
 [See Model 56X10]  
 Ch. RC-1034  
 [See Model 65X11]  
 Ch. RC-1037, RC-1037A  
 [See Model 64F1]  
 Ch. RC-1037B  
 [See Model 8F43]  
 Ch. RC-1038, RC-1038A  
 [See Model 66X1]  
 Ch. RC-1040, RC-1040A  
 [See Model 66B]  
 Ch. RC-1040C  
 [See Model 88X6]  
 Ch. RC-1045  
 [See Model 65BR9]  
 Ch. RC-1046, A, B  
 [See Model 66X11]  
 Ch. RC-1047  
 [See Model 54B5]  
 Ch. RC-1050, RC-1050B  
 [See Model 75X11]  
 Ch. RC-1057A  
 [See Model 77U]  
 Ch. RC-1057B  
 [See Model 9Y7]  
 Ch. RC-1059  
 [See Model 88X5]  
 Ch. RC-1059B, RC-1059C  
 [See Model 98X5]  
 Ch. RC-1060  
 [See Model 8R71]  
 Ch. RC-1060A  
 [See Model 8R72]  
 Ch. RC-1061  
 [See Model 8X681]  
 Ch. RC-1064  
 [See Model 8X53]  
 Ch. RC-1064  
 [See Model 65X1]  
 Ch. RC-1065, RC-1065A  
 [See Model 8X541]  
 Ch. RC-1066  
 [See Model 8X521]

**RCA VICTOR—Cont.**

Ch. RC-1066A  
 [See Model 8X522]  
 Ch. RC-1068  
 [See Model 98X56]  
 Ch. RC-1069A, B  
 [See Model 8841]  
 Ch. RC-1070  
 [See Model 8X71]  
 Ch. RC-1070A  
 [See Model X711]  
 Ch. RC-1077  
 [See Model 9Y51]  
 Ch. RC1077A, B  
 [See Model 9Y510]  
 Ch. RC-1079, A  
 [See Model 9X571]  
 Ch. RC-1079B, RC-1079C  
 [See Model 9X561]  
 Ch. RC1079K, L  
 [See Model 1X591]  
 Ch. RC-1080C  
 [See Model 2X61]  
 Ch. RC-1080D  
 [See Model 2X62]  
 Ch. RC-1082  
 [See Model 8X6]  
 Ch. RC-1085, RC-1085A  
 [See Model 9X651]  
 Ch. RC-1085B  
 [See Model 2X621]  
 Ch. RC-1087  
 [See Model A55]  
 Ch. RC-1088, RC-1088A  
 [See Model 8X55]  
 Ch. RC1089B, C  
 [See Model X551]  
 Ch. RC1090  
 [See Model 4T141]  
 Ch. RC-1092  
 [See Model 9T89]  
 Ch. RC1094  
 [See Model A-82]  
 Ch. RC1096  
 [See Model A-108]  
 Ch. RC1096A  
 [See Model 45-W-10]  
 Ch. RC1098  
 [See Model 8411]  
 Ch. RC1098A  
 [See Model B-411]  
 Ch. RC-1102  
 [See Model 1R81]  
 Ch. RC-1104, -1, A, A-1,  
 B, B-1, C, D, E  
 [See Model 1X51]  
 Ch. RC-1110  
 [See Model PX600]  
 Ch. RC1111 [See Model  
 2510]  
 Ch. RC1111A [See Model  
 21T197DE]  
 Ch. RC-1114  
 [See Model 2B400]  
 Ch. RC-1115  
 [See Model 2B463]  
 Ch. RC-1117A  
 [See Model 2U57]  
 Ch. RC-1117B  
 [See Model 21T242]  
 Ch. RC-1117C  
 [See Model 2U57]  
 Ch. RC1118, A, B, C  
 [See Model 2C511]  
 Ch. RC1119  
 [See Model 2R51]  
 Ch. RC-1120, A  
 [See Model 2C521]  
 Ch. RC-1121  
 [See Model 2XF91]  
 Ch. RC1121A [See Model  
 2XF931]  
 Ch. RK-117  
 [See Model 711V2]  
 Ch. RK-117A  
 [See Model 8TV41]  
 Ch. RK-121  
 [See Model 612V1]  
 Ch. RK-121A  
 [See Model 648PTK]  
 Ch. RK-121C  
 [See Model RV151]  
 Ch. RK-135, RK-135A  
 [See Model 8TK29]  
 Ch. RK-135A-1  
 [See Model 8TK320]  
 Ch. RK135C  
 [See Model 9TW309]  
 Ch. RK135D  
 [See Model TA169]  
 Ch. RS-123  
 [See Model 612V1]  
 Ch. RS-123A  
 [See Model 9PC41A]  
 Ch. RS-123B  
 [See Model 648PV]  
 Ch. RS-123C  
 [See Model 8PCS41]  
 Ch. RS-123D  
 [See Model RV151]  
 Ch. RS-126  
 [See Model 66E]  
 Ch. RS-127  
 [See Model 63E]  
 Ch. RS-132  
 [See Model 9EY3]  
 Ch. RS-132F, H  
 [See Model 45EY1]  
 Ch. RS-132H  
 [See Model 45-EY-15]  
 Ch. RS-138, A, H  
 [See Model 45-EY-2]  
 Ch. RS-138L, H  
 [See Model 45-EY-26]  
 Ch. RS140  
 [See Model 45-EY-4]  
 Ch. RS141 [See Model 2510]  
 Ch. RS141A [See Model  
 21T197DE]  
 Ch. RS141C  
 [See Model 21T244]  
 Ch. RS142  
 [See Model 2E53]  
 Bentley [See Model 4T101]  
 Benton [See Model  
 21T175DE]

**RCA VICTOR—Cont.**

Bristol [See Model 17T153]  
 Cabot [See Model 21D305, U]  
 Caldwell [See Model  
 17T162]  
 Calhoun [See Model  
 17T173, 17T173K]  
 Clarendon [See Model  
 21T179]  
 Clermont [See Model  
 21D330, U]  
 Covington [See Model  
 17T172, 17T172K]  
 Cumberland [See Model  
 2T60]  
 Deauville [See Model  
 21T315, U]  
 Dobson [See Model  
 21T322, U]  
 Donley [See Model 21T177]  
 Fairfax [See Model 6T84]  
 Fairfield [See Model 6T71,  
 6T72, 7T122]  
 Farmington [See Model  
 21T166DE]  
 Glendale [See Model 17T302]  
 Hampton [See Model  
 17T160]  
 Hanley [See Model 17T310]  
 Harford [See Model 6T87]  
 Hayward [See Model  
 7T111B]  
 Highland [See Model 6T65,  
 7T112, 7T112B]  
 Hillside [See Model 9T77,  
 9T126]  
 Hilton [See Model 21T316, U]  
 Jeffrey [See Model 21T313, U]  
 Kenbridge [See Model  
 21D328, U]  
 Kendall [See Model  
 17T174, 17T174K]  
 Kent [See Model 6T54,  
 7T104, 7T104B]  
 Kingsbury [See Model  
 6T64]  
 Kirby [See Model 21T303, U]  
 Lexington [See Model  
 21T323, U]  
 Merritt [See Model  
 21D317, U]  
 Madara [See Model 6T75,  
 7T124]  
 New Port [See Models  
 6T53, 7T103, 7T103B]  
 Northampton [See Model  
 9T79]  
 Penfield [See Model 21T244]  
 Prentiss [See Model  
 21T314, U]  
 Preston [See Model 17T155]  
 Provincial [See Model  
 6T76, 7T125B, 9T128]  
 Regency [See Model  
 6T74, 7T123, 7T123B]  
 Rockingham [See Model  
 21T178]  
 Rutland [See Model 6T86,  
 7T143]  
 Sedgwick [See Model 9T89,  
 9T147]  
 Shelby [See Model 2T51]  
 Somerville [See Model 2T81,  
 4T141]  
 Southbridge [See Model  
 21D329, U]  
 Staunton [See Model  
 21D326, U]  
 Stockton [See Model  
 21T324, U]  
 Sunderland [See Model  
 21T197DE]  
 Suffolk [See Model 21T176]  
 Talbot [See Model 16T152]  
 Wayne [See Model 17T301]  
 Westland [See Model 21T242]  
 Whitfield [See Model  
 17T154]  
 Winston [See Model  
 7T132]  
 York [See Model 9T57,  
 9T105]  
 Yorktown [See Model  
 21D327, U]

**RME**

DB-22A ..... 50-14  
 HF10-20 ..... 49-17  
 VHF-2-11 ..... 79-14  
 VHF-152A ..... 51-18  
 45 ..... 13-25  
 84 ..... 14-13

**RADIOLA**

61-1, 61-2, 61-3  
 [Ch. RC-1011] ..... 14-25  
 61-5 [Ch. RC-1023] ..... 12-25  
 61-8, 61-9 [Ch. RC-1034] ..... 27-21  
 61-10 [Ch. RC-1023B] ..... 12-35  
 62-2 [See RCA Model  
 65U-1—Set 14-23]  
 732U [Ch. RC-1063A] ..... 36-19  
 762X11, 762X12 [Ch.  
 RC-1058, RC-1058A] ..... 36-20  
 Ch. RC-1011  
 [See Model 61-1]  
 Ch. RC-1023, RC-1023B  
 [See Model 61-5]  
 Ch. RC-1023B [See  
 Model 61-10]  
 Ch. RC-1034  
 [See Model 61-8]  
 Ch. RC-1058, RC-1058A  
 [See Model 762X11]  
 Ch. RC-1063A  
 [See Model 732U]

**RADIO CRAFTSMEN**

CA00 ..... 186-11  
 RC-1 [Tuner] .....  
 RC-2 [Audio Amp.] ..... 39-19  
 "Kitchenaire" ..... 6-14  
 RC-8 ..... 66-13  
 RC-10 ..... 110-12  
 RC100 Tel. Rec. .... 96-9

**RADIO CRAFTSMEN—Cont.**

RC-100A Tel. Rec. [Also  
 See Prod. Chg. Bul.  
 39—Set 170-2] ..... 117-11  
 RC101 Tel. Rec. .... 142-10  
 RC200 Tel. Rec. [Also  
 See Prod. Chg. Bul. 40—  
 Set 172-1] ..... 140-9  
 RC201 Tel. Rec. .... 151-10  
 2 ..... 176-8  
 10 ..... 176-9  
 202 Tel. Rec. .... 184-13  
 500 ..... 164-8  
 800 ..... 204-8

**RADIO DEVELOPMENT & RESEARCH CO.**

[See *Magic-Tone*]  
**RADIOETTE**  
 PR-2 ..... 50-15

**RADIONIC**

[Also See *Chancellor*]  
 Y62W, Y72B ..... 26-22

**RANGER**

118 ..... 28-27

**RADIO MFG. ENGINEERS**

[See *RME*]  
**RADIO WIRE TELEVISION**

[See *Lafayette*]  
 BAU21 ..... 211-10  
 BA21 ..... 87-10  
 W-819-A ..... 43-16  
 1810 ..... 179-10  
 1814 ..... 99-13  
 1820 ..... 100-10  
 1821, 1822 ..... 59-17  
 1825 ..... 97-14  
 1835 ..... 60-17  
 1841 ..... 58-19  
 1904 ..... 140-10  
 1932 ..... 148-14  
 1960 ..... 208-9  
 1961 ..... 212-4  
 2100 (Sub-station) ..... 39-20  
 2101-A (Master Station) ..... 39-20  
 2105 (Master Station) ..... 36-21  
 2206, 2206H, 2212,  
 2212H, 2218, 2218H,  
 2224, 2224H ..... 80-13  
 2306, 2312, 2324 ..... 87-10  
 2400 Series ..... 33-12  
 3406, H ..... 210-6  
 3412, H ..... 210-6  
 3424, H ..... 210-6

**RAY ENERGY**

AD ..... 7-24  
 AD4 ..... 7-25  
 SRB-1X ..... 13-26

**RAYTHEON (Also see Belmont)**

A-7DX22P Tel. Rec. [See  
 Model 7DX21—Set 81-31]  
 A-10DX24, B-10DX22  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 1—  
 Set 103-19] ..... 75-14  
 CR-41, A, CR-42, A, CR-43,  
 A [Ch. 4D16-A] ..... 212-5  
 C1102 [Ch. 12AX22]  
 Tel. Rec. [Also See Prod.  
 Chg. Bul. 3—  
 Set 105-1] ..... 94-8  
 C1104 [Ch. 12AX22]  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 3—  
 Set 105-1] ..... 94-8  
 C-1104B [Ch. 12AX26,  
 12AX27] Tel. Rec. .... 141-11  
 C-1401 [Ch. 14AX21]  
 Tel. Rec. .... 123-12  
 C-1602, A, B, C [Ch.  
 17AX23, 25, 26]  
 Tel. Rec. .... 99-14  
 C-1602, Series 2 [Ch.  
 16AX29] Tel. Rec. [See  
 Prod. Chg. Bul. 19—  
 Set 126-1 and  
 Model C-1602—  
 Set 99-14]  
 C-1614A [Ch. 16AY211]  
 Tel. Rec. [See Prod.  
 Chg. Bul. 19—Set  
 132-1 and Model  
 C-1615A—Set 124-8]  
 C-1614B [Ch. 16AY28]  
 Tel. Rec. [See Prod.  
 Chg. Bul. 19—  
 Set 132-1 and Model  
 C-1615B—Set 124-8]  
 C-1615A [Ch. 16AY211]  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 19—  
 Set 132-1] ..... 124-8  
 C-1616A [Ch. 16AY211]  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 19—  
 Set 132-1] ..... 124-8  
 C-1714A [Ch. 17AY24]  
 Tel. Rec. [See Prod.  
 Chg. Bul. 19—Set  
 132-1 and Model  
 C-2103A—Set 173-1A]  
 C-1714B [Ch. 17AY21]  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 19—  
 Set 132-1] ..... 124-8  
 C-1715A [Ch. 17AY24]  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 19—  
 Set 132-1] ..... 124-8  
 C-1716A [Ch. 17AY24]  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 19—  
 Set 132-1] ..... 124-8  
 C-1716B [Ch. 16AY211]  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 19—  
 Set 132-1] ..... 124-8

**RAYTHEON—Cont.**

C-1724A [Ch. 17AY21]  
 Tel. Rec. [See Prod.  
 Chg. Bul. 19—Set  
 132-1 and Model  
 C-1615A—Set 124-9]  
 C-1729, C-1731A  
 [Ch. 17AY21A] ..... 176-10  
 C-1735A, C-1736A  
 [Ch. 17T1] Tel. Rec. .... 189-14  
 C-2001A, C-2002A [Ch.  
 20AY21] Tel. Rec. ....  
 [Also See Prod. Chg.  
 Bul. 43—Set 177-1] ..... 149-9  
 C-2005A [Ch. 20AY21]  
 Tel. Rec. [Also See  
 Prod. Chg. Bul. 43—  
 Set 177-1] ..... 149-9  
 C-2103A, C-2105A  
 [Ch. 21AY21] Tel. Rec. 173-1A  
 C-2108 [Ch. 21T1]  
 Tel. Rec. .... 189-14  
 C-2109A [Ch. 21T2]  
 Tel. Rec. [For TV Ch. See  
 Model C-1735A—Set  
 189-14, For UHF Tuner  
 See Model UHF-100—  
 Set 207-8]  
 C-2110A, C-2111A [Ch.  
 21T1] Tel. Rec. .... 189-14  
 C-2112A [Ch. 21T3]  
 Tel. Rec. .... 202-7  
 C-2113A [Ch. 21T3]  
 Tel. Rec. .... 202-7  
 C-2114A [Ch. 21T3]  
 Tel. Rec. .... 202-7  
 BA21 ..... 87-10  
 W-819-A ..... 43-16  
 1810 ..... 179-10  
 1814 ..... 99-13  
 1820 ..... 100-10  
 1821, 1822 ..... 59-17  
 1825 ..... 97-14  
 1835 ..... 60-17  
 1841 ..... 58-19  
 1904 ..... 140-10  
 1932 ..... 148-14  
 1960 ..... 208-9  
 1961 ..... 212-4  
 2100 (Sub-station) ..... 39-20  
 2101-A (Master Station) ..... 39-20  
 2105 (Master Station) ..... 36-21  
 2206, 2206H, 2212,  
 2212H, 2218, 2218H,  
 2224, 2224H ..... 80-13  
 2306, 2312, 2324 ..... 87-10  
 2400 Series ..... 33-12  
 3406, H ..... 210-6  
 3412, H ..... 210-6  
 3424, H ..... 210-6

**RAYTHEON—SILVERTONE**

**RAYTHEON—Cont.**

RC-1619A (Ch. 16AY211) Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1) 124-8

RC-1619B (Ch. 16AY28) Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1) 124-8

RC-1718A (Ch. 17AY24) Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1 and Model M-1711A—Set 124-8) 124-8

RC-1718B (Ch. 17AY24) Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1) 124-8

RC-1719A (Ch. 17AY24) Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1 and Model M-1711A—Set 124-8) 124-8

RC-1719B (Ch. 17AY21) Tel. Rec. (Also See Prod. Chge. Bul. 43—Set 177-1 and Model C-2001A—Set 149-9) 202-7

RC-2117A (Ch. 21T3) Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 105-1) 75-14

10DXF44 Tel. Rec. (See Model C-1102—Set 94-8 and Model A-10DX24—Set 75-14) 147-9

10DX21, 10DX22 Tel. Rec. (Also See Prod. Chge. Bul. 3—Set 105-1) 75-14

10DX24 Tel. Rec. (See Model A-10DX24—Set 75-14) 75-14

18DX21A Tel. Rec. 81-13

Ch. 4D16-A (See Model CR-41) 81-13

Ch. 4P12, A (See Model PR-31, A) 81-13

Ch. 10AX22 (See Model M701) 81-13

Ch. 12AX22 (See Model C1102) 81-13

Ch. 12AX26, 12AX27 (See Model C-1104B) 81-13

Ch. 14AX21 Tel. Rec. (See Model C-1401) 81-13

Ch. 16AX23, 25, 26 (See Model C-1602) 81-13

Ch. 16AY28 (See Model C-1615B) 81-13

Ch. 16AY211 (See Model C-1615A) (Also See Prod. Chge. Bul. 19—Set 132-1) 81-13

Ch. 16AY212 (See Model M-1626) 81-13

Ch. 17AY21 (See Model C-1748) 81-13

Ch. 17AY21A (See Model C-1729) 81-13

Ch. 17AY24 (See Model C-1715A) 81-13

Ch. 17AY27 (See Model RC-1720A) 81-13

Ch. 17T1 (See Model C-1735A) 81-13

Ch. 17T2 (See Model M-1734A) 81-13

Ch. 20AY21 (See Model C-2001A) 81-13

Ch. 21AY21 (See Model C-2103A) 81-13

Ch. 21T1 (See Model C-2108) 81-13

Ch. 21T2 (See Model C-2109A) 81-13

Ch. 21T3 (See Model C-2112A) 81-13

**RECORDIO (Wilcox-Gay)**

1810 149-10

1C-10 146-9

1J10 (Ch. 1J1) 128-12

2A10 163-10

6A10, 6A20 (Ch. 6A) 10-27

6B10, 6B20, 6B30, 6B32 8-27

7D42, 7D44 (Ch. 7D1) 52-18

7E40, 7E44 47-20

8J10, 8J50 62-17

9G10 91-10

9G40M, 9G42 86-9

9H40B 89-13

Ch. 1J1 (See Model 1J10) 10-27

Ch. 5A (See Model 6A10) 10-27

Ch. 7D1 (See Model 7D42) 10-27

**REELEST (See Recorder Listing)**

**REGAL (TOK-PONE)**

Tok-Pone (20-watt Amp.). 13-27

AP40, ARP40, ARP450. 15-26

AP48 49-11

C473 217-12

C827 18-27

CD31 Tel. Rec. (See Model 16T31—Set 80-14) 18-27

CD36 Tel. Rec. 50-16

CR761 49-11

CR762 48-14

L-76 5-18

P-175 183-12

W700 (See Model W800—Set 14-26) 14-26

W800, W801 14-26

W900, W901 13-28

**REGAL—Cont.**

16T31 Tel. Rec. 80-14

16T36 Tel. Rec. \*

17HD31, 17HD36, Tel. Rec. 147-10

17T22, 17T2DX Tel. Rec. 143-13

19C31, 19C36 Tel. Rec. 147-10

19D31, 19D36 Tel. Rec. 147-10

20C22, 20C2DX Tel. Rec. 143-13

20C31, 20C36 Tel. Rec. 147-10

20D22, 20D2DX Tel. Rec. 143-13

20D31, 20D36 Tel. Rec. 147-10

20H31, 20H36 Tel. Rec. 147-10

20T22, 20T2DX Tel. Rec. 143-13

22D17, 22D17DX, 22D19, 22D19DX Tel. Rec. 143-13

205 26-23

208 (See Model W800—Set 14-26) 210-7

271 217-12

472 210-8

477 27-22

707 53-21

1007 Tel. Rec. 83-9

1030, 1031 Tel. Rec. 80-14

1049 17-28

1107 41-19

1207, 1208 Tel. Rec. 83-9

1230 Tel. Rec. 80-14

1500 38-19

1607 Tel. Rec. 83-9

1708, 1708DX Tel. Rec. 143-13

1749 28-29

1877 182-10

2117, 2217DX, 2219, 2219DX Tel. Rec. 143-13

7152 70-8

7162 69-12

7163 66-14

7251 40-16

**REGENCY**

RC-600 Tel. UHF Conv. 200-8

**REMBRANDT**

721, 1606, 1606-15, 1950 Tel. Rec. 65-11

**REMLER**

MP5-53 8-28

5300B, 530081, 53001 23-18

5310 40-17

5400, 5410 44-19

5500 "Scottie Pup" 27-23

5505 "Scottie Pup" (See Model 5500—Set 27-23) 27-23

5510 "Scottie Pup" 27-23

5515 "Scottie Pup" (See Model 5500—Set 27-23) 27-23

5520, 5530 "Scottie Junior" 27-23

6000 77-9

**RENARD**

L-1A, PT-1A, 185T-1 9-28

**REVERE (See Recorder Listing)**

**ROLAND**

4T1 213-7

5C1 215-11

5T1E 205-8

5T1V 208-10

5T2M 204-9

5X1, 5X2 217-13

6T1M 216-9

8F11M 214-9

8XF1, 8XF2 211-11

**ROYAL (Lee)**

AN150, AN160 179-11

20CP, 20TW Tel. Rec. (Similar to Chassis) 149-13

**SCOTT (E. H.)**

Musical 44-20

Music Control, Dynamic Noise Suppressor 46-21

"Ravenswood" Tel. Rec. 150-11

6T11, 6T11A Tel. Rec. (Also See Prod. Chge. Bul. 4—Set 105-2) 52-19

13A Tel. Rec. 40-18

300 Tel. Rec. 154-11

400 Tel. Rec. (See Prod. Chge. Bul. 4—Set 105-2 and Model 6T11—Set 52-19) 103-14

510 165-11

710, 710A, 710X Tel. Rec. 150-11

6T11 Tel. Rec. 14-27

800B Tel. Rec. (For TV Ch. See Prod. Chge. Bul. 4—Set 52-19, For Radio Ch. See Model 800B—Set 14-27) 817C (Ch. 9029, 9031) Tel. Rec. (See Model 820C—Set 178-9) 817C (Ch. 9036, 9037, 9038, 9039) Tel. Rec. 217-14

817CU (Ch. 9029, 9031) Tel. Rec. (See Model 820C—Set 178-9) 817C (Ch. 9029, 9031) Tel. Rec. (See Model 820C—Set 178-9) 817 T (Ch. 9036, 9037, 9038, 9039) Tel. Rec. 217-14

817T (Ch. 9036, 9037, 9038, 9039) Tel. Rec. 217-14

817T1 (Ch. 9029, 9031) Tel. Rec. (See Model 820C—Set 178-9) 817 T (Ch. 9036, 9037, 9038, 9039) Tel. Rec. 217-14

820C Tel. Rec. 178-9

820CU Tel. Rec. 178-9

820CU (See Model 820C—Set 178-9) 28-30

**SCOTT (E. H.)—Cont.**

820T, 820TU Tel. Rec. (See Model 820C—Set 178-9) 821C, CB, D, T, TB (Ch. 9036, 9037, 9038, 9039) Tel. Rec. 217-14

910 Tel. Rec. 150-11

920C, 920D Tel. Rec. 176-11

924W Tel. Rec. 180-8

1000 181-11

1510 81-14

Ch. 9036, 9037, 9038, 9039 (See Model 817C) 111-8

112-8 144-8

120-A 183-13

210-A 79-15

210-B 145-9

211-A 81-14

214-A (120-A, 220-A) 183-13

220-A 183-13

**SEARS-ROEBUCK (See Silvertone)**

**SEEBURG (See Record Changer Listing)**

**SENTINEL**

1U-284GA 22-25

1U-284N, 1U-284NA, 1U-284NI, 1U-284W 1-2

1U-285P 6-27

1U-293CT 29-29

1U-2931, 1U-293T, 1U-293V 1-14

1U-2941, 1U-294N 1-11

1U-294T 1-11

1U312PG, 1U312PW 103-15

1U-3131, 1U-313W 39-21

1U-314E, 1U-314I, 1U-314W 38-21

1U-316PM, 1U-316PT 48-22

1U-335PG, PI, PM, PW 105-9

1U338, 1U338R, 1U338V 122-9

1U339-K 111-12

1U340-C 129-10

1U342K 155-14

1U-343 212-6

1U-344 183-14

1U-345 209-11

1U416 Tel. Rec. 117-12

1U419, 1U420 Tel. Rec. 115-9

1U420B Tel. Rec. 124-9

1U421, 1U422 (Series "VA") Tel. Rec. (See Prod. Chge. Bul. 6—Set 126-1 and Model 412—Set 100-11) 122-9

1U423 Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1) 124-9

1U423B, 1U423-17 Tel. Rec. (See Prod. Chge. Bul. 19—Set 132-1 and Model 1U423B—Set 124-9) 124-9

1U424 Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1) 124-9

1U424-17 (See Prod. Chge. Bul. 19—Set 132-1 and Model 1U424—Set 124-9) 127-10

1U428 Tel. Rec. (See Model 1U424) 127-10

1U429, 1U430, 1U431 Tel. Rec. (See Prod. Chge. Bul. 25—Set 144-1 and Model 1U420B—Set 124-9) 127-10

1U432 Tel. Rec. (Also See Prod. Chge. Bul. 21—Set 136-1 and Model 1U420B—Set 124-9) 127-10

1U435 Tel. Rec. (See Prod. Chge. Bul. 21—Set 136-1 and Model 1U420B—Set 124-9) 127-10

1U438 Tel. Rec. (See Model 1U435) 127-10

1U441, 1U443, 1U444 (Series "XD, XXD, 2XD") Tel. Rec. 157-9

1U446, 1U447 (Series "XD, XXD, 2XD") Tel. Rec. (See Model 1U438—Set 157-9) 157-9

1U447-A, 1U448-A, 1U449-A, 1U450-A, 1U451-A Tel. Rec. 178-10

1U-44B, 1U-449, 1U-450 (Series "XD, XXD, 2XD") Tel. Rec. (See Model 1U447-A, 1U448-A, 1U449-A, 1U450-A) 178-10

1U-45A, 1U-455, 1U-456, 1U-457 Tel. Rec. (Also See Prod. Chge. Bul. 63—Set 197-1) 191-17

1U-458, 1U-459, 1U-460, 1U-461 Tel. Rec. 199-10

1U462, 1U463 (Ch. 2WA) Tel. Rec. 205-9

L-2841, L-284NA, L-284NI, L-284NR, L-284W 23-19

284GA 22-25

2841 1-2

284NA, 284NI 1-2

285P 6-27

286P, 286PR 23-20

289T 6-28

292K 16-30

293 Series 1-14

293-CT 29-22

2931, 293T, 293V 1-14

294 Series 1-11

294C, 294N, 294T 1-11

295-T 22-26

296B, 296M 46-22

302-1, 302-T, 302-W 33-23

305-1, 305-1-3, 305-W, 305-W3 33-24

309-1, 309-N, 309-R, 309-W 28-30

**SENTINEL—Cont.**

312PG, 312PW 103-15

313-1, 313-W 39-21

314-E, 314-I, 314-W 38-21

315-1, 315-W 40-19

316PM, 316PT 48-22

332 (See Model 313-1—Set 40-19) 48-22

333 (See Model 315-1—Set 40-19) 48-22

335PG, PI, PM, PW 105-9

338-1, 338-R, 338-W 122-9

339-K 111-12

340-C 129-10

342K 155-14

344 212-6

344 211-12

345P 183-14

346 209-11

400TV Tel. Rec. 73-11

401, 402 Series Tel. Rec. 70-9

405VM Tel. Rec. 73-11

405 Series Tel. Rec. 70-9

406 Series Tel. Rec. 70-9

407 Series Tel. Rec. \*

409 Series Tel. Rec. \*

411 Series Tel. Rec. (See Model 401 Series—Set 70-9) 70-9

413, 413-1, 414, 415 Series VA, YB, YC, YD, YE, YF Tel. Rec. (Also See Prod. Chge. Bul. 4—Set 105-2) 100-11

416 Tel. Rec. 117-12

419, 420 Tel. Rec. 115-9

420B Tel. Rec. 124-9

421, 422 Tel. Rec. (See Prod. Chge. Bul. 16—Set 126-1 and Model 412—Set 100-11) 124-9

423, 424 Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1) 124-9

423B, 423-17 Tel. Rec. (See Prod. Chge. Bul. 19—Set 132-1 and Model 423B—Set 124-9) 124-9

424 Tel. Rec. (Also See Prod. Chge. Bul. 19—Set 132-1) 124-9

424-17 Tel. Rec. (See Prod. Chge. Bul. 19—Set 132-1 and Model 424—Set 124-9) 127-10

425 Tel. Rec. 127-10

428 Tel. Rec. 127-10

429, 430, 431 Tel. Rec. (See Prod. Chge. Bul. 25—Set 144-1 and Model 1U420B—Set 124-9) 127-10

432 Tel. Rec. (Also See Prod. Chge. Bul. 21—Set 136-1) 127-10

435 Tel. Rec. (See Prod. Chge. Bul. 21—Set 136-1 and Model 425—Set 127-10) 127-10

438, 439, 440, 441, 443, 444 (Series "XD, XXD, 2XD") Tel. Rec. 157-9

446 (Series "XD, XXD, 2XD") Tel. Rec. (See Model 438—Set 157-9) 157-9

452, 453 Tel. Rec. (See Model 1U-447-A—Set 178-10) 191-17

454, 455, 456, 457, 458, 459, 460, 461 Tel. Rec. (See Model 1U-458—Set 199-10) 191-17

462, 463 (Ch. 2WA) Tel. Rec. 205-9

464, 465, 466 (See Model 1U-454—Set 191-17) 191-17

Ch. 2WA (See Model 462) 191-17

**SETCHELL-CARLSON**

53 (Ch. 152) Tel. Rec. 209-12

150 Tel. Rec. 144-9

151-A17, 151-A17-LR, 151-B17, 151-B17-LR, 151-B20, 151-B20-LR, 151-C20, 151-C20-LR Tel. Rec. 155-15

416 2-14

427 21-29

437 39-22

447 40-20

458-RD 106-13

469 99-15

531 (Ch. 152) Tel. Rec. 209-12

570 97-15

2500, 2500LP Tel. Rec. 144-9

5301, 5302 (Ch. 122) Tel. Rec. 209-12

Ch. 152 (See Model 53) 209-12

**SHAW**

Ch. 224 (Runs 301, 302, 303, 304, 304-1, 2, 305, 305-2) Tel. Rec. 202-8

**SHERATON**

C-26B, M (Ch. 260-C) Tel. Rec. \*

C-26B24 (Ch. 260-C) Tel. Rec. \*

C-26M24 (Ch. 260-C) Tel. Rec. \*

C30B, M Tel. Rec. 176-13

C30B24, C30M24 176-13

C-2125 (Ch. 250XL Series) Tel. Rec. 218-10

T-26M, B (Ch. 260-C) Tel. Rec. \*

T30M Tel. Rec. 176-13

T-1755 (Ch. 250XL Series) Tel. Rec. 218-10

**SHERATON—Cont.**

T-2155 (Ch. 250XL Series) Tel. Rec. 218-10

17M20 (Ch. 530DX Series) Tel. Rec. 210-9

18B10, 21B10, 21BT10 (Ch. 530DX Series) Tel. Rec. 210-9

21M10, 21MD10 (Ch. 530DX Series) Tel. Rec. 210-9

21MT10U (Ch. 530DX Series) Tel. Rec. 210-9

Chassis 270-C (See Model C-26B) Ch. 250XL (See Model C-2125) Ch. 530DX (See Model 17M20) 210-9

**SHERIDAN ELECTRONICS (See Vogue)**

**SIGNAL**

AF252 37-19

141 44-21

241 33-25

341-A 39-23

341-T 25-25

**SILVERTONE (Also See Changer and Recorder Listing)**

1, 2 (Ch. 132.878) 101-10

5, 6 (Ch. 132.881) 144-10

10, 11 (Ch. 132.896) 144-11

15, 16 (Ch. 132.884, -1, -2) 141-12

18 (Ch. 132.877) 140-11

20 (Ch. 132.877) 140-11

25, 27 (Ch. 478.258) 161-8

33 (Ch. 548.373) 111-13

41, 41A (Ch. 135.245) 101-11

51, 53 (Ch. 132.887) 112-8

54, 56 (Ch. 132.888) 113-10

64, 65 (Ch. 101.859-2) 115-8

67 (Ch. 101.859-1, -2) (See Model 64—Set 75-14) 115-8

67B (Ch. 101.859-2) (See Model 64—Set 75-14) 115-8

69 (Ch. 100.201) 162-10

72 (Ch. 134.111) 142-11

101 (Ch. 549.100) 102-12

101A (Ch. 549.100-1) 102-12

102 (Ch. 549.100-2) 102-12

102A (Ch. 549.100-3, -7) 161-9

102B (Ch. 132.882) 106, 107 (Ch. 132.889-1) 106, 107 (Ch. 132.889-2) 106, 107 (Ch. 132.889-2) 149-12

108 (Ch. 549.100) 102-12

110, A (Ch. 478.303, A) 125—Set 104-10

111 (Ch. 110.700) Tel. Rec. \*

112 (Ch. 478.289) 118-9

113 (Ch. 110.700) Tel. Rec. \*

114 (Ch. 478.302) Tel. Rec. (See Model 125—Set 104-10) 115 (Ch. 110.499-7A, B, 8A, B) Tel. Rec. \*

116, 116A (Ch. 110.700-1, -10) Tel. Rec. 139-13

120 (Ch. 478.311) Tel. Rec. 115-11

125 (Ch. 478.257) 104-10

125B (Ch. 478.257-1) Tel. Rec. \*

127-12 (Ch. 110.700) Tel. Rec. \*

131, 131A (Ch. 110.700-1, -10) Tel. Rec. 139-13

132 (Ch. 110.499-1) Tel. Rec. (See Model 9123—Set 79-16) 133 (Ch. 100.107 and Radio Ch. 100.043) Tel. Rec. 156-12

134 (Ch. 110.700-2, -20) Tel. Rec. \*

135 (Ch. 110.499-7A, B, 8A, B) Tel. Rec. \*

137 (Ch. 549.100-1 and Radio Ch. 101.831-1) Tel. Rec. (For TV Ch. See Model 101—Set 102-12, For Radio Ch. See Model 8127—Set 41-20) 138 (Ch. 549.100-3 and Radio Ch. 101.831-1) Tel. Rec. (For TV Ch. See Model 102A—Set 161-9, For Radio Ch. See Model 8127—Set 41-20) 139 (Ch. 110.700) Tel. Rec. \*

140 (Ch. 110.700) Tel. Rec. \*

141 (Ch. 132.889-1) Tel. Rec. \*

141 (Ch. 132.889-2) Tel. Rec. \*

142 (Ch. 100.115) and Radio (Ch. 100.959) Tel. Rec. \*

143 Tel. Rec. (See Model 143A—Set 121-12) 143A (Ch. 100.111) Tel. Rec. 121-12

144 (Ch. 478.312 and Radio Ch. 478.240) Tel. Rec. 160-11

SILVERTONE-Cont.

149 (Ch. 100.107-1) Tel. Rec. (See Model 133—Set 156-12)  
 150-14 (Ch. 478.338) Tel. Rec. 142-12  
 151-16, 151-17 (Ch. 528.630-1) Tel. Rec. 528.630-1  
 152-16, 16A (Ch. 549.102, 549.102-2) Tel. Rec. 549.102-2  
 159 (Ch. 478.309) Tel. Rec. 115-11  
 160-12 (Ch. 549.100-4) Tel. Rec. 97A-12  
 161-16 (Ch. 100.112) Tel. Rec. 99A-10  
 162-17 (Ch. 110.700-10) Tel. Rec. 139-13  
 163-16 (Ch. 478.319) Tel. Rec. 157-10  
 164-14 (Ch. 478.313) Tel. Rec. 144-12  
 165-16 (Ch. 100.120) Tel. Rec. 166-16 (Ch. 478.339) Tel. Rec. 166-17 (Ch. 478.339-A) Tel. Rec. 167-16, 167-16A (Ch. 549.101, -1) Tel. Rec. 168-16 (Ch. 549.100-3) Tel. Rec. 169-16 (Ch. 549.102, 549.102-2) Tel. Rec. 170-16 (Ch. 549.102, 549.102A) Tel. Rec. 173-16 (Ch. 110.700-10) Tel. Rec. 175-16, A (Ch. 549.100-5, -6, -7, -8, -9) Tel. Rec. 176-19 (Ch. 549.100-6) Tel. Rec. 177-19 (Ch. 110.700-40) Tel. Rec. 179-16, 180-16 (Ch. 132.890) Tel. Rec. 185-16 (Ch. 549.101-2) Tel. Rec. 186-19 (Ch. 549.101-2) Tel. Rec. 187-16, 188-16 (Ch. 110.700-10) Tel. Rec. (See Model 116—Set 139-13)  
 189-16 (Ch. 110.700-1, 10) Tel. Rec. 139-13  
 191-16 (Ch. 110.700-50) Tel. Rec. 194-16, 195-16 (Ch. 132.890) Tel. Rec. 210 (Ch. 132.880) 109-12  
 215 (Ch. 528.174) 117-13  
 217, 218 (Ch. 528.174) (See Model 215—Set 117-13)  
 220 (Ch. 528.173) 110-13  
 222, 223, 224 (Ch. 528.173) (See Model 220—Set 110-13)  
 225 (Ch. 528.171) 107-8  
 237 (Ch. 488.237) 145-10  
 238 (Ch. 548.360-1, 548.361) (See Model 239—Set 115-12)  
 239 (Ch. 548.360-1, 548.361) 115-12  
 245 (Ch. 548.358) 107-9  
 246 (Ch. 137.906) 111-14  
 249 (Ch. 548.360-1, 548.361) 115-12  
 1017, 1018 (Ch. 528.210, -1, -2) 183-11  
 1032 (Ch. 528.196) 183-15  
 1035, A (Ch. 528.195, -1, -2) 213-12  
 1040, 1045 (Ch. 528.194) 181-12  
 1040A (Ch. 528.194-1) (See Model 1040—Set 181-12)  
 1045A (Ch. 528.194-1) (See Model 1040—Set 181-12)  
 1052 (Ch. 132.011) 174-10  
 1052A (Ch. 132.011-1) (See Model 1052—Set 174-10)  
 1053 (Ch. 132.011) 174-10  
 1053A (Ch. 132.011-1) (See Model 1053—Set 174-10)  
 1054 (Ch. 132.012) 173-12  
 1054A (Ch. 132.012-1) (See Model 1054—Set 173-12)  
 1055 (Ch. 132.012) 173-12  
 1055A (Ch. 132.012-1) (See Model 1055—Set 173-12)  
 1058, 1059 (Ch. 101.860) 162-11  
 1062, 1063 (Ch. 101.860) 162-11  
 1066 (Ch. 100.202) 162-10  
 1116-16 (Ch. 110.700-90), 1117-17 (Ch. 110.700-96) Tel. Rec. 96  
 1117-17 (Ch. 110.700-100, -104) Tel. Rec. 201-8  
 1130-17 (Ch. 110.700-96) Tel. Rec. 1130-17 (Ch. 110.700-104) Tel. Rec. 201-8  
 1135-17 (Ch. 110.700-96) Tel. Rec. 201-8  
 1141-20 (Ch. 110.700-93) Tel. Rec. 201-8  
 1141-20 (Ch. 110.700-120) Tel. Rec. 201-8  
 1145-20 (Ch. 110.700-140) Tel. Rec. 201-8  
 1150-14 (Ch. 478.361, A) Tel. Rec. 205-10  
 1161-17 (Ch. 110.702-10) Tel. Rec. 205-10  
 1162-16 (Ch. 110.700-90) Tel. Rec. 96  
 1162-17 (Ch. 110.700-96) Tel. Rec. 201-9

SILVERTONE-Cont.

1172-17 (Ch. 110.700-100, 1162-17 (Ch. 110.700-100, -104) Tel. Rec. 201-8  
 1166-17 (Ch. 478.339-8) Tel. Rec. 110-702-10  
 1171-17 (Ch. 110.702-10, -50) Tel. Rec. 205-10  
 1173-20 (Ch. 110.700-140) Tel. Rec. 201-8  
 1176-21 (Ch. 100.208) Tel. Rec. 165-12  
 1181-20 (Ch. 110.700-120) Tel. Rec. 201-8  
 1183-21 (Ch. 110.700-150) Tel. Rec. 201-8  
 1184-20 (Ch. 528.631, -1) Tel. Rec. 181-13  
 1186-21 (Ch. 100.208) Tel. Rec. 165-12  
 1188-20 (Ch. 110.700-140) Tel. Rec. 201-8  
 1191-17 (Ch. 110.700-97) Tel. Rec. 201-8  
 1239 (Ch. 488.237) (See Model 237—Set 145-10)  
 1240 (Ch. 456.150, -2) Tel. Rec. 201-8  
 1261 (Ch. 456.150-2) Tel. Rec. 201-8  
 1266 (Ch. 456.150, -2) Tel. Rec. 201-8  
 1268-21 (Ch. 456.150-1) Tel. Rec. 201-8  
 1270-21 (Ch. 456.150-1) Tel. Rec. 201-8  
 1271-21 (Ch. 456.150-1) Tel. Rec. 201-8  
 1272-21 (Ch. 456.150-1) Tel. Rec. 201-8  
 1273-21 (Ch. 456.150-1) Tel. Rec. 201-8  
 1274-21 (Ch. 456.150-1) Tel. Rec. 201-8  
 1275-21 (Ch. 456.150-1) Tel. Rec. 201-8  
 1300 (Ch. 319,200) 90-10  
 1301 (Ch. 319,190) 91-11  
 2001, 2002 (Ch. 132.878) (See Model 1—Set 101-10)  
 2003, 2004, 2005, 2006 (Ch. 757,110) 211-13  
 2007 (Ch. 757,100) 198-12  
 2009, 2010, 2011, 2012, 2013 (Ch. 132.022) 196-14  
 2014, 2015, 2016 (Ch. 132.022) 196-15  
 2022 (Ch. 132.027) 197-11  
 2023, 2024, 2025, 2026, 2027 (Ch. 132.896-1) (See Model 10—Set 144-11)  
 2028 (Ch. 528.230) 203-8  
 2035A (Ch. 528.195, -1, -2) 215-12  
 2041 (Ch. 528.235) 208-11  
 2041 (Ch. 528.235-1) (See Model 2041—Set 208-11)  
 2056 (Ch. 132.026-3) 207-9  
 2060, 2061 (Ch. 101.861-1) 203-9  
 2063, 2064 (Ch. 101.860, -1) (See Model 1058—Set 162-11)  
 2100 (Ch. 110.700-100, -104) Tel. Rec. 201-8  
 2100A (Ch. 110.817-1) Tel. Rec. 217-15  
 2101 (Ch. 647,023) Tel. Rec. 215-12  
 2105 (Ch. 132.024, -1, -2) Tel. Rec. 198-13  
 2105A (Ch. 132.024-3, -31) Tel. Rec. 198-13  
 2110A, 2111A (Ch. 528.631, -1, Ch. 528.632, -1, -2, -3, -4, -5, Ch. 528.632A, -1, -2, -3, -5) Tel. Rec. 212-7  
 2115B (Ch. 528.631, -1, Ch. 528.632, -1, -2, -3, -5) Tel. Rec. 212-7  
 2130 (Ch. 100.210, -1, -3) Tel. Rec. 207-10  
 2140 (Ch. 110.817-1) Tel. Rec. 217-15  
 2145 (Ch. 132.024, -1, -2) Tel. Rec. 198-13  
 2145A (Ch. 132.024-3, -31) Tel. Rec. 198-13  
 2145B (Ch. 132.024-4) Tel. Rec. 198-13  
 2150 (Ch. 110.700-140) Tel. Rec. 201-8  
 2150A (Ch. 110.820-1) Tel. Rec. 217-15  
 2150B (Ch. 528.631, -1, Ch. 528.632, -1, -2, -3, -4, -5, Ch. 528.632A, -1, -2, -3, -5) Tel. Rec. 212-7  
 2160, 2162 (Ch. 528.631, -1, Ch. 528.632, -1, -2, -3, -4, -5, Ch. 528.632A, -1, -2, -3, -5) Tel. Rec. 212-7  
 2170-C (Ch. 100.209) Tel. Rec. 193-10  
 2170-D, -E (Ch. 100.210, -1, -3) Tel. Rec. 207-10  
 2172 (Ch. 100.210, -1, -3) Tel. Rec. 207-10  
 2174 (Ch. 132.035) Tel. Rec. 2195-21 (Ch. 100.208-1 and Radio Ch. 100.202-1) Tel. Rec. (See Prod. Chae. Bul. 59—Set 193-1 and Model 1176-21—Set 165-12 For TV Ch. and Model 1066—Set 162-10 for Radio Ch.)  
 2200, 2202, 2203 (Ch. 528.229) 201-9

SILVERTONE-Cont.

2210 (Ch. 132.880) (See Model 210—Set 109-12)  
 2225 (Ch. 528.233) 208-12  
 3035A (Ch. 528.195, -1, -2) 215-12  
 3040 (Ch. 528.253) 216-10  
 3044, 3046 (Ch. 528.254) 216-10  
 3105 (Ch. 132.024-5, -6) Tel. Rec. 198-13  
 3106 (Ch. 132.045, -1) Tel. Rec. 199-11  
 3127 (Ch. 100.210, -1, -3) Tel. Rec. 207-10  
 3171 (Ch. 132.024-5, -6) Tel. Rec. 198-13  
 3170 (Ch. 528.239) Tel. Rec. 207-10  
 3170-B (Ch. 100.210, -1, -3) Tel. Rec. 207-10  
 3170C (Ch. 528.249, -1) Tel. Rec. 217-16  
 3171 (Ch. 528.247, -1) Tel. Rec. 217-16  
 3174 (Ch. 132.035-2) Tel. Rec. 206-11  
 3175 (Ch. 132.044) Tel. Rec. 203-10  
 3177 (Ch. 100.210, -1, -3) Tel. Rec. 207-10  
 3187 (Ch. 100.210, -1, -3) Tel. Rec. 207-10  
 3200 (Ch. 528.259) (See Model 2200—Set 201-9)  
 3202, 3203 (Ch. 528.259) (See Model 2200—Set 201-9)  
 4120 (Ch. 456.150, -2) Tel. Rec. 217-16  
 4140 (Ch. 528.247, -1) Tel. Rec. 217-16  
 4143 (Ch. 528.247, -1) Tel. Rec. 217-16  
 4145 (Ch. 528.247, -1) Tel. Rec. 217-16  
 4150 (Ch. 528.247, -1) Tel. Rec. 217-16  
 4153 (Ch. 528.247, -1) Tel. Rec. 217-16  
 4155 (Ch. 528.247, -1) Tel. Rec. 217-16  
 6002 (Ch. 132.818) 5-35  
 6011 (Ch. 132.816), 6012 (Ch. 132.816A), 6016 (Ch. 132.820) 27-24  
 6050 (Ch. 132.825-4) 15-28  
 6051 (Ch. 110.451), 6052 (Ch. 110.452) 13-29  
 6052A (Ch. 110.452-1) (See Model 6051—Set 13-29)  
 6071 (Ch. 132.826-1) 15-29  
 6072 (Ch. 110.454) 13-30  
 6092 (Ch. 101.672-1B), 6093 (Ch. 101.672-1A) 10-28  
 6100 (Ch. 101.660-1A), 6104 (Ch. 101.662-20) (See Model 6105—Set 7-26)  
 6105 (Ch. 101.662-2B) 7-26  
 6106A (Ch. 101.662-4E) 29-23  
 6111 (Ch. 101.662-3C) 7-26  
 6200A (Ch. 101.800-3), 6200A (Ch. 101.800-1) 9-29  
 6200A (Ch. 101.800A) (See Model 6200A—Set 9-29)  
 6220, 6220A (Ch. 101.801, 101.801-1A) 9-30  
 6230 (Ch. 101.802) 11-21  
 6230A (Ch. 101.802-1) 11-21  
 6285A (Ch. 101.666-1B) 20-28  
 6286 (Ch. 528.6286, -1, -3) 185-12  
 6287 (Ch. 528.6287, -1, -3) 185-12  
 6290 (Ch. 101.677-8) 20-29  
 6293 (Ch. 528.6293-2) 99-16  
 6295 (Ch. 528.6295) 98-12  
 6685 (Ch. 139.150, Ch. 139.150-1) 15-30  
 7020 (See Model 7021—Set 16-31)  
 7021 (Ch. 101.807, 101.807A) 16-31  
 7025 (Ch. 132.807-2) 29-24  
 7052 (Ch. 101.808) 15-31  
 7070 (Ch. 101.817) 30-26  
 7080 (Ch. 101.809) 16-32  
 7080, 7080A (Ch. 101.809-2) 58-20  
 7085 (Ch. 101.814) 30-27  
 7086 (Ch. 110.466) 27-25  
 7090 (Ch. 101.810) 15-32  
 7095 (Ch. 101.826) (See Model 7115—Set 16-33)  
 7100 (Ch. 101.811) 17-29  
 7102 (Ch. 101.814-1A) 30-27  
 7103 (Ch. 110.466-1) 27-25  
 7111 (Ch. 434.140) 30-28  
 7115 (Ch. 101.823), 7116 (Ch. 101.825-1A), 7117 (Ch. 101.825-1B) 16-33  
 7119 (Ch. 101.825-2C) 62-18  
 7145 (Ch. 436.200) 23-21  
 7148 (Ch. 431.188) 23-22  
 7148A (Ch. 431.188-1) 23-22  
 7152 (Ch. 109.626) 25-26  
 7153 (Ch. 109.627) 26-30  
 7165 (Ch. 101.823-A, 1A) 10-29  
 7166 (Ch. 101.823, 101.823-1) 10-29  
 7210 (Ch. 101.801) 32-20  
 7220 (Ch. 101.801-2C) (See Model 6220—Set 9-30)  
 7226 (Ch. 101.819A) 31-28  
 7230 (Ch. 101.802-2A) (See Model 6230—Set 11-21)  
 7300 (Ch. 435.240) 45-22  
 7350 (Ch. 435.241) 38-22

SILVERTONE-Cont.

7353 (See Model 7350—Set 38-22)  
 8000 (Ch. 132.838) 31-29  
 8003 (Ch. 132.818-1) 53-22  
 8004 (See Model 8003—Set 33-22)  
 8005 (Ch. 132.839) 33-26  
 8010 (Ch. 132.840) 40-21  
 8011 (See Model 8010—Set 40-21)  
 8020 (Ch. 132.841) 43-17  
 8021 (Ch. 132.868) 70-10  
 8024, 8025 (Ch. 478.206-1) 80-15  
 8050 (Ch. 101.813) 33-27  
 8051 (Ch. 101.839) 49-19  
 8052 (Ch. 101.808-1C) 68-15  
 8053 (Ch. 101.808-1D) (See Model 8052—Set 68-15)  
 8070 (Ch. 101.817-1A) (See Model 7070—Set 30-26)  
 8072 (Ch. 101.834) 34-19  
 8073 (Ch. 132.843) 84-9  
 8080 (Ch. 101.852) 52-20  
 8083, 8083A (Ch. 101.809-1A) 58-20  
 8084, 8084A (Ch. 101.809-1B) 58-20  
 8086 (Ch. 101.814-5C) 61-18  
 8086A, 8086B (Ch. 101.814-6C) 61-18  
 8090 (Ch. 101.821) 49-20  
 8097 (Ch. 101.825-3G) (See Model 8115—Set 62-18)  
 8097A (Ch. 101.825-4) 62-18  
 8100 (Ch. 101.829) 51-19  
 8101, 8101A, 8101B, 8101C (Ch. 101.809-3C) 58-20  
 8102 (Ch. 101.814-2B) 61-18  
 8102A (Ch. 101.814-3B) 61-18  
 8102B (Ch. 101.814-2B) 61-18  
 8103 (Ch. 110.473) 56-21  
 8104 (See Model 8086—Set 61-18)  
 8105, 8105A (Ch. 101.833) 35-20  
 8106, A (Ch. 101.833-1A) (See Model 8115—Set 35-20)  
 8107A, 8108, 8108A (Ch. 101.851), 8109 (Ch. 101.851-1) 64-10  
 8112, 8113 (Ch. 101.851) (See Model 8107A—Set 64-10)  
 8115 (Ch. 101.825-3D) 62-18  
 8115 A, B, C (Ch. 101.825-4) 62-18  
 8115D (Ch. 101.825-4) (See Model 8115A—Set 62-18)  
 8117 (Ch. 101.825-3E) 62-18  
 8117 (Ch. 101.825-3F) 62-18  
 8118 (Ch. 101.825-3F) 62-18  
 8118 A, B, C (Ch. 101.825-4) 62-18  
 8118D (Ch. 101.825-4) (See Model 8118A—Set 62-18)  
 8124, 8125, 8126, (Ch. 101.831A), 8128, A, B, C (Ch. 101.831), Wire Recorder Amp. (Ch. 101.773) 41-20  
 8127CX (Ch. 101.831A and Wire Recorder Amp. 101.773) (See Model 8127—Set 41-20)  
 8130 (Tel. Rec. 41-20) 49-21  
 8132 (Ch. 101.854) Tel. Rec. 66-15  
 8133 (Ch. 101.829-1, Ch. 101.846) Tel. Rec. 66-15  
 8144 (Ch. 431-199) 32-21  
 8145 (Ch. 109.631) 45-23  
 8148 (Ch. 109.632) 44-22  
 8149 (Ch. 109.633) 48-23  
 8150 (Ch. 109.634) 32-22  
 8152 (Ch. 109.635) (See Model 8153—Set 42-22)  
 8153 (Ch. 109.635), 8153A (Ch. 109.635-1) 42-22  
 8155 (Ch. 463.155) 57-17  
 8160 (Ch. 109.636A) 50-17  
 8168 (Ch. 109.638) 46-23  
 8169 (Ch. 109.638) (See Model 8168—Set 46-23)  
 8200 (Ch. 101.800-2B) (See Model 6200A—Set 45-12)  
 8201 (See Model 6200A—Set 65-12)  
 8210 (Ch. 101.820-1A) 71-13  
 8220, 8221 (Ch. 101.801-3D) (See Model 6220—Set 9-30)  
 8222 (See Model 6220—Set 9-30)  
 8230 (Ch. 101.835) 59-18  
 8231 (See Model 8230—Set 59-18)  
 8260 (Ch. 101.823-2B) (See Model 7165—Set 10-29)  
 8270 (Ch. 101.8221), 8270A (Ch. 101.822A) 57-18  
 9000 (Ch. 132.857) 65-13  
 9005, 9006 (Ch. 132.858) 72-11  
 9022 (Ch. 132.871) 76-17  
 9054 (Ch. 101.849) 63-16  
 9073, 9073A (Ch. 135.244, 9073B (Ch. 135.244-1) 83-10

SILVERTONE-Cont.

9073C (Ch. 135.243-1) (See Model 9073—Set 83-10)  
 9082 (Ch. 135.245) 101-11  
 9101 (Ch. 101.809-3C) (See Model 7080—Set 58-20)  
 9102 (See Model 7080—Set 58-20)  
 9105 (Ch. 132.875) 89-14  
 9107A (Ch. 101.851-1) (See Model 8107A—Set 64-10)  
 9111 (Ch. 110.499) Tel. Rec. (See Model 9123—Set 79-16)  
 9112 (Ch. 110.499-1) Tel. Rec. (See Model 9124—Set 79-16)  
 9113 (Ch. 110.499) Tel. Rec. (See Model 9123—Set 79-16)  
 9114 (Ch. 110.499-1) Tel. Rec. (See Model 9124—Set 79-16)  
 9115 (Ch. 478.224), 9116 (Ch. 478.221) Tel. Rec. 97-16  
 9116 (Ch. 478.221) Tel. Rec. 97-16  
 9119, 9120 (Ch. 101.865) Tel. Rec. 91-18  
 9120A (Ch. 101.862-1) Tel. Rec. 91-18  
 9121 (Ch. 101.867) Tel. Rec. 91-18  
 9122 (Ch. 101.864) (See Model 8132—Set 66-15)  
 9122A (Ch. 101.868) Tel. Rec. 79-16  
 9123 (Ch. 110.499) Tel. Rec. 79-16  
 9124 (Ch. 110.499-1) Tel. Rec. 79-16  
 9125 (Ch. 478.252) Tel. Rec. 79-16  
 9125A (Ch. 478.253) Tel. Rec. 104-10  
 9125B (Ch. 478.253-1) Tel. Rec. 79-16  
 9126 (Ch. 110.499-2) Tel. Rec. 79-16  
 9127 (Ch. 110.499-2) Tel. Rec. (See Model 9126—Set 79-16)  
 9128A (Ch. 101.868) Tel. Rec. 79-16  
 9129 (Ch. 110.499) Tel. Rec. (See Model 9123—Set 79-16)  
 9130 (Ch. 110.499-1) Tel. Rec. (See Model 9124—Set 79-16)  
 9131 (Ch. 478.210) Tel. Rec. 84-10  
 9132 (Ch. 104.499-1) Tel. Rec. (See Model 9124—Set 79-16)  
 9133, 9134 (Ch. 101.866, Radio Ch. 101.859) Tel. Rec. 95-5  
 9139, 9140 (Ch. 110.499-1) Tel. Rec. (See Model 9126—Set 79-16)  
 9153 (Ch. 435.417) 67-16  
 9161 (Ch. 548.358) 88-10  
 9260 (Ch. 101.850) 51-20  
 9270 (Ch. 547.245) 82-11  
 9280 (Ch. 528.688) 94-9  
 (See Model 133) Ch. 100.107  
 (See Model 149) Ch. 100.111  
 (See Model 143A) Ch. 100.112  
 (See Model 161-16) Ch. 100.115  
 (See Model 142) Ch. 100.120  
 (See Model 165-16) Ch. 100.201  
 (See Model 69) Ch. 100.202  
 (See Model 1066) Ch. 100.202-1  
 (See Model 2195-21) Ch. 100.208  
 (See Model 1176-21) Ch. 100.208-1  
 (See Model 2195-21) Ch. 100.209  
 (See Model 2170-C) Ch. 100.210, -1, -3  
 (See Model 2130) Ch. 100.959  
 (See Model 142) Ch. 101.660-1A  
 (See Model 6100) Ch. 101.672-2B  
 (See Model 6105) Ch. 101.662-2D  
 (See Model 6105) Ch. 101.662-3C  
 (See Model 6111) Ch. 101.662-4E  
 (See Model 106A) Ch. 101.662-5F  
 (See Model 6111A) Ch. 101.666-1B  
 (See Model 6285A) Ch. 101.672-1A  
 (See Model 6093) Ch. 101.672-1B  
 (See Model 6092) Ch. 101.677B  
 (See Model 6290) Ch. 101.773

SILVERTONE—SPARTON

SILVERTONE—Cont.

Ch. 101.800-3 (See Model 6200A, Ch. 101.800-3)  
 Ch. 101.801, -1A (See Model 6230)  
 Ch. 101.802, -1 (See Model 6230)  
 101.807, A (See Model 7021)  
 Ch. 101.808 (See Model 7054)  
 Ch. 101.808-1C (See Model 8052)  
 Ch. 101.808-1D (See Model 8053)  
 Ch. 101.809 (See Model 7080, Ch. 101.809)  
 Ch. 101.809-1A (See Model 8083)  
 Ch. 101.809-1B (See Model 8084)  
 Ch. 101.809-2 (See Model 7080, Ch. 101.809-2)  
 Ch. 101.809-3C (See Model 8101)  
 Ch. 101.810 (See Model 7090)  
 Ch. 101.811 (See Model 7100)  
 Ch. 101.813 (See Model 8050)  
 Ch. 101.814 (See Model 7085)  
 Ch. 101.814-1A (See Model 7102)  
 Ch. 101.814-2B (See Model 8102)  
 Ch. 101.814-3B (See Model 8102A)  
 Ch. 101.814-4 (See Model 8086)  
 Ch. 101.814-6C (See Model 8086A)  
 Ch. 101.817 (See Model 7070)  
 Ch. 101.819A (See Model 7226)  
 Ch. 101.820 (See Model 7210)  
 Ch. 101.821 (See Model 8090)  
 Ch. 101.822 (See Model 8270)  
 Ch. 101.822A (See Model 8270A)  
 Ch. 101.823, -1 (See Model 7166)  
 Ch. 101.823-A, -1A (See Model 7165)  
 Ch. 101.825 (See Model 7115)  
 Ch. 101.825-1A (See Model 7116)  
 Ch. 101.825-1B (See Model 7117)  
 Ch. 101.825-2C (See Model 7119)  
 Ch. 101.825-3D (See Model 8115)  
 Ch. 101.825-3E (See Model 8117)  
 Ch. 101.825-3F (See Model 8118)  
 Ch. 101.825-3G (See Model 8097)  
 Ch. 101.825-4 (See Model 8097A)  
 Ch. 101.829 (See Model 8100)  
 Ch. 101.829-1 (See Model 8133)  
 Ch. 101.831 (See Model 8128)  
 Ch. 101.831A (See Model 8127)  
 Ch. 101.831-1 (See Model 8124)  
 Ch. 101.833 (See Model 8105)  
 Ch. 101.834 (See Model 8072)  
 Ch. 101.835 (See Model 8230)  
 Ch. 101.839 (See Model 8051)  
 Ch. 101.846 (See Model 8133)  
 Ch. 101.849 (See Model 9054)  
 Ch. 101.850 (See Model 9260)  
 Ch. 101.851 (See Model 8107A)  
 Ch. 101.851-1 (See Model 8109)  
 Ch. 101.852 (See Model 8080)  
 Ch. 101.854 (See Model 8132)  
 Ch. 101.859 (See Model 9133)  
 Ch. 101.859-1 (See Model 67)  
 Ch. 101.859-2 (See Model 64)  
 Ch. 101.860 (See Model 1058)  
 Ch. 101.861, -1 (See Model 2060)  
 Ch. 101.864 (See Model 9122)  
 Ch. 101.865 (See Model 9119)  
 Ch. 101.865-1 (See Model 9120A)  
 Ch. 101.866 (See Model 9133)  
 Ch. 101.867 (See Model 9121)  
 Ch. 101.868 (See Model 9122A)  
 Ch. 109.626 (See Model 7152)

SILVERTONE—Cont.

Ch. 109.627 (See Model 7153)  
 Ch. 109.631 (See Model 8145)  
 Ch. 109.632 (See Model 8148)  
 Ch. 109.633 (See Model 8149)  
 Ch. 109.634 (See Model 8150)  
 Ch. 109.635 (See Model 8153)  
 109.635-1 (See Model 8153A)  
 Ch. 109.636 (See Model 8160)  
 Ch. 109.636A (See Model 8160A)  
 Ch. 109.638 (See Model 8168)  
 Ch. 110.451 (See Model 6051)  
 Ch. 110.452 (See Model 6052)  
 Ch. 110.454 (See Model 6072)  
 Ch. 110.466 (See Model 7086)  
 Ch. 110.466-1 (See Model 7103)  
 Ch. 110.473 (See Model 8103)  
 Ch. 110.499 (See Model 9123)  
 Ch. 110.499-1 (See Model 9124)  
 Ch. 110.499-2 (See Model 9126)  
 Ch. 110.700 (See Model 1111)  
 Ch. 110.700-1 (See Model 116)  
 Ch. 110.700-2 (See Model 114)  
 Ch. 110.700-2 (See Model 134)  
 Ch. 110.700-40 (See Model 177-19)  
 Ch. 110.700-90 (See Model 1116-16)  
 Ch. 110.700-96 (See Model 1117-17)  
 Ch. 110.700-100 (See Model 1117-17)  
 Ch. 110.700-120 (See Model 1181-20)  
 Ch. 110.700-140 (See Model 1145-20)  
 Ch. 110.700-150 (See Model 1183-21)  
 Ch. 110.702-10, -50 (See Model 1171-17)  
 Ch. 110.817-1 (See Model 2100A)  
 Ch. 110.820-1 (See Model 2150A)  
 Ch. 132.011 (See Model 1052)  
 Ch. 132.011-1 (See Model 1053A)  
 Ch. 132.012 (See Model 1054)  
 Ch. 132.012-1 (See Model 1054A)  
 Ch. 132.021 (See Model 2014)  
 Ch. 132.022 (See Model 2009)  
 Ch. 132.024, -1, -2 (See Model 2105)  
 Ch. 132.024-3 (See Model 2105A)  
 Ch. 132.024-4 (See Model 2145B)  
 Ch. 132.024-5, -6 (See Model 3105)  
 Ch. 132.024-31 (See Model 2105A)  
 Ch. 132.026-3 (See Model 2056)  
 Ch. 132.027 (See Model 2022)  
 Ch. 132.035 (See Model 2174)  
 Ch. 132.035-2 (See Model 3174)  
 Ch. 132.044 (See Model 3175)  
 Ch. 132.045, -1 (See Model 3106)  
 Ch. 132.807-2 (See Model 7025)  
 Ch. 132.816 (See Model 6011)  
 Ch. 132.816A (See Model 6012)  
 Ch. 132.818 (See Model 6002)  
 Ch. 132.818-1 (See Model 8003)  
 Ch. 132.820 (See Model 6016)  
 Ch. 132.825-4 (See Model 6050)  
 Ch. 132.826-1 (See Model 6071)  
 Ch. 132.838 (See Model 8000)  
 Ch. 132.839 (See Model 8005)  
 Ch. 132.840 (See Model 8010)  
 Ch. 132.841 (See Model 8020)  
 Ch. 132.858 (See Model 9005)  
 Ch. 132.868 (See Model 8021)  
 Ch. 132.871 (See Model 9022)  
 Ch. 132.875 (See Model 9105)

SILVERTONE—Cont.

Ch. 132.877 (See Model 18)  
 Ch. 132.878 (See Model 1)  
 Ch. 132.880 (See Model 210)  
 Ch. 132.881 (See Model 5)  
 Ch. 132.882 (See Model 105)  
 Ch. 132.884, -1, -2 (See Model 15)  
 Ch. 132.887 (See Model 51)  
 Ch. 132.888 (See Model 54)  
 Ch. 132.889, -1 (See Model 106, Ch. 132.889-1)  
 Ch. 132.889, -2 (See Model 106, Ch. 132.889-2)  
 Ch. 132.890 (See Model 179-16)  
 Ch. 132.896 (See Model 10)  
 Ch. 132.896-1 (See Model 2023)  
 Ch. 134.111 (See Model 72)  
 Ch. 135.243 (See Model 8073)  
 Ch. 135.243-1 (See Model 9073C)  
 Ch. 135.244 (See Model 9073)  
 Ch. 135.244-1 (See Model 9073B)  
 Ch. 135.245 (See Model 41)  
 Ch. 137.906 (See Model 246)  
 Ch. 139.150, -1 (See Model 6685)  
 Ch. 185.706 (See Model 1304)  
 Ch. 319.190 (See Model 1301)  
 Ch. 319.200 (See Model 1300)  
 Ch. 319.200-1 (See Model 1300-1)  
 Ch. 431.188 (See Model 7148)  
 Ch. 431.188-1 (See Model 7148A)  
 Ch. 431.199 (See Model 8144)  
 Ch. 431.202 (See Model 8130)  
 Ch. 434.140 (See Model 7111)  
 Ch. 435.240 (See Model 7300)  
 Ch. 435.410 (See Model 7350)  
 Ch. 435.417 (See Model 9153)  
 Ch. 436.200 (See Model 7145)  
 Ch. 456.150 (See Model 1260)  
 Ch. 465.150-1 (See Model 1268-21)  
 Ch. 456.150-2 (See Model 1260)  
 Ch. 463.155 (See Model 8155)  
 Ch. 478.206-1 (See Model 8024)  
 Ch. 478.210 (See Model 9131)  
 Ch. 478.221 (See Model 9116)  
 Ch. 478.224 (See Model 9115)  
 Ch. 478.238 (See Model 25)  
 Ch. 478.240 (See Model 144)  
 Ch. 478.252 (See Model 9125)  
 Ch. 478.253 (See Model 9125A)  
 Ch. 478.253-1 (See Model 9125B)  
 Ch. 478.257 (See Model 125)  
 Ch. 478.257-1 (See Model 125B)  
 Ch. 478.289 (See Model 112)  
 Ch. 478.302 (See Model 114)  
 Ch. 478.303, A (See Model 110)  
 Ch. 478.309 (See Model 159)  
 Ch. 478.311 (See Model 120)  
 Ch. 478.312 (See Model 144)  
 Ch. 478.313 (See Model 164-14)  
 Ch. 478.319 (See Model 163-16)  
 Ch. 478.338 (See Model 150-14)  
 Ch. 478.339 (See Model 166-16)  
 Ch. 478.339A (See Model 166-17)  
 Ch. 478.339-B (See Model 1166-17)  
 Ch. 478.361, A (See Model 1150-14)  
 Ch. 488.237 (See Model 237)  
 Ch. 528.168 (See Model 9280)  
 Ch. 528.171-1 (See Model 225)  
 Ch. 528.173 (See Model 220)  
 Ch. 528.174 (See Model 215)

SILVERTONE—Cont.

Ch. 528.194 (See Model 1040)  
 Ch. 528.195, -1, -2 (See Model 1035)  
 Ch. 528.196 (See Model 1032)  
 Ch. 528.210, -1 (See Model 1017)  
 Ch. 528.229 (See Model 2200)  
 Ch. 528.230 (See Model 2028)  
 Ch. 528.233 (See Model 2225)  
 Ch. 528.235 (See Model 2041)  
 Ch. 528.239 (See Model 3170)  
 Ch. 528.247, -1 (See Model 3171A)  
 Ch. 528.249, -1 (See Model 3170C)  
 Ch. 528.253 (See Model 3040)  
 Ch. 528.254 (See Model 3045)  
 Ch. 528.259 (See Model 3200)  
 Ch. 528.630, -1 (See Model 151-16)  
 Ch. 528.631 (See Model 1184-20)  
 Ch. 528.631, -1 (See Model 2110A)  
 Ch. 528.632, -1, -2, -3, -4, -5 (See Model 2110A)  
 Ch. 528.632A, -1, -2, -3, -5 (See Model 2110A)  
 Ch. 528.6286, -1, -3 (See Model 6286)  
 Ch. 528.6287, -1, -3 (See Model 6287)  
 Ch. 528.6293-2 (See Model 6293)  
 Ch. 528.6295 (See Model 6295)  
 Ch. 547.245 (See Model 9270)  
 Ch. 548.358 (See Model 9161)  
 Ch. 548.358-1 (See Model 245)  
 Ch. 548.360-1 (See Model 239)  
 Ch. 548.361 (See Model 239)  
 Ch. 548.363 (See Model 33)  
 Ch. 549.100 (See Model 101)  
 Ch. 549.100-1 (See Model 101A)  
 Ch. 549.100-3 (See Model 102A)  
 Ch. 549.100-4 (See Model 160-12)  
 Ch. 549.100-5, -6, -7, -8, -9 (See Model 175-16)  
 Ch. 549.102, -2 (See Model 169-16)  
 Ch. 757.100 (See Model 2007)  
 Ch. 757.110 (See Model 2003)

SONORA—Cont.

323, 324, 325  
 Tel. Rec. 174-11  
 332 Tel. Rec. 174-11  
 350, 351 Tel. Rec. 173-13  
 352 Tel. Rec. 182-12  
 401 47-21  
 402A (See Model RMR-219—Set 19-28)  
 402F (See Model WLRU-219A—Set 37-21)

**SOUND, INC.**  
 "Intersound" 7-27  
 MB6P3, MB6P6, MB6P30, MB6R4 35-21  
 MB7E3 28-31  
 MB7E8 26-24  
 5R2 28-32

**SPARKS-WITHINGTON (See Sparton)**

**SPARTON (Also see Record Changer Listing)**  
 4AW17 (Ch. 417) 50-18  
 4AW17-A (Ch. 417A) 49-22  
 5AH06, 5A106 (See Model 5AW06—Set 41-7)  
 5A116 (Ch. 5-16) 30-29  
 5AM26-PS (Ch. 5-26-PS) 5-17  
 5AW06 (Ch. 5-06) 4-17  
 5AW16 (Ch. 5-16) 30-29  
 6AM06 (Ch. 6-06) 34-21  
 6AM26 (See Model 6AW26PA—Set 15-33)  
 6AW26PA (Ch. PC5-6-26) 15-33  
 6-66A (Ch. 666A) 51-21  
 7AM46 (Ch. 7-46) 1-31  
 7AM46PA, 7BAM46PA, 7BW46PA (See Model 7AM46—Set 1-31)  
 8AM46 (Ch. 8-46) 1-31  
 10AB76-PA, 10AM76-PA, 10BM76-PA (See Model 10BW76-PA—Set 15-34)  
 10BW76-PA (Ch. 10-76PA) 15-34  
 100, 101 (Ch. 5A7) 38-23  
 102, 103, 104 (See Model 100—Set 31-33)  
 121 (Ch. 8L9) 57-19  
 122 (See Model 121—Set 57-19)  
 130, 132, 135, 139 (Ch. 5A10) 94-10  
 141 (See Model 121—Set 57-19)  
 141A (Ch. 8L10) 92-6  
 141XX, 142XX (Ch. 8W10) 126-12  
 142 (See Model 121—Set 57-19)  
 150, 151, 152, 155 (Ch. 4E10) 91-12  
 230 (Ch. 5A10, A) 210-10  
 232 (Ch. 5A10, A) 210-10  
 239 (Ch. 5A10, A) 210-10  
 350, 351 (Ch. 6L3) 197-12  
 1000, 1001, 1003 (Ch. 8L9) 60-18  
 1005, 1006, 1007, 1008 (Ch. 8-57) 29-25  
 1010 (Ch. 7J7) 35-22  
 1015 (See Model 10BW76PA—Set 15-34)  
 1020, 1021, 1023 60-18  
 1030, 1030A (Ch. 6B8) 37-22  
 1031, A (See Model 1030—Set 37-22)  
 1035, 1035A, 1036, 1036A, 1037, 1037A, 1039, 1040, 1041 (Ch. 9L8) 62-19  
 1040XX, 1041XX (Ch. 8W10) 126-12  
 1051, 1052 (Ch. 6B9) 58-21  
 1058, 1059, 1060, 1061, 1064 (Ch. 8L9) 57-19  
 1071 (See Model 121—Set 57-19)  
 1072 (Ch. 8L9) 57-19  
 1080 (Ch. 9L8A) (See Model 4900TV—Set 64-11)  
 1080A (Ch. 8L10) (See Model 141A—Set 92-6)  
 1081 (Ch. 9L8A) (See Model 4900TV—Set 64-11)  
 1081A (Ch. 8L10) (See Model 141A—Set 92-6)  
 1085, 1086, (Ch. 8W10) 126-12  
 1090, 1091, (Ch. 8W10) 126-12  
 1210, 1211 (Ch. 8W10) (See Model 141XX—Set 126-12)  
 1300, 1301 (Ch. 6L3) 197-12  
 4900TV (Ch. 24TV9C, 3TV9C, 9L8A) Tel. Rec. 64-11  
 4915, 4917, 4918 (Ch. 24TL10, 3TL10, 6510) Tel. Rec. 164-9  
 4924, 4921, 4922 (Ch. 24TW10) Tel. Rec. 164-9  
 4935 (Ch. 23TC10) Tel. Rec. 133-1A  
 4939TV, 4940TV, 4941TV (Ch. 24TV9, 3TV9) Tel. Rec. 64-11  
 4942 (Ch. 23TC10) Tel. Rec. 133-1A  
 4944, 4945 (Ch. 3TB10, 24TB10) Tel. Rec. 86-10  
 4951, 4952 (See Model 4900TV—Set 64-11)  
 4954 (Ch. 23TC10) Tel. Rec. (See Model 4939) 133-1A  
 4960 (Ch. 23TC10) 133-1A  
 4964, 4965 (Ch. 23TB10) Tel. Rec. 157-11  
 4970, 4971, 4972 (Ch. 8510) 92-6  
 5002, 5003 (Ch. 23TD10) Tel. Rec. 102-13  
 5006, 5007 (Ch. 23TD10) Tel. Rec. 102-13

**SPARTON—Cont.**

5006X (Ch. 25TK10A) Tel. Rec. 121-13  
 5007X (Ch. 25TK10A) Tel. Rec. 121-13  
 5010, 5011 (Ch. 19TS10, A) Tel. Rec. 104-11  
 5014, 5015 (Ch. 19TS10, A) Tel. Rec. 104-11  
 5025 (Ch. 26SS160) Tel. Rec. 128-13  
 5025BA Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5026 Tel. Rec. 128-13  
 5029, 5030 (Ch. 26SD160) Tel. Rec. 128-13  
 5035, 5036, 5037 (Ch. 26SS160) Tel. Rec. 128-13  
 5052 (Ch. 24TR10, 3TR10) Tel. Rec. 97A-13  
 5056, 5057 (Ch. 19TS10, A) Tel. Rec. 104-11  
 5064, 5065 (Ch. 23TB10) Tel. Rec. 157-11  
 5068, 5069 (Ch. 24TV9C) Tel. Rec. (See Model 4900TV—Set 64-11)  
 5071, 5072 (Ch. 19TS10, A) Tel. Rec. 104-11  
 5075BA Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5076 (Ch. 26SS160, B) Tel. Rec. 128-13  
 5076BA Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5076BB Tel. Rec. 128-13  
 5077 Tel. Rec. 128-13  
 5077BA Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5078 Tel. Rec. 128-13  
 5079 Tel. Rec. 128-13  
 5079B Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5080 Tel. Rec. 128-13  
 5080C Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5082, 5083 (Ch. 26SD170, 26SD170D) Tel. Rec. (For TV Ch. See Set 128-13, For Radio Ch. See Model 141XX—Set 126-12)  
 5082, 5083 (Ch. 26SD170X, XP) Tel. Rec. (For TV Ch. See Prod. Chge. Bul. 22—Set 138-1 and Model 5082—Set 128-13, For Radio Ch. See Model 141XX—Set 126-12)  
 5085, 5086 (Ch. 2RD190, 25SD190) Tel. Rec. 139-14  
 5088, 5089, 5090 (Ch. 26SD160, 26SD170 and Radio Ch. 8W10) (For TV Ch. See Set 128-13, For Radio Ch. See Model 141XX—Set 126-12)  
 5101, 5102, 5103 (Ch. 26SS170, P) Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5104, 5105 (Ch. 26SS170D, P) Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5107, 5108 (Ch. 26SS170D, 26SS170DD) Tel. Rec. \*  
 5107X (Ch. 26SS171) Tel. Rec. \*  
 5110 (Ch. 26SS170D, 26SS170DD) Tel. Rec. \*  
 5125 (Ch. 27SS170D, 26SS170DD) Tel. Rec. \*  
 5152, 5153, 5154 (Ch. 26SS170, P) Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5155, 5156, 5157 (Ch. 26SD170X, XP) Tel. Rec. (See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13)  
 5162X, 5163X (Ch. 26SS171A) Tel. Rec. \*  
 5165X, 5166X (Ch. 26SD171) Tel. Rec. 156-13  
 5170, 5171 (Ch. 25SD201, 25SD201I) Tel. Rec. 147-11  
 5175X (Ch. 26SD171) Tel. Rec. 156-13  
 5178X (Ch. 26SD171) Tel. Rec. 156-13  
 5182, 5183, 5188, 5189 (Ch. 26SD170, P and Radio Ch. 8W10) Tel. Rec. (For TV Ch. See Prod. Chge. Bul. 22—Set 138-1 and Model 5025—Set 128-13, For Radio Ch. See Model 141XX—Set 126-12)  
 5191, 5192 (Ch. 25SD201, 25SD201I) Tel. Rec. (See Model 5170—Set 147-11)  
 5207, 5208 (Ch. 26SS172, A) Tel. Rec. 167-14  
 5207A (Ch. 25S172) Tel. Rec. \*

**SPARTON—Cont.**

5210 (Ch. 26SS172B) Tel. Rec. 167-14  
 5212 (Ch. 21S172) Tel. Rec. 174-12  
 5220 (Ch. 26SD172C) Tel. Rec. 167-14  
 5225, 5226 (Ch. 26SD172C) Tel. Rec. 167-14  
 5240, 5241 (Ch. 21S172) Tel. Rec. 201-10  
 5250, 5252, 5253 (Ch. 21S172) Tel. Rec. 174-12  
 5262, 5263 (Ch. 26SS172, A) Tel. Rec. 167-14  
 5265 (Ch. 26SD172, A) Tel. Rec. 167-14  
 5267, 5268 (Ch. 26SD172, A) Tel. Rec. 167-14  
 5270 (Ch. 26SD172C) Tel. Rec. 167-14  
 5271 (Ch. 26SD172C) Tel. Rec. (See Model 5006X)  
 5272, 5273 (Ch. 26SD172C) Tel. Rec. 167-14  
 5280, 5281 (Ch. 21S172) Tel. Rec. 201-10  
 5288, 5289 (Ch. 25CD202) Tel. Rec. 178-11  
 5290 (Ch. 25SD202) Tel. Rec. \*  
 5291, 5292, 5293, 5294, 5295 (Ch. 25CD202) Tel. Rec. 178-11  
 5296A, 5297A (Ch. 25CD202) Tel. Rec. 178-11  
 5296, 5297 (Ch. 25SD202) Tel. Rec. \*  
 5299 (Ch. 25CD202) Tel. Rec. (See Model 5298—Set 178-11)  
 5301 (Ch. 21S173-D) Tel. Rec. 201-10  
 5340, 5341 (Ch. 21S173) Tel. Rec. 201-10  
 5342 (Ch. 25D213) Tel. Rec. \*  
 5342A (Ch. 27D213) Tel. Rec. 210-11  
 5343 (Ch. 25D213) Tel. Rec. \*  
 5343A (Ch. 27D213) Tel. Rec. 210-11  
 5344 (Ch. 27D213) Tel. Rec. 210-11  
 5380, 5381 (Ch. 21S173) Tel. Rec. 201-10  
 5382A (Ch. 27D213) Tel. Rec. 210-11  
 5382B (Ch. 27D213-A) Tel. Rec. 210-11  
 5383A (Ch. 27D213) Tel. Rec. 210-11  
 2384A (Ch. 27D213) Tel. Rec. 210-11  
 5386A (Ch. 27D213) Tel. Rec. 210-11  
 10352, 10353 (Ch. 27D213) Tel. Rec. 210-11  
 Ch. PC-5-6-26 ((See Model 6AW26PA) Ch. 2RD190 (See Model 5085) Ch. 25D201 (See Model 5170) Ch. 3TB10 (See Model 4944) Ch. 3TL10 (See Model 4916) 3AR1 (See Model 5052) Ch. 3TV9, 3TV9C (See Model 4900TV) Ch. 4E10 (See Model 150) Ch. 5A7 (See Model 100) Ch. 5-06 (See Model 3AW05) Ch. 5A10 (See Model 130) Ch. 5A10, A (See Model 230) Ch. 5-16 (See Model 5A116) Ch. 5-26PS (See Model 5AM26PS) Ch. 6B9 (See Model 1051) Ch. 613 (See Model 350) Ch. 618 (See Model 1030) Ch. 6-06 (See Model 6AM06) Ch. 717 (See Model 1010) Ch. 7-46 (See Model 7AM46) Ch. 819 (See Model 121) Ch. 8110 (See Model 141A) Ch. 8510 (See Model 4970) Ch. 8W10 (See Model 141XX) Ch. 8-46 (See Model 8AM46) Ch. 8-57 (See Model 1005) Ch. 918 (See Model 1035) Ch. 918A (See Model 4900TV) Ch. 1077A (See Model 10BW76PA) Ch. 1217 (See Model 1000) Ch. 19TS10, 19TS10A (See Model 5010) Ch. 21S172 (See Model 5212) Ch. 21S173-D (See Model 5301) Ch. 21S172 (See Model 5240) Ch. 21S213 (See Model 5340) Ch. 23TB10 (See Model 4964) Ch. 23TC10 (See Model 4935) Ch. 23TD10 (See Model 5002) Ch. 24TB10 (See Model 4944) Ch. 24TL10 (See Model 4916)

**SPARTON—Cont.**

Ch. 24TM10 (See Model 4920) Ch. 24TR10 (See Model 5052) Ch. 24TV9 (See Model 4939TV) Ch. 24TV9C (See Model 4900TV) Ch. 25CD202 (See Model 5288) Ch. 25D213 (See Model 5342) Ch. 25RD190 (See Model 5085) Ch. 25S172 (See Model 5207A) Ch. 25SD201 (See Model 5170) Ch. 25SD202 (See Model 5290) Ch. 25TK10A (See Model 5006X) Ch. 26SD160 (See Model 5025) Ch. 26SD170 (See Model 5082) Ch. 26SD170P (See Model 5182) Ch. 26SD170X, XP (See Model 5082) Ch. 26SD171 (See Model 5165X) Ch. 26SD172, A (See Model 5267) Ch. 26SD172C (See Model 5270) Ch. 26SD170DD (See Model 5107) Ch. 26SS170 P (See Model 5104) Ch. 26SS171, A (See Model 5107X) Ch. 26SS172, A, B (See Model 5207) Ch. 27D213 (See Model 5342A) Ch. 27D213-A (See Model 5382B) Ch. 417 (See Model 4AW17) Ch. 417A (See Model 5AW17A) Ch. 466A (See Model 6-66A) SPIEGEL (See Airsteie) STARRT 410 40-22 1010 88-2 1020 89-5 STARRETT Gotham Tel. Rec. 101-12 Henry Hudson, Henry Parks Tel. Rec. 92-7 John Hancock Tel. Rec. 96-10 Nathan Hale Tel. Rec. 87-12 Robert E. Lee Tel. Rec. 92-7 A17CG-1 (Ch. 1751) Tel. Rec. (See Ch. 1751—Set 165-2A) A17TG-1 (Ch. 1751) Tel. Rec. (See Ch. 1751—Set 165-2A) A20C-2 (Ch. 1851) Tel. Rec. (See Ch. 1851—Set 165-2A) A20CD-1 (Ch. 1851) Tel. Rec. (See Ch. 1851—Set 165-2A) A20TG (Ch. 1851) Tel. Rec. (See Ch. 1851—Set 165-2A) 178M1 (Ch. 1251) Tel. Rec. 149-13 208M1 (Ch. 1551) Tel. Rec. 149-13 278M1 (Ch. 1251) Tel. Rec. 149-13 29AM1 (Ch. 1451) Tel. Rec. 149-13 308M1 (Ch. 1551) Tel. Rec. 149-13 378B1 (Ch. 1251) Tel. Rec. 149-13 39AM1 (Ch. 1451) Tel. Rec. 149-13 Ch. 1251 (See Model 178M1) Ch. 1451 (See Model 29AM1) Ch. 1551 (See Model 208M1) Ch. 1751 (See Model 165-2A) Ch. 1851 (See Model 165-2A) STEELMAN AF1100 180-9 3AR1 217-9 3D2 211-14 3RP1 210-12 102 184-14 107 178-12 200 23-25 215 165-13 303 19-31 327 182-13 330 186-12 350, 351 21-31 357 178-13 450, 451 178-14 487 182-14 517 179-12 595 164-10 597 183-16 601 177-12 602 185-13 STEELMAN Cont. 4000 176-12 5000 186-13 5101 162-12 6000 163-11 STEWART-WARNER AVCI (Code 9054B), AVC2 (Code 9054C), AVTI (Code 9054-A) Tel. Rec. 64-12 A51T1 (Code 9020-A), A-51T2 (Code 9020-B), A51T3 (Code 9020-C), A51T4 (Code 9020-D), A51T5 (Code 9020-E), A61CR1 (Code 9034-C), A61CR2 (Code 9034-D), A61CR3 (Code 9034-E), A61CR4 (Code 9034-F) 39-25 A61P1 (Code 9036-A), A61P2 (Code 9036-B), A61P3 (Code 9036-C) 42-23 A72T1 (Code 9026-A), A72T2 (Code 9026-B), A72T3 (Code 9026-C), A72T4 (Code 9026-D) 32-24 A92CR3, A92CR5, A92CR6, A92CR8 (Code 9026-C), A92CR6 (Code 9026-F) 29-26 B51T1, B51T2, B51T3 (Code 9044-A, B, C) 58-22 B61T1, B61T2 (Code 9046-A, B) 59-19 B72CR1 (Code No. 9038A) 47-22 B92CR1, B92CR2, B92CR3, B92CR4, B92CR8, B92CR9, B92CR10 (Codes 9043-A, B, C, D, K, L, M) 65-14 C51T1 (Code 9054-A), C51T2 (Code 9054-B) 41-22 T-711 (Code 9031-A) Tel. Rec. 95A-12 T-711M (Code 9031-AM) Tel. Rec. 95A-12 T-712 (Code 9031-B) Tel. Rec. 95A-12 TRC-721 (Code 9037-A) Tel. Rec. 95A-12 21C-9210C (Series "A, B, C, D, E") Tel. Rec. 192-8 21C-9211D, E, F, G (Series "A, B, C") Tel. Rec. 200-9 21T-9210A (Series "A, B, C, D, E") Tel. Rec. 192-8 21T-9211B (Series A, B) Tel. Rec. 200-9 21T-9211C (Series A, B, C) Tel. Rec. 200-9 27C-9212A (Series A, B, C) Tel. Rec. 211-15 51T46 (Code 9024B), 51T56 (Code 9024-C) 39-24 51T126 (Code 9018-C), 51T136 (Code 9018-F), 51T146 (Code 9018-H), 51T176 (Code 9018-B) 15-35 61T16 (Code 9022-A), 61T26 (Code 9022-B) 1-6 62T16 (Code 9023-C), 62T1C16 (Code 9023-D), 62T26 (Code 9023-E), 62T36 (Code 9023-F) 2-21 72CR16, 72CR26 18-28 9000-B 11-22 9001-C, D, E, F, G 8-29 9002-A, 9002-B, 9002-P, 9002-R 38-24 9005-A, B 13-31 9007-A, F, G 10-30 9100A, 9100B, 9100C, 9100D, 9100E, 9100F, 9100G, 9100H Tel. Rec. 75-15 9103-B, C, 9104-A, -B, -C Tel. Rec. 105-10 9106A, B Tel. Rec. 118-10 9108A, B, 9109A, B Tel. Rec. 118-10 9113A Tel. Rec. 118-10 9120-A, -B, -C, -D, -E, -F Tel. Rec. 137-11 9121-A, 9121-B, 9122-A Tel. Rec. 138-9 9126-A, -B Tel. Rec. (See Prod. Chge. Bul. 51—Set 185-1 and Model 9120-A—Set 137-11) 9127-A Tel. Rec. 162-13 9130-A Tel. Rec. 190-13 9150-B, 9150-D, 9150-DZ 140-12 9151-A, -B 106-14 9152-A, -B, -C 102-14 9153-A 108-12 9154-C, 9154-CZ 142-13 9160 AU, BU, CU, DU, EU 171-10 9161A, B, C 110-12 9162A, B 168-13 9164-A, -B (See Model 9162A—Set 168-13) 9165A, -B 193-11 9200-A, -C, -D, -FA, -G Tel. Rec. 132-13 9202-A, -B (Thru Series "B") Tel. Rec. (See Model 9202-C Series "B"—Set 158-12) 9202-A, -B (Thru Series "H") Tel. Rec. 172-9 9202-A, -B (Series "M") Tel. Rec. (See Prod. Chge. Bul. 60—Set 194-1 and Model 9202-A (Series "H")—Set 172-9) 9202-C, -DA, -DB, -DD, -E, -F (Thru Series "B") Tel. Rec. 158-12 9202-C, -DA, -DB, -DD, -DDA, -E, -F (Thru Series "H") Tel. Rec. 172-9

**STEWART-WARNER—Cont.**

9202-C, -DA, -DB, -DD, -DDA, -E, -F (Series "M") Tel. Rec. (See Prod. Chge. Bul. 60—Set 194-1 and Model 9202-A (Series "H")—Set 172-9) 9202-FA (Thru Series "B") Tel. Rec. (See Model 9202-C (Series "B")—Set 158-12) 9202-F (Thru Series "H") Tel. Rec. 172-9 9202-FA (Series "M") Tel. Rec. (See Prod. Chge. Bul. 60—Set 194-1 and Model 9202-A (Series "H")—Set 172-9) 9203A Tel. Rec. 166-14 9203B, Tel. Rec. 164-11 9209-A, -AW, B, C, D, E (Series A, B, C, D, E) Tel. Rec. 181-14 9210-C (Series "A, B, C, D, E") Tel. Rec. 192-8 ST. GEORGE (See Recorder Listing) STRATOVOX 579-58A 6-32 STROMBERG-CARLSON AM-43 129-11 AM-48, AM-49 131-14 AP-50 130-13 AR-37 128-14 AR-37A 173-15 AR-410 194-12 AR-425 199-12 AU-29 125-11 AU-32 134-12 AU-33 134-10 AU-34 128-15 AU-35 138-10 AU-36 132-14 AU-42 137-12 AV-38, AV-39 126-13 C-1 153-14 SR-40 191-18 TC-10 Tel. Rec. (Also See Prod. Chge. Bul. 1—Set 103-19) 79-17 TC-19 Tel. Rec. 97-17 TC-125 Tel. Rec. 95A-13 TS-15, TS-16, TS-125 Series Tel. Rec. 72-12 TV-10L, TV-10LV (112020) Tel. Rec. \* TV-10PM, TV-10PY (112025, 112022) Tel. Rec. \* TV-12 (See Model TV-125—Set 68-16) TV-12 PGM (For TV Ch. Only See Model TV-125—Set 68-16) TV-12M5M (For TV Ch. Only See Model TV-125—Set 68-16) TV-12UM (See Model TV-125—Set 68-16) TV-125 [Ch. 12] Tel. Rec. 68-16 16 Series Tel. Rec. 135-12 17 Series Tel. Rec. 135-12 24 Series Tel. Rec. 138-11 32 Series Tel. Rec. 11-23 116 Series Tel. Rec. 135-12 117 Series Tel. Rec. (See Model 119CDM—Set 130-14) 119C Tel. Rec. (See Prod. Chge. Bul. 43—Set 177-1 and Model 119CDM—Set 130-14) 119CDM, 119CM Tel. Rec. 130-14 119M5A, D, G, I, M, R Tel. Rec. 130-14 119 RPM Tel. Rec. 130-14 317BRP, 317TR (See Model 146-10) 321CDM, 321CD20, 321CF, 321CM Tel. Rec. 165-14 324CDM, 324CSM (Series 324) Tel. Rec. 172-10 417CS-M, 417CS-O, 417CS-D, 417CT (Series 417) Tel. Rec. 178-15 421CDM, CM, TX Tel. Rec. (Also See Prod. Chge. Bul. 47—Set 181-1) 170-13 421 Series (Revised) Tel. Rec. 198-14 1020 (See Model 1220 Series—Set 50-19) 1100-H, 1100-H1 20-31 1101-HB, 1101-H1 (Ch. 112002), 1101-HM, 1101-HW, 1101-HY (Ch. 112001) 2-9 1101-HM, -HW, -HY (Ch. 112001) 2-9 1101-HPW 41-23 1105 (Series 10-11) 18-29 1110-HW, 1110-PTW (Series 10) 18-30 1120 (See Model 1220 Series—Set 50-19) 1121-HW, LW, M1-O, M2-W, M2-Y, PFM, PFW, PGM, PGW, PLM, PLW, PSM (Series 10-11-12) 10-31 1135-PFM, 1135-PLM, 1135-PLW (Series 10-11) 23-26 1200 57-20 1202 (Series 10) 55-21 1204 (Ch. 112021) 34-22 1210M2-M, 1210M2-W, 1210M3, 1210M4, 1210M5, 1210PM, 1210PGW, 1210PLM, 1210PFW (Series 10-11) 37-23 1220 Series 50-19 1235 Series 49-23

**STROMBERG-CARLSON-TELE-KING**

**STROMBERG-CARLSON-Cont.**

1400 ..... 57-20  
 1407PFM, 1407PLM ..... 58-23  
 1409M-2, 1409M-2-Y,  
 1409M-2-W, 1409M-3-A,  
 1409M-3-M, 1409PG-M,  
 1409PG-W ..... 62-20  
 1500 ..... 132-15  
 1507 ..... 133-13  
 1608 ..... 150-12

**STUDEBAKER**

AC2111 (S5127) ..... 166-15  
 AC2113 (S5123) ..... 172-11  
 AC-2301 (S-5323) ..... 213-8  
 S-4624, S-4625 ..... 21-32  
 S-4626, S-4627 ..... 19-32

**SUPREME (Lipán)**

711 ..... 68-17  
 712S ..... 63-17  
 733 ..... 60-19  
 738LP ..... 64-13  
 750 ..... 55-22

**SUTCO (Sutton)**

21-A Tel. UHF Conv. .... 201-11

**SWANK**

5 Tube Radio-phon  
 (DU101) ..... 5-21  
 ER6 ..... 17-33

**SYLVANIA**

C33M Tel. UHF Conv. .... 199-13  
 SH758 (See Hudson  
 Model 236486—  
 Set 214-4)

SH759 (See Hudson  
 Model 236476—  
 Set 215-8)

1-075 (Ch. 1-139) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 48—Set  
 182-1) ..... 92-8

1-076 (Ch. 1-108) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 2—Set  
 103-20 and Prod. Chge.  
 Bul. 49—Set 183-1) ..... 96-11

1-090 (Ch. 1-168) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 49—Set  
 183-1) ..... 99-17

1-113, 1-114 Tel. Rec.  
 (Also see Prod. Chge.  
 Bul. 48—Set 182-1) ..... 92-8

1-124, 1-125 Tel. Rec.  
 (Also see Prod. Chge.  
 Bul. 48—Set 182-1) ..... 92-8

1-125-1 (Ch. 1-186) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 49—Set  
 183-1) ..... 113-9

1-128 (Ch. 1-108) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 2—Set 103-20  
 and Prod. Chge. Bul.  
 49—Set 183-1) ..... 96-11

1-177 (Ch. 1-186) Tel. Rec.  
 (Also see Prod. Chge.  
 Bul. 48—Set 182-1) ..... 92-8

1-197 (Ch. 1-139) Tel. Rec.  
 (See Prod. Chge. Bul.  
 49—Set 182-1 and Model  
 1-075—Set 92-8)

1-197-1 (Ch. 1-186)  
 Tel. Rec. (Also see  
 Prod. Chge. Bul. 49—  
 Set 183-1) ..... 113-9

1-210 (Ch. 1-139) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 48—Set 182-1 and  
 Model 1-075—Set 92-8)

1-245, 1-246 (Ch. 1-139)  
 Tel. Rec. (See Prod.  
 Chge. Bul. 48—Set  
 182-1 and Model 1-075—  
 Set 92-8) ..... 113-9

1-245-1, 1-246-1  
 (Ch. 1-186) Tel. Rec.  
 (Also see Prod. Chge.  
 Bul. 49—Set 183-1) ..... 113-9

1-247 (Ch. 1-168) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 49—Set  
 183-1) ..... 99-17

1-247-1 (Ch. 1-231)  
 Tel. Rec. .... \*

1-250, 1-251, 1-252  
 (Ch. 1-215) ..... 103-16

228-11 (Ch. 1-507-1)  
 Tel. Rec. .... 174-13

22M (Ch. 1-387) Tel. Rec.  
 (See Model 2221M—  
 Set 137-13)

22M-1, -2 (Ch. 1-387-1)  
 Tel. Rec. (Also see  
 Prod. Chge. Bul. 41—  
 Set 174-1) ..... 154-12

22M-11 (Ch. 1-507-1)  
 Tel. Rec. .... 174-13

238, B-1, M, M-1,  
 (Ch. 1-387-1) Tel. Rec.  
 (Also see Prod. Chge.  
 Bul. 41—Set 174-1) ..... 154-12

238-11 (Ch. 1-507-1)  
 Tel. Rec. .... 174-13

23M-11 (Ch. 1-507-1)  
 Tel. Rec. .... 174-13

24M (Ch. 1-462-1)  
 Tel. Rec. .... 154-12

24M-1 (Ch. 1-387-1)  
 Tel. Rec. (Also see  
 Prod. Chge. Bul. 41—  
 Set 174-1) ..... 154-12

24M-3 (Ch. 1-387-1)  
 Tel. Rec. (See Prod.  
 Chge. Bul. 41—Set 174-1  
 and Model 24M-1—Set  
 154-12)

**SYLVANIA-Cont.**

25M, 25M-1 (Ch. 1-387-1  
 and Radio Ch. 1-603-1)  
 Tel. Rec. (For TV Ch. See  
 Prod. Chge. Bul. 41—  
 Set 174-1 and Model  
 22M-1—Set 154-12, For  
 Radio Ch. See Model  
 178B—Set 192-9)

71M (Ch. 1-441) Tel. Rec.  
 (See Model 7110XB)

71M-1 (Ch. 1-502-1) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 42—Set  
 176-1) ..... 163-12

728 (Ch. 1-366) Tel. Rec.  
 (See Prod. Chge. Bul.  
 55—Set 189-1 and Model  
 7110X—Set 124-10)

728-1 (Ch. 1-502-1) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 42—Set  
 176-1) ..... 163-12

728-11 (Ch. 1-502-3) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 42—Set 176-1 and  
 Model 71M-1—Set  
 163-12)

72M (Ch. 1-366) Tel. Rec.  
 (See Prod. Chge. Bul.  
 55—Set 189-1 and Model  
 7110X—Set 124-10)

72M-1 (Ch. 1-502-1) Tel.  
 Rec. (Also see Prod.  
 Chge. Bul. 42—Set  
 176-1) ..... 163-12

72M-2 (Ch. 1-437-3) Tel.  
 Rec. (See Model 738-5)

72M-11 (Ch. 1-502-3) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 42—Set 176-1 and  
 Model 71M-1—Set  
 163-12)

738 (Ch. 1-366) Tel. Rec.  
 (See Prod. Chge. Bul.  
 55—Set 189-1 and Model  
 7110X—Set 124-10)

738-5 (Ch. 1-437-3) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 41—Set 174-1 and  
 Model 7140MA—  
 Set 131-15)

738-11 (Ch. 1-502-3) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 42—Set 176-1 and  
 Model 71M-1—Set 163-12)

73M (Ch. 1-366) Tel. Rec.  
 (See Prod. Chge. Bul.  
 55—Set 189-1 and Model  
 7110X—Set 124-10)

73M-1, 73M-2 (Ch.  
 1-502-2) Tel. Rec.  
 (Also see Prod. Chge.  
 Bul. 42—Set 176-1) ..... 163-12

73M-3, -5, -6 (Ch. 1-437-3)  
 Tel. Rec. (See Prod.  
 Chge. Bul. 41—Set  
 174-1 and Model 7140MA  
 —Set 131-15)

73M-11 (Ch. 1-502-3)  
 Tel. Rec. (See Prod.  
 Chge. Bul. 42—Set 176-1  
 and Model 71M-1—Set  
 163-12)

748 (Ch. 1-356) Tel. Rec.  
 (See Prod. Chge. Bul.  
 55—Set 189-1 and Model  
 6140M—Set 120-10)

748-1 (Ch. 1-437-1) Tel.  
 Rec. (See Prod. Chge. Bul.  
 41—Set 174-1 and Model  
 7140MA—Set 131-15)

748-2 (Ch. 1-437-2) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 41—Set 174-1 and  
 Model 7140MA—Set  
 131-15)

74M (Ch. 1-356) Tel. Rec.  
 (See Prod. Chge. Bul.  
 55—Set 189-1 and Model  
 6140M—Set 120-10)

74M-1 (Ch. 1-437-1) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 41—Set 174-1 and  
 Model 7140MA—Set  
 131-15)

74M-3 (Ch. 1-437-2) Tel.  
 Rec. (See Model 74M-2)

758, M, M-1 (Ch. 1-437-1  
 and Radio Ch. 1-603-1)  
 Tel. Rec. (For TV Ch. See  
 Model 5150M—Set  
 131, For Radio Ch. See  
 Model 178B—Set 192-9)

1058 (Ch. 1-504-1)  
 Tel. Rec. .... 212-8

1058BU (Ch. 1-504-2, -4)  
 Tel. Rec. .... 212-8

105M (Ch. 1-504-1)  
 Tel. Rec. .... 212-8

102MU (Ch. 1-504-2, -4)  
 Tel. Rec. .... 212-8

120B (Ch. 1-510-1)  
 Tel. Rec. .... 212-8

120BU (Ch. 1-510-2, -4)  
 Tel. Rec. .... 212-8

120M (Ch. 1-510-1)  
 Tel. Rec. .... 212-8

120MU (Ch. 1-510-2, -4)  
 Tel. Rec. .... 212-8

1268 (Ch. 1-510-1)  
 Tel. Rec. .... 212-8

1268BU (Ch. 1-510-2, -4)  
 Tel. Rec. .... 212-8

126L (Ch. 1-510-1)  
 Tel. Rec. .... 212-8

126LU (Ch. 1-510-2, -4)  
 Tel. Rec. .... 212-8

**SYLVANIA-Cont.**

126MU (Ch. 1-510-2, -4)  
 Tel. Rec. .... 212-8

150A, L (Ch. 1-437-3)  
 (Codes CO6 and up)  
 Tel. Rec. .... 187-11

155A, L, M (Ch. 1-437-3)  
 (Codes CO6 and up) ..... 187-11

172K (Ch. 1-508-1, -3)  
 (Also See Prod. Chge.  
 Bul. 70—Set 210-1) ..... 192-9

172KU (Ch. 1-508-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

172M (Ch. 1-508-1, -3)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

172MU (Ch. 1-208-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

175B (Ch. 1-508-1, -3)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

175BU (Ch. 1-508-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

175M (Ch. 1-508-1, -3)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

176M (Ch. 1-508-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

176MU (Ch. 1-508-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

176L, M (Ch. 1-508-1, -3)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

176MU (Ch. 1-508-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

177B (Ch. 1-508-1, -3)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

177M (Ch. 1-508-1, -3)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

177MU (Ch. 1-508-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

178B (Ch. 1-508-1, -3 and  
 Radio Ch. 1-603-1)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

178BU (Ch. 1-508-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

178M (Ch. 1-508-1, -3  
 and Radio Ch. 1-603-1)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

178MU (Ch. 1-508-2)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 70—Set  
 210-1) ..... 192-9

200M (Ch. 1-504-1)  
 Tel. Rec. .... 212-8

200MU (Ch. 1-504-2, -4)  
 Tel. Rec. .... 212-8

205 Series (Ch. 1-504-1,  
 -2, -4) Tel. Rec. .... 212-8

220 Series (Ch. 1-510-1,  
 -2, -4) Tel. Rec. .... 212-8

225M (Ch. 1-510-1)  
 Tel. Rec. .... 212-8

225MU (Ch. 1-510-2, -4)  
 Tel. Rec. .... 212-8

226 Series (Ch. 1-510-1,  
 -2, -4) Tel. Rec. .... 212-8

250 Series (Ch. 1-504-1,  
 -2, -4) Tel. Rec. .... 212-8

270 Series (Ch. 1-510-1,  
 -2, -4) Tel. Rec. (See  
 Model 120B) ..... 212-8

430L (Ch. 1-254) ..... 165-15

510B, 510H, 510W ..... 103-16

511B, H, M, 5128R, CH,  
 GR, RE, YE  
 (Ch. 1-601-1) ..... 160-12

540B, BA, 540H, HA,  
 540M, MA ..... 119-11

541B, H, M, 5428R, CH,  
 GR, RE, YE  
 (Ch. 1-602-1) ..... 159-13

1110X (Ch. 1-329) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 47—Set 181-1 and  
 Model 1210X—Set 128-16)

**SYLVANIA-Cont.**

2130B, M, W (Ch. 1-462)  
 Tel. Rec. (See Prod.  
 Chge. Bul. 55—Set  
 189-1 and Model 5130B—  
 Set 120-10)

2140B, M (Ch. 1-462) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 55—Set 189-1 and  
 Model 5140B—Set 120-10)

2221M (Ch. 1-387)  
 Tel. Rec. .... 137-13

4120M (Ch. 1-260) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 55—Set  
 189-1) ..... 124-10

4130B, E, M, W (Ch.  
 1-260) Tel. Rec. (Also  
 See Prod. Chge. Bul.  
 55—Set 189-1) ..... 124-10

5130B, M, W (Ch. 1-290)  
 Tel. Rec. (Also See  
 Prod. Chge. Bul. 17—  
 Set 128-1) ..... 120-10

5140B, M (Ch. 1-290) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 17—Set  
 128-1) ..... 120-10

5150M (Ch. 1-274)  
 Tel. Rec. .... 131-15

6110X (Ch. 1-261) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 55—Set  
 189-1) ..... 124-10

6120B, M, W (Ch. 1-261)  
 Tel. Rec. (Also See  
 Prod. Chge. Bul. 55—  
 Set 189-1) ..... 124-10

6130B, M, W (Ch. 1-261)  
 Tel. Rec. (Also See  
 Prod. Chge. Bul. 55—  
 Set 189-1) ..... 124-10

6140M, W (Ch. 1-271)  
 Tel. Rec. .... 120-10

7110X (Ch. 1-366) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 55—Set  
 189-1) ..... 124-10

7110XB (Ch. 1-441) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 55—Set 189-1 and  
 Model 7110X—Set  
 124-10)

7110XF (Ch. 1-376-66) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 55—Set  
 189-1) ..... 124-10

7110XFA (Ch. 1-441) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 55—Set 189-1 and  
 Model 7110X—Set  
 124-10)

7111MA (Ch. 1-366) Tel.  
 Rec. (See Prod. Chge.  
 Bul. 55—Set 189-1 and  
 Model 7110X—Set  
 124-10)

7120B (Ch. 1-366) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 55—Set  
 189-1) ..... 124-10

7120BF (Ch. 1-366-66) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 55—Set  
 189-1) ..... 124-10

7120M (Ch. 1-366) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 55—Set  
 189-1) ..... 124-10

7120MF (Ch. 1-366-66)  
 Tel. Rec. (Also See Prod.  
 Chge. Bul. 55—Set  
 189-1) ..... 124-10

7120MFA (Ch. 1-442)  
 Tel. Rec. .... 131-15

7120W (Ch. 1-366) Tel.  
 Rec. (Also See Prod.  
 Chge. Bul. 55—

**TELE-KING—Cont.**

T-516 Tel. Rec. (See Model 114—Set 141-13)  
 16DC3CR Tel. Rec. (For TV Ch. Only See Model 162—Set 129-12)  
 114 Tel. Rec. .... 141—13  
 116, 116C Tel. Rec. .... 141—13  
 117, 117C, 117LO Tel. Rec. .... 141—13  
 117CA, CAF Tel. Rec. (For TV Ch. Only See Model 117—Set 141-13)  
 162 Tel. Rec. .... 129—12  
 172 (Ch. TVG) Tel. Rec. (See Model 201—Set 131-16)  
 174 (Ch. TVG) Tel. Rec. (See Model 201—Set 131-16)  
 201, 202 Tel. Rec. .... 131—16  
 203 (Ch. TVG) Tel. Rec. (See Model 201—Set 131-16)  
 210 Tel. Rec. .... \*  
 310 Tel. Rec. .... \*  
 410 Tel. Rec. .... 88—12  
 416 Tel. Rec. (See Model 162—Set 129-12)  
 510 Tel. Rec. (See Model 410—Set 88-12)  
 512 Tel. Rec. .... 88—12  
 516 Tel. Rec. (See Model 114—Set 141-13)  
 612 Tel. Rec. .... 88—12  
 710 Tel. Rec. .... 88—12  
 712 Tel. Rec. (See Model 410—Set 88-12)  
 716 Tel. Rec. .... 129—12  
 816-3CR Tel. Rec. (For TV Ch. Only See Model 162—Set 129-12)  
 916CAF Tel. Rec. (For TV Ch. Only See Model 162—Set 129-12)  
 919C Tel. Rec. .... 141—13  
 919CAF Tel. Rec. (For TV Ch. Only See Model 114—Set 141-13)  
 920 (Ch. TVG) Tel. Rec. (See Model 201—Set 131-16)  
 1014 (Ch. TVG) Tel. Rec. (See Model 201—Set 131-16)  
 1016 (Ch. TVG) Tel. Rec. (See Model 201—Set 131-16)  
 Ch. RD-1 (See Model RK41)  
 Ch. TVG Tel. Rec. (See Model 201)  
 Ch. TVJ (See Model K21)  
**TELEQUIP**  
 5135, 5136, 5140A .... 11—24  
**TELESONIC (Medco)**  
 1635 .... 20—22  
 1636 .... 21—33  
 1642 .... 20—23  
 1643 .... 21—34  
**TELE-TONE**  
 TV149 Tel. Rec. .... 56—22  
 TV-170 Tel. Rec. .... 83—12  
 TV-208 Tel. Rec. .... 90—11  
 TV208TR Tel. Rec. .... 95—6  
 TV-209 Tel. Rec. (See Prod. Chge. Bul. 21—Set 136-1and Model TV-249—Set 57-21)  
 TV-210 Tel. Rec. (See Prod. Chge. Bul. 21—Set 136-1and Model TV-249—Set 57-21)  
 TV-220 Tel. Rec. .... 95—6  
 TV-245, 246 Tel. Rec. .... \*  
 TV-249 Tel. Rec. (See Prod. Chge. Bul. 21—Set 136-1)  
 TV-250 Tel. Rec. .... 91—13  
 TV-254 Tel. Rec. .... 91—13  
 TV-255, TV-256 (Ch. TS) Tel. Rec. .... 101—13  
 TV-259 Tel. Rec. (See Model TV-249—Set 57-21)  
 TV-282 Tel. Rec. .... 71—14  
 TV-283 (See Model TV-285—Set 87-13)  
 TV-284 Tel. Rec. .... 93—10  
 TV-285 Tel. Rec. .... 87—13  
 TV-286, 287, 288 Tel. Rec. .... 93—10  
 TV-300, TV-301 (Ch. TAA, TAB) Tel. Rec. .... 99A—12  
 TV-300, TV-301 (Ch. TV) Tel. Rec. .... 107—10  
 TV-304, TV-305 (Ch. TAA, TAB) Tel. Rec. .... 99A—12  
 TV-304, TV-305 (Ch. TV) Tel. Rec. .... 107—10  
 TV-306, TV-307 (Ch. TV, TZ) Tel. Rec. .... 104—12  
 TV-308 (Ch. TAC) Tel. Rec. .... 109—14  
 TV-314 (Ch. TAJ) Tel. Rec. .... 125—12  
 TV-315 (Ch. TAA, TAB) Tel. Rec. .... 115—13  
 TV-316 (Ch. TAH) Tel. Rec. .... 135—13  
 TV-317 Tel. Rec. .... \*  
 TV-318 (Ch. TAM) Tel. Rec. .... 124—11  
 TV-322, TV-323 (Ch. TAM) Tel. Rec. .... 124—11  
 TV-324, TV-325, TV-326 (Ch. TAP, TAP-1, TAP-2) Tel. Rec. .... 127—12  
 TV-328, TV-329 (Ch. TAP-1, TAP-2) Tel. Rec. .... 127—12

**TELE-TONE—Cont.**

TV-330, TV-331, TV-332, TV-333 (Ch. TAO) Tel. Rec. .... 145—11  
 TV-335, TV-336 (Ch. TAP, TAP-1, ATP-2) Tel. Rec. .... 127—12  
 TV-340 (Ch. TAP, TAP-1, TAP-2) Tel. Rec. .... 127—12  
 TV-345 (Ch. TAP, TAP-1, TAP-2) Tel. Rec. .... 127—12  
 TV-348, TV-349 (Ch. TAP-2) Tel. Rec. (See Model TV-324—Set 127-12)  
 TV-352 Tel. Rec. (See Model TV-324—Set 127-12)  
 TV-355 (Ch. 8001, 8002, 8003) Tel. Rec. .... 145—11  
 TV-355-U (Ch. 8010, 8016) Tel. Rec. .... \*  
 TV-357 (Ch. 8001, 8002, 8003) Tel. Rec. .... 145—11  
 TV-357-U (Ch. 8010, 8016) Tel. Rec. .... \*  
 TV-358, TV-359 (See Model TV-324—Set 127-12)  
 TV-360, TV-365 (Ch. 8001, 8002, 8003) Tel. Rec. .... 145—11  
 TV-365-U (Ch. 8010, 8016) Tel. Rec. .... \*  
 TV-374 (Ch. 8001, 8002, 8003) Tel. Rec. (See Prod. Chge. Bul. 35—Set 164-1and Model TV-357—Set 45-11)  
 TV-374-U (Ch. 8010, 8016) Tel. Rec. .... \*  
 TV-379-U (Ch. 8010, 8016) Tel. Rec. .... \*  
 TV-384-U (Ch. 8010, 8016) Tel. Rec. .... 11—25  
 TV-385, TV-386-U (Ch. 8013, 8015) Tel. Rec. .... \*  
 100, 100-A, 101, 109 (Ch. Series A) .... 39—26  
 109 (Ch. Series) .... 8—30  
 110 (See Model 117-A—Set 1-35) .... 39—26  
 111, 113 .... 39—26  
 117-A (Ch. Series "D") .... 1—35  
 119, 120 (See Model 117-A—Set 1-35) .... 39—26  
 122, 123 .... 39—26  
 124 (See Model 117-A—Set 1-35) .... 39—26  
 125 (See Model 117-A—Set 1-35) .... 39—26  
 126 (See Model 117-A—Set 1-35) .... 39—26  
 127, 130, 131 .... 39—26  
 132 (See Model 117-A—Set 1-35) .... 11—25  
 133 .... 11—25  
 134 .... 14—29  
 135 .... 14—29  
 138 (Ch. Series N) .... 23—27  
 139, 140, 141 (Ch. Series "H") (See Model 135—Set 14-29) .... 142, 143, 144 (See Model 14—Set 23-28) .... 23—28  
 145 (Ch. Series "R") .... 24—26  
 148 (Ch. Series "S") .... 24—26  
 149 (Ch. Series "H") (See Model 135—Set 14-29) .... 38—25  
 150 (Ch. Series "T") .... 38—25  
 151 (Ch. Series "S") (See Model 148—Set 24-26) .... 38—26  
 152 (Ch. Series "R") (See Model 145—Set 23-28) .... 35—23  
 156 (Ch. Series "H") (See Model 135—Set 14-29) .... 49—24  
 157 (Ch. Series AE) .... 59—20  
 158 (Ch. Series AT) .... 38—26  
 159 (Ch. Series AX) .... 36—24  
 160 (Ch. Series Y) .... 38—25  
 161, 162 (Ch. Series T) .... 50—20  
 163, 164 (Ch. Series "H") (See Model 135—Set 14-29) .... 49—24  
 165 (Ch. Series AG) .... 38—25  
 166 (Ch. AE) .... 51—22  
 167, 168, 171 (Ch. Series T) .... 38—25  
 172 (Ch. Series U) .... 38—25  
 174 (Ch. Series T) .... 38—25  
 176 (Ch. Series U) .... 51—22  
 182 .... 53—24  
 183 .... 52—21  
 185 (Ch. Series AH) .... 61—19  
 195 (Ch. Series BH) .... 71—15  
 198 .... 59—20  
 200 (Ch. Series "AZ") (See Model 190—Set 61-19) .... 74—9  
 201—(Ch. Series AX) .... 73—12  
 205 (Ch. Series BD) .... 127—11  
 206 (Ch. Series "AZ") (See Model 190—Set 61-19) .... 73—12  
 215 (See Model 205) .... 228 (Ch. BL) .... 144—13  
 232 (Ch. Series "BP") (See Model 205—Set 73-12) .... 141—14  
 235 (Ch. BQ) .... 30—30  
 Ch. Series A .... 57—22  
 Ch. Series AA .... 9—33  
 (See Model 159) .... 20—34  
 Ch. Series AE (See Model 157) .... 76—18  
 Ch. Series AG (See Model 165) .... 44—24  
 Ch. Series AH (See Model 185) .... 43—19  
 Ch. Series AT (See Model 158) .... 43—19  
 Ch. Series AX (See Model 201) .... 66—16  
 Ch. Series AZ (See Model 190) .... 66—16  
 Ch. Series BD (See Model 205) .... 66—16

**TELE-TONE—Cont.**

Ch. Series BH (See Model 195) .... 66—16  
 Ch. BL (See Model 228) .... 66—16  
 Ch. BQ (See Model 235) .... 66—16  
 Ch. Series CA (See Model 134) .... 66—16  
 Ch. Series D (See Model 117A) .... 66—16  
 Ch. Series H (See Model 135) .... 66—16  
 Ch. Series J (See Model 109) .... 66—16  
 Ch. Series N (See Model 138) .... 66—16  
 Ch. Series R (See Model 148) .... 66—16  
 Ch. Series S (See Model 145) .... 66—16  
 Ch. Series T (See Model 150) .... 66—16  
 Ch. TAA, TAB (See Model TV-315) .... 66—16  
 Ch. TAC (See Model TV-308) .... 66—16  
 Ch. TAJ (See Model TV-314) .... 66—16  
 Ch. TAJ (See Model TV-318) .... 66—16  
 Ch. TAC (See Model TV-330) .... 66—16  
 Ch. TAP, TAP-1, TAP-2 (See Model TV-324) .... 66—16  
 Ch. TS (See Model TV-255) .... 66—16  
 Ch. TW, TX (See Model TV-300) .... 66—16  
 Ch. TZ (See Model TV-306) .... 66—16  
 Ch. Series U (See Model 156) .... 66—16  
 Ch. Series Y (See Model 160) .... 66—16  
 Ch. 8001, 8002, 8003 (See Model TV-355) .... 66—16  
 Ch. 8010 (See Model TV-355-U) .... 66—16  
 Ch. 8013 (See Model TV-385-U) .... 66—16  
 Ch. 8015 (See Model TV-385-U) .... 66—16  
 Ch. 8016 (See Model TV-355-U) .... 66—16  
**TELEVOGUE (See Muntz)**  
**TELEVOX**  
 RP .... 22—29  
 2718-2W .... 20—32  
 27K-W .... 20—33  
 27-P-T .... 22—28  
**TEL-VAR (See Audar)**  
**TEMPLE**  
 E-301 .... 21—35  
 E-510 .... 2—3  
 E-511 (See Model 11—26) .... 11—26  
 E-512, E-514 (See Model E-510—Set 2-3) .... 2—3  
 E-519 .... 12—26  
 F-611 .... 9—32  
 F-616 .... 5—38  
 F-617 .... 12—27  
 G-410 .... 43—18  
 G-415 .... 17—34  
 G-418, G-419 .... 26—25  
 G-513 .... 23—29  
 G-515 .... 17—34  
 G-516 .... 18—31  
 G-518 .... 29—27  
 G-521 .... 28—33  
 G-522 .... 26—26  
 G-619 .... 22—30  
 G-622 .... 44—24  
 G-721 (See Model G-722—Set 24-27) .... 24—27  
 G-722 (See Model G-722—Set 24-27) .... 38—27  
 G-725 .... 34—23  
 G-1430 .... 43—19  
 G-4108 (See Model G-418—Set 26-25) .... 47—22  
 G-7205 (See Model G-722—Set 24-27) .... 47—22  
 H-411 (See Model H-521—Set 28-33) .... 44—24  
 H-521 (See Model H-622—Set 34-23) .... 44—24  
 H-727 (See Model G-725—Set 34-23) .... 44—24  
 TV-1776, TV-1777, TV-1778, TV-1779 Tel. Rec. .... 66—16  
**TEMPOTONE**  
 500 E Series .... 2—8  
**TEMPLETONE (See Temple)**  
**THORADSON**  
 T-30W08A .... 8—31  
 T-31W10A .... 30—30  
 T-31W10-AX .... 57—22  
 T-31W25A .... 9—33  
 T-31W50A .... 20—34  
 T-32W00, T-32W10 .... 76—18  
**THORENS (See Record Changer Listing)**  
**TRAD**  
 C-2020, C-2420, CD2020 Tel. Rec. .... 173—14  
 T-20-A Tel. Rec. .... 133—14  
 T-20-E Tel. Rec. .... 165—17A  
 T-1720 Tel. Rec. .... 173—14  
 T-1853, A, Tel. Rec. .... 200—10

**TRANSVISION**

Ch. Model A Tel. Rec. .... 107—11  
 Ch. A-3 Tel. Rec. .... 130—15  
 Ch. A-4 Tel. Rec. .... 192—10  
 WRS-5 Tel. Rec. .... 112—10  
**TRANSVUE**  
 17XC, 17XT Tel. Rec. .... 132—8  
 (Similar to Chassis) .... 132—8  
 20XC, 20XT Tel. Rec. .... 132—8  
 (Similar to Chassis) .... 132—8  
 160-L (Ch. 12AX21) Tel. Rec. .... \*  
 601 (Ch. 16AX23, 25, 26) Tel. Rec. .... 99—14  
 (Similar to Chassis) .... 99—14  
 710 (Ch. 16AX23, 25, 26) Tel. Rec. .... 99—14  
 (Similar to Chassis) .... 99—14  
 1400T Tel. Rec. .... 132—8  
 (Similar to Chassis) .... 132—8  
 1700C, T Tel. Rec. .... 132—8  
 (Similar to Chassis) .... 132—8  
 2000C Tel. Rec. .... 132—8  
 (Similar to Chassis) .... 132—8  
 12AX21 Tel. Rec. .... \*  
**TRAX-LER (Also see Record Changer Listing)**  
 10T Tel. Rec. .... 86—11  
 12L50, A Tel. Rec. .... 108—13  
 12T Tel. Rec. .... 86—11  
 14B50, A, 14C50, A Tel. Rec. .... 108—13  
 16G50A Tel. Rec. .... 108—13  
 16R50A, 16T50A Tel. Rec. .... 108—13  
 16T Tel. Rec. (Also see Prod. Chge. Bul. 31 Set 156-3) .... 86—11  
 20A50 Tel. Rec. .... 146—11  
 62R50, 63R50 Tel. Rec. .... 150—13  
 64R50, 64R50-1, 64R50-2 Tel. Rec. .... 146—11  
 65G50, -1, -2 Tel. Rec. .... 146—11  
 (See Model 20A50—Set 146-11) .... 146—11  
 75A50, 75A50-1, 75A50-2 Tel. Rec. .... 146—11  
 114-1A, -2 (Ch. 32A1) Tel. Rec. .... 150—13  
 117-3, -4, -6 (Ch. 32A1) Tel. Rec. .... 150—13  
 119-5 (Ch. 32A1) Tel. Rec. .... 150—13  
 217, -10, -11, -12, -14 (Ch. 32A2) Tel. Rec. .... 171—11  
 217-15, 217-16 (Ch. 34A2) Tel. Rec. .... 170—14  
 217-25 (Ch. 34A2) Tel. Rec. (See Model 217-15—Set 170-14) .... 170—14  
 219-8A, 219-8B (Ch. 11A2) Tel. Rec. .... 162—14  
 220-9, -9A, -9B (Ch. 33A2) Tel. Rec. .... 171—11  
 220-22, 23, 24, 27 (Ch. 34A2) Tel. Rec. (See Model 217-15—Set 170-14) .... 171—11  
 5000 (See Model 5000I—Set 11-27) .... 11—27  
 5000I .... 12—28  
 5002 Series (Ch. 109) .... 1—36  
 5007, 5008, 5009 (Ch. 104) .... 2—5  
 5010, 5011, 5012 (Ch. 105) .... 2—5  
 5015 .... 36—25  
 5019 .... 23—30  
 5020 (Ch. 800) .... 11—28  
 5021 .... 49—20  
 5022 .... 101—14  
 5027 .... 31—30  
 5028 .... 34—24  
 5029 .... 33—29  
 5030, 5031 .... 32—25  
 5036 .... 54—19  
 5049 (See Model D1645—Set 6-33) .... 32—26  
 5054 .... 36—26  
 5056-A .... 90—12  
 5060, 5061 .... 116—11  
 5066 .... 42—24  
 5170 .... 163—13  
 5021 .... 60—23  
 56—23  
 7000, 7001 .... 59—21  
 7003 (Ch. 501) .... 12—29  
 7014 .... 59—21  
 7016, 7017 (See Model 7023) .... 83—13  
 7036 .... 112—11  
 Ch. 11A2 (See Model 219-8A) .... 68—18  
 Ch. 32A1 (See Model 62R50) .... 70—11  
 Ch. 33A2 (See Model 217-15) .... 69—13  
 Ch. 34A2 (See Model 217-15) .... 69—13  
 Ch. 104 (See Model 5007) .... 18—32  
 Ch. 105 (See Model 5010) .... 19—23  
 Ch. 109 (See Model 5002) .... 24—29  
 Ch. 501 (See Model 7003) .... 32—28  
 Ch. 800 (See Model 5021) .... 51—24  
**TRELA**  
 HW301 .... 14—28  
**TRUETONE**  
 D1034A, B, C (See Model D1046A—Set 102-15) .... 102—15  
 D1046, C, D (See Model D1046A—Set 102-15) .... \*  
 D1090 Tel. Rec. .... \*  
 D1092 Tel. Rec. .... \*  
 (Similar to Chassis) .... 108—7  
 D1234A, B .... 189—15  
 D1240A .... 187—12

**TRUETONE—Cont.**

D1612 .... 28—34  
 D1644 .... 12—30  
 D1645 (Factory Model 26A76-650) .... 6—33  
 D1747, D1748 .... 32—27  
 D1752 (Factory 7901-14) .... 34—25  
 D1835 (Factory Model 25A80-856) .... 44—25  
 D1836, D1836A (Factory Model 26A85-856) .... 45—25  
 D1840 (Fact. No. 138PCXM) .... 46—24  
 D1845 .... 31—31  
 D1846A, B, C .... 40—23  
 D1850 (Series A) .... 51—23  
 D1949 .... 60—20  
 D1950, D1951 (See Model D1850—Set 51-23)  
 D1952 (See Model D1949—Set 60-20)  
 D1990 (Factory No. 7AF22) Tel. Rec. .... 69—13  
 D1991, B Tel. Rec. .... 77—11  
 D1992 (Factory No. 7AF22) Tel. Rec. .... 69—13  
 D1993, B Tel. Rec. .... 77—11  
 D1994 Tel. Rec. .... 77—11  
 D1996 Tel. Rec. (See Model D2983—Set 68-18) .... \*  
 D2974 Tel. Rec. .... \*  
 D1887A Tel. Rec. .... \*  
 D2017, D2018 .... 101—15  
 D2020 .... 106—15  
 D2025A (Fact. Mod. 26A95-906) .... 83—14  
 D2027A .... 97—18  
 D2050A Tel. Rec. .... 200—11  
 D-2102A, B .... 200—11  
 D-2103A, B, D-2109A .... 199—14  
 D2145 .... 197—13  
 D-2205 .... 201—12  
 D-2214A .... 204—10  
 D2226 .... 196—16  
 D2237 .... 182—25  
 D2255 .... 197—14  
 D2263 .... 190—14  
 D2270 .... 211—16  
 D2325-A .... 205—11  
 D-2383 .... 199—15  
 D2603 (Factory No. 461) .... 13—33  
 D2604 .... 13—34  
 D2605 (Factory Model 2AW2) .... 9—34  
 D2606 .... 65—15  
 D2612 (Code SW-9022) .... 3—9  
 D2613 .... 13—37  
 D2615 (Factory Model 6D110) .... 2—18  
 D2616 (Factory Model 6D117) .... 10—32  
 D2616-B .... 31—32  
 D2619 (Factory No. 2701) .... 27—29  
 D2620 .... 1—28  
 D2621 .... 4—32  
 D2622 .... 14—30  
 D2623 .... 11—29  
 D2624 (Factory 27D14-600) .... 2—6  
 D2626 (Fact. No. 457-2) .... 52—22  
 D2630 (Factory Model 27D14-602 Issue A) .... 1—10  
 D2634 .... 12—31  
 D2640 (Factory No. 459) .... 43—21  
 D2642 .... 11—29  
 D2644 (Factory No. 101C) .... 11—30  
 D2645 .... 4—39  
 D2646 (Factory 4B19) .... 2—23  
 D2663 (Ch. 4C1) .... 11—31  
 D2665 (Factory 4B114 Series A) .... 22—31  
 D2692 .... 19—28  
 D2709 (Factory No. 470) .... 27—30  
 D2710 (Factory No. 24D22-630BR) .... 23—31  
 D2718 (Factory No. 22D714-6381U) .... 23—32  
 D2743 .... 25—29  
 D2745 (See Model D1645—Set 6-33) .... \*  
 D2748 (Ch. 7156) .... 26—27  
 D2806, D2807 (Factory Model 181) .... 44—26  
 D2810 (Factory No. 24D24-730BB) .... 36—27  
 D2815 .... 48—25  
 D2819 (Factory No. 26A82-738) .... 35—24  
 D2851 .... 38—28  
 D2906 (Factory No. 189) .... 69—14  
 D2907 .... 69—14  
 D2910 .... 65—16  
 D2919 (Fact. No. 60F21) .... 59—22  
 D2963 .... 73—13  
 D2982 Tel. Rec. .... \*  
 D2983 Tel. Rec. .... 68—18  
 D2985 Tel. Rec. .... 70—11  
 D2987 Tel. Rec. .... 69—13  
 D2988, D2989 Tel. Rec. .... \*  
 D2990 Tel. Rec. .... \*  
 D-3120A .... 203—12  
 D-3130A, B .... 203—13  
 D3210A .... 190—15  
 D3265A .... 189—16  
 D3615 (Factory 25BD2-606) .... 18—32  
 D3619 (Factory SP110) .... 10—33  
 D3630, D3630N .... 19—23  
 D3720 .... 24—29  
 D3721 (Factory 1108X) .... 32—28  
 D3722 (Fact. No. 472) .... 51—24  
 D3809 (Factory No. 178) .... 43—22  
 D3810 .... 39—27  
 D3811 (Fact. No. 1148XH) .... 47—24  
 D3840 .... 49—26  
 D3910 (Fact. Model 140611) .... 74—10  
 D-4118, B .... 200—12  
 D4142A .... 142—14  
 D4620 (Factory No. 9C12) .... 26—28  
 D4730 (Factory 26C19-411) .... 7—28  
 D4818 (Factory No. 134XD) .... 45—26  
 D4832 (Fact. No. 25C22-82) .... 47—25  
 D4842 (Fact. No. 26C21-81) .... 50—21

**TRUETONE—WESTINGHOUSE**

**TRUETONE—Cont.**

2D1088A Tel. Rec. 105—11  
 2D1088B Tel. Rec. 145-1A  
 2D1089A Tel. Rec. 113—10  
 2D1089B Tel. Rec. 136—14  
 2D1091 Tel. Rec. 161—10  
 2D1093A, 2D1094A 119—12  
 2D1095 Tel. Rec. 134—11  
 2D1095A (Ch. 16AX27) Tel. Rec. \*  
 2D1185A Tel. Rec. (See Model 2D1185B—Set 154-13)  
 2D1185B Tel. Rec. 154—13  
 2D1185C, D Tel. Rec. (See Prod. Chge. Bul. 43—Set 177-1 and Model 2D1185B—Set 154-13)  
 2D1185E Tel. Rec. (See Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 46—Set 180-1 and Model 2D1185B—Set 154-13)  
 2D1190A, B Tel. Rec. 147—12  
 2D1191A (Ch. BRC20AY22 Tel. Rec. \*  
 2D1194A Tel. Rec. 151—11  
 2D1195A (Ch. 16AX216) Tel. Rec. \*  
 2D1224A (Ch. 20AY21) Tel. Rec. \*  
 2D1225A (Ch. 21AY21A) Tel. Rec. \*  
 2D1228A (Ch. 20AY21) Tel. Rec. (See Model 2D-1224A)  
 2D1230B Tel. Rec. (Also See Prod. Chge. Bul. 59—Set 193-1) 185—14  
 2D1235A (Ch. 17MS345) Tel. Rec. 188—13  
 2D1235B, C, D, E Tel. Rec. (See Prod. Chge. Bul. 74—Set 215-1 and Model 2D1235A—Set 188-13)  
 2D1303A Tel. Rec. 207—11  
 2D1315A Tel. Rec. 204—11  
 2D1325A Tel. Rec. 204—11  
 2D1344A, B (Ch. 21MS36C) Tel. Rec. 210—13  
 2D1354A (Ch. 9210P) Tel. Rec. 194—13  
 2D2043A Tel. Rec. 161—10  
 2D2047B Tel. Rec. 161—10  
 2D2049A (Ch. 16AY210) Tel. Rec. \*  
 2D2052 Tel. Rec. 134—11  
 2D2052A, B (Ch. 16AY210) Tel. Rec. \*  
 2D2052C (Ch. 17AY23) Tel. Rec. \*  
 2D2052D, E (Ch. 17AY28) Tel. Rec. \*  
 2D2053 Tel. Rec. 120—11  
 2D2149A (Ch. 17AY212) Tel. Rec. 177—14  
 2D2152A (Ch. 17AY26) Tel. Rec. \*  
 2D2215A (Ch. 21AY21A) Tel. Rec. \*  
 2D2219A Tel. Rec. 179—13  
 2D2223A (Ch. 21AY21A) Tel. Rec. \*  
 2D2312A Tel. Rec. 204—11  
 2D2314A Tel. Rec. 204—11  
 2D2321A Tel. Rec. 204—11  
 2D2322A, B Tel. Rec. \*  
 2D2333A, B Tel. Rec. 203—14

**ULTRADYNE**

L-46 4—21

**UNITED MOTORS SERVICE (See Delco or Buick, Chevrolet, Oldsmobile and Pontiac)**

**U. S. TELEVISION**

Cl6030 Tel. Rec. 99A-12  
 Cl19031 Tel. Rec. 99A-12  
 Cl10823 Tel. Rec. 89—15  
 Tl6030 Tel. Rec. 99A-12  
 Tl9031 Tel. Rec. 99A-12  
 5A16, 5B16, 5C16 (See Model 5C66—Set 17-9)  
 5A66, 5B66, 5C66, 5D66MPA 24—30  
 5C66 Early 17—9  
 8-16M (Dumbarton) 26—29

**UNITONE**

88 5—26

**UNIVERSAL CAMERA (See Record Changer Listing)**

**UTAH (See Record Changer Listing)**

**V-M (Also see Record Changer Listing)**

110 191—19  
 150 139—15  
 150A 213—9  
 160 187—13  
 190 159—15  
 972 203—15  
 975 165—16  
 980 138—12  
 985 166—16  
 10G1-A 10—34

**VAN-CAMP**

576-1-6A 7—29

**VIDEO CORP. OF AMERICA (See Videola)**

**VIEDODYNE**

10FM, 10TV, 12FM, 12TV Tel. Rec. 69—15

**VIDEOLA**

V5-160, V5-161 Tel. Rec. 92—9  
 V5-165, V5-166, V5-167, V5-168 Tel. Rec. 92—9  
**VIDEO PRODUCTS**  
 530-DX Series Tel. Rec. 213—10  
 630-DXC Tel. Rec. 176—13  
 630-DX24C Tel. Rec. 176—13  
 630-K3C Tel. Rec. 176—13  
 630-K24C Tel. Rec. 176—13

**VIEWTONE**

RC-201A, RRC-201 11—32

**VISION MASTER**

14MC, MT Tel. Rec. (Similar to Chassis) 117—8  
 16MC, 16MT, 16MXC, 16MXCS, 16MXT, 16MXTS Tel. Rec. (Similar to Chassis) 117—8  
 17MC, 17MT, 17MXC, 17MXCS, 17MXT, 17MXTS Tel. Rec. (Similar to Chassis) 117—8

**VIZ**

RS-1 14—31

**VOGUE**

532 A-P 11—33  
 Ch. Models 533R, 554R 8—32

**WARWICK (See Clorion)**

**WATERSON**

ARC-459A 16—36  
 PA-4585, APA-4587 3—2  
 RC-4581 16—35  
 4581 3—32  
 4582 6—34  
 4782 24—31  
 4790 16—34  
 4800 43—23

**WAVEFORMS**

A-20 191—20  
 C-5 191—20

**WEBCOR (See Webster-Chicago)**

**WEBSTER-CHICAGO (Also see Changer and Recorder Listings)**

B-123-1 204—12  
 B-124-1 203—16  
 B-134-1 205—12  
 B-135-1 210—14  
 B-136-1 207—12  
 F-123-1 204—12  
 F-134-1 205—12  
 F-136-1 207—12  
 T-136-1 207—12  
 66-1A 34—26  
 100-608 121—14  
 100-621 113—11  
 129-1, 129-2 215—13  
 130-1 119—13  
 166 159—16  
 288 117—14  
 362 105—12  
 760 112—12  
 762 105—12

**WEBSTER ELECTRIC (Also see Recorder Listing)**

81-15, 81-15A 142—15  
 82-25, 82-25A, 83-25, 143—15  
 84-25 145—12  
 85-25 144—14

**WEBSTER (Telehome)**

W606M 56—24  
 604M 57—23

**WELLS-GARDNER**

317G534C-218 Tel. Rec. 195—12  
 317G534C-220 Tel. Rec. 195—12  
 317G534C-278 Tel. Rec. 195—12  
 321MS31C-222, -224 194—14  
 321MS31C-272, -274, -276 Tel. Rec. 194—14  
 321MS31C-280, -282, -284 Tel. Rec. 194—14  
 321MS31C-296 Tel. Rec. 194—14

**WESTERN AUTO (See Truetime)**

**WESTINGHOUSE (Also see Record Changer Listing)**

H-104, H-105 4—11  
 H-105A, H-105A, H-107A, H-108A (See Set 21-36 and Model H-104—Set 4-11)  
 H-107, H-108, H-110, H-111 4—19  
 H-113, H-114, H-116 (See Model H-117—Set 1-34)  
 H-117, H-119 11—34  
 H-122 6—35  
 H-122A, B (See Model H-122—Set 6-35)  
 H-125, H-126 3—19  
 H-130 6—35  
 H-133 14—34  
 H-137 (See Model H-138—Set 6-36)  
 H-138 6—36  
 H-147 31—33  
 H-148 15—37  
 H-148A (See Model H-148—Set 15-37)  
 H-153, H-153A (Ch. V-2103) 35—25  
 H-154 (See Set 21-36 and Model H-104—Set 4-11)  
 H-155 (See Model H-153—Set 35-25)  
 H-157 (Ch. V-2122) 33—31  
 H-161 (Ch. V-2118) 34—27

**WESTINGHOUSE—Cont.**

H-162 (See Model H-117—Set 11-34)  
 H-164 (Ch. V-2119-1) 36—28  
 H-165 32—29  
 H-166, H-167 (See Model H-164) 36—28  
 H-168, H-168A, H-168B (Ch. V-2118) (See Model H-161) 34—27  
 H-168B (Ch. V-2118) (See Model H-168—Set 34-27)  
 H-169 (Ch. V-2124-1) 37—24  
 H-171 (Ch. V-2103) 35—25  
 H-171A, C (Ch. V-2103) (See Model H-153—Set 35-25)  
 H-178 (Ch. V-2123) 35—26  
 H-181 Tel. Rec. \*  
 H-182 (Ch. V-2128), (Ch. V-2128-1) 53—25  
 H-183, H-183A 48—26  
 H-184 (See Model H-153—Set 35-25)  
 H-185 (Ch. V-2131, V-2131-1) 54—20  
 H-186M, H-187 (Ch. V-2132) 60—21  
 H-188 (Ch. V-2133) 51—25  
 H-190, H-191, H-191A (Ch. V-2134) 59—23  
 H-195 54—20  
 H-196 Tel. Rec. 65—17  
 H-196A (Ch. V-2130-1) Tel. Rec. (See Model H-196—Set 65-17)  
 H-196A (DX) (Ch. V-2130-1DX) or (Ch. V-2130-1DX) Tel. Rec. 84—13  
 H-198 (Ch. V-2137-2) 73—15  
 H-199 (Ch. V-2137-1) 69—16  
 H-201 (Ch. V-2137-2) 50—22  
 H-203 (Ch. V-2137) 62—21  
 H-204 50—22  
 H-207A (Ch. V-2130-1, V-2137) Tel. Rec. 65—17  
 H207A (DX) (Ch. V-2130-1DX) or (Ch. V-2130-1DX and Radio Ch. V-2137) Tel. Rec. 84—13  
 H207B (DX) (Ch. V-2130-1DX) or (Ch. V-2130-2DX and Radio Ch. V-2137) Tel. Rec. 84—13  
 H-210, H-211 (Ch. V-2144, V-2144-1) 61—20  
 H-212 (Ch. V-2137) 62—21  
 H-214, H-214A (Ch. V-2103-3) 75—16  
 H-216, H-216A (Ch. V-2146-05, V-2146-45, V-2149-1) Tel. Rec. 97A-14  
 H-217 (Ch. V-2146-11DX, V-2137, V-2149) Tel. Rec. (See Set 99A-14 and Model H-217B—Set 91-14)  
 H-217B (Ch. V-2146-3DX, V-2137, V-2149) Tel. Rec. 91—14  
 H-223 (Ch. V-2150-01, V-2150-02) Tel. Rec. 78—14  
 H-225 (DX) (Ch. V-2130-3DX) or (Ch. V-2130-3DX) Tel. Rec. 84—17  
 H-226 (Ch. V-2146-21DX, -25DX, V-2149) Tel. Rec. (See Model H-217B—Set 91-14)  
 H-231 (Ch. V-2150-51, V-2137-3, V-2149-2) Tel. Rec. 99A-14  
 H-242 (Ch. V-2150-31) Tel. Rec. 97A-14  
 H-251 (Ch. V-2150-81, -84) Tel. Rec. (See 99A-14 and Model H-609T10—Set 95-7)  
 H-300T5, H-300T5 (Ch. V-2148) 88—14  
 H-302P5 (Ch. V-2151-1) 91—15  
 H-302P4 (Ch. V-2153) 89—16  
 H-307T7, H-308T7 (Ch. V-2136) 100—13  
 H-309P5, H-309P5U (Ch. V-2156) 101—16  
 H-310T5, H-310T5U, H-311T5, H-311T5U (Ch. V-2161) 99—18  
 H-312P4, H-312P4U, H-313P4, H-313P4U, H-314P4, H-314P4U, H-315P4, H-315P4U (Ch. V-2153-1) 98—13  
 H-316C7 (Ch. V-2136-1) 112—13  
 H-317C7 (Ch. V-2136-1) (See Model H-316C7—Set 112-13)  
 H-318T5, U (Ch. V-2157) 117—15  
 H-320T5, U (Ch. V-2157) 117—15  
 H-321T5, U, H-322T5, U (Ch. V-2157-1, U) 117—15  
 H-323T5, U (Ch. V-2157-2, U) 117—15  
 H-324T7, H-325T7, U (Ch. V-2136-2) 113—13  
 H-326C7 (See Model H-316C7—Set 112-13)  
 H-327T6U (Ch. V-2157-3U) 126—14  
 H-328C7, U (Ch. V-2136-4) 137—15  
 H-331P4, U (Ch. V-2164, U) (Also see Prod. Chge. Bul. 52—Set 187-1) 171—12  
 H-332P4 (See Model H-331P4U—Set 171-12)

**WESTINGHOUSE—Cont.**

H-333P4, U (Ch. V-2164, U) (Also see Prod. Chge. Bul. 52—Set 187-1) 171—12  
 H-334T7U, H-335T7U (Ch. V-2136-5U) 142—16  
 H-334T7UR (Ch. V-2136-5R) 149—14  
 H-336T5U, H-337T5U (Ch. V-2157U) 134—12  
 H-341T5U, H-342T5U (Ch. V-2157-4U) 140—13  
 H-343T5U, H-344T5U (Ch. V-2157-4U) 140—13  
 H-342P25U, H-32P25U (Ch. V-2156-1U) 138—13  
 H-345T5, H-346T5 (Ch. V-2157-4U) (See Model H-338T5U—Set 140-13)  
 H-348P5, H-349P5 (Ch. V-2156-1U) (See Model H-342P25U—Set 138-13)  
 H-350T7, H-351T7 (Ch. V-2180-1) (Also see Prod. Chge. Bul. 52—Set 186-1) 154—13  
 H-354C7 (Ch. V-2180-2) 158—13  
 H-355T5, H-356T5 (Ch. V-2157-5) 161—11  
 H-357C10 (Ch. V-2180-5) 161—12  
 H-359T5, H-360T5 (Ch. V-2157-6) 191—21  
 H-361T6 (Ch. V-2181-1) 186—15  
 H-363T5, H-364T5 (Ch. V-2157-7) 185—15  
 H-367T5 (Ch. V-2157-8), H-368P5, H-369P5 (Ch. V-2156-1U) (See Model H-342P25U—Set 138-13)  
 H-370T7, H-371T7 (Ch. V-2180-8) 186—16  
 H-372P4, H-373P4, Ch. V-2182-1 and H-377 Optional Pwr. Supply 188—14  
 H-374T5, H-375T5 (Ch. V-2157-9) 189—17  
 H-376P4, H-377 (Ch. V-2182-1 and H-377 Optional Power Supply) 188—14  
 H-377 (Power Supply) 188—14  
 H-378T5, H-379T5, H-380T5, H-381T5 (Ch. V-2184-1) 211—17  
 H-382T5, H-383T5 (Ch. V-2157-10) 215—14  
 H-385T5, H-386T5 (Ch. V-2157-11) 204—13  
 H-387T5 (Ch. V-2157-11) (See Model H-385T5—Set 204-13)  
 H-388T5 (Ch. V-2157-12) 215—15  
 H-393T6 (Ch. V-2182-2) 210—15  
 H-400P4, H-401P4, H-402P4, H-403P4 (Ch. V-2164-2) 205—13  
 H-600T16 (Ch. V-2150-61, A, B) Tel. Rec. 98—14  
 H-601K12, H-602K12 (Ch. V-2150-41) Tel. Rec. 98—14  
 H-603C12 (Ch. V-2151-01 and V-2149-3) Tel. Rec. 100—14  
 H-604T10, A (Ch. V-2150-91A, -94, -94A) Tel. Rec. (See Set 99A-14 and Model H-609T10—Set 95-7)  
 H-605T12 (Ch. V-2150-101) Tel. Rec. 97—19  
 H-606K12 (Ch. V-2150-111, A) Tel. Rec. 120—12  
 H-607K12 (Ch. V-2150-111, A) Tel. Rec. 120—12  
 H-608C12 (Ch. V-2152-01, V-2149-3) Tel. Rec. (See Model H-603C12—Set 100-14)  
 H-609T10 (Ch. V-2150-94C) Tel. Rec. 95—7  
 H-610T12 (Ch. V-2150-136) Tel. Rec. 105—13  
 H-611C12 (Ch. V-2152-16) Tel. Rec. 112—14  
 H-613K16 (Ch. V-2150-146) Tel. Rec. 107—12  
 H-614T12 (Ch. V-2150-136) Tel. Rec. 105—13  
 H-615C12 (Ch. V-2152-16) Tel. Rec. 112—14  
 H-617T12 (Ch. V-2150-176, U, -177U) (Also see Prod. Chge. Bul. 10—Set 116-1) 103—17  
 H-619T12, U (Ch. V-2150-176, U, -177U) Tel. Rec. (Also see Prod. Chge. Bul. 10—Set 116-1) 103—17  
 H-620K16 (Ch. V-2150-186, A, C, CA) Tel. Rec. (Also see Prod. Chge. Bul. 10—Set 116-1 and Model H-617T12—Set 103-17)  
 H-625T12 (Ch. V-2150-197) Tel. Rec. 114—11  
 H-626T16 (Ch. V-2172) Tel. Rec. 116—13  
 H-627K16 (Ch. V-2171) Tel. Rec. 116—13  
 H-628K16, H-629K16 (Ch. V-2171) 116—13  
 H-630T14 (Ch. V-2176) Tel. Rec. 116—13  
 H-633C17, H-634C17 (Ch. V-2173) 122—11

**WESTINGHOUSE—Cont.**

H-636T17 (Ch. V-2175) Tel. Rec. 116—13  
 H-637T14 (Ch. V-2177) Tel. Rec. 116—13  
 H-638K20 (Ch. V-2178) Tel. Rec. 129—13  
 H-639T17 (Ch. V-2192, -1) Tel. Rec. 133—15  
 H-640T17 (Ch. V-2175-3, -4), H-640T17A (Ch. V-2192, -1, -2, -3, -4, -5, -6) Tel. Rec. (Also see Prod. Chge. Bul. 28—Set 150-1) 133—15  
 H-641K17 (Ch. V-2175-1, -5), H-641K17A (Ch. V-2192, -1, -2, -3, -4, -5, -6) Tel. Rec. (Also see Prod. Chge. Bul. 28—Set 150-1) 133—15  
 H-642K20 (Ch. V-2178-1, -3) Tel. Rec. 129—13  
 H-642K20A (Ch. V-2194, V-2194A, V-2194-1) Tel. Rec. 137—16  
 H-643K16 (Ch. V-2179, V-2179-1) Tel. Rec. 127—13  
 H-646K17 (Ch. V-2192) Tel. Rec. 133—15  
 H-647K17 (Ch. V-2175-3) Tel. Rec. (Also see Prod. Chge. Bul. 28—Set 150-1) 133—15  
 H-648T20 (Ch. V-2201-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-649T17 (Ch. V-2200-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-650T17 (Ch. V-2200-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-651K17 (Ch. V-2192) Tel. Rec. (See Model H-639T17—Set 133-15)  
 H-651K17 (Ch. V-2200-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-651K17 (Ch. V-2192) Tel. Rec. (See Model H-639T17—Set 133-15)  
 H-651K17 (Ch. V-2200-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-652K20 (Ch. V-2194-2, -3) Tel. Rec. (See Prod. Chge. Bul. 31—Set 157-3 and Model H-642K20A—Set 137-16)  
 H-652K20 (Ch. V-2201-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-653K24 (Ch. V-2202-2, V-2201-1) Tel. Rec. (Also see Prod. Chge. Bul. 35—Set 164-1) 160—13  
 H-654T17 (Ch. V-2175-3, -4, V-2192, -1) Tel. Rec. 133—15  
 H-655T17 (Ch. V-2200-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-657K17 (Ch. V-2200-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-657K17 (Ch. V-2192-4, -5, -6) Tel. Rec. (See Prod. Chge. Bul. 28—Set 150-1 and Model H-639T17—Set 133-15)  
 H-658T17 (Ch. V-2192, -1) Tel. Rec. (See Prod. Chge. Bul. 28—Set 150-1 and Model H-639T17—Set 133-15)  
 H-659T17 (Ch. V-2204-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-660C17, H-661C17 (Ch. V-2203-1 and Radio Ch. V-2180-3) Tel. Rec. (Also see Prod. Chge. Bul. 46—Set 180-1) 157—12  
 H-662K20 (Ch. V-2201-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-663T17 (Ch. V-2192-2) Tel. Rec. (See Prod. Chge. Bul. 28—Set 150-1 and Model H-639T17—Set 133-15)  
 H-663T17 (Ch. V-2204) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 177-1) 154—15  
 H-664K17 (Ch. V-2200-1) Tel. Rec. (Also see Prod. Chge. Bul. 42—Set 176-1) 154—15  
 H-665T16 (Ch. V-2206-1) Tel. Rec. (See Prod. Chge. Bul. 42—Set 176-1 and Model H-648T20—Set 154-15)  
 H-667T17, H-668T17 (Ch. V-2216) Tel. Rec. (Also see Prod. Chge. Bul. 40—Set 172-1) 167—15  
 H-673K17 (Ch. V-2217-1) Tel. Rec. (See Model H-667T17—Set 167-15)  
 H-676T21 (Ch. V-2217-1) Tel. Rec. (See Model H-667T17—Set 167-15)

**WESTINGHOUSE—Cont.**

H-678K17, H-679K17 (Ch. V-2216-1, -2, -3) Tel. Rec. (Also See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 45—Set 179-1 and Prod. Chge. Bul. 52—Set 186-1) . . . 167—15  
 H-681T17 (Ch. V-2215-1) Tel. Rec. (See Prod. Chge. Bul. 45—Set 179-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-688K24 (Ch. V-2219-1) (Also See Prod. Chge. Bul. 52—Set 186-1) . . . 174—14  
 H-689T16 (Ch. V-2214-1) (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 58—Set 192-1 and Model H-667T17—Set 167-15)  
 H-690K21, H-691K21 (Ch. V-2217-1) Tel. Rec. (See Model H-667T17—Set 167-15)  
 H-692T21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-695K21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-699K17 (Ch. V-2216-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 45—Set 179-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-700T17, H701T17 (Ch. V-2216-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 45—Set 179-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-701K21 (Ch. V-2217-2) Tel. Rec. (See Prod. Chge. Bul. 43—Set 177-1 and Model H-667T17—Set 167-15)  
 H-702K17, H-703K17 (Ch. V-2216-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 45—Set 179-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-704T17 (Ch. V-2216-2) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 45—Set 179-1, Prod. Chge. Bul. 51—Set 185-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-704T17 (Ch. V-2216-2) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 45—Set 179-1, Prod. Chge. Bul. 51—Set 185-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-705K17 (Ch. V-2216-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 45—Set 179-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-706T16 (Ch. V-2207-1) Tel. Rec. . . . 193—12  
 H-708T20 (Ch. V-2220-1, -3, -11) Tel. Rec. . . . 193—12  
 H-710T21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-710T21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-711T21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-711T21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-713K21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-714K21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-714K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10

**WESTINGHOUSE—Cont.**

H-715K21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-715K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-718K20 (Ch. V-2220-2) Tel. Rec. . . . 193—12  
 H-720K21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-720K21 (Ch. V-2217-2, -3) Tel. Rec. . . . 202—10  
 H-721K21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-721K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-722K21 (Ch. V-2217-2, -3) Tel. Rec. (See Prod. Chge. Bul. 40—Set 172-1, Prod. Chge. Bul. 43—Set 177-1, Prod. Chge. Bul. 52—Set 186-1 and Model H-667T17—Set 167-15)  
 H-722K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-723K21 (Ch. V-2217-5) Tel. Rec. . . . 202—10  
 H-724T20, H-725T20 (Ch. V-2220-2) Tel. Rec. . . . 193—12  
 H-730C21 (Ch. V-2218-1) and Radio Ch. V-2180-9, -10) Tel. Rec. . . . 190—16  
 H-730C21 (Ch. V-2218-1) and Radio Ch. V-2180-9, -10) Tel. Rec. (Also See Prod. Chge. Bul. 59—Set 193-1) . . . 190—16  
 H-732C21 (Ch. V-2218-1) and Radio Ch. V-2180-9, -10) Tel. Rec. (Also See Prod. Chge. Bul. 59—Set 193-1) . . . 190—16  
 H-732C21 (Ch. V-2218-1) and Radio Ch. V-2180-9, -10) Tel. Rec. (Also See Prod. Chge. Bul. 59—Set 193-1) . . . 190—16  
 H-733C21 (Ch. V-2218-1) and Radio Ch. V-2180-9, -10) Tel. Rec. . . . 190—16  
 H-733C21 (Ch. V-2218-1) and Radio Ch. V-2180-9, -10) Tel. Rec. (Also See Prod. Chge. Bul. 59—Set 193-1) . . . 190—16  
 H-736T17 (Ch. V-2216-5) Tel. Rec. . . . 202—10  
 H-737T17 (Ch. V-2232-2) Tel. Rec. . . . 212—9  
 H-738T17 (Ch. V-2227-1) Tel. Rec. . . . 214—10  
 H-739T17 (Ch. V-2231-1) (Ch. V-2227-2) Tel. Rec. . . . 214—10  
 H-740T21 (Ch. V-2233-1) Tel. Rec. . . . 212—9  
 H-746K21, H-746K21, H-747K21, H-747K21 (Ch. V-2233-4) Tel. Rec. . . . 215—16  
 H-750T21 (Ch. V-2221-1) Tel. Rec. . . .  
 H-750T21 (Ch. V-2233-3) Tel. Rec. . . . 212—9  
 H-751T21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-751T21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-752T21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-752T21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-753K21 (Ch. V-2221-1) Tel. Rec. . . .  
 H-753K21 (Ch. V-2233-3) Tel. Rec. . . . 212—9  
 H-754K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-754K21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-755K21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-756K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-756K21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-757K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-757K21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-758K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-758K21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-759K21 (Ch. V-2217-4, -5) Tel. Rec. . . . 202—10  
 H-759K21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-760T21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-760T21 (Ch. V-2233-2) Tel. Rec. . . . 212—9

**WESTINGHOUSE—Cont.**

H-761T21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-761T21 (Ch. V-2233-2) Tel. Rec. . . . 212—9  
 H-802 (Ch. V-11900-1, -2, -3, -4, -5, V-11213) Tel. UHF Conv. . . . 209—13  
 H-1251 (Ch. V-2102) Tel. Rec. . . . 3—19  
 (See Model H-104)  
 Ch. V-2102-1 (See Model H-138)  
 Ch. V-2103 (See Model H-153)  
 Ch. V-2103-3 (See Model H-214)  
 Ch. V-2107 (See Model H-133)  
 Ch. V-2118 (See Model H-161)  
 Ch. V-2119-1 (See Model H-164)  
 Ch. V-2120 (See Model H-165)  
 Ch. V-2122 (See Model H-157)  
 Ch. V-2123 (See Model H-178)  
 Ch. V-2124 (See Model H-169)  
 Ch. V-2127 (See Model H-183)  
 Ch. V-2128, V-2128-1 (See Model H-182)  
 Ch. V-2128-2 (See Model H-202)  
 Ch. V-2130-1 (See Model H-196)  
 Ch. V-2130-11DX, -12DX (See Model H-196A [DX])  
 Ch. V-2130-21DX, -22DX (See Model H-207A [DX])  
 Ch. V-2130-31DX, -32DX (See Model H-225 [DX])  
 Ch. V-2131, V-2131-1 (See Model H-185)  
 Ch. V-2132 (See Model H-186M)  
 Ch. V-2133 (See Model H-188)  
 Ch. V-2134 (See Model H-190)  
 Ch. V-2136 (See Model H-307T7)  
 Ch. V-2136-1 (See Model H-316C7)  
 Ch. V-2136-2 (See Model H-324T7)  
 Ch. V-2136-4 (See Model H-328C7)  
 Ch. V-2136-5 (See Model H-334T7UR)  
 Ch. V-2137-5U (See Model H-334T7U)  
 Ch. V-2137 (See Model H-203)  
 Ch. V-2137-1 (See Model H-199)  
 Ch. V-2137-2 (See Model H-198)  
 Ch. V-2137-3 (See Model H-231)  
 Ch. V-2144, V-2144-1 (See Model H-210)  
 Ch. V-2146-05 (See Model H-216)  
 Ch. V-2146-11DX (See Model H-217)  
 Ch. V-2146-21DX, -25DX (See Model H-226)  
 Ch. V-2146-35DX (See Model H-217B)  
 Ch. V-2146-45 (See Model H-216)  
 Ch. V-2148 (See Model H300T5)  
 Ch. V-2149 (See Model H-217B)  
 Ch. V-2149-1 (See Model H-216)  
 Ch. V-2149-3 (See Model H-603C12)  
 Ch. V-2150-01, V-2150-02 (See Model H-223)  
 Ch. V-2150-31 (See Model H-242)  
 Ch. V-2150-41 (See Model H-601K12)  
 Ch. V-2150-51 (See Model H-231)  
 Ch. V-2150-61, A, B (See Model H-600T16)  
 Ch. V-2150-81, -82, -84 (See Model H-251)  
 Ch. V-2150-91A (See Model H-604T10)  
 Ch. V-2150-94 (See Model H-604T10, A)  
 Ch. V-2150-94C (See Model H-609T10)  
 Ch. V-2150-101 (See Model H-605T12)  
 Ch. V-2150-11A (See Model H-606K12)  
 Ch. V-2150-136 (See Model H-610T12)  
 Ch. V-2150-146 (See Model H-613K16)  
 Ch. V-2150-176, U (See Model H-617T12)  
 Ch. V-2150-177U (See Model H-617T12)  
 Ch. V-2150-184, A, C, CA (See Model H-618T16)  
 Ch. V-2150-197 (See Model H-625T12)  
 Ch. V-2151-1 (See Model H-302P5)  
 Ch. V-2152-01 (See Model H-603C12)

**WESTINGHOUSE—Cont.**

Ch. V-2152-16 (See Model H-611C12)  
 Ch. V-2153 (See Model H303P4)  
 Ch. V-2153-1 (See Model H-312P4)  
 Ch. V-2156 (See Model H-309P5)  
 Ch. V-2156-1U (See Model H-342P5U)  
 Ch. V-2157, U (See Model H-318T5)  
 Ch. V-2157-1, -1U (See Model H-321T5)  
 Ch. V-2157-2, -2U (See Model H-323T5)  
 Ch. V-2157-3U (See Model H-327T6U)  
 Ch. V-2157-4U (See Model H338T5U)  
 Ch. V-2157-5 (See Model H-355T5)  
 Ch. V-2157-6 (See Model H-359T5)  
 Ch. V-2157-8 (See Model H-367T5)  
 Ch. V-2157-9 (See Model H-374T5)  
 Ch. V-2157-10 (See Model H-382T5)  
 Ch. V-2157-11 (See Model H-385T5)  
 Ch. V-2157-12 (See Model H-388T5)  
 Ch. V-2161, V-2161U (See Model H-310T5)  
 Ch. V-2164, U (See Model H-331P4)  
 Ch. V-2164-2 (See Model H-400P4)  
 Ch. V-2171 (See Model H-627K16)  
 Ch. V-2172 (See Model H-626T16)  
 Ch. V-2173 (See Model H-633C17)  
 Ch. V-2175 (See Model H-636T17)  
 Ch. V-2175-1 (See Model H-641K17)  
 Ch. V-2175-3 (See Model H-640T17)  
 Ch. V-2175-5 (See Model H-641K17)  
 Ch. V-2176 (See Model H-630T14)  
 Ch. V-2177 (See Model H-637T14)  
 Ch. V-2178, -1, -3 (See Model H-638K20)  
 Ch. V-2180-1 (See Model H350T7)  
 Ch. V-2180-2 (See Model H-354C7)  
 Ch. V-2180-3 (See Model H-660C17)  
 Ch. V-2180-5 (See Model H-357C10)  
 Ch. V-2180-8 (See Model H-370T7)  
 Ch. V-2180-9, -10 (See Model H-730C21)  
 Ch. V-2181-1 (See Model H-361T6)  
 Ch. V-2182-2 (See Model H-393T6)  
 Ch. V-2184-1 (See Model H-378T5)  
 Ch. V-2192, -1 (See Model H-639T17)  
 Ch. V-2192, -3, -4, -5, -6 (See Model H-640T17A)  
 Ch. V-2194, V-2194A, V-2194-1 (See Model H-642K20A)  
 Ch. V-2194-2, -3 (See Model H-652K20)  
 Ch. V-2200-1 (See Model H-651K17)  
 Ch. V-2201-1 (See Model H-652K20)  
 Ch. V-2202-2 (See Model H-653K24)  
 Ch. V-2203-1 (See Model H-660C17)  
 Ch. V-2204-1 (See Model H-659T17)  
 Ch. V-2206-1 (See Model H-665T16)  
 Ch. V-2207-1 (See Model H-706T16)  
 Ch. V-2208-1 (See Model H-716T17)  
 Ch. V-2210-1 (See Model H-653K24)  
 Ch. V-2214-1 (See Model H-689T16)  
 Ch. V-2215-1 (See Model H-681T17)  
 Ch. V-2216-1 (See Model H-667T17)  
 Ch. V-2216-2, -3 (See Model H-678K17)  
 Ch. V-2216-4, -5 (See Model H-704T17)  
 Ch. V-2217-1 (See Model H-673K21)  
 Ch. V-2217-2, -3 (See Model H-692T21)  
 Ch. V-2217-4, -5 (See Model H-710T21)  
 Ch. V-2218-1, -2, -11 (See Model H-730C21)  
 Ch. V-2219-1 (See Model H-688K24)  
 Ch. V-2220-1 (See Model H-708T20)  
 Ch. V-2220-2 (See Model H-718K20)  
 Ch. V-2220-3 (See Model H-708T20)  
 Ch. V-2221-1 (See Model H-750T21)  
 Ch. V-2227-1 (See Model H-736T17)

**WESTINGHOUSE—Cont.**

Ch. V-2227-2 (See Model H-737T17)  
 Ch. V-2232-2 (See Model H-737T17)  
 Ch. V-2233-1 (See Model H-740T21)  
 Ch. V-2233-2 (See Model H-751T21)  
 Ch. V-2233-3 (See Model H-750T21)  
 Ch. V-2233-4 (See Model H-746K21)  
 Ch. V-11213 (See Model H-802)  
 Ch. V-11900-1, -2, -3, -4, -5 (See Model H-802)  
**WILCOX-GAY (Also See Majestic (Also See Recadio))**  
 G-306, G-402, G-403, G-404 Tel. Rec. (See Majestic Model 1212—Set 108-7)  
 G-414 Tel. Rec. (See Majestic Model G-414—Set 133-8)  
 G-426, G-427 Tel. Rec. (See Majestic Model 1272—Set 108-7)  
 G-614, G-624 Tel. Rec. (See Majestic Model G-414—Set 133-8)  
 G-914 Tel. Rec. (See Majestic Model G-414—Set 133-8)  
 OD-446M (OD Series) Tel. Rec. . . . 101—17  
 OF439-1C (Ch. OF Series) Tel. Rec. . . . 98—15  
 OD Series (See Model OD-446M)  
 OL Series Tel. Rec. . . .  
 PD Series Tel. Rec. . . .  
 9W Series Tel. Rec. . . .  
**WILLYS-OVERLAND**  
 8030 (670777) . . . 50—23  
 670777 (See Model 9030—Set 50-23)  
 677012 . . . 156—14  
 679517 . . . 172—12  
**WILMAK**  
 W-446 "DENchum" . . . 21—11  
**WIRE RECORDING CORP. (See Recorder Listing)**  
**WOOLRAC**  
 3-1A (Ch. 6-9022-J), 3-2A (Ch. 9022-K) . . . 6—37  
 3-3A (Code 7-9003-D) . . . 6—38  
 3-5A . . . 22—32  
 3-6A/5 . . . 24—32  
 3-9A, 3-10A . . . 7—30  
 3-11A (Ch. 56A76) . . . 8—33  
 3-12/3 . . . 23—33  
 3-13A, 3-14A, 3-15A, 3-16A . . . 34—28  
 3-17A, 3-18A . . . 34—29  
 3-20A . . . 24—33  
 3-29A . . . 7—31  
 3-61A (See Model 3-71A—Set 36-29)  
 3-70A . . . 31—34  
 3-71A . . . 36—29  
**ZENITH (Also see Record Changer Listing)**  
 G500 (Ch. 5G40) . . . 83—16  
 G503 (Ch. 5G41) . . . 99—19  
 G510, G510T, (Ch. 5G02) . . . 84—14  
 G511, G511W, G511Y (Ch. 5G01) . . . 85—14  
 G516 (Ch. 5G03) . . . 109—15  
 G615, G615W, G615Y (Ch. 6G05) . . . 86—14  
 G640, G645, G646 (Ch. 6G01) . . . 96—12  
 G723 (Ch. 7G04) . . . 104—13  
 G724 (Ch. 7G02) . . . 103—18  
 G725 (Ch. 7G01) . . . 101—18  
 G881, G882, G883, G884, G885 (Ch. 8G20) . . . 98—16  
 G-2322 (Ch. 23G22) Tel. Rec. . . . 98—17  
 G-2322Z (Ch. 23G24) Tel. Rec. (See Ch. 23G24—Set 91A-13)  
 G2322Z (Ch. 23G24) Tel. Rec. (See Ch. 23G24—Set 91A-13)  
 G-2340, R (Ch. 23G22) Tel. Rec. . . . 98—17  
 G2340RZ, Z (Ch. 23G24) Tel. Rec. (See Ch. 23G24—Set 91A-13)  
 G2340Z1, G2340RZ1 (Ch. 23G24Z1) Tel. Rec. (See Ch. 23G24—Set 91A-13)  
 G2346R (Ch. 23G22) Tel. Rec. . . . 93—11  
 G2420-EOX (Ch. 24G20-OX) Tel. Rec. . . . 93—11  
 G2420R (Ch. 24G20) Tel. Rec. . . . 93—11

ZENITH

ZENITH-Cont.

G2420-ROX (Ch. 24G20-OX) Tel. Rec. 93-11
G2437RZ, G2438RZ, Z, G2439RZ (Ch. 24G26) Tel. Rec. (See Ch. 24G26)
G2426-Set 91A-12)
G2441 (Ch. 24G24) Tel. Rec. 98-17
G2441R (Ch. 24G22/24) Tel. Rec. 98-17
G2441RZ, Z (Ch. 24G26) Tel. Rec. (See Ch. 24G26-Set 91A-12)
G2441Z, G2441RZ (Ch. 24G26Z1) Tel. Rec. (See Ch. 24G26-Set 91A-12)
G2442E, R (Ch. 24G22/24) Tel. Rec. 98-17
G2442RZ (Ch. 24G26Z1) Tel. Rec. (See Ch. 24G26-Set 91A-12)
G2442Z (Ch. 24G26) Tel. Rec. (See Ch. 24G26-Set 91A-12)
G2442Z1, G2442Z2 (Ch. 24G26Z1) Tel. Rec. (See Ch. 24G26-Set 91A-12)
G2448R (Ch. 24G22/24) Tel. Rec. 98-17
G2448RZ (Ch. 24G26) Tel. Rec. (See Ch. 24G26-Set 91A-12)
G2448RZ1, G2448RZ2 (Ch. 24G26Z1) Tel. Rec. (See Ch. 24G26-Set 91A-12)
G2454R (Ch. 24G21) Tel. Rec. 93-11
G-2454-ROX (Ch. 24G21-OX) Tel. Rec. 93-11
G2548R-OX (Ch. 28F20) Tel. Rec. (See Model 28T960)
Set 64-15)
G2951, R, OX, ROX, G2952, R, ROX (Ch. 29G20, -OX) Tel. Rec. 95-8
G2957, R (Ch. 23G23 and Radio Ch. 6G20) Tel. Rec. 98-17
G2958R (Ch. 23G23 and Radio Ch. 6G20) Tel. Rec. 98-17
G-3059R (Ch. 24G23/25 and Radio Ch. 6G20) Tel. Rec. 98-17
G3062 (Ch. 24G23/25 and Radio Ch. 6G20) Tel. Rec. 98-17
G3157RZ, Z (Ch. 23G24 and Radio Ch. 8G20/22) Tel. Rec. (See Ch. 23G24 and Ch. 8G20/22-Set 91A-13)
G3157Z1, G3157RZ1 (Ch. 23G24Z1 and Radio Ch. 8G22) Tel. Rec. (See Ch. 23G24 and Ch. 8G20/22-Set 91A-13)
G3158RZ (Ch. 23G24Z1 and Radio Ch. 8G20/22) Tel. Rec. (See Ch. 23G24 and Ch. 8G20/22-Set 91A-13)
G3158RZ1 (Ch. 23G24Z1 and Radio Ch. 8G22) Tel. Rec. (See Ch. 23G24 and Ch. 8G20/22-Set 91A-13)
G3173RZ, Z, G-3174RZ (Ch. 23G24 and Radio Ch. 8G20/22) Tel. Rec. (See Ch. 23G24 and Ch. 8G20/22-Set 91A-13)
G3259RZ (Ch. 24G26 and Radio Ch. 8G20/22) Tel. Rec. (For TV Ch. See Ch. 24G26-Set 91A-12, For Radio Ch. See Ch. 8G20/22-Set 91A-13)
G3259RZ1 (Ch. 24G26Z1 and Radio Ch. 8G22) Tel. Rec. (For TV Ch. See Ch. 24G26-Set 91A-12, For Radio Ch. See Ch. 8G20/22-Set 91A-13)
G3262Z (Ch. 24G26 and Radio Ch. 8G20/22) Tel. Rec. (For TV Ch. See Ch. 24G26-Set 91A-12, For Radio Ch. See Ch. 8G20/22-Set 91A-13)
G3262Z1 (Ch. 24G26Z1 and Radio Ch. 8G22) Tel. Rec. (For TV Ch. See Ch. 24G26-Set 91A-12, For Radio Ch. See Ch. 8G20/22-Set 91A-13)
G3275RZ (Ch. 24G26 and Radio Ch. 8G20/22) Tel. Rec. (For TV Ch. See Ch. 24G26-Set 91A-12, For Radio Ch. See Ch. 8G20/22-Set 91A-13)
G3276Z (Ch. 24G26 and Radio Ch. 8G20/22) Tel. Rec. (For TV Ch. See Ch. 24G26-Set 91A-12, For Radio Ch. See Ch. 8G20/22-Set 91A-13)
H-401, G (Ch. 4H40) 156-15
H500 (Ch. 5H40) 152-12
H-503, Y (Ch. 5H41) 151-12
H511, H511W, H511Y (Ch. 5H01) 147-13
H615 (Ch. 6G05) 140-14
H615Z1 (Ch. 6G05Z1) 178-16
H661E, H661R (Ch. 6H01) 125-13
H664 (Ch. 6H02) 149-15
H665, R, RZ, Z (Ch. 6H01) 125-13
H723 (Ch. 7H04) 122-12
H723Z (Ch. 7H04Z) 134-14

ZENITH-Cont.

H723Z1 (Ch. 7H04Z1) (See Model H724Z1-Set 163-14)
H723Z2 (Ch. 7H04Z2) 178-17
H724 (Ch. 7H02) 126-15
H724Z (Ch. 7H02Z) (See Model H723Z-Set 134-14)
H-724Z1 (Ch. 7H02Z1) 163-14
H724Z2 (Ch. 7H02Z2) 178-17
H725 (Ch. 7G01Z) 135-15
H880, H880R (Ch. 8H20 Revised) 127-14
H880RZ (Ch. 8H20) 114-12
H1083E (Ch. 10H20) (See Model H3467R-Set 120-13)
H1086R, H-1087R (Ch. 10H20) (See Model H3467R-Set 120-13)
H2029R, H2030E, H2030R (Ch. 20H20) Tel. Rec. 144-15
H2041R (Ch. 20H20) Tel. Rec. 144-15
H-2052R, H2053E (Ch. 20H20) Tel. Rec. 144-15
H222E, R (Ch. 22H2) 114-13
H2227R (Ch. 22H20) Tel. Rec. (See Ch. 22H21) Tel. Rec. 151-13
H2241R (Ch. 22H21) Tel. Rec. (See Ch. 22H22) Tel. Rec. 151-13
H2250R (Ch. 22H20) Tel. Rec. 114-13
H2252R, H2253E (Ch. 22H21) Tel. Rec. 151-13
H2254R (Ch. 22H22) Tel. Rec. 151-13
H2255E (Ch. 22H20) Tel. Rec. 114-13
H2328E, EZ, R, RZ (Ch. 23H22, Z) Tel. Rec. 118-11
H2329R, RZ (Ch. 23H22, Z) Tel. Rec. (See Model H2328E-Set 118-11)
H2330E, R (Ch. 23H22, Z) Tel. Rec. (See Model H2328E-Set 118-11)
H2341R (Ch. 23H22) Tel. Rec. (See Model H2328E-Set 118-11)
H2352R, RZ, H2353E, EZ (Ch. 23H22, Z) Tel. Rec. 118-11
H2436O (Ch. 24H21) Tel. Rec. (See Model H3477R-Set 120-13)
H-2437E, H-2438R, H-2439R (Ch. 24H20) Tel. Rec. 120-13
H2443R (Ch. 24H20) Tel. Rec. (See Model H2437E-Set 120-13)
H2445R (Ch. 24H21) Tel. Rec. 120-13
H2447R (Ch. 24H21) Tel. Rec. 120-13
H2449E (Ch. 24H20) Tel. Rec. 120-13
H2868 (Ch. 28H20 and Radio Ch. 8H20Z) Tel. Rec. (For TV Ch. See Model H-2029R-Set 144-15, For Radio Ch. See Model J880-Set 168-14)
H3068R (Ch. 22H21 and Radio Ch. 8H20Z) Tel. Rec. (For TV Ch. See Model H2229R-Set 151-13, For Radio Ch. See Model J880-Set 168-14)
H-3074 (Ch. 20H20 and Radio Ch. 10H20) Tel. Rec. (For TV Ch. See Model H2029R-Set 144-15, For Radio Ch. See Model H2229R-Set 151-13)
H3168R (Ch. 23H22 and Radio Ch. 8H20) Tel. Rec. (For TV Ch. See Model H2328E-Set 118-11, For Radio Ch. See Model H880RZ-Set 114-12)
H3267, R (Ch. 24H20 and Radio Ch. 8H20) Tel. Rec. (For TV Ch. See Set 120-13, For Radio Ch. See Model H800RZ-Set 114-12)
H3273E, H3274R (Ch. 22H21 and Radio Ch. 10H20) Tel. Rec. 151-13
H3284R (Ch. 22H22 and Radio Ch. 10H20) Tel. Rec. 151-13
H3467R (Ch. 24H20 and Radio Ch. 10H20) Tel. Rec. 120-13
H3469E (Ch. 24H20 and Radio Ch. 10H20) Tel. Rec. (See Model H3467R-Set 120-13)
H3475R (Ch. 24H20 and Radio Ch. 10H20) Tel. Rec. 120-13
H3477R (Ch. 24H21 and Radio Ch. 10H20) Tel. Rec. 120-13
H3478E (Ch. 24H21 and Radio Ch. 10H20) Tel. Rec. 120-13
H3490EQ (Ch. 24H21 and Radio Ch. 10H20) Tel. Rec. (For TV Ch. See Model H2445R-Set 120-13, For Radio Ch. See Model H3273E-Set 151-13)

ZENITH-Cont.

J402 (Ch. 4J40) 178-18
J420T (Ch. 4J60T) 185-16
J514 (Ch. 5J03) 176-14
J615, F, G, W, Y 182-16
J616 (Ch. 6J03) 179-14
J644, J645E, R (Ch. 6J02) 172-13
J733, G, R, Y (Ch. 7J03) 186-17
J880, J880R (Ch. 8H20Z) 168-14
J1083E, EZ (Ch. 10H20Z) (See Model H3273E-Set 151-13)
J1086, R, RZ (Ch. 10H20Z) (See Model H3273E-Set 151-13)
J1087, Z (Ch. 10H20Z) (See Model H3273E-Set 151-13)
J2026R (Ch. 20J21) Tel. Rec. 159-18
J2027E, R, J2029E, R, J2030E, R (Ch. 20J21) Tel. Rec. 159-18
J2031R (Ch. 20J21) Tel. Rec. (See Model J2026R-Set 159-18)
J2032R (Ch. 20J22) Tel. Rec. (See Model J2051E-Set 159-18)
J2040E, J2042R, J2043R, J2044E, R (Ch. 20J21) Tel. Rec. 159-18
J2049R (Ch. 20J21) Tel. Rec. (See Model J2027E-Set 159-18)
J2050R (Ch. 20J21) Tel. Rec. (See Model J2027E-Set 159-18)
J2051R, J2053R, J2054R, J2055R (Ch. 20J22) Tel. Rec. 159-18
J2126R (Ch. 21J21) Tel. Rec. 159-18
J2127E, R, J2129E, R, J2130E, R (Ch. 21J20) Tel. Rec. 159-18
J2140E, J2142R, J2143R, J2144E, R (Ch. 21J20) Tel. Rec. 159-18
J2151E, J2153R, J2154R, J2155R (Ch. 21J21) Tel. Rec. 159-18
J2688 (Ch. 20J21 and Radio Ch. 8H20Z) Tel. Rec. (For TV Ch. See Set 159-18, For Radio Ch. See Model J880-Set 168-14)
J2968R (Ch. 21J20 and Radio Ch. 8H20Z) Tel. Rec. (For TV Ch. See Set 159-18, For Radio Ch. See Model J880-Set 168-14)
J3069E (Ch. 20J21 and Radio Ch. 10H20Z) Tel. Rec. (For TV Ch. See Set 159-18, For Radio Ch. See Model H3273E-Set 151-13)
J3169E (Ch. 21J20 and Radio Ch. 10H20Z) Tel. Rec. (For TV Ch. See Set 159-18, For Radio Ch. See Model H3273E-Set 151-13)
K412G, R, W, Y (Ch. 4K01) 195-13
K510, K510W, K510Y, Ch. 5K02) 181-15
K515 (Ch. 5K03) (See Model J514-Set 176-14)
K518 (Ch. 5J03) (See Model J514-Set 176-14)
K526, W, Y (Ch. 5K04) 215-18
K622, F, G, W, Y (Ch. 6K03) 203-17
K666R, F, G (Ch. 6K02) 212-10
K725, F, G (Ch. 7K01) 212-10
K777E, R (Ch. 7K20) 190-17
K1812E (Ch. 19K22) Tel. Rec. 184-15
K-1812E-3 (Ch. 19K22-3) 214-11
K1812R (Ch. 19K22) Tel. Rec. 184-15
K1812R-3 (Ch. 19K22-3) 214-11
K1815E, R (Ch. 19K20) Tel. Rec. 184-15
K1820E, R (Ch. 19K20) Tel. Rec. 184-15
K1846E, R (Ch. 19K20) Tel. Rec. 184-15
K1850E, R (Ch. 19K20) Tel. Rec. 184-15
K1808R (Ch. 19K20) Tel. Rec. 184-15
K2229E, F, G (Ch. 19K24) Tel. Rec. (See Model K1812E-Set 184-15)
K2229E-3 (Ch. 19K24-3) 214-11
K2229R (Ch. 19K23) Tel. Rec. 184-15
K2229R-3 (Ch. 19K24-3) 214-11
K2230E, R (Ch. 21K20) Tel. Rec. 187-14
K2235E, R (Ch. 19K23) Tel. Rec. (See Model K1812E-Set 184-15)
K2240E, R (Ch. 21K20) Tel. Rec. 184-14
K2258E (Ch. 19K23) Tel. Rec. (See Model K2258R-Set 184-15)
K2258R (Ch. 19K23) Tel. Rec. 184-15
K2260R (Ch. 21K20) Tel. Rec. 187-14
K2262R (Ch. 19K23) Tel. Rec. (See Model K2229R-Set 184-15)

ZENITH-Cont.

K2263E (Ch. 21K20) Tel. Rec. 187-14
K2266, R (Ch. 21K20) Tel. Rec. 187-14
K2267E (Ch. 21K20) Tel. Rec. 187-14
K2268R (Ch. 21K20) Tel. Rec. 187-14
K2270H, R (Ch. 21K20) Tel. Rec. 187-14
K2271H (Ch. 21K20) Tel. Rec. (See Model K2230E-Set 187-14)
K2286R (Ch. 19K23) Tel. Rec. 184-15
K2287R (Ch. 21K20 and Radio Ch. 8H20Z) Tel. Rec. (For TV Ch. See Set 187-14, For Radio Ch. See Model J880-Set 168-14)
K2288E (Ch. 19K23) Tel. Rec. 184-15
K2290R, K2291E (Ch. 21K20 and Radio Ch. 10H20Z) Tel. Rec. (For TV Ch. See Set 187-14, For Radio Ch. See Model H3273E-Set 151-13)
K2872R, K2873E (Ch. 28K20) Tel. Rec. 215-19
L518, F, G, W, Y (Ch. 5L03) 217-18
4G800 (Ch. 4E41) 35-27
4G800WZ, 4G800YZ, 4G800Z (Ch. 4E41Z) 52-23
4G903, 4G903Y (Ch. 4F40) 76-20
4K016 (Ch. 4C52) 6-39
4K035 (Ch. 4C53) 6-40
5D011, 5D02 (Ch. 5C01, 5C01Z) 3-17
5D810 (Ch. 5E02) 54-21
5G003 (Ch. 5C40) 17-35
5G003Z (Ch. 5C40Z) 30-31
5G003ZZ (Ch. 5C40ZZ) 30-32
5R080-5R086 (Ch. 5C02, 5C04) 4-4
6D014, 6D014W, 6D029, 6D029G (Ch. 6C01) 9-35
6D015, 6D015Y, 6D030 (Ch. 6C05, 6C05Z) 3-24
6D815, 6D815W, 6D815Y (Ch. 6E05) 55-24
6G001, 6G001Y (Ch. 6C40) 3-14
6G001Y1Z1 (See Model 6G001-Set 3-14)
6G004Y (Ch. 6C41) 20-35
6G038 (Ch. 6C50) 32-30
6G801 (Ch. 6E40) 53-26
6R084 (Ch. 6C21) 20-36
6R087 (Ch. 6C22) 7-32
7R886 (Ch. 6E02) 34-30
7H820, 7H820W (Ch. 7E01) 43-24
7H822 (Ch. 7E02), 7H822WZ, 7H822Z (Ch. 7E02Z) 55-25
7H918 (Ch. 7F03) 75-18
7H920, 7H920W (Ch. 7F01) 77-13
7H921 (Ch. 7F04) 73-16
7H922 (Ch. 7F02) 87-15
7R070 (Ch. 6C06) 37-25
7R887 (Ch. 7E21) 54-22
8G005Y (Ch. 8C40) 7-33
8G005YT (Z1) (Ch. 8C40T) (Z1, 8G005YT) (Z2) (Ch. 8C40T) (Z2) 53-27
8H023 (Ch. 8C01) 4-40
8H032, 8H033 (Ch. 8C20) 1-33
8H034 (See Model 8R087) 4-20
8H050, 8H051, 8H052, 8H061 1-33
8H832, 8H861 (Ch. 8E20) 52-24
9H079, 9H079E, 9H079R, 9H081, 9H082R, 9H085R, 9H088R (Ch. 8C21) 7-34
9H881, 9H882R, 9H885, 9H888R (Ch. 9E21) 43-25
9H984, 9H984LP (Ch. 9F22) 64-14
9H995 (Ch. 9E21Z) 74-12
12H090, 12H091, 12H092, 12H093, 12H094 (Ch. 11C21) 2-20
14H789 (Ch. 13D22) 41-24
27T965R (Ch. 27F20) Tel. Rec. 95-8
28T925 E, R (Ch. 28F22) Tel. Rec. 64-15
28T926E, R (Ch. 28F25) Tel. Rec. (See Model 28T925-Set 64-15)
28T960E (Ch. 28F20) Tel. Rec. (See Model 28T960-Set 64-15)
28T960E-Z (Ch. 28F20Z) Tel. Rec. (See Model 28T960-Set 64-15)
28T960-GO, 28T960K (Ch. 28F20) Tel. Rec. (See Model 28T960-Set 64-15)
28T961E, 28T961-GO (Ch. 28F21) Tel. Rec. (See Model 28T961-Set 64-15)
28T962R (Ch. 28F20) Tel. Rec. (See Model 28T962-Set 64-15)
28T962R-Z (Ch. 28F20Z) Tel. Rec. (See Model 28T962-Set 64-15)
28T963 (Ch. 28F21) Tel. Rec. 64-15
28T964R (Ch. 28F23) Tel. Rec. 74-13

ZENITH-Cont.

37T996R1P (Ch. 28F23 and Radio Ch. 9E21Z) Tel. Rec. (For TV Ch. See Model 42T996R1P-Set 74-15, For Radio Ch. See Model 9H995-Set 74-12)
37T998R1P (Ch. 28F20 and Radio Ch. 9E21Z) Tel. Rec. (For TV Ch. See Model 28T960-Set 64-15, For Radio Ch. See Model 9H995-Set 74-12)
42T999R1P (Ch. 28F23, Radio Ch. 13D22) Tel. Rec. See Model 28T964R)
Ch. 4C52 (See Model 4K016) Ch. 4C53 (See Model 4K035) Ch. 4E41 (See Model 4G800) Ch. 4E41Z (See Model 4G800Z) Ch. 4F40 (See Model 4G903) Ch. 4H40 (See Model H-401) Ch. 4J40 (See Model J402) Ch. 4J60 (See Model J420T) Ch. 4K01 (See Model K412G) Ch. 5C01, 5C01Z (See Model 5D011) Ch. 5C02, 5C02Z (See Model 5R080) Ch. 5C04 (See Model 5R080) Ch. 5C40 (See Model 5G003) Ch. 5C40Z (See Model 5G003Z) Ch. 5C40ZZ (See Model 5G003ZZ) Ch. 5C51 (See Model 5G036) Ch. 5G036 (See Model 5G036) Ch. 5E02 (See Model 5D810) Ch. 5G01 (See Model G511) Ch. 5G02 (See Model G510) Ch. 5G03 (See Model G516) Ch. 5G40 (See Model G500) Ch. 5G41 (See Model G503) Ch. 5H01 (See Model H511) Ch. 5H40 (See Model H500) Ch. 5H41 (See Model H503) Ch. 5J03 (See Model J514) Ch. 5K02 (See Model K510) Ch. 5K03 (See Model K518) Ch. 5K04 (See Model K526) Ch. 5L03 (See Model L518) Ch. 6C01 (See Model 6D014) Ch. 6C05, Z (See Model 6D015) Ch. 6C06 (See Model 7R070) Ch. 6C21 (See Model 6R084) Ch. 6C22 (See Model 6R087) Ch. 6C40 (See Model 6G001) Ch. 6C41 (See Model 6G004Y) Ch. 6C50 (See Model 6G038) Ch. 6E02 (See Model 6R886) Ch. 6E05 (See Model 6D815) Ch. 6E40 (See Model 6G801) Ch. 6G01 (See Model 6G05) Ch. 6G05Z1 (See Model H615Z1) Ch. 6G20 (See Model G2957) Ch. 6H01 (See Model H661E) Ch. 6H02 (See Model H664) Ch. 6J02 (See Model J644) Ch. 6J03 (See Model J616) Ch. 6J05 (See Model J615) Ch. 6K02 (See Model K666R) Ch. 6K03 (See Model K622) Ch. 7E01 (See Model 7H820) Ch. 7E02 (See Model 7H822) Ch. 7E02Z (See Model 7H822WZ) Ch. 7E22 (See Model 7R887) Ch. 7F01 (See Model 7H920) Ch. 7F02 (See Model 7H922)

## ZENITH—Cont.

Ch. 7F03  
[See Model 7H918]  
Ch. 7F04  
[See Model 7H921]  
Ch. 7G01  
[See Model G725]  
Ch. 7G01Z  
[See Model H725]  
Ch. 7G02  
[See Model G724]  
Ch. 7G04  
[See Model G723]  
Ch. 7H02  
[See Model H724]  
Ch. 7H02Z  
[See Model H724Z]  
Ch. 7H02Z1  
[See Model H724Z1]  
Ch. 7H02Z2  
[See Model H724Z2]  
Ch. 7H04  
[See Model H723]  
Ch. 7H04Z  
[See Model H723Z]  
Ch. 7H04Z1  
[See Model H723Z1]  
Ch. 7H04Z2  
[See Model H723Z2]  
Ch. 7I03  
[See Model J733]

## ZENITH—Cont.

Ch. 7K01 [See Model K725]  
Ch. 7K20  
[See Model K777E]  
Ch. 8C01  
[See Model 8H023]  
Ch. 8C20  
[See Model 8H032]  
Ch. 8C21  
[See Model 9H079]  
Ch. 8C40  
[See Model 8G005Y]  
Ch. 8C40T(Z1)  
[See Model 8G005YT(Z1)]  
Ch. 8C40T(Z2)  
[See Model 8G005YT(Z2)]  
Ch. 8E20  
[See Model 8H832]  
Ch. 8G20  
[See Model G881]  
Ch. 8C20/Z2 ..... 91A-13  
Ch. 8H20  
[See Model H880RZ]  
Ch. 8H20 Revised  
[See Model H880]  
Ch. 8H20Z  
[See Model J880]  
Ch. 9E21  
[See Model 9H881]  
Ch. 9E21Z  
[See Model 9H995]

## ZENITH—Cont.

Ch. 9F22  
[See Model 9H984]  
Ch. 10H20  
[See Model H3467R]  
Ch. 10H20Z  
[See Model H3273E]  
Ch. 11C21  
[See Model 12H090]  
Ch. 13D22  
[See Model 14H789]  
Ch. 19K20  
[See Model K1815E]  
Ch. 19K22  
[See Model K1812E]  
Ch. 19K22-3 [See Model K1812E-3]  
Ch. 19K23  
[See Model K2229R]  
Ch. 19K24-3 [See Model K2229E-3]  
Ch. 20H20  
[See Model H2029R]  
Ch. 20J21  
[See Model J2027E]  
Ch. 20J22  
[See Model J2026R]  
Ch. 21J20  
[See Model J2127E]  
Ch. 21J21  
[See Model J2127R]

## ZENITH—Cont.

Ch. 21K20  
[See Model K-2230E]  
Ch. 22H20  
[See Model H2226R]  
Ch. 22H21  
[See Model H2229R]  
Ch. 22H22  
[See Model H2242E]  
Ch. 23G22 [See Model G2322] Tel. Rec.  
Ch. 23G23  
[See Model G2957]  
Ch. 23G24  
..... 91A-13  
Ch. 23G24Z1  
[See Model G2322Z1]  
Ch. 23H22, 23H22Z  
[See Model H-2328E]  
Ch. 24G20  
[See Model G2420E]  
Ch. 24G20-OX  
[See Model G2420-EOX]  
Ch. 24G21  
[See Model G2454R]  
Ch. 24G21-OX  
[See Model G2454-ROX]  
Ch. 24G22/24  
[See Model G2441R]  
Ch. 24G23/25  
[See Model G3059R]

## ZENITH—Cont.

Ch. 24G24  
[See Model G2441]  
Ch. 24G26  
..... 91A-12  
Ch. 24G26Z1  
[See Model G2441Z1]  
Ch. 24H20  
[See Model H2437E]  
Ch. 24H21  
[See Model H2445R]  
Ch. 27F20  
[See Model 27T965R]  
Ch. 28F20  
[See Model 28T960E]  
Ch. 28F20Z  
[See Model 28T960E-Z]  
Ch. 28F21  
[See Model 28T961E]  
Ch. 28F22  
[See Model 28T925E]  
Ch. 28F23  
[See Model 28T964R]  
Ch. 28F25  
[See Model 28T926E]  
Ch. 28K20 [See Model 28T92R]  
Ch. 29G20  
[See Model G2951]

## RECORD CHANGERS

(CM-1) indicates service data also available in Howard W. Sams 1947 Record Changer Manual. (CM-2) indicates service data available in Howard W. Sams 1948 Record Changer Manual. (CM-3) indicates service data available in Howard W. Sams 1949, 1950 Record Changer Manual. (CM-4) indicates service data available in Howard W. Sams 1951, 1952 Record Changer Manual.

## ADMIRAL

RC-150 ..... (CM-1) 26—31  
RC160, RC160A, RC161,  
RC-161A [See Model  
RC200—Set 9 and Model  
RC160—Set 21-37]  
RC-170, RC-170A ..... (CM-1) 31—2  
RC-180, RC-181 ..... (CM-2) 76—1  
RC-182 [See Model  
RC-181—Set 76-1 and  
Supplement—Set 76-2]  
RC-200 ..... (CM-1) 9  
RC-210, RC211, RC212  
..... (CM-3) 72  
RC-220, RC-221, RC-222,  
RC-320, RC-321, RC-322  
[See Set 79-1 and Changes  
in Set 108-2 (CM-3)]  
RC400 ..... (CM-4) 104—1  
RC500 ..... (CM-4) 132—2  
RC-550 [See Model RC-500  
—Set 132-2 (CM-4) and  
Model RC-550—  
Set 185-2]  
RC600 ..... 218—2

## AERO

46A ..... (CM-1) 19—34  
47A ..... (CM-2) 77—2

## AVIOLA

100 ..... (CM-1) 33—32

## BELMONT

C-9 ..... (CM-2) 34—31

## COLLARO

RC.521, RC.522 ..... 205—4  
3RC.521, 3RC.522 ..... 205—4

## COLUMBIA

104 ..... 124—2

## CRESCENT

C-200 ..... (CM-1) 20—37  
6 Series ..... (CM-3) 89—4  
250 Series ..... (CM-2) 78—5  
350 Series ..... (CM-2) 80—3  
500 Series ..... 197—4

## FARNSWORTH

P-51, P56 ..... (CM-1) 13—36  
P-72, P73 ..... (CM-2) 75—8

## GARRARD

RC-60 ..... (CM-2) 81—7  
RC80 ..... (CM-4) 157—5

## GENERAL ELECTRIC

P6 ..... (CM-2) 79—8

## GENERAL INDUSTRIES

RC130L ..... (CM-1) 22—33

## GENERAL INSTRUMENT

204 ..... (CM-1) 23—34  
205 ..... (CM-1) 10

## LEAR

PC-206A ..... (CM-1) 18—33

## MAGUIRE

ARC-1 ..... (CM-1) 7

## MARKEL

70, 71 ..... (CM-2) 84—8  
74, 75 [See Set 91-7  
(CM-3) and Supplement—  
Set 131-1]

## MILWAUKEE ERWOOD

10700 ..... (CM-1) 16—37  
11200 ..... (CM-2) 86—6  
11600 ..... (CM-3) 73—7  
12300 ..... (CM-4) 138—5

## MOTOROLA

B24RC, B25RC,  
B27RC, B28RC ..... (CM-1) 12—35  
RC30 ..... (CM-2) 80—9  
RC36, A ..... (CM-4) 147—8  
RC36 ..... (CM-4) 147—8  
RC36—Set 147-8  
RC37 ..... (CM-4) 141—8  
RC40 [See Model RC37—  
Set 141-8 (CM-4)]

## OAK

6666 ..... (CM-1) 19—35  
9201 ..... (CM-3) 111—10

## PHILCO

D10, D10A ..... (CM-1) 14—21  
M-4 ..... (CM-1) 25—30  
M-7 ..... (CM-1) 28—35  
M-8 ..... (CM-2) 83—7  
M-9 ..... (CM-2) 74—7  
M-12C ..... (CM-3) 109—9  
M-20 ..... (CM-3) 103—11  
M22 ..... (CM-4) 140—6

## RCA

RP168 ..... (CM-3) 72—10  
RP-176 ..... (CM-1) 25—3  
RP-177 [See Model  
(SM-2) 44—27]  
RP-178 ..... (CM-2) 79—12  
RP190 Series ..... (CM-4) 144—7

## SEEBURG

K ..... (CM-1) 11—36  
L ..... (CM-1) 24—34  
M ..... (CM-1) 32—19  
S, SQ ..... (CM-2) 78—12

## SILVERTONE

101.761-2,  
101.762-2 ..... (CM-2) 77—10  
101.761-3 ..... 183—8  
101.762-3 ..... (CM-2) 83—11  
101.762,  
101.763 ..... (CM-2) 88—11

## SPARTON

C48 ..... (CM-2) 87—11

## THORENS

CD-40 ..... (CM-1) 39—29

## TRAV-LER

A ..... (CM-3) 72—13

## UNIVERSAL CAMERA

100 ..... (CM-1) 36—30

## UTAH

550 ..... (CM-1) 8  
650 ..... (CM-1) 22—34  
7000 ..... (CM-1) 27—31  
7001 ..... (CM-2) 83—15

## V-M

200-B ..... (CM-1) 15—36  
400 ..... (CM-1) 26—33  
400 (Late) ..... (CM-2) 90—13  
402, 400C ..... (CM-2) 82—12  
402D, 400D ..... (CM-2) 87—14  
404 [See Model 405—  
Set 73-14 (CM-3)]  
405 ..... (CM-3) 73—14  
406, 407 ..... (CM-3) 102—17  
800 ..... (CM-1) 21—38  
800-D ..... (CM-2) 84—12  
802 ..... (CM-3) 77—12  
910 ..... (CM-3) 115—14  
950 [See Set 107-13  
(CM-3) and Supplement—  
Set 131-17]  
950, 951 (Late) ..... 216—11

## WEBSTER-CHICAGO

50 ..... (CM-1) 24—35  
56 ..... (CM-1) 17—36  
70 ..... (CM-1) 29—28  
77 ..... (CM-4) 137—14

## WEBSTER-CHICAGO—Cont.

100 ..... (CM-4) 135—14  
106 ..... (CM-4) 146—12  
121, 122, 123, 124, 125 206—12  
126, 127, 129 ..... 208—13  
133 ..... (CM-2) 82—13  
148 ..... (CM-2) 86—12  
246 ..... (CM-2) 74—11  
256 ..... (CM-2) 88—13  
346 ..... (CM-3) 100—12  
356, 357 ..... (CM-3) 106—16

## WESTINGHOUSE

V4914 ..... (CM-2) 47—26  
V4944 ..... (CM-2) 86—13  
V6235 ..... 134—13  
V6676 ..... 136—15

## ZENITH

S11478 ..... (CM-1) 23—35  
S11680 ..... (CM-1) 27—32  
S14001 ..... (CM-2) 75—17  
S13675, S14002,  
S14006, S14008 (CM-2) 85—15  
S14004, S14007 ..... (CM-2) 79—18  
S14012, S14014 (CM-3) 110—14  
S14022 ..... (CM-3) 112—15  
S14023 ..... (CM-3) 105—14  
S14024, S14025 (CM-3) 112—15  
S14026 ..... (CM-3) 105—14  
S14027 ..... (CM-3) 112—15  
S-14028, S-14029,  
S-14030,  
S-14031 ..... (CM-4) 145—13  
S-14036 ..... (CM-4) 145—13

## MISCELLANEOUS

Series 700F ..... (CM-2) 89—9  
Series 700F 33/45 (CM-3) 75—11  
Series 700FLP ..... (CM-2) 101—6  
Series 700FS ..... (CM-2) 104—8  
Series 700R ..... (CM-2) 91—8

## RECORDERS

## AMPREX

400A, 401A ..... 213—1

## AMPRO

730 ..... (CM-4) 133—4  
731 [For electrical unit see  
Folder 166-5; for me-  
chanical unit see Folder  
133-4]  
731-R [See Model 731]

## BRUSH SOUND MIRROR

BK-401 ..... (CM-1) 42—25  
BK-403 ..... (CM-2) 78—3  
BK-416 ..... (CM-2) 81—4  
BK-437, S-BK-439,  
BK-441, BK-442,  
BK-443P ..... 164—3

## BRUSH MAIL-A-VOICE

BK-501, BK-502,  
BK-503 ..... (CM-1)

## CONCERTONE

1401 (401) ..... (CM-4) 155—4

## CRESCENT

H-1A ..... (CM-4) 130—5  
H-2A1 Series ..... (CM-3) 119—4

## CRESCENT—Cont.

H-19 Series  
"Steno" ..... (CM-4) 122—3  
H-22A1 ..... 125—4  
M2000 Series ..... (CM-4) 120—4  
M-2001 Series ..... 120—4  
M-2500 Series ..... 120—4  
M-3000 Series ..... 120—4  
M-3001 Series ..... 120—4  
M-3500 Series ..... 120—4  
1000 Series ..... (CM-2)  
1000 Series Revised (CM-3) 77—4

## CRESTWOOD

CP-201 ..... (CM-3) 118—4

## DUKANE

11A55FF, 11B55 ..... 187—5

## EICOR

1000 ..... (CM-3) 90—4

## EKOTAPE (WEBSTER-ELECTRIC)

101-4, 5, 102-4, 5, 103-4,  
5, 104-4, 5 ..... (CM-3) 116—12  
101-8, 101-9, 102-9,  
103-8 ..... 107—6  
109, 110, 111,  
112 ..... (CM-4) 152—5  
114, 115, 116, 117 ..... 189—8

## GENERAL INDUSTRIES

R70, R90 ..... (CM-1) 35—26  
250 ..... (CM-4) 143—8

## INTERNATIONAL ELECTRONICS

PT3 ..... (CM-2) 88—4

## KNIGHT

96-144 (CM-4) ..... 158—6  
96-485 ..... 183—8  
96-499 (CM-4) ..... 158—6

## LEAR DYNAPORT

WC-311-D ..... (CM-2) 80—8

## MAGNECORD AUDIAD

AD-1R ..... (CM-2) 84—7  
PT6-A, AH, AHX, AX ..... 190—6  
PT63-A, AH, AHX, AX ..... 190—6

## MASCO

DC37R (CM-4) ..... 148—9  
D37 (CM-4) ..... 148—9  
D37R ..... (CM-4) 148—9  
LD37, LD37R ..... (CM-4) 148—9  
52, 52C, 52CR, 52L,  
52LR, 52R ..... 214—6  
375 ..... (CM-3) 117—7

## PENTRON

PB-A2, PB-1 ..... 184—11  
9T-3 ..... (CM-4) 153—10  
9T-3C ..... (CM-4) 162—9

## RCA

MI-12875 ..... (CM-2) 85—12

## RECORDIO (See Wilcox Gay)

REELEST  
C1A ..... (CM-4) 123—13

## REVERE

T-100 ..... (CM-4) 149—11  
TR-200 [For electrical unit  
see Folder 165-10; for  
mechanical unit see  
Folder 149-11]  
T-70153, T-70157,  
T-70163, T-70167,  
T-70235, T-70257,  
T-70263, T-70267,  
T-77153, T-77157,  
T-77163, T-77167,  
T-77253, T-77257,  
T-77263, T-77267 ..... 193—9

## SILVERTONE

70 (Ch. 567, 230,  
577, 231) ..... (CM-4) 121—11  
771 ..... (CM-1) 26—32  
101, 774-2, 101, 774-4  
..... (CM-3) 114—10

## ST. GEORGE

1100 Series ..... (CM-1) 40—24

## TAPE MASTER

PT-121 ..... 186—14  
PT-125 ..... 198—15

## WEBSTER-CHICAGO

79-80 ..... (CM-1) 37—26  
178 ..... (CM-3) 113—12  
210 ..... (CM-4) 159—17  
228 ..... (CM-4) 156—13

## WEBSTER ELECTRIC

(See Ekotape)

## WILCOX GAY

2A10, 2A10B, 2A11,  
2A11B ..... 180—10  
3A10, 3A11 ..... 200—13  
3C10 ..... 215—17

## WIRE RECORDING CORP.

WP ..... (CM-2) 76—19



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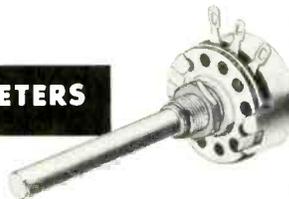
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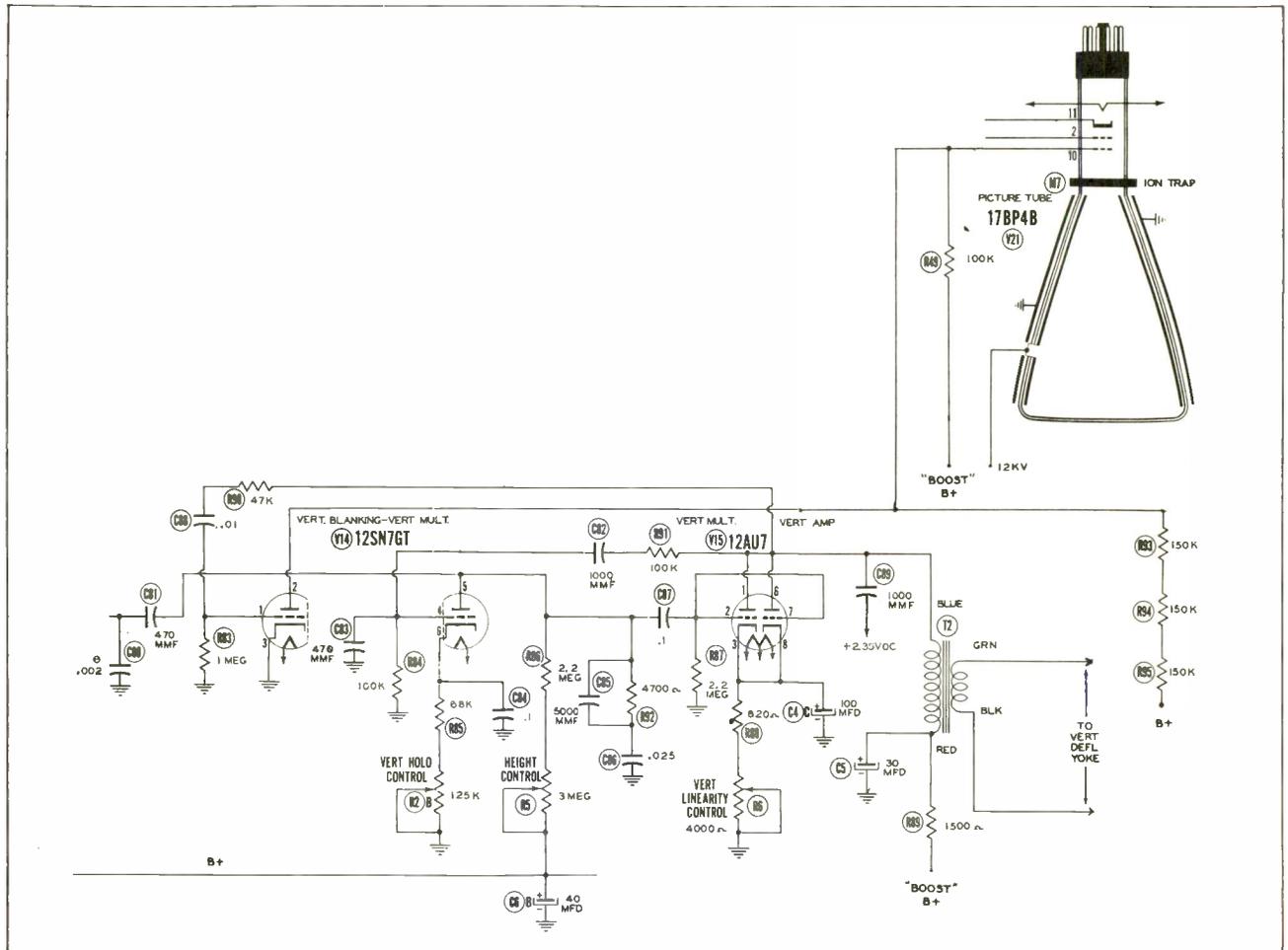


Figure 2. Vertical Blanking Circuit Employed in the GE Model 17C103 TV Receiver.

ture screen. This is the reason it is labeled "Vertical Blanking".

The foregoing analysis was not particularly involved, yet it did require that the serviceman recognize a number of basic features. First, there was the stage designation and its position in the circuit. Second, there was recognition of the type of bias employed and how it was produced. And third, the plate lead had to be traced to R93, R94, R95 and, from here, to the picture tube.

As another example, consider the AGC network employed in Hoffman Model 21B116 television receivers. This is shown in Figure 4.

This first thing we note from the diagram is the name assigned to the tube "Keyed AGC". This notifies us that the AGC system is of the keyed variety. We know, for example, that a pulse is obtained from some point in the horizontal output circuit and applied to the plate of the keyer tube. Also, a portion

of the video signal, with positive sync pulses, is brought to the control grid of the same tube. Whenever both of these pulses are simultaneously present, current which is proportional to signal amplitude flows through the tube and a negative AGC bias voltage is established in the plate circuit. Here, this voltage would appear across R39, R34, R5 and R29.

R5 is variable and while this is not usual, the manner in which it operates is simple to determine. In pentodes, the current that flows through the tube is not appreciably

affected by the amount of resistance in the plate circuit. The keyer tube is a pentode and so varying R5 will not alter plate current flow. When the full resistance of R5 is in the circuit, the IF stages receive maximum bias and their gain is lowered. This would be the recommended position of the control for strong signals.

In weak signal areas, the bias on the controlled IF stages should be lower and this is achieved by reducing the amount of R5 resistance effective in the circuit.

Because of this action of R5, it is called the "Maximum Performance Selector".

So much for that portion of the AGC circuit. Also connected to the plate of the keyer tube is another branch containing R41, R74 & R40. At point A, between R41 and R74, the diode section of a 6SQ7 tube is connected. This arrangement, too,

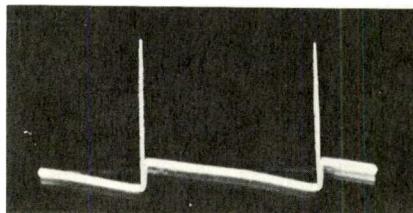


Figure 3. Waveform Present on the Plate of Vertical Amplifier.



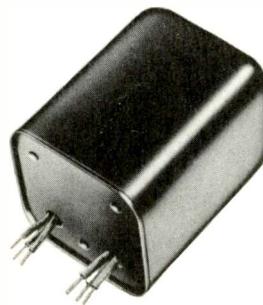
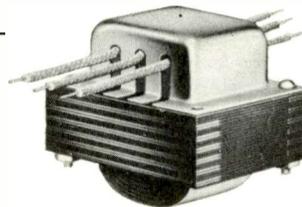
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\* Identical electrically—mounting change necessary



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is not an unusual one. The diode is placed here to keep the potential at (or close to) zero as long as the incoming signal is weak. When the signal strength increases, enough negative voltage appears at the plate of the keyer tube to override the small positive voltage from R74 that is keeping the diode in conduction. The diode then ceases to conduct and the negative potential at point A rises and falls as the signal strength varies.

Now, ordinarily, point A is tied in directly to the control grid of the RF amplifier. Here this is not so. Rather, another resistor (R40) is inserted between point A and the RF amplifier. Furthermore, an auxiliary line, containing R107, brings in a negative voltage obtained from the grid of the horizontal output amplifier.

What does this line do? One end, we see, is attached to a negative 15-volt source of voltage and since this 15 volts represents part of the bias of the horizontal output stage, it can be considered as being substantially constant. If now we examine the circuit, we see that the 15 volts divide across R107 and R40 since the bottom end of R40 goes to point A and this point is, under weak signal conditions, at ground potential (or very close to it). The voltage division across R40 and R107 is in proportion to their respective resistance values, which means that R107 gets 14/15ths of the voltage, leaving 1/15 to appear across R40. Since we have 15 volts to start with, this provides - 1 volt for R40, and of course - 1 volt for the control grid of the RF amplifier.

Hence, here is what we have. When the incoming signal is weak, the RF amplifier receives - 1 volt bias. This is fixed and represents the minimum bias on the grid of the RF amplifier. Any increase in signal will cause point A to go negative and this, in turn, will raise the negative bias voltage of the RF amplifier.

The foregoing Hoffman circuit analysis relied to a great extent on a knowledge of keyed AGC circuits in general. This, you recall, was one of the pointers previously specified, namely, to compare any new circuits with those you already know. Keyed AGC systems are widely used and considerable information has appeared on them in books and trade publications.

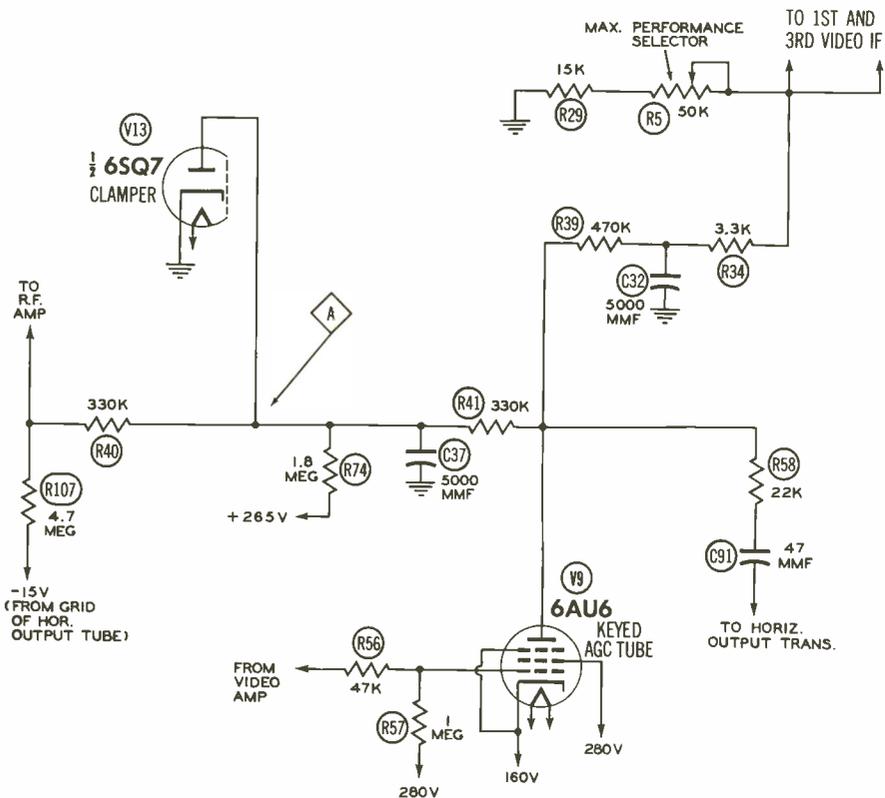


Figure 4. The AGC System in the Hoffman Model 21B116 TV Receiver.

**REVIEW.** A completely dead receiver does not often present too difficult a problem for the service man to solve. You start, perhaps, with the tubes, then go to the power supply, and if the results are still nil, turn to the back end of the set and work forward, section by section.

On the other hand, when a customer brings in a set with the complaint of weak output, your problem is not as clearly defined. Now every component in the receiver is open to suspicion and it's your job to decide which parts are functioning normally and which are not. The decision can often be difficult.

Jack Darr, in two articles entitled, "Those Weak Chassis Complaints" which appeared in the March and April, 1953 issues of Service Magazine, discusses a number of causes and solutions to loss-of-sensitivity problems in broadcast receivers. The highlights of these articles are discussed below.

Service Magazine is published monthly by the Bryan Davis Publishing Co., Inc., 52 Vanderbilt Avenue, New York 17, N. Y. The subscription rate is \$2.00 per year.

The equipment which is recommended for the attack on weak sets is that which one would expect to find in any well-stocked radio shop. A vacuum-tube voltmeter, AM and FM signal generators, an oscilloscope, a reliable capacitor checker, a signal tracer with (preferably) tuned channels for RF, IF, and AF voltages, and an audio oscillator. We are concerned here with sound broadcast receivers; if television were included, it would be necessary to augment the foregoing with a TV sweep generator.

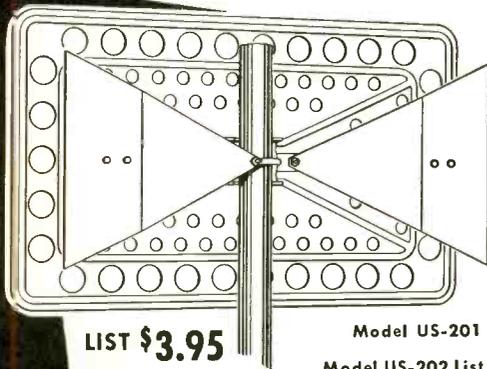
When the service man is confronted with the complaint of weak output, perhaps the first logical step for him to take is to check all of the tubes. Not only are weak tubes very likely prospects, but they also permit the service man to make the test without the time consuming task of removing the chassis from the cabinet.

If the tubes prove to be O K, then there are a number of courses open to the service man. The author, personally, likes to turn next to the power supply and determine whether the B plus (and B minus) voltages are close to their specified values. Many sets, especially those in the midget class, are quite sensitive to



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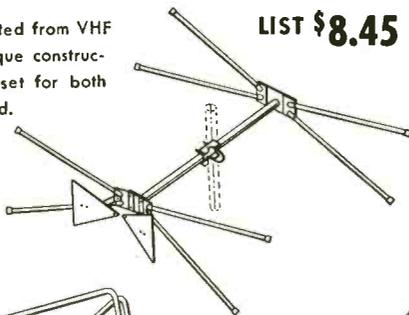
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relatively small changes in voltage and a 5 to 7 per cent drop can have a marked effect on set performance.

If selenium rectifiers are employed in the power supply and the output voltage is low, test the unit with a selenium rectifier tester or substitute another unit.

Beyond the power supply, a frequent trouble spot is at the local oscillator. If this stage does not generate enough voltage to provide a strong IF beat note, the set output will be weak. The normal trouble is a low-emission tube and this will be uncovered by a good mutual conductance tube checker. If you are at all in doubt about the tube, try another one.

A good clue to the performance of an oscillator is the amount of grid bias voltage that it develops. An average value, at the low end of the band, is from 5 to 15 volts; anything less than 5 volts should be viewed with suspicion. If the oscillator voltage remains low with a new tube, the trouble most frequently will be found in the oscillator coil, usually in the plate or tickler winding. The latter winding seems to be most vulnerable to corrosion, possibly because of the higher voltage applied to it. Occasionally opens will be found in the grid or tuned windings of the oscillator coil. This is due to mechanical damage, breakage of the leads by rough treatment, and will be found near the end of the winding.

Important, too, in the operation of the oscillator is the grid leak resistance, especially if this should decrease appreciably in value. Do not overlook, either, the oscillator capacitor, if one is used, or oscillator slugs, if the set uses permeability tuners. Hygroscopic insulators or leakage through an accumulation of grease or dirt can reduce the efficiency of an oscillator to a remarkable degree. A positive test for leakage is by direct measurement with a high-range ohmmeter. Leakage on the order of 75,000 to 100,000 ohms will seriously degrade oscillator efficiency.

Three-way portables are particularly touchy about filament voltage fluctuations. If the filament voltage becomes too low, the oscillator can cause trouble. It will manifest itself in the form of weak output, low oscillator bias, and oscillator dropout at low frequencies. Although this difficulty will usually be found to be due to low emission rectifiers (tube or selenium), occasionally the

trouble might be in the surge limiting resistors connected between the rectifier cathode and the input of the filter system. Some portables develop a filament voltage for the battery tubes across the cathode resistor of a 50L6 or similar tube used in the output stage, when operating on AC. A weak tube here, or a leaky coupling capacitor, will cause the filament voltages to be low or high, respectively.

Circuit alignment, which includes the tracking between the oscillator and antenna tuning sections, should also be given careful scrutiny in any weak receiver. IF alignment in broadcast receivers is generally stable and seldom causes trouble unless something happens to one of the tuning circuit components. Corrosion of the coils or leakage across the trimmer capacitors are frequent causes of poor IF operation. From time to time, high resistance joints in one of the IF windings will result in a severe loss in gain and selectivity. Fortunately, this is usually easy to locate; any IF trimmer which does not show a very definite peak indicates a defect in the associated circuit.

Proper tracking of the oscillator with the antenna tuning section is an important factor that is often overlooked. It may be found that the set is tracking at one end of the dial, but not at the other. Or, in the extreme, tracking is poor over the entire dial. If the set's design includes a padder for low-frequency adjustments, or a variable inductance oscillator coil, the trouble can be easily remedied, for most of the mistracking will probably be due to misalignment. On the other hand, where only a high-frequency trimmer is provided, and nothing else, adjustments at the low end of the scale must be made by adjusting the plates of the tuning capacitor itself.

Common causes of mistracking in the antenna circuit include defective loops or turns missing from the loop. Open AVC bypass capacitors or high-leakage in these units can also cause tuning trouble.

Another reason for low set sensitivity stems from resistances which have increased in value. Particularly prone to this are the higher valued resistors: 2.2, 3.3 megohms and so on. Some recent production sets have used very small resistors

often referred to as matchsticks. These have been found to be quite troublesome, particularly in the higher values. In amplifier stages, such as the first audio, changes in plate load resistors will have less effect than corresponding changes in screen grid resistors (where pentodes are employed). It is well to keep in mind, too, that the performance of triodes is more sensitive to plate load changes than pentodes.

Electrolytics used as cathode bypasses will often be found open, especially in the older sets. This will result in the impairment of tone and loss of volume. Once in a while a shorted capacitor will be found, causing the bias to drop to zero. These same electrolytics are frequently part of a multiple-section filter, with the other sections doing duty in the power supply. Any leakage between sections will serve to introduce an AC voltage in the audio signal path, with resultant audible hum.

Gain in every sound receiver is controlled to a large extent by an AVC voltage. Hence, this is another item to check. Jack Darr cites one case history when very weak signals were obtained on a 3-way portable. The usual tests yielded nothing since all the tubes checked good and the plate and screen voltages were within their normal operating range. Finally, a VTVM was placed across the AVC line and it was noted that the AVC voltage on the converter input grid was much higher than it was on any of the other controlled tubes. Furthermore, the AVC voltage varied as the set was tuned across the dial. What had happened was this: the oscillator coil was coupled to the oscillator grid through a gimmick, an open-ended winding of only a few turns. The tuned coil was returned to the AVC line through a 10-megohm resistor. The gimmick had shorted to the coil, causing a leakage of about 50,000 ohms and by this means the oscillator grid voltage had been able to reach the AVC line. This voltage, applied to the converter signal grid, was almost blocking the tube. A simple trouble to correct, once it was located, but it certainly wasn't easy to locate.

Probably the best advice that can be given on weak sets is to work slowly and carefully. Never move any faster than you can think !!

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## Color TV (NTSC Standards)

(Continued from page 9)

to the luminance signal a subcarrier which is modulated by chrominance information. It is possible to do this because the energy contained in the monochrome signal is located in groups or bunches which are concentrated near even harmonics of the line frequency. Therefore, the vacant portions of the monochrome signal can be used for the transmission of the color signal. Since the energies of the luminance signal are grouped near the even harmonics of the line frequency, the chrominance information is placed at the odd harmonics of one-half the line frequency. Refer to Figure 1 for a representation of how the concentrated energies of the two different signals are spaced.

During the process of band sharing, the monochrome receiver responds only to the luminance signal because the interleaved chrominance signal tends to cancel itself out every two frames. This can be shown by referring to Figure 2. Figure 2A shows a line with its modulation frequency occurring at the even harmonic of the line-scanning of the monochrome signal. The time period of 63.5 microseconds contains an integral number of complete cycles of modulation. Because of this, the next lines are in phase with the preceding lines which results in line 526 reinforcing line 1. The opposite is true of the signal due to chrominance information as is shown in Figure 2B. As has been stated before, this signal has a frequency that is an odd harmonic of one-half the line frequency. This line period then will contain an extra half-cycle. This extra half-cycle causes a phase reversal with the result of line 526 cancelling the information of line 1. This leaves the original black and white picture undisturbed, at least to the extent that persistence of vision eliminates frame-frequency flicker.

### Color Subcarrier -

Figure 3 shows the complete video spectrum of the NTSC signal. The frequency of the chrominance subcarrier (also referred to as the burst-frequency) has been chosen to be 3.579545 megacycles. This frequency is an odd harmonic (455th) of one-half the line frequency, and was determined by the following reasoning and procedure.

First it was decided to set the subcarrier frequency at the

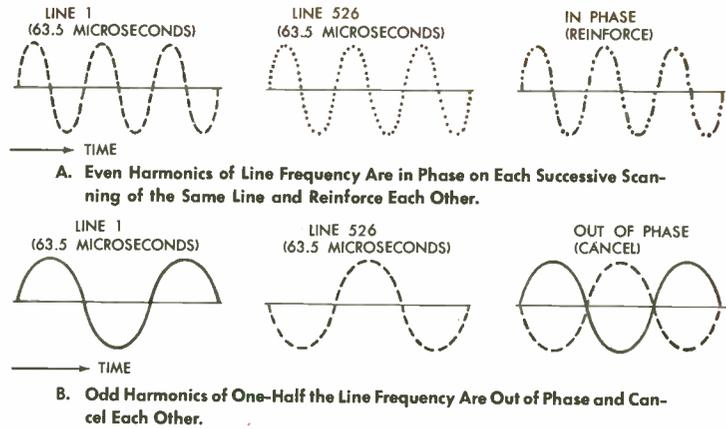


Figure 2. Cancellation of the Chrominance Information.

455th harmonic of one-half the line-frequency (15,750 cycles). This would set the subcarrier as being 3.583125 megacycles. This frequency was satisfactory until a consideration of the sound carrier was made. It was found that when this frequency was employed, an objectionable 0.9 megacycle (approx.) beat signal, resulting from the difference of the 4.5 megacycle sound carrier and the 3.583125 megacycle color subcarrier, was very evident. It was felt that in some monochrome receivers there is not enough attenuation of the sound carrier to eliminate the not-

iceable 0.9 megacycle beat. Therefore, since it would not be wise to change the sound carrier it was decided to lower the subcarrier frequency.

It was calculated that the 286th harmonic of the horizontal frequency (15,750 cycles) is 4.5045 megacycles. Since 4.5045 megacycles is relatively close to the sound carrier it was decided to use the 286th harmonic in determining the new horizontal frequency which, in turn, could be used in determining the new subcarrier frequency. Therefore, the new horizontal

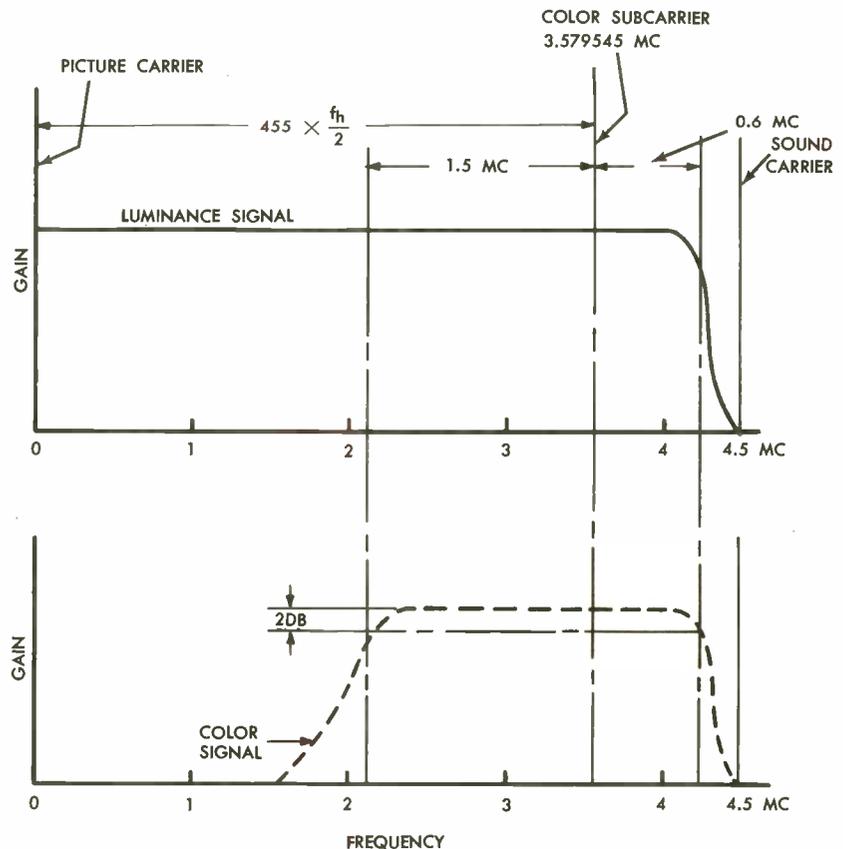


Figure 3. The Complete Video Spectrum of the NTSC Signal.

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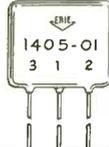
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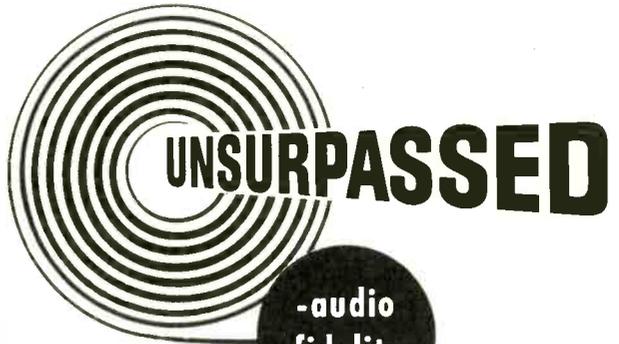


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frequency was calculated by dividing the 4.5 mc signal by 286 or:

$$f_h = \frac{4.5 \times 10^6}{286} \text{ cycles per second}$$

$$= 15,734.26 \text{ cycles per second}$$

A new field frequency becomes evident when employing a horizontal frequency of 15,734.26 cycles per second. With the number of lines per frame remaining as 525 the new field frequency now becomes.

$$f_f = \frac{f_h}{525/2}$$

$$= \frac{15,734.26}{525/2}$$

$$= 59.94 \text{ cycles per second}$$

The subcarrier frequency is then defined as being equal to the 455th harmonic of one-half the horizontal frequency ( $f_h$ ).

$$f_s = 455 \frac{f_h}{2}$$

$$= 455 \times \frac{15,734.26}{2}$$

$$= 3.579545 \text{ megacycles per second}$$

It is important to note that the new values derived for  $f_h$  and  $f_f$  differ from the nominal values now used for monochrome transmission by only 0.1 per cent. This percentage is well within the allowable tolerance of 1 per cent for proper operation.

The chrominance subcarrier frequency had to be made high enough so that it would be less likely to interfere with the luminance signal. Therefore, in the monochrome receiver, any dot structure resulting from the presence of the subcarrier will be as fine as possible. On the other hand, the subcarrier frequency had

to be made as low as possible so that the upper sidebands of the chrominance subcarrier will fall within the useful video band. It has been determined that the spectrum of the chrominance signal needs to extend only to frequencies lying approximately 0.6 megacycles above the subcarrier. Since it is practical to obtain bandwidths of approximately 4.2 megacycles in transmitters and receivers, the subcarrier of 3.579545 megacycles can be employed with proper results.

#### Color Burst -

The color burst follows each horizontal pulse and is located on the back porch of each blanking pedestal. The burst is omitted following the equalizing pulses and during the broad vertical pulses. See Figure 4 for the NTSC specifications for the location of the color burst. The burst is shown in the form that it appears at the point where it is generated and not as it appears after it is passed through bandwidth-limiting circuits. The tolerance on the frequency shall be 0.0003 per cent with a maximum rate of change of frequency not to exceed 1/10 cycle per second per second. The dimensions specified for the burst determine the times of starting and stopping the burst, but not its phase. Dimension "P" represents the peak-to-peak excursion of the luminance signal, but does not include the chrominance signal.

The subcarrier is placed on the back porch of the blanking pedestal because at this position it will be above the black level of the composite video signal and will not produce unwanted brightness on monochrome receivers. If it were located at a lower level, the color subcarrier would produce undesirable spurious picture tube light

during retrace time, particularly on receivers that don't have horizontal blanking signals applied to the picture tube.

The burst is so located on the blanking pedestal as to provide an adequate allowance for a back-back porch. The gap between the horizontal synchronizing and the color synchronizing pulses is rather narrow but is considered to be adequate enough to allow proper transmission.

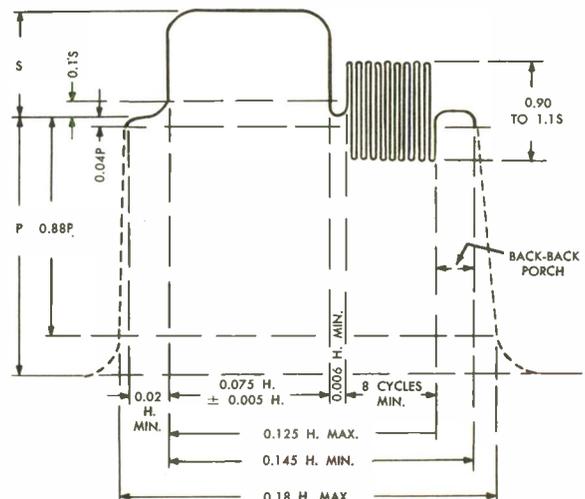
#### Synchronizing the Monochrome Receiver -

As has been discussed previously, the chrominance information of the color signal is eliminated and the luminance information is undisturbed when the combined signals are being received on a monochrome receiver. This is one of the criteria for a compatible color system. Another criterion is that the color synchronizing signal must not interfere with the operation of the horizontal system of the monochrome receiver. This is accomplished by placing the color burst on the back porch of the horizontal blanking pedestal, as is shown in Figure 4. By this method the horizontal synchronizing pulse is unchanged and will trigger the horizontal oscillator of the monochrome receiver as it normally does during the conventional monochrome transmission. The horizontal system in the receiver is so designed that it is immune to any noise or pulse that occurs immediately after it is once triggered. Therefore, the color burst has no effect on the triggering of the horizontal oscillator. The horizontal scanning frequency of the NTSC color system is 15,734.26 cycles per second, which is slightly lower than the present standards for monochrome transmission. However, this frequency is well within

(Right) Figure 4. NTSC Specifications for the Location of the Color Burst.

#### NOTES

1. The radiated signal envelope shall correspond to the modulating signal of the above figure, as modified by the transmission characteristics of specification number 6.
2. The burst frequency shall be the frequency specified for the chrominance subcarrier. The tolerance on the frequency shall be  $\pm 0.0003\%$  with a maximum rate of change of frequency not to exceed 1/10 cycle per second per second.
3. The horizontal scanning frequency shall be  $\frac{2}{455}$  times the burst frequency.
4. Burst follows each horizontal pulse, but is omitted following the equalizing pulses and during the broad vertical pulses.
5. Vertical blanking 0.07 to 0.08V.
6. The dimensions specified for the burst determine the times of starting and stopping the burst, but not its phase.
7. Dimension "P" represents the peak-to-peak excursion of the luminance signal, but does not include the chrominance signal.



the tolerance of 1 per cent which is allowed for proper operation. How efficiently the monochrome receiver will operate during color transmission will depend upon the degree of tolerance of the horizontal system designs. Since the color bursts are not incorporated after the equalizing or vertical pulses, the vertical section of the monochrome receiver will operate equally well on a color or black and white signal.

Specifications for Field Test of NTSC Compatible Color Television -

Following are some of the specifications used for field testing the NTSC Compatible Color Television System. Note the similarity of each of the specifications with those currently being employed for black and white telecasting.

1. The image is scanned at uniform velocities from left to right and from top to bottom with 525 lines per frame and nominally 60 fields per second, interlaced 2-to-1.

2. The aspect ratio of the image is 4 units horizontally and 3 units vertically.

3. The blanking level is fixed at 75 per cent ( $\pm 2.5$  per cent) of the peak amplitude of the carrier envelope. The maximum white (luminance) level is not more than 15 per cent nor less than 10 per cent of the peak carrier amplitude.

4. The horizontal synchronizing pulses are to be modified as shown in Figure 4 in order to provide color synchronization.

5. An increase in initial light intensity corresponds to a decrease in the amplitude of the carrier envelope (negative modulation).

6. The television channel occupies a total width of 6 mc. Vestigial-sideband amplitude-modulation transmission is used for the picture signal in accordance with the FCC Rules cited in Specification 4, above.

7. The sound transmission is by frequency modulation, with maximum pre-emphasis in accordance with a 75-microsecond time constant. The frequency of the unmodulated sound carrier is 4.5 mc  $\pm 1000$  cycles above the frequency of the main picture carrier actually in use at the transmitter.

8. The radiated signals are horizontally polarized.

9. The power of the aural-signal transmitter is not less than 50 per cent nor more than 70 per cent of the peak power of the visual-signal transmitter.

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**Horizontal Output Transformer Replacement**

(Continued from page 17)

close terminal connections for best matching between the new transformer and the original yoke. In other instances the technician is referred to a particular schematic out of several which are packed with the replacement transformer being recommended. In case information of this nature is not furnished, a trial-and error method of securing proper matching may have to be adopted.

Returning to the field experience with the RCA 232T1, we find that the service technician was referred to one of several schematic diagrams on the instruction sheet with that transformer. This schematic has been reproduced in Figure 9. By following this diagram, the technician was assured of obtaining near optimum performance from the replacement transformer in this particular application.

Now, with a clear idea of what lay ahead, the technician began the actual replacement. First, he dis-

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connected the width coil and fuse connections so that the high voltage cage could be removed from the chassis and set out of the way. Then he proceeded to disconnect the original transformer, noting on the receiver's schematic the respective colors of the leads (See Figure 7) for identification purposes. Before the old transformer could be removed, the filament connections to the 1B3GT socket had to be unsoldered. The 3.3 ohm filament dropping resistor, encased in its insulating sleeve (See Figure 8), was removed from the original transformer and wired in series with the RCA 232T1 high voltage filament winding.

Two new holes were drilled in the receiver chassis for mounting the replacement transformer. For convenience in mounting, the terminal board of the transformer faced the side of the chassis rather than the rear as was the case with the original transformer. Where necessary, extensions were spliced to the existing leads to facilitate the required connections.

Only one underchassis change was needed. In the original wiring arrangement, the brown lead from the yoke had been tied in to the B+ boost line beneath the chassis; now

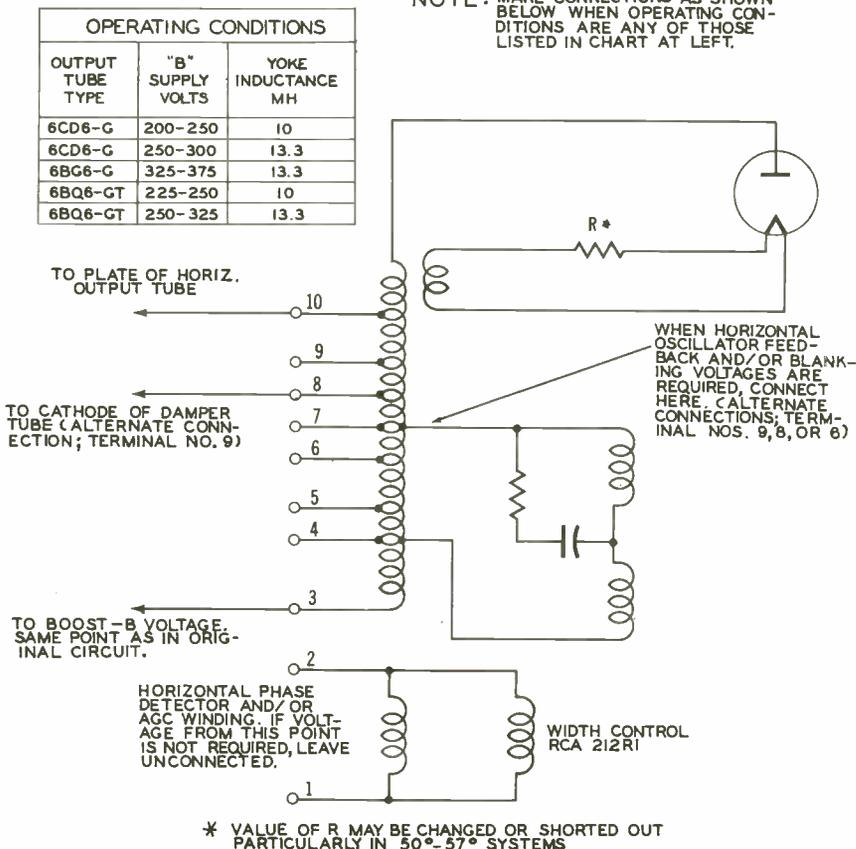


Figure 9. One of Several Schematic Guides Packed with the RCA 232T1 Horizontal Output Transformer.

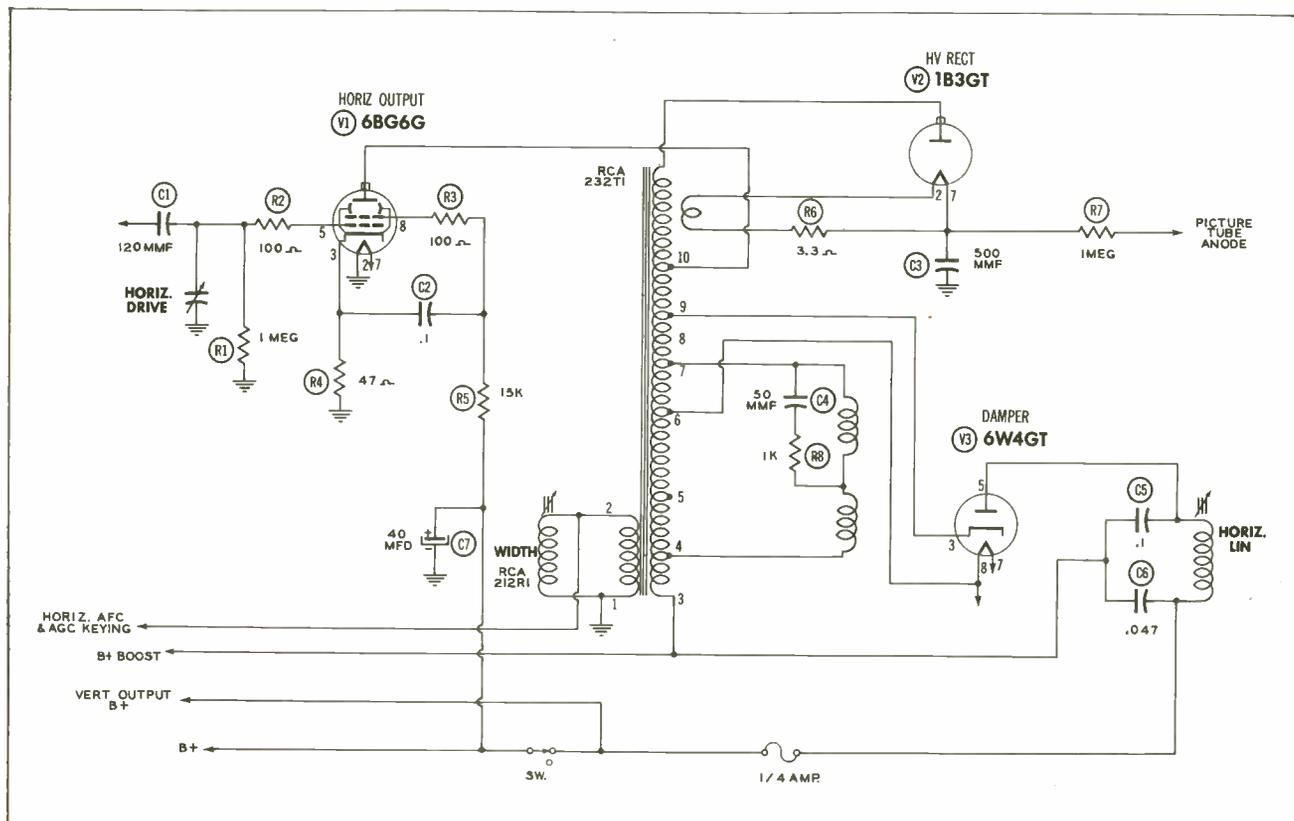


Figure 10. Schematic of Horizontal Deflection Output Section After Transformer Replacement.



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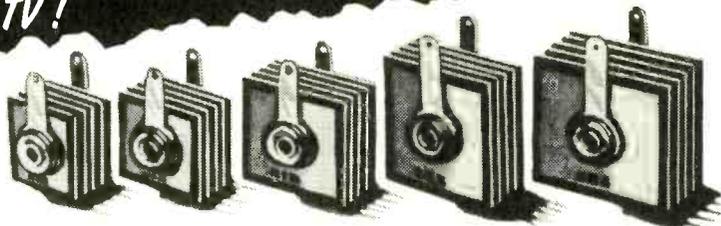
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8Y1	1/2" sq.	5/16"	130	380	20 MA*
16Y1	1/2" sq.	1/4"	260	760	20 MA*
8J1	1 1/4" sq.	5/16"	130	380	65 MA
5M4	1" sq.	1/4"	130	380	75 MA
5M1	1" sq.	3/8"	130	380	100 MA
5P1	1 1/8" sq.	3/8"	130	380	150 MA
6P2	1 1/8" sq.	1 1/8"	156	456	150 MA
5R1	1 1/2" x 1 1/4"	7/8"	130	380	200 MA
5Q1	1 1/2" sq.	1 1/8"	130	380	250 MA
6Q1	1 1/2" sq.	1 1/8"	156	456	250 MA
6Q2	1 1/2" sq.	1 3/8"	156	456	250 MA
6Q4 (+)	1 1/2" sq.	1 1/8"	130	380	300 MA
5QS1	1 1/2" x 2"	1 1/8"	130	380	350 MA
6QS2	1 1/2" x 2"	1 1/4"	156	456	350 MA
5S1	2" sq.	1 1/8"	130	380	500 MA
6S2	2" sq.	1 3/8"	156	456	500 MA

\* This rectifier is rated at 25 MA when used with a 47 ohm series resistor.  
(+) Stud mounted—overall: 2"

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it was necessary to remove this yoke lead and bring it up through the chassis bed into the high voltage compartment to terminal #4 on the RCA 232T1. The remaining transformer connections were made as shown in the schematic of Figure 10. The new width coil (RCA 212R1) was used in the same mounting as the original width coil, and connections to the fuse and width coil were made after the high voltage cage was replaced. In soldering the filament leads to the 1B3GT socket, care was observed so as not to create the sharp points which invite corona discharge troubles. Once all the connections were completed, the tubes were placed in their respective sockets and the set was turned on.

Figure 11 is a photograph showing the completed replacement.

### SECURING SATISFACTORY OPERATION

The receiver operated from the moment it warmed up. Some adjustments on the width coil, the horizontal linearity coil, the horizontal drive trimmer, and the centering device were required; but

after these were made, a very acceptable picture was obtained. Measurements were taken of the voltage at various points in the deflection system. The screen voltage on the 6BG6G horizontal output tube was found to be slightly high --310 volts as compared to the 282 volts which was the specified value of voltage at this point. On the other hand, the B+ boost voltage was a trifle low. 610 volts was found on terminal #3 of the RCA 232T1 as compared to 670 volts originally available as B+ boost.

Both of the alternative connections (terminals #8 and #9 specified in Figure 9) for the damper cathode lead were tried. Little difference in boost voltage was noted between the two, so the connection was left at terminal #9.

Concerning the screen voltage on the 6BG6G output tube, some circuits draw from the B+ boost supply for this voltage. In these receivers it may be necessary to vary the value of the screendropping resistor in order to attain the proper screen voltage. This is particularly true in

those instances where, as a result of the transformer replacement, the boost voltage might be appreciably changed from its original value.

Returning to the field experience under discussion, the presence of a satisfactory picture, properly framed on the screen, indicated to the technician that the polarity of the pulse voltage for AGC keying and horizontal AFC was correct. Had RF-IF overloading and horizontal phase displacement of the picture (evidenced by a vertical black bar near the center of the screen) occurred, the trouble would have probably been due to incorrect polarity of this pulse voltage. The remedy would have been to reverse the feedback connections on terminals #1 and #2 of the replacement transformer.

The high voltage was checked with a voltmeter and high voltage probe at the 500 mmf. capacitor. With the picture brightness turned completely down, the voltage was 13 kilovolts. This dropped to 11.4 kilovolts with the brightness at maximum. Although the voltage was somewhat low, the picture tube appeared to function satisfactorily with only a slight blooming at maximum brightness.

By way of summary, the major considerations which should be observed when replacing horizontal output transformers can be grouped in two categories--mechanical and electrical. The mechanical is principally one of selecting a transformer to meet the space limitations and of mounting it properly with regard to high voltage precautions and structural rigidity. The electrical considerations are more numerous, the chief ones being (1) the identification of the new transformer's terminals, often numbered differently from those on the original transformer; (2) the selection of windings or portions of windings for proper feedback voltages; (3) the choice of, and connections to a width coil; and (4) the selection of transformer taps for satisfactory impedance matching to the horizontal deflection coils. Once these requirements are met, the problem of transformer replacement is substantially overcome.

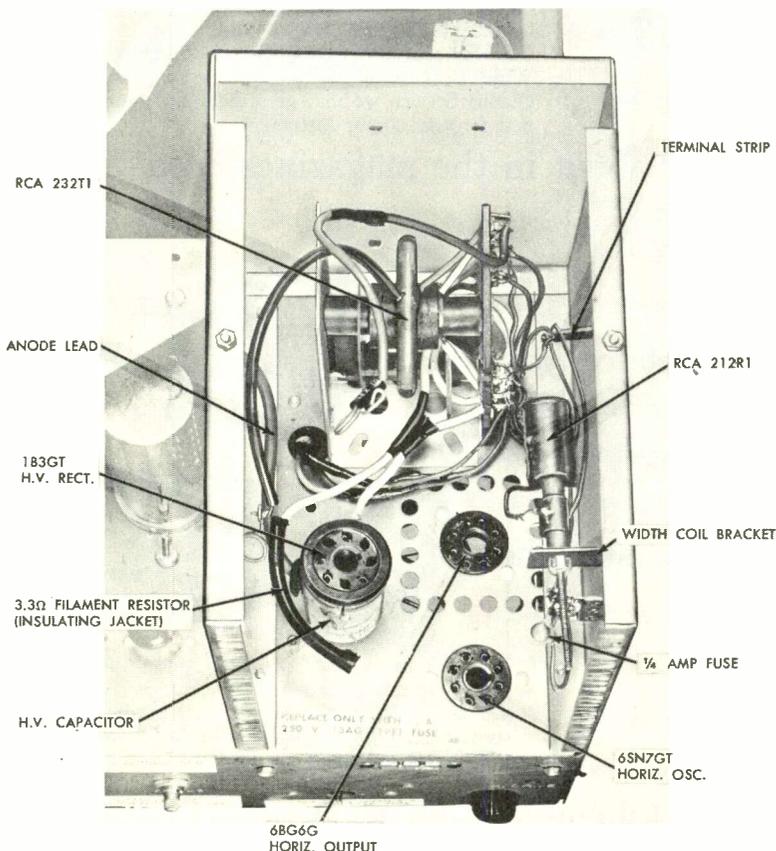


Figure 11. High Voltage Compartment After Transformer Replacement.

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## Transistors

(Continued from page 13)

junction is biased in the reverse or high resistance direction and only a small current will flow.

With  $S_1$  closed and  $S_2$  open, a fairly high current will flow in the emitter circuit as indicated on  $M_1$ . Compare the circuit, E to B, with Figure 4B. This junction is biased in the forward or low resistance direction and current flow will be limited only by the external circuit resistance.

Now let us consider the control which the emitter circuit has on the current flowing in the collector circuit. With  $S_2$  closed and current flowing in the collector circuit, close  $S_1$ . The collector current will increase considerably. As electrons are withdrawn from the crystal by the emitter, holes are left in the crystal. These holes (positive charges) drift toward the collector under the mutual attraction of their positive charge and the negative potential applied to the collector. As they approach the collector field, they increase the collector current in three ways. First, they form a space charge of positive charges about the

collector area and attract electrons from other portions of the crystal to add to the collector current. Second, they form a current path from collector to emitter as electrons are drawn from the collector by the holes injected by the emitter. This current flows around the outer circuit shown in Figure 6 and completely by-passes the base connection. Third, a portion of the emitter voltage is added in series with the collector circuit to further increase the collector current. Thus, by these three methods, an increase in emitter current produces a greater increase in collector current. The ratio of the change in collector current to the change in emitter current is called the current gain or alpha, and, in commercially built transistors, may reach a maximum of 3 or 4.

There is a second type of transistor currently being manufactured, namely the junction type. This consists of a single crystal of germanium, the ends of which have N-type conductivity, and the center having P-type. This is commonly called an N-P-N junction transistor. To this crystal are attached three connections, one to each of the three sections, and all of a low resistance type. There are no cat-whiskers in

this unit. Note in the sketch of Figure 7 that current in the collector depends on free electrons from the base. Since the base is P-type there are no electrons or N-carriers, thus the collector is biased in the reverse or high impedance direction. Current in the emitter circuit depends on P-carriers from the base; therefore, as the base is P-type, current will flow, and the emitter is biased in the forward direction. The emitter need be made only a fraction of a volt negative to cause the free electron (A) to flow from the emitter into the base. This electron, when it crosses the N-P barrier (position 1), fills the hole in the boron atom. This hole is normally on the emitter side of the boron atom due to the attraction toward the negative potential on the emitter. The boron atom, having a positive charge of only 3, cannot hold more than 3 valence electrons. The extra electron is attracted by the positive charge on the collector and crosses the P-N barrier (position 2). Since the collector itself has an extra electron (B), it is replaced by the new electron and flows out through the collector output circuit (position 3). The hole in the collector side of the boron atom returns to the emitter side (position 4), and is thus

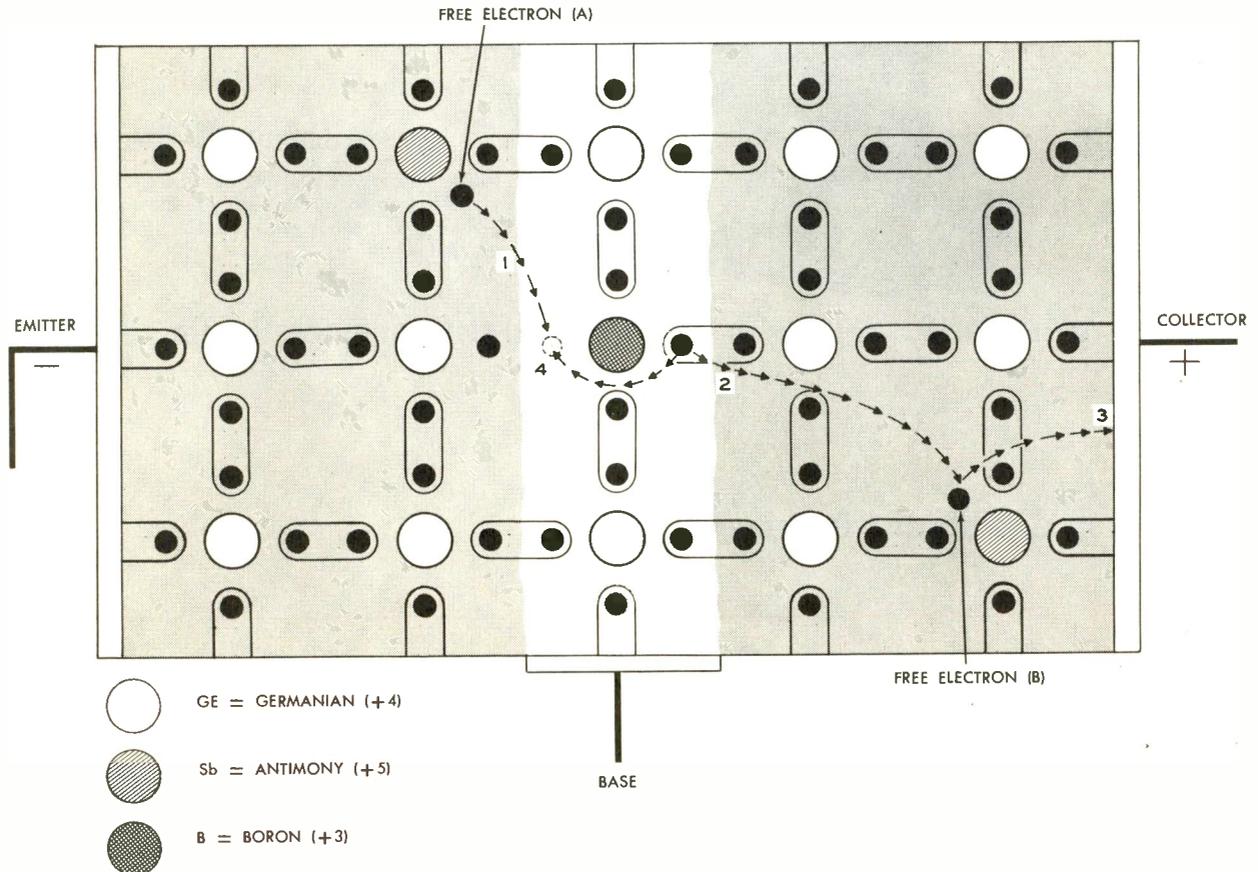


Figure 7. Enlarged Portion of Junction Transistor Showing Carrier Action.

ready for the next electron coming from the emitter. As one electron from the emitter releases only one electron to the collector, there can never be a current gain in the junction transistor. In actual practice, an alpha of .98 or .99 is the highest that can be achieved when the input circuit is to the emitter and the output circuit from the collector. By transposition of the transistor elements in the circuit, it is possible to attain a current gain larger than unity.

The junction transistor can also be made as a P-N-P unit. In this case, the battery polarities will be reversed, and the transistor action will depend on the holes traversing from emitter to collector.

Figure 8 is intended to present a clearer picture of the method by which power and voltage gains are achieved, even when the current gain is less than one, as in the case of the junction transistor. As mentioned previously, the emitter and the collector circuits have different impedance values, and in this circuit there is an increase of impedance from emitter to collector. Figure 8 illustrates the basic circuitry for either a point-contact or a P-N-P junction transistor.

$E_1$ , which is the signal to be amplified, is inserted in series with the emitter circuit. The current in the collector circuit (through  $R_2$ ) is similar in waveform to the emitter current but it has a different mag-

nitude. To understand how a power or voltage gain has been achieved, consider the circuit impedances.  $R_1$  has been matched with the emitter impedance for the most favorable input current.  $R_2$  has been matched to the collector impedance for the highest value of  $E_2$  and the most efficient value of collector current. Typical input-output impedance ratios in this circuit would be 400 : 20,000 ohms for the point contact transistor and 100 : 10,000,000 ohms for the junction type. It can be seen that a substantial voltage gain can be achieved even when alpha is less than unity.

A comparison can be made between respective elements of triode tubes and triode transistors as shown in Figure 9. Each circuit has its own characteristics as follows:

9 (a) The input impedance is low, output impedance is high and there is no phase reversal through the amplifier. Gain of the transistor circuit is moderate; about 20 - 22 db is average.

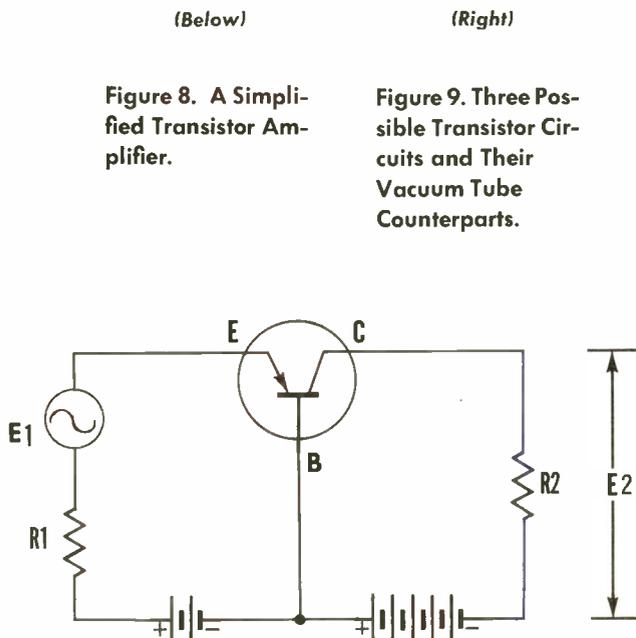
9 (b) Input impedance is higher than in the grounded base connection, and output impedance is lower. A phase reversal does occur through the amplifier, as in the related vacuum tube circuit. Gain of the transistor circuit is higher than in (a); averaging about 30 db.

9 (c) There is no phase reversal in this circuit and input impedance is much higher than the output imped-

ance. Unlike the equivalent vacuum tube circuit, a gain can be realized from the transistor circuit; an average value is about 12 db, considerably less than in the other two possible circuits. A unique characteristic of the point-contact transistor when it is utilized in this circuit occurs when the current gain (alpha) exceeds unity. The amplifier then will amplify signals going in either direction.

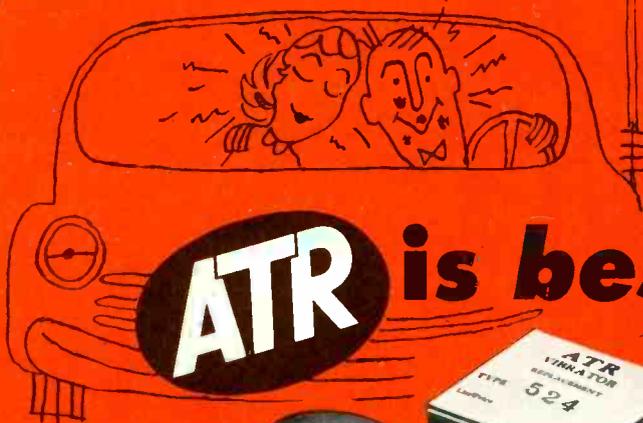
An attempt to evaluate the relative merits of transistors as compared to vacuum tubes brings forth many facts to warrant the statement that the transistor is still in its infancy and many other items seem to confirm that statement. Transistors have yet to be made with a noise factor approaching that of tubes. They are adversely affected by temperature changes - gain and resistivity both vary widely. Another reason for variation is high humidity, even going so far as to completely ruin the transistor. This trouble seems to have been eliminated through the use of hermetically sealed units. As of this date, the highest announced frequency that transistor oscillators have attained has been about 425 mc. This is still far below the upper frequency limit of vacuum tubes.

On the other side of the fence are many advantages in favor of the transistor. Their physical size is very minute as compared to the smallest tubes, approaching 1/10th cubic inch for some units. By virtue of



TRANSISTOR	VACUUM TUBE
<p>A</p> <p>GROUNDING BASE</p>	<p>GROUNDING GRID</p>
<p>B</p> <p>GROUNDING EMITTER</p>	<p>GROUNDING CATHODE</p>
<p>C</p> <p>GROUNDING COLLECTOR</p>	<p>GROUNDING PLATE</p>

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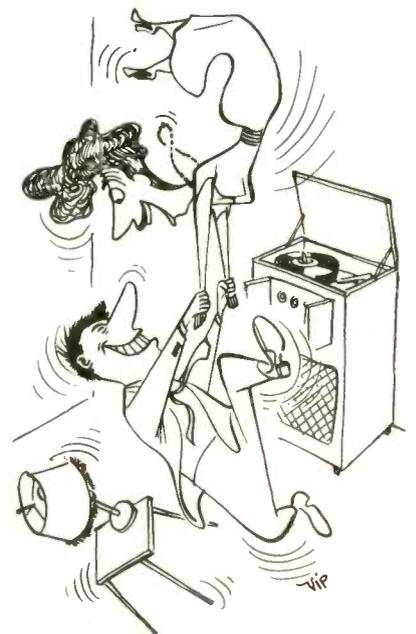
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their small size and simplicity of construction they can be subjected to extremely heavy shocks. Units have been built that can survive accelerations of 20,000 gravities, which is much more than any tube could possibly survive. The power requirements for the average transistor range from the microwatt level up to an, as yet, undetermined value; the actual power input being very much less than that needed by the smallest of the vacuum tubes. Perhaps the most advantageous viewpoint for the transistor is that of their estimated life --- approaching 70,000 hours.

\* \* \*

In order to acquaint the service technician with terms associated with transistor application and theory, a Glossary of Transistor Terms is presented on page 121 for ready reference.

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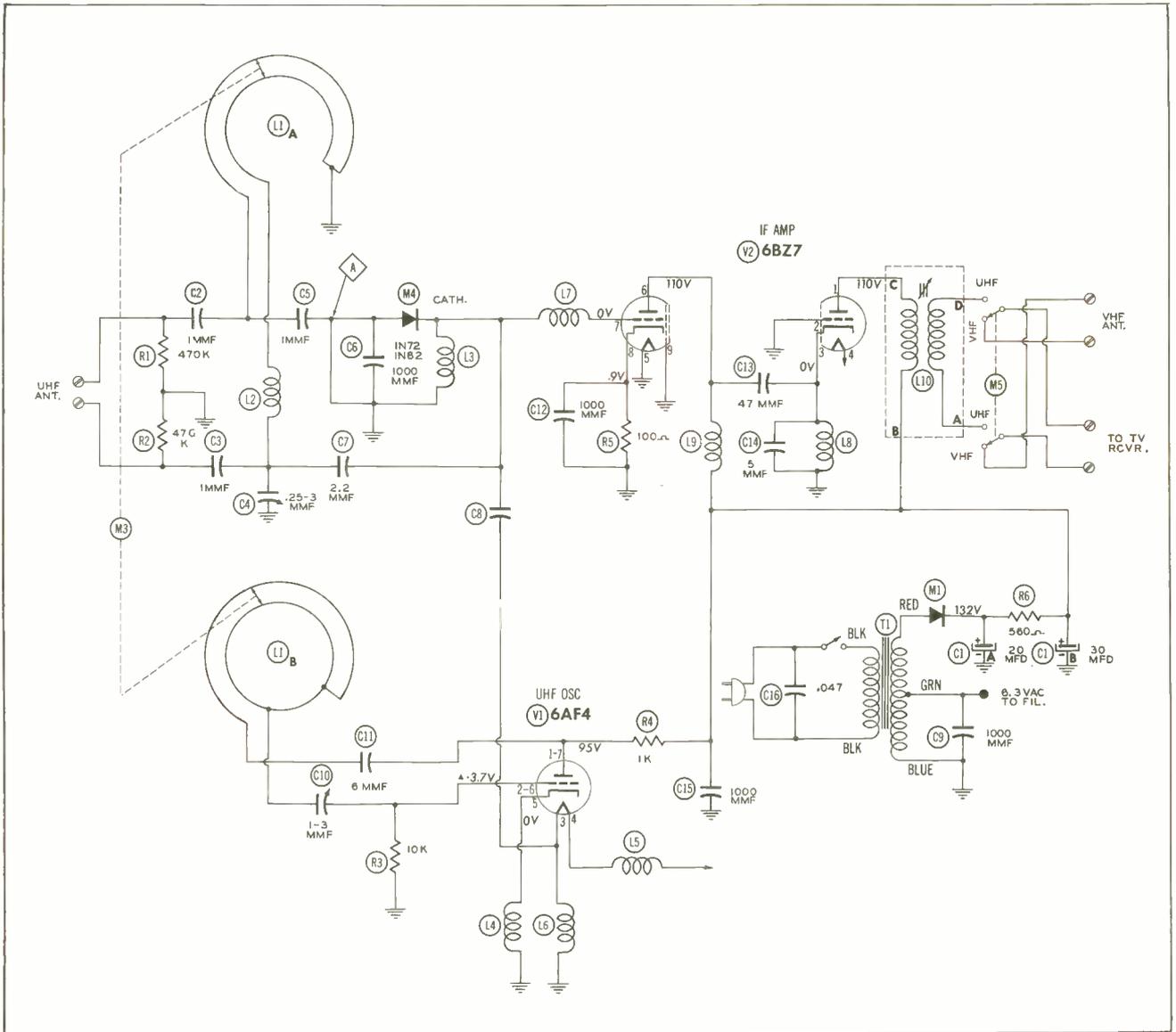


Figure 8. Schematic of Bogen UHF Converter (Model UCT).

point to ground. If a reading of between 1 and 4 milliamps is obtained, the crystal may be considered good. A defective crystal will usually indicate a reading outside this range.

Since this converter is adjusted at the factory for peak output at channel 6 it will be necessary in some instances to change this output to channel 5 in locations where VHF signals are normally received on channel 6. To effect that setting, tune in a UHF station with the television receiver set to channel 5 using the fine tuning control to obtain best reception. Connect a VTVM across the AGC line in the television receiver and turn the adjustment screw on the top of the converter's IF output transformer for maximum reading on the meter.

**Granco UHF Converter (Model CTU)**

The Granco Model CTU is a self-contained UHF converter design-

ed for use with any television receiver capable of tuning channel 5 or 6. Thus, a double conversion system is employed to change the frequency of an incoming UHF signal to the frequency of a receiver's video IF circuits.

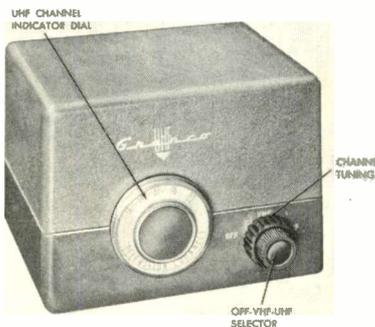


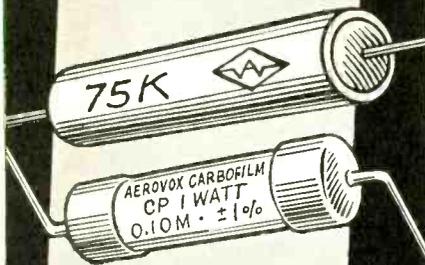
Figure 9. Granco UHF Converter Model CTU.

On the front of the cabinet is the UHF channel indicator dial graduated with channel numbers from 14 to 83 and shown in Figure 9. The selector knob and tuning knob are contained on a concentric shaft at the lower right front of the cabinet. Selector switch positions are OFF, VHF, and UHF.

On the back of the unit are the antenna terminal strips and the converter output terminals. In addition, an AC receptacle is available on the rear of the chassis for providing

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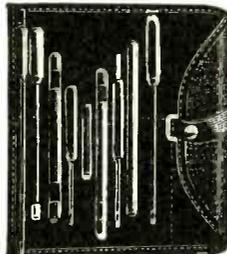
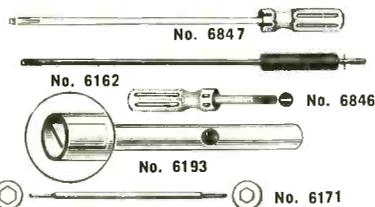
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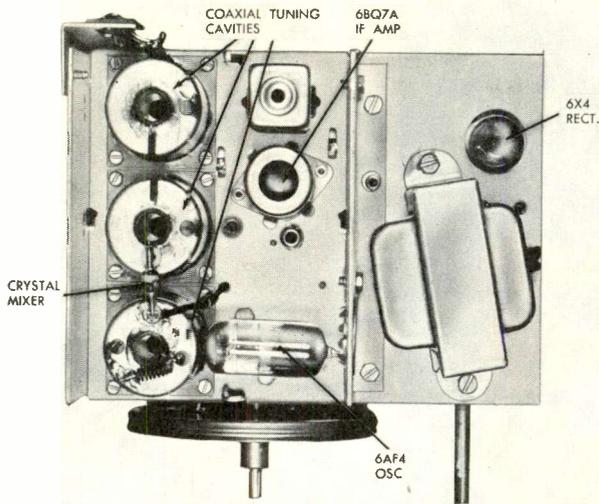


Figure 10. Top Chassis View of Granco Converter.

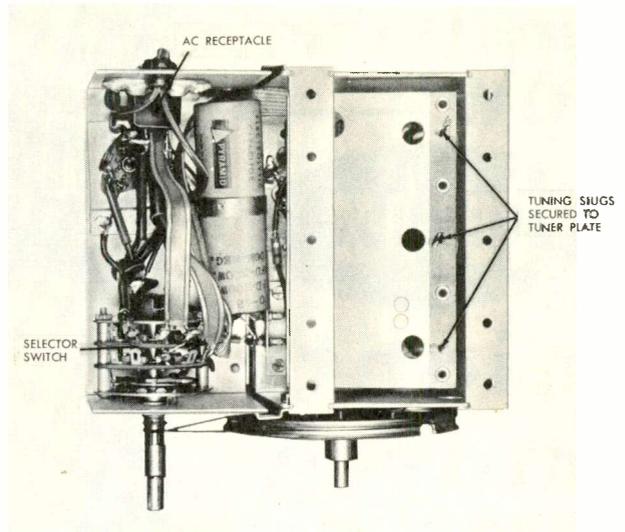


Figure 11. Bottom Chassis View of Granco Converter.

power to the television receiver. When this power source is used, the television receiver's on-off switch may be left in ON position and power to both converter and receiver controlled by the selector switch.

To install the Granco Converter, first remove the VHF antenna lead from the television receiver and connect to the terminals marked

"VHF ANT" on the rear of the converter. Connect a short lead of 300 ohm transmission line from the antenna terminals of the receiver to the converter terminals marked "TV RCVR". Connect a lead from the UHF antenna to the terminals marked "UHF ANT". The receiver's AC line cord plug may be inserted in the receptacle at the back of the converter and the converter plugged

into a wall socket. This completes the installation of the unit. Turn the receiver channel selector knob to channel 5 or 6. If one of these positions is used to tune in a local or strong VHF signal, the other position should be used to accept the converter output. The converter selector switch is turned to UHF position, allowing a minute or so to stabilize its operation. UHF channels may

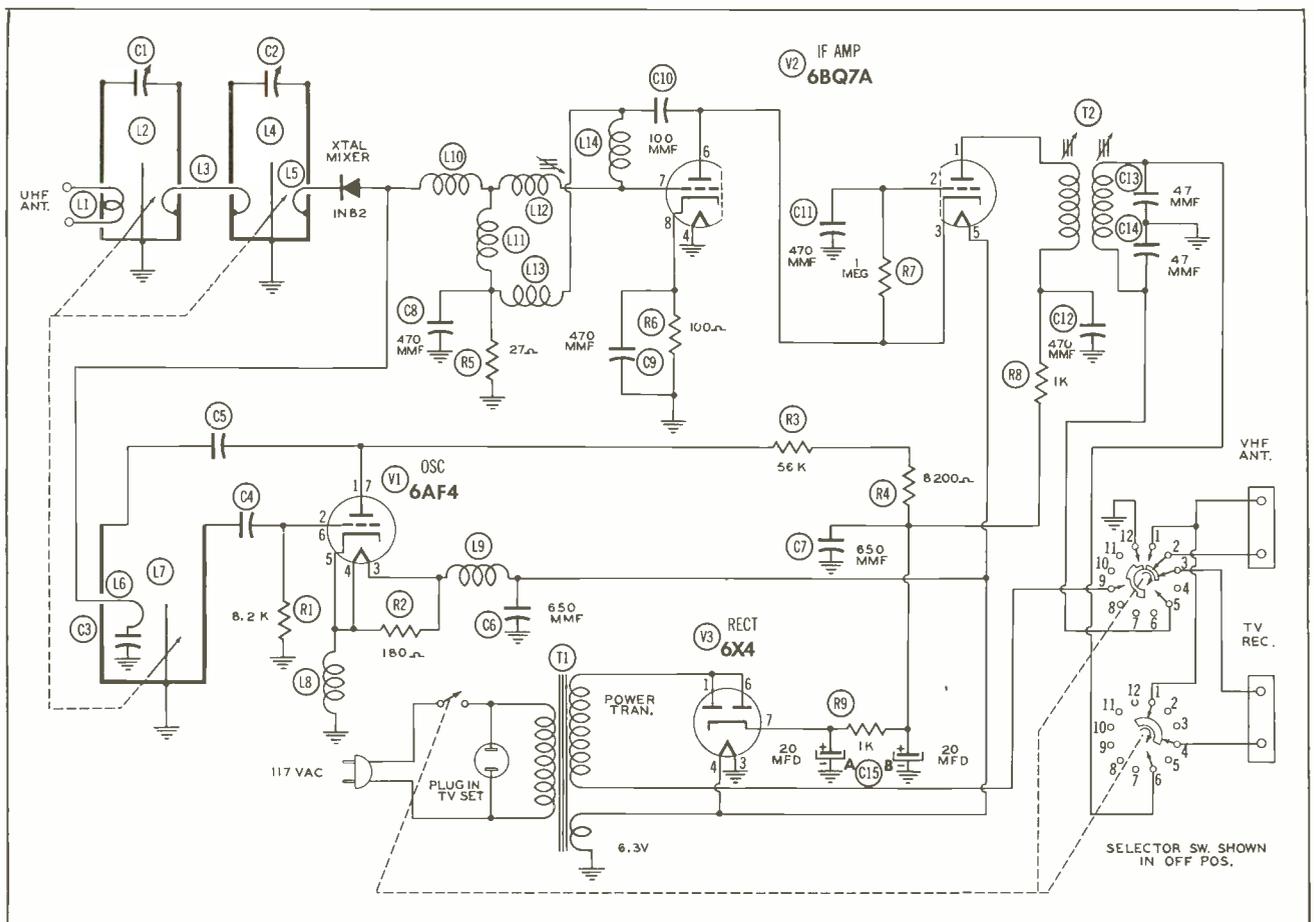


Figure 12. Schematic of Granco Converter.

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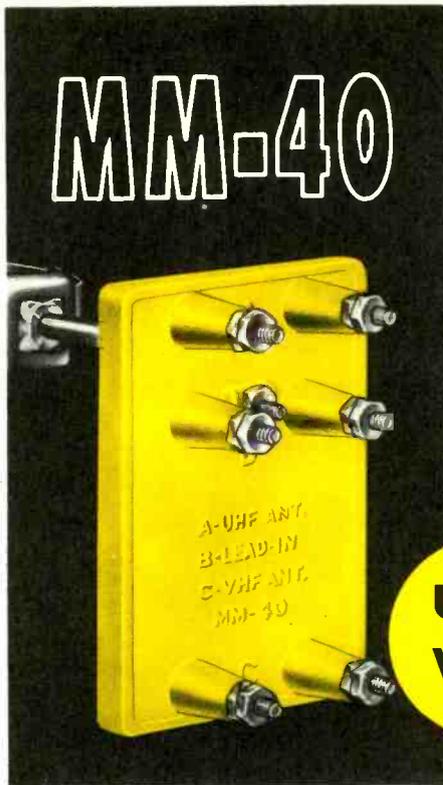
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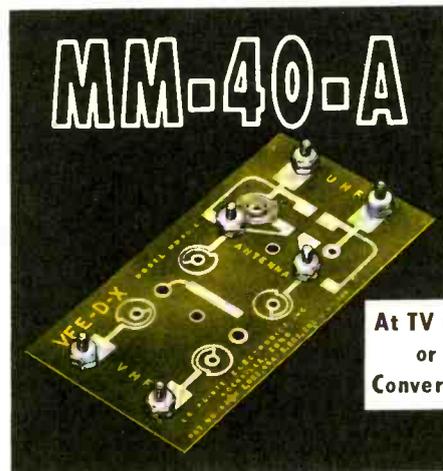
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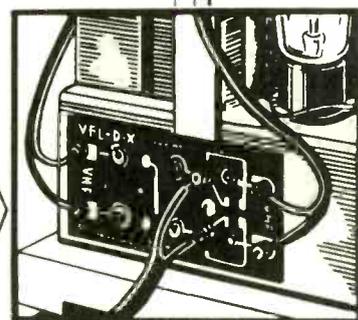


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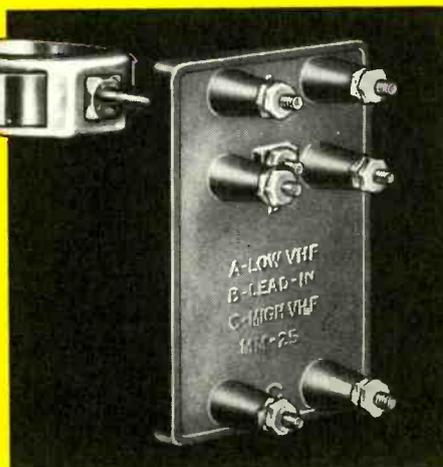


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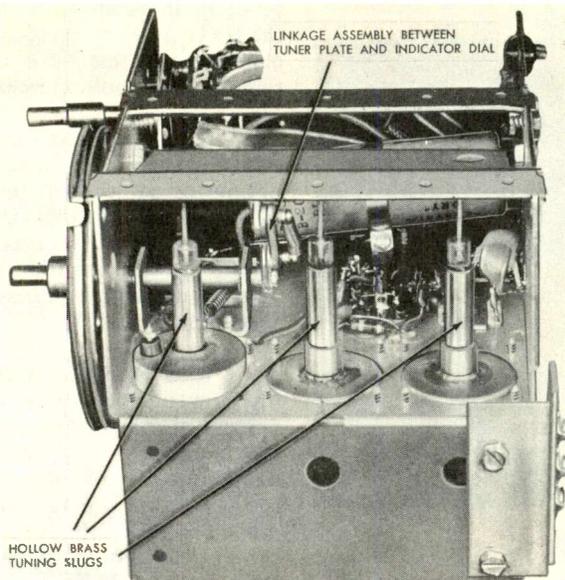


Figure 13. Tuning Slugs Attached to Tuner Plate.

then be tuned in with the converter channel selector knob. In some instances, the fine tuning control on the television receiver may be adjusted for best performance. The remaining operating controls of the receiver should be treated in the same manner as when receiving VHF signals.

The operation of the unit in conjunction with a television receiver is as follows:

**OFF POSITION -**

Power to the converter and to the AC receptacle on the back of the unit is turned off. The VHF antenna is connected through the selector switch to the antenna input of the receiver.

**VHF POSITION -**

Power to the receptacle and to the converter filaments is turned on. The antenna connections remain the same as in OFF position.

**UHF POSITION -**

B+ power is also applied to the converter. The VHF antenna lead is shorted to ground and the converter output is connected through the switch to the antenna input terminals of the TV receiver.

A top chassis view of the converter is shown in Figure 10. The tuner compartment shield is removed so that components in this section may be observed. Note that the 6AF4 oscillator tube socket is mounted directly into the coaxial cavity making up the oscillator circuit.

This allows the use of very short connecting leads and at the same time restricts oscillator radiation.

Should it become necessary to inspect or replace components in the tuner section above the chassis, the tuner compartment shield is lifted off by pressing against the two ends which frees the two ears holding the shield in place. Available in this section are the crystal mixer, IF amplifier (type 6BQ7A), and 6AF4 oscillator tube. To facilitate the removal of the oscillator tube, a plug opposite the end of the tube is first removed, allowing the oscillator tube to be lifted out. This plug has a dual function. It not only provides access to the oscillator tube, but also presses against the tip of the tube, holding it firmly in place.

A bottom chassis view of the Granco Converter is shown in Figure 11. In this photo may be seen the selector switch, 300 ohm connector leads, AC receptacle, filter capacitor, and a large metal plate to which the tuning slugs are attached. Figure 13 better illustrates the components contained in the tuner section below the chassis. A linkage assembly is attached between the tuner plate and the channel indicator dial.

The three tuner slugs connected to the tuner plate operate in a somewhat different fashion to achieve tuning as compared to the usual manner. In this instance, the tuning slugs, formed of hollow brass material, function as the tuning members of the tuned circuits to control the resonant frequency of the coaxial cavity sections.

A schematic for the Granco Converter is shown in Figure 12. L2,

L4, and L7 are the three coaxial type tuning elements. UHF signals are fed to L2 where they are tuned and then link coupled to L4 where additional tuning occurs. Thus, the circuits of L2 and L4 form a double-tuned preselector for achieving a maximum of selectivity consistent with the required bandwidth.

The crystal mixer, type 1N82, is coupled between the preselector output and the oscillator tuned line, L7. The heterodyne action at the crystal provides an intermediate frequency signal to the input of the amplifier stage. The IF amplifier, employing a dual triode 6BQ7A tube, functions in a cascode-type circuit and is used particularly for its efficient performance in this application. Transformer coupling the output from the amplifier stage through the selector switch provides a 300 ohm balanced output to the terminal strip at the back of the unit. However, if desired, an unbalanced output is possible by connecting an unbalanced line between the ground connection and either of the remaining two terminals on the converter output terminal strip.

The power supply built into the Granco Converter consists of a power transformer, rectifier tube type 6X4, a filter resistor, and a dual filter capacitor. Note in the schematic (Figure 13), that the low side of the power transformer's high voltage secondary winding is connected to the selector switch while the filament winding connects directly to the tube filaments. This permits the tubes to remain heated during VHF reception while disabling converter action. When the selector switch is turned to UHF position, the low side of the secondary winding is grounded, which applies B+ to the tubes.

It is recommended that servicing of this unit be confined only to that portion of the converter other than the tuning unit, with the exception of tube and crystal replacement. Should servicing in the tuner proper be indicated, which tube or crystal replacement does not solve, it is suggested that the entire unit be sent to the factory where the necessary facilities and equipment are available for this type of work.

MERLE E. CHANEY

and

GLEN E. SLUTZ

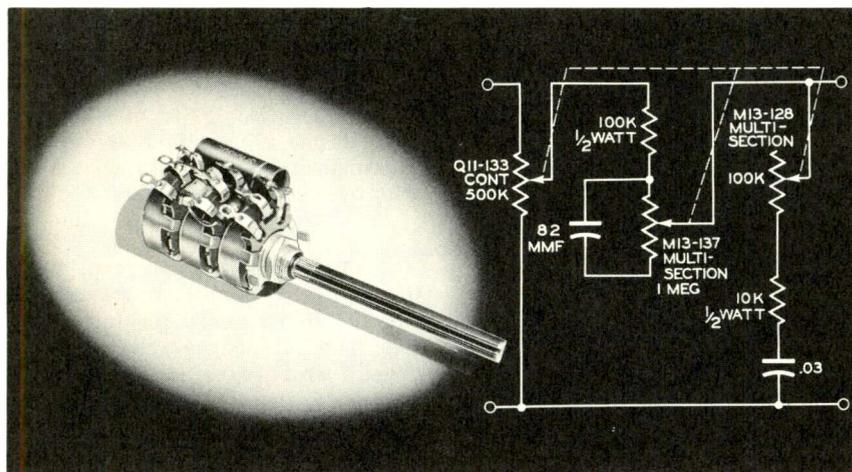


Figure 2. IRC LC-1 Loudness Control.

The term loudness itself can bear some explanation. In the field of acoustics the loudness of sound means something different than the intensity. Intensity is the actual physical measurement of the amount of sound but loudness is the sensation produced in the ear and usually measured relative to another sound. In simple words, how loud it actually sounds to the ear.

Maybe you can recall the old riddle "What is louder than a pig caught under a gate?" The answer of course was "two pigs." But if the question was changed to "What is twice as loud as a pig caught under a gate?", the answer of two pigs would not necessarily be correct due to the characteristics of the loudness of sound.

The loudness for one thing, would depend upon whether the two pigs squealed as Basso Profundos or as Coloratura Sopranos since frequency is a great factor. Also whether the pigs were "moaning low" or really bearing down with a boogie beat, as the intensity or level of the sound has a great effect upon the loudness. Additionally, to a certain extent the individual listening to the sound can hear the increase in loudness as being different than another would hear it. So; Susie, whose ear is tuned to hearing "Sweet nothings whispered in the moonlight," might say the second pig's squeal increased the sound a tremendous lot, while Johnnie, who can fall asleep on his job in the boiler factory, might not notice the difference.

Now all of this is in a facetious vein, but actually it illustrates why we have the pro and con discussions

on the desirability of loudness controls. Loudness is so much of a psychological thing and does depend upon frequency, intensity and the individual hearing the sound.

The characteristics of the human ear are responsible for the desirability of a loudness control. The sensitivity of the ear varies with frequency and intensity of the sound. This is illustrated by the often mentioned Fletcher-Munson curves shown in Figure 1. At a very high level (100 db) the full range of frequencies are heard most nearly balanced. At lower levels the ear is less sensitive to the extremely low and high frequencies. Thus, music played over a sound system at normal room level will sound deficient in bass and upper treble, if compensation is not used to boost these frequencies. A study of the curves shows that as the intensity of the sound decreases, the sensitivity of the ear to low and high frequencies also decreases, which indicates that unbalance varies with sound level.

The loudness control is designed to vary the compensation the necessary amount to maintain correct balance, as the control is varied through its range. When set to operate at low volume the bass and higher treble tones receive maximum boost; if set for high level output the boost is reduced to maintain loudness balance. Thus, balance can be had without varying tone controls as the volume is varied. Maintaining this balance is certainly important when listening to music.

One of the outstanding effects noticed when first operating a loudness control is that the increase in volume is not so apparent as the

level is increased. Evidently since the balance of frequencies is not changed, the increase in sound intensity is not so noticeable.

Since loudness controls are compensating and frequency discriminating devices, some things must be taken into consideration when incorporating one in a circuit, if maximum benefits are to be had. These usually do not present any great problems.

It is evident, after consulting the curves shown in Figure 1 that the amount of compensation furnished by the control is correct only at a certain degree of loudness. If necessary, a gain control should be employed to find this level. The gain control can then be set for the maximum volume ordinarily used and then the loudness control adjusted for the desired normal listening level. In the usual equipment the

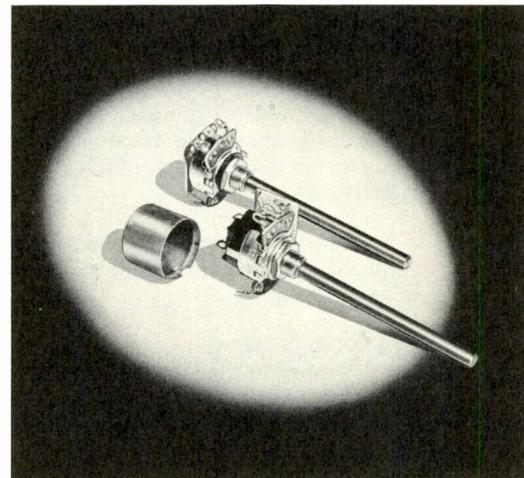


Figure 3

gain control can be the volume control of the tuner or tape recorder being used or the input control of a phono preamplifier.

Loudness controls should be connected into a circuit of correct impedance, as loading is important. Usually the source impedance will be indicated in the discussion of the application of a particular control. Also, since these are frequency compensating devices, they should not be installed within the feedback loop of an amplifier for the feedback will largely nullify the desired results.

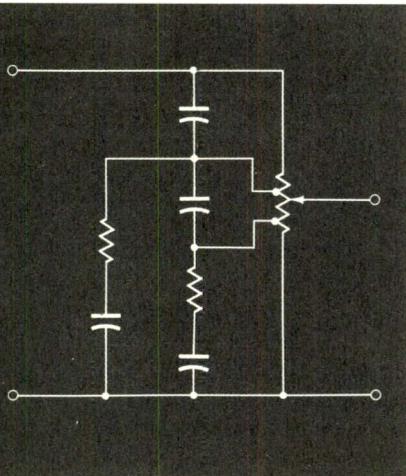
Originally the only loudness controls available were of the step type, such as shown in the heading of this article. This type is very satisfactory, particularly if a sufficient number of steps are included, but it is rather bulky and expensive due to the number of component

parts involved in its construction. Also, it seems the average user, especially in the home, prefers a continuous type control.

Several articles have been written on the construction of the step type control and modifications of it, which give many details of design, construction and operation (See listing at the end of article.).

### Continuous Type Loudness Control

The introduction of the IRC LC-1 Loudness Control shown in Figure 2, made available a small continuous type control at a very reasonable cost. It can be purchased as a complete unit or can be made up from standard parts. An on-off switch can be attached if needed and additional sections added, as in the preamplifier and control unit described in PF INDEX No. 33 Audio Facts article.



Centralab Compentrol.

As shown in the photo and schematic of Figure 2, the LC-1 is made up of three ganged variable sections with two fixed resistors and two capacitors. The first section acts as a volume control to select the amount of signal desired which is then fed through the 100,000 ohm isolation resistor to the frequency compensating sections.

Although the 100,000 ohm isolation or limiting resistor is included, the input impedance of the control is not constant at, or very near, maximum loudness position. For this reason it should not be installed in the plate circuit of a high impedance tube.

The LC-1 can be installed in many existing pieces of audio equipment by just using it to replace the original volume control. It does have an insertion loss of 6 db, thus in

some low gain circuits another stage of amplification may need to be added. If the normal listening level is at a setting of not too much over 50% of control rotation, however, no additional gain will be needed. The best operating position seems to be at about one third clockwise rotation. A separate gain control can be used to set the normal operating level at this position.

### Compensated Control

The Centralab Compentrol (Figure 3) has been developed to compensate for the characteristics of the ear. This small control is available in values of 500,000 ohms or one megohm and with or without an on-off switch. The Printed Electronic Circuit, visible in the photo, is a feature of this control, being an important factor in the satisfactory operation and low cost of the complete control. The small P.E.C. and the special taper variable section with two taps, form the network shown in the schematic of Figure 3. This results in continuous control of loudness with compensation following the Fletcher-Munson Curves very closely.

Since the Compentrol is small and has no insertion loss, it can be used to replace a volume control with no modification of the circuit. But, as is true with all such types of controls, if the sound level does not allow the control to operate over the correct range, a gain control must be used to make this adjustment possible. Centralab is introducing a Dual Compentrol (Figure 4) which has a gain control front section, for operation as a dual concentric control. This is a solution of the separate gain control problem since the gain section can be set by a simple adjustment of the outside shaft knob.

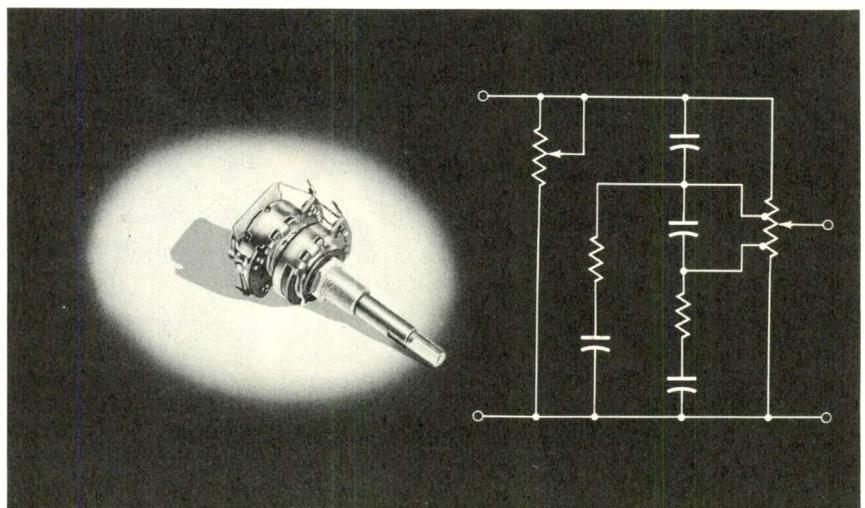


Figure 4. Centralab Compentrol with Concentric Gain Control Section.

When installing any of these controls, precautions should be taken to not overheat them when making soldered connections. Such overheating is a common cause of noisy controls. Care should be used to apply heat just long enough to make a good connection. Holding the control terminal lug between the body of the control and the point of soldering with a pair of long nose pliers while applying the heat, will aid in dissipating the unwanted high temperature.

The difference in operation of a familiar piece of equipment, after replacing the conventional volume control with one of the controls discussed, can be very obvious. With the sound output balanced, the characteristics of the amplifier involved seem to change. Of course, a loudness control must not be misused, but if correct adjustments are made and an understanding of what is to be accomplished is kept in mind, listening enjoyment can be greatly increased.

\* \* \*

References on Step Type Loudness Controls:

\* \* \*

"Loudness Control for Reproducing Systems" by David C. Bomberger, appearing in Audio Engineering, May 1948. (Also in Audio Anthology).

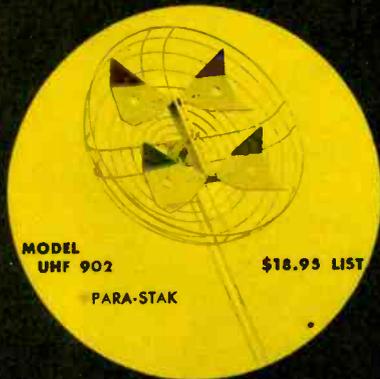
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"Full-Range Loudness Control", appearing in Audio Engineering, February 1949. (Also in Audio Anthology).

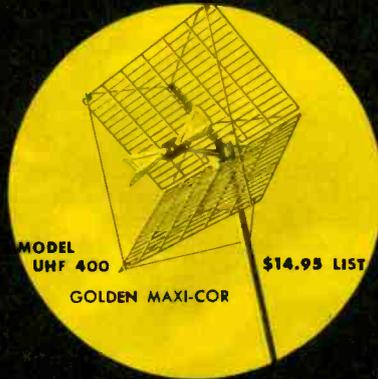
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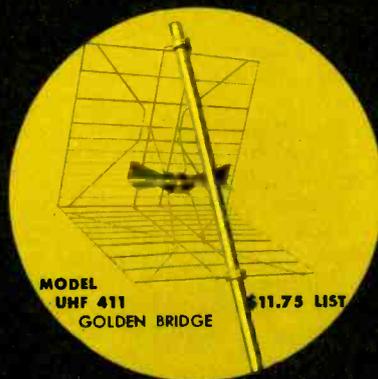
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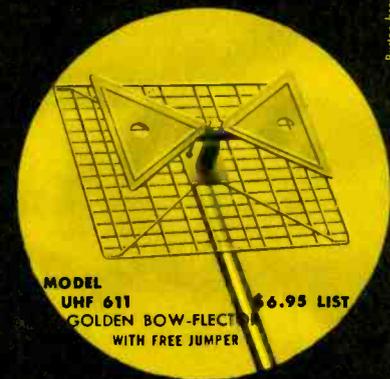
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## Adjustment Procedure for UHF Strips

(Continued from page 39)

adjustment of these UHF strips. Figure 2 shows a set of UHF strips showing these adjustment points, as well as other components.

Another adjustment which might be made to improve the performance is that of A2, which is in the second preselector circuit. Note that the mixer crystal is directly connected to L2. Thus the loading afforded by the mixer circuit might affect the resonance of L2 and A2. This adjustment then becomes the third step in adjusting the UHF strip. As previously stated, no adjustment should be made on A1 or A4 unless it is known that they have been tampered with.

Some dealers have adopted the policy of adjusting all UHF receivers employing standard coil strips before they are delivered to the customer. Since most receivers are designed so that the chassis must be removed from the cabinet in order to gain access to the tuner, it is quite easy to make the adjustment at that time.

The most satisfactory signal to use for making these adjustments is that of the transmitted signal. The first step is the connection of a VTVM to the AGC line of the receiver. This is used as the indicating device while making the adjustments. Rotate the tuner to the UHF position which is to be adjusted and remove two additional strips opposite the UHF strip as shown in the heading of this article. This will give access to the UHF coil slugs. There were a few of the early UHF strips delivered which did not have slots in both ends of the slugs. It might be well to check the strips before they are inserted into the tuner to be sure that the slugs are slotted on both ends. If they are not, they cannot be adjusted from the lower end. Refer again to the heading of this article, it can be seen that the coil slugs are accessible through the hole resulting from the removal of the VHF strips. They can be adjusted using a flexible alignment screw driver. These screw drivers are readily available in alignment kits or may be obtained separately. The units made of nylon seem to be most satisfactory for this application as they are quite flexible.

Before attempting to turn the adjusting slug, it is wise to use a metal screwdriver to "break loose" the slug. Failure to do so will usually result in damage to the nylon alignment screwdriver. After it is determined that adjustment is required on a particular slug, rotate the drum so that the UHF strip is accessible. Turn the slug very slightly with the metal screwdriver and turn it back as nearly as possible to its original setting. Rotate the turret so that the UHF strip is in use and make the necessary adjustment using the nylon screwdriver.

After the oscillator slug has been adjusted, A3, the harmonic generator circuit, should be adjusted for maximum deflection on the meter. Next adjust A2 for maximum deflection. All three of these steps should be repeated several times, in the order given, until no further improvement can be obtained. As was noted previously, it should not be necessary to adjust A1 or A4. If these units have been tampered with, it might be necessary to touch up their adjustment.

There are some cabinet designs that permit the adjustment of these slugs without removing the chassis from the cabinet. If, after delivery of the receiver, it is felt that the performance might be improved by adjustment of these slugs, the adjustment can be made while observing the picture. Obviously this is not nearly as accurate as using the meter, but by carefully making the adjustment while viewing the picture, satisfactory results can be obtained.

It is always wise to check the performance of the receiver after the VHF strips which were removed are replaced in the unit and the shield is reinstalled. Normally, the reassembly of these parts does not affect the operation of the UHF strip. In some cases, however, it might; so it is recommended that a check on the performance of the receiver be made after replacing these parts.

The adjustment of these strips is particularly recommended whenever a UHF strip is added to a new receiver. This assists the installer in getting maximum performance from the UHF position on the receiver. Let us assume for the moment that a receiver is being installed at a location approximately 25 miles

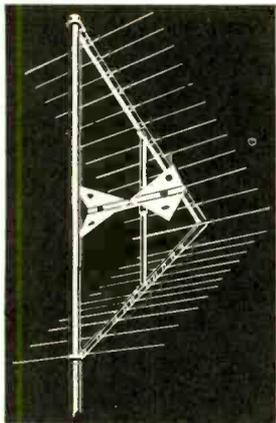
from the UHF transmitter. If, after making the installation, the picture received from the UHF station is weak and snowy, the installer might attempt adjusting the UHF slugs. There is a possibility that the customer (who is watching the whole procedure) might suspect that the receiver was not properly adjusted or perhaps defective when it was delivered. Almost all service technicians have dealt with this psychological aspect whereby the customer suspects that there is something wrong with the receiver when it was delivered. Later on, whenever anything happens that affects the operation of the receiver, perhaps everyday interference, the customer has the feeling that the receiver is defective and is dissatisfied. It is certainly desirable to be able to deliver the receiver without making all of these extra adjustments in the customer's home.

Normally the UHF strips are adjusted so accurately at the factory that only a slight amount of improvement can be obtained. Sometimes, this slight improvement is the difference between satisfactory and unsatisfactory reception. After making a few adjustments, the service technician should become aware of the amount of improvement which can be expected. As was mentioned earlier, it normally is not necessary to make any adjustment at all on receivers that are to be installed in the primary area. If the receiver is to operate on an indoor type antenna, it might be well to check the adjustment of these slugs.

The most important thing to remember in making any of these adjustments is that only a very slight movement of the slug is required. If they are turned too far, the adjustment may be so far off that they cannot be properly realigned without the use of very elaborate signal generating equipment. Keep this in mind when making the adjustments on the first few sets and experience will show what little movement of a slug is required.

Chart 1 shows an alignment table which should prove helpful in making the required adjustments.

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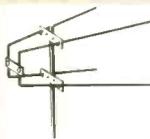
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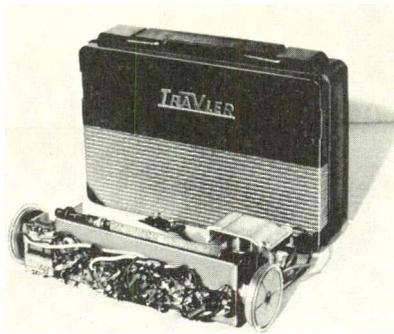


Figure 8. View of Trav-ler Portable 5300 Chassis and Cabinet.

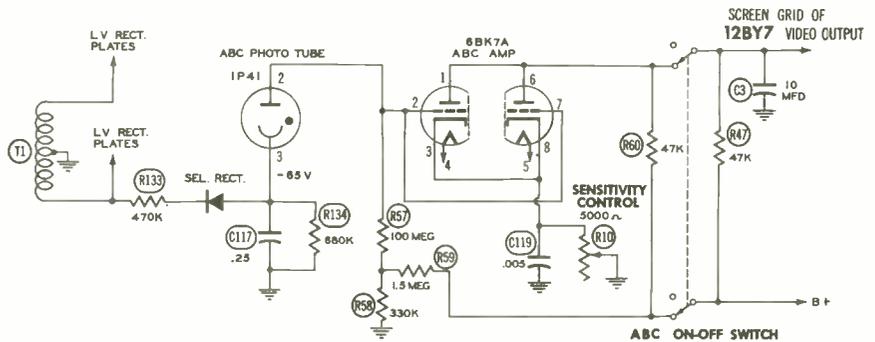


Figure 9. Partial Schematic of Westinghouse Chassis V-2233-4 Showing Circuit of Automatic Brightness Control.

rigid. The tubes are located on the top of the chassis in a straight row and are easy to substitute. All in all, the service technician should find this an easy chassis to service.

### WESTINGHOUSE CHASSIS (V-2233-4)

#### Automatic Brightness Control

A recent development in the television field is the Automatic Brightness Control (ABC) employed in the Westinghouse Chassis V-2233-4. It serves to vary the picture brightness and contrast proportional to the changes in room lighting. If the room is brightened by turning on a lamp or opening a curtain, the picture becomes brighter and the contrast increases automatically. Once the controls are set for a desired picture and the sensitivity control is properly adjusted, the contrast and brightness controls will only need adjusting as the components age or if there is a great change in line voltage. The schematic of Figure 9 shows the circuitry employed to accomplish this.

The negative 85 volts for the cathode of the phototube is developed by the selenium rectifier connected as a halfwave rectifier, as shown in Figure 9. The amount of light falling on the cathode of the phototube determines the amount of current that flows through the phototube. The greater the intensity of the light, the greater will be the current flow. This current flowing through the resistor R57, produces a negative voltage at the grid of the ABC amplifier. Because a positive voltage is applied by the voltage divider network (R58 and R59) to the bottom of R57, the grid voltage and polarity is determined by the amount of light falling upon the light sensitive cathode of the phototube.

Turning on a light in the room increases current flow through the phototube, causing the voltage of the ABC amplifier grid to go in a negative direction. This causes less current to flow through the amplifier, thus reducing the voltage drop across R47 and R60 (in parallel). Therefore, the voltage applied to the screen grid of the video amplifier is greater. This increase in screen voltage increases the video gain, thereby increasing the contrast of the picture. The increase in

screen voltage also reduces the voltage on the plate of the video amplifier and since the plate of the video amplifier is directly coupled to the cathode of the picture tube, the positive voltage on the cathode of the picture tube is reduced, causing a brighter picture. These conditions are reversed when the lighting is reduced.

It may be well to note here that the 1P41 phototube is infrared sensitive. Therefore, it is less sensitive to fluorescent light than to natural or incandescent.

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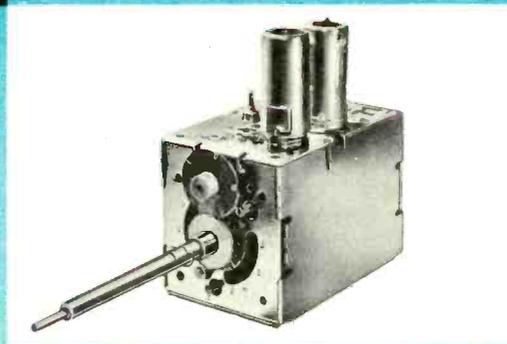
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## Servicing with the Scope

(Continued from page 21)

difficulty. Check for a bad tube, shorted RF coil, improper tube voltages, and an inoperative oscillator stage. In a circuit of this type, where double conversion is performed, there will be no signal at the output of the first converter stage when the oscillator is inoperative. Consequently, there will be no signal at the input of the second converter stage. This is not true, however, for FM receivers that do not employ double conversion. When trouble-shooting receivers of this type, a signal will be present at the output of the RF stage and also at the input of the mixer stage, even though the oscillator may be inoperative. During testing of circuits of this type, the oscillator stage is tested after it has been determined that the trouble is not in the RF or Mixer sections.

If the signal was present at the output of the first converter, move to the input of the second converter (test point 15). If the

signal is not present at this test point, check the circuit between this point and the output of the first converter. However, if the signal is obtained at test point 15, check for a bad second converter tube, shorted primary in the plate load, or improper tube voltages.

At this point, the trouble-shooting procedure ends. Beginning at test point 1 and progressing through test point 15, the entire circuit has been covered. By following the procedure as it has been presented, the stage in which the trouble is located should soon be detected. There are two important test points in this trouble-shooting procedure. The first one is located at test point 1 (input of the first limiter) and the second one is located at test point 6 (plate of the second converter). With a quick check at these two points, the trouble is narrowed down to a very small portion of the circuit. A check at test point 1 tells whether there is need to check the stages following this point or whether to check the stages preceding this point. If trouble lies before test

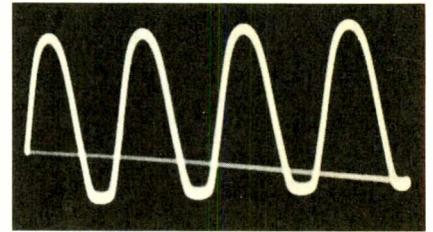


Figure 3. Sample Waveform Indicating the Presence of a Signal.

point 1, then a check at test point 6 reveals whether the trouble lies in the RF-Converter section or in the IF section. At this test point, a large portion of the receiver has been eliminated by checking at only two test points.

In cases where hum causes a great deal of distortion on the scope pattern, a couple of helpful pointers may be given. First, the scope probe should be held by placing the hand as far to the rear of the probe as possible. This will keep the amount of hum down to a certain degree. Second, if the hand is placed on the chassis while making the test, the hum will be decreased

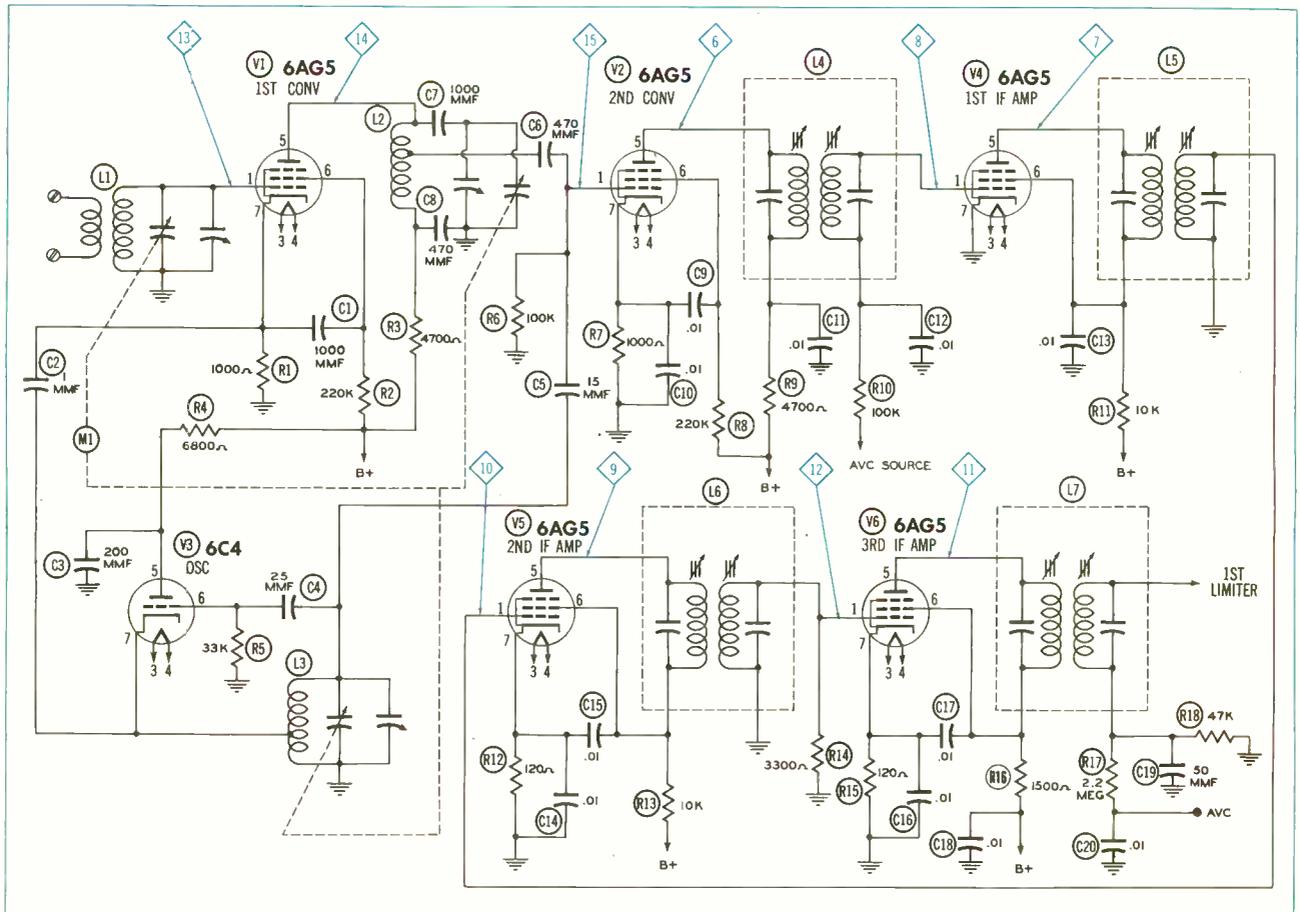


Figure 2. Partial Circuit of a Typical FM Receiver, Showing Test Points 6 to 15 Discussed in Text.

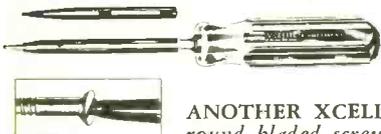
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When interference is caused by harmonics from a transmitter, it can be greatly reduced or eliminated at the transmitter by use of a Bud LF-601 Low Pass Filter.

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Almost any one can make a television interference filter, but it takes real "know how" and experience to produce a unit that will do an efficient job. Bud Filters are the result of intensive research and development in this field. Wide acceptance of these products is proof of their exceptionally high quality.

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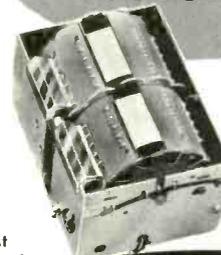
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CHART 1

	NO SIGNAL	SIGNAL PRESENT
Test Point 1	Move to Test Point 6.	Move to Test Point 2.
Test Point 2	Move to Test Point 3.	Move to Test Point 5.
Test Point 3	Move to Test Point 4.	Check for Bad 2nd Limiter Tube or Improper Tube Voltages.
Test Point 4.	Check for Bad 1st Limiter Tube or Improper Tube Voltages.	Check for Bad Coupling Between the Two Limiters.
Test Point 5	See Text	See Text.
Test Point 6	Move to Test 13.	Test at the successive Plates of Each IF Amp. (Test Points 7,9, and 11.) until Signal is Lost.
Test Point 7	Move to Test Point 8.	Move to Test Point 9.
Test Point 8	Check the Circuit Between Test Point 6 and Test Point 8.	Check for Bad 1st IF Tube, Shorted Pri. in Plate Load, or Improper Tube Voltages.
Test Point 9	Move to Test Point 10.	Move to Test Point 11.
Test Point 10	Check the Circuit Between Test Point 7 and Test Point 12.	Check for Bad 2nd IF Tube, Shorted Pri. in Plate Load, or Improper Tube Voltages.
Test Point 11	Move to Test Point 12.	Check the Circuit Between Test Point 11 and Test Point 1.
Test Point 12	Check the Circuit Between Test Point 9 and Test Point 12.	Check for Bad 3rd IF Tube, Shorted Pri. in Plate Load, or Improper Tube Voltages.
Test Point 13	Check RF Input Circuit.	Move to Test Point 14.
Test Point 14	Check for Bad 1st Conv. Tube, Shorted RF Coil, Improper Tube Voltages, or Inoperative Oscillator. (See Text Pertaining to the oscillator Stage.)	Move to Test Point 15.
Test Point 15	Check Circuit Between Test Point 14 and Test Point 15.	Check for a Bad 2nd Conv. Tube, Shorted Pri. in Plate Load, or Improper Tube Voltages.

considerably. This is especially true while testing the earlier stages of the receiver. A properly shielded lead should be used throughout the test procedure; this will also reduce the amount of hum pickup.

If the signal is weak in the receiver, a high impedance probe

should be used so that the scope loads the receiver as little as possible.

Chart 1 is provided for a quick reference of the preceding trouble-shooting procedure. When the scope is connected to a certain

test point, the chart points out what steps should be taken under the condition of "no signal" or "signal present".

C. P. OLIPHANT

### Record Changer Servicing

(Continued from page 27)

the changer test bench. This is particularly desirable in those cases of intermittent troubles when prolonged operation is required for their detection and cure. Such a bench need not be large; a four foot width is ample in most cases. A small audio amplifier and speaker arrangement having a provision for phonograph input may be installed on this bench.

The amplifier should be a fairly high quality unit in order to enable the detection of faulty phonograph pickup cartridges. If hi-fi equipment is serviced, the requirements on this amplifier are even more strict since it is necessary to check the operation of the changer and pickup at extremely low and high frequencies. Once the changer passes this test, it will operate satisfactorily in the owner's home regardless of the type of equipment he has.

### The Mechanics of a Changer -

In an automatic record changer, the mechanical series of operations which occur between the end of one record play and the start of the next record play is referred to as the change cycle. Since the change cycle constitutes a major part of changer operation, a thorough understanding of its action and the parts involved is essential. The change cycle operations may be listed as follows:



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that Rauland made the first rectangular tube in 1945?  
everybody knows . . . that engineering leadership means  
sales leadership . . . and that means RAULAND

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1. Tripping.
2. Vertical and horizontal movement of the tone arm.
3. Record ejection.
4. Set-down.

These operations are not listed necessarily according to the order of their occurrence (record ejection normally takes place while the tone arm is still moving). However, all are required for automatic record changing. When automatic shut-off is employed, the change cycle is altered after the last record is played, to the extent that the phonograph motor is turned off and the tone arm is returned to the rest position.

In order to become familiar with the moving parts involved in the change cycle of a particular changer, it is suggested that the following step-by-step investigation be conducted:

- a. Place the changer on a rack and secure it properly. Adjust the rack so that the changer base is horizontal.
- b. Place a 10" record on the turntable.
- c. Set the mechanism to play 10" records. This may not be required in some changers having a provision for playing mixed record sizes.

d. Trip the changer mechanism by actuating the "Reject" control.

e. Rotate the turntable slowly by hand in a clockwise direction until the change cycle is completed.

During the final three steps, study the movements of the various parts and the linkages between the controls and the changer mechanism. Also determine which parts are associated with each of the four basic operations in the change cycle. Try to identify the various adjustment points. A study of this kind will yield considerable information which can be applied in servicing the changer.

#### Check Owner's Complaint -

Frequently the owner of an automatic record changer can supply information which will substantially lessen the problem of locating a trouble. This is particularly true when the complaint, by itself, does not positively point to the area of investigation. Take, for example, a case where the complaint is a "squeaking sound in the changer." Here, additional information from the owner may indeed be helpful. He can be asked whether the squeak occurs during the playing of all records, or with a particular record, or during the changing operation between record plays. If the changer squeaks during the change cycle, the area of investigation can be narrowed to the mechanism involved. If the customer says that the squeak

occurs only when he plays his particular record of Beethoven's Fifth Symphony, the record itself is probably at fault. Often it is a help to learn if a trouble appears only when a certain size of record is played. For example, a few changers do not function very well with 45 RPM records fitted with small-spindle inserts.

One of the principal reasons for getting a complete story from the owner is that sometimes during transit from the owner's home to the shop, the changer parts shift position in such a way that difficulty may be encountered in reproducing the trouble with the changer on the shop bench. If the technician has a general idea of where the trouble is before he leaves the owner's home, he is in a much better position to service the changer in his shop.

#### Visual Inspection -

A sharp eye for broken or loose parts in a changer will very often locate troubles. When lifting a changer from its pan, watch for bits of broken parts or loose connections. Springs may come loose at one end and hang down from the underside of the base plate. The same procedure applies when inspecting the mechanism beneath the turntable.

A jammed changer can also be detected by inspection. If the tone arm hangs in mid-air and a moderate, clockwise hand pressure on the turntable does not complete the change cycle, the changer is jammed and may be freed by slow backward rotation of the turntable. However, this should be done after the changer mechanism is exposed so that the jammed part(s) can be located visually.

It is suggested that a notebook be kept and an entry made after each changer repair, listing the customer's complaint, the make and model of the unit, the remedy found for the trouble, and any other pertinent information which might be of value in handling future service problems.

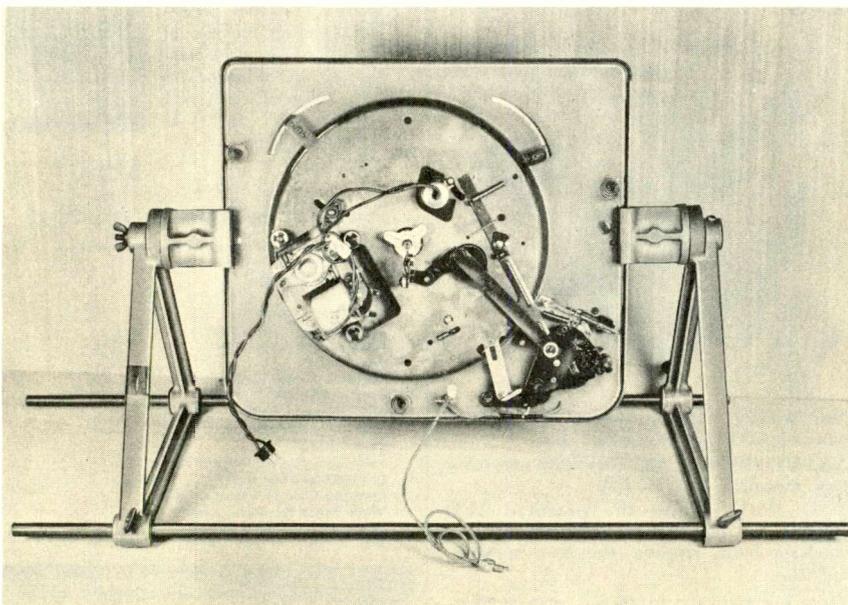


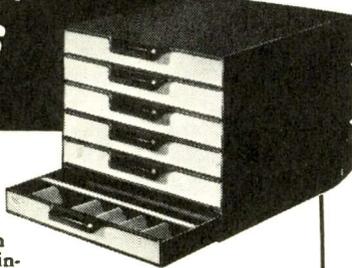
Figure 1. Mounting Rack for Holding Record Changer.

LESTER W. CAUDELL and  
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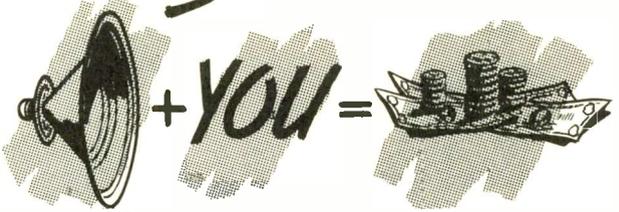
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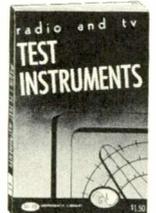
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# GLOSSARY OF TRANSISTOR TERMS

**Acceptor** - Impurity atom with three valence electrons.

**Alpha** - Ratio of collector current to emitter current. Current gain.

**Base** - One element of a transistor. The center section of the junction type and the main or largest section of the point-contact type. Function can be compared to that of the grid of a vacuum tube.

**Collector** - One element of a transistor. Function can be compared to that of the plate of a vacuum tube.

**Conductor** - A material which passes current readily. Composed of an element or elements having many free electrons.

**Donor** - Impurity atom with five valence electrons.

**Emitter** - One element of a transistor. Function can be compared to that of the cathode of a vacuum tube.

**Free Electrons** - Those electrons in atomic structure which are not held in a valence bond and contribute to current flow.

**Hole** - An area in the atomic structure where an electron is not likely to be found. Effectively acts as a positive charge.

**Insulator** - A material which passes a very minute current or none at all.

Composed of an element or elements having very few or no free electrons.

**Molecule** - The smallest increment of material which still retains the characteristics of that material.

**N-carriers** - Free electrons present in the N-type semi-conductor.

**N-type semi-conductor** - Germanium with atoms having five valence electrons added as impurities.

**Nucleus** - The central portion of an atom. Has a positive charge equal to the number of valence electrons held by that atom.

**P-carriers** - Holes or positive charges present in the P-type semi-conductor.

**P-type semi-conductor** - Germanium with atoms having three valence electrons added as impurities.

**Semi-conductor** - A material that can conduct a small current normally. Conduction can be varied by application of energy to the material.

**Valence Bonds** - A combination or sharing of electrons between two atoms.

**Valence Electrons** - The electrons, in the outer ring or shell of an atom, that react in any chemical or physical reaction. Also constitute the ingredients of an electric current through any material.

## Dollar and Sense Servicing

(Continued from page 47)

**FADEOUT.** Transit broadcasting, once the last-ditch hope of struggling FM, is rapidly fading away. According to Television Digest, the only major operation left by early summer was KCMO-FM in Kansas City. Reasons cited for the downfall are: (1) High operating cost, chiefly in fixed payments to the transit company plus receiver installation and maintenance costs; (2) too few markets to attract national advertising commercials, there being at the peak only 21 cities with transit broadcasting to buses and streetcars; (3) loss of momentum during years of litigation on the legality of commercials for commuters, carried up through the Supreme Court. Vic-

tory came too late to recover this momentum. Comment of one ex-transitcaster: "I still don't see why we didn't make millions".



**PHONY.** A vacuum-cleaner dealer gets the credit, in the Better Business Bureau publication of New York City, for bringing phony trade-in allowances to the ridiculous extreme for which they have obviously been heading. His ad reads as follows: "Liberal Trade-In Allowance - No Trade Necessary".

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536K Multimeter Kit \$12.90  
Wired \$14.90  
1000 ohms/volt

425K 5" Scope  
Kit \$44.95,  
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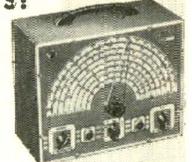
625K Tube Tester  
Kit \$34.95.  
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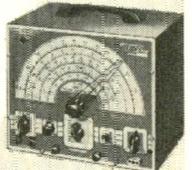
221K VTVM Kit \$25.95.  
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565K Multimeter Kit \$24.95.  
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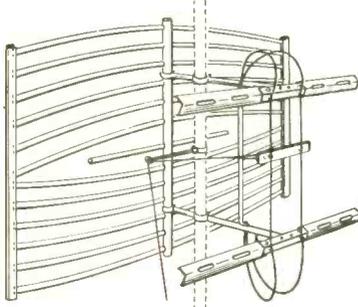
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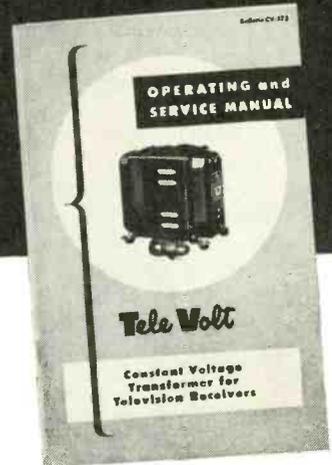
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# STATUS OF TV BROADCAST OPERATIONS

Supplement No. 2 -

The following charts show the construction permits and stations which have come on the air during the period between April 19 and August 15. A third chart lists the 10 (of an original 30) stations still required to shift channels. This supplemental data, when combined with the data presented in the March-April and May-June issues of the PF INDEX and Technical Digest, presents a complete picture of the status of TV broadcast operations in the United States.

The following stations have relinquished their construction permits and should be removed from previous listings. Austin, Texas, KCTV - Ch 18 and KTVA - Ch 24; Gadsden, Ala., WTVS - Ch 21; Kalamazoo, Mich., Ch 36; Lynchburg, Va., WWOD-TV - Ch 16; McAllen, Texas, KRIO-TV - Ch 20; Midland, Texas, KMID-TV - Ch 2; Roanoke, Va., WROV-TV - Ch 27; San Angelo, Texas, KGKL-TV - Ch 3; Warren, Ohio, WHHH-TV - Ch 67; and Wichita Falls, Texas, KTVW - Ch 22.

## CONSTRUCTION PERMITS GRANTED FROM APRIL 19, 1953 THROUGH AUGUST 15, 1953

<b>ALASKA</b> Anchorage - - - - Ch. 2 Anchorage - - - - Ch. 11 Fairbanks - - - - Ch. 2  <b>ARIZONA</b> Phoenix KOY-TV Ch. 10) Phoenix )*) KOOL-TV Ch. 10)  <b>ARKANSAS</b> Pine Bluff KATV Ch. 7 Little Rock KARK-TV Ch. 4  <b>CALIFORNIA</b> Bakersfield KERO-TV Ch. 10 Berkeley - - - - Ch. 9# Fresno - - - - Ch. 53 Sacramento KBIC-TV Ch. 46 Sacramento - - - - Ch. 40 San Francisco KSAN-TV Ch. 32 San Jose - - - - Ch. 48  <b>COLORADO</b> Denver - - - - Ch. 6# Denver KLZ-TV Ch. 7  <b>CONNECTICUT</b> New Haven WELI-TV Ch. 59 Stamford - - - - Ch. 27  <b>FLORIDA</b> Jacksonville WJHP-TV Ch. 36 WOBW Ch. 30	<b>FLORIDA Cont' d.</b> Pensacola WEAR-TV Ch. 3  <b>GEORGIA</b> Savannah WTOC-TV Ch. 11  <b>HAWAII</b> Honolulu KABS Ch. 4  <b>IDAHO</b> Meridian KTOO Ch. 2  <b>ILLINOIS</b> Champaign - - - - Ch. 21 Evanston - - - - Ch. 32 Quincy WGEN-TV Ch. 10 Rockford WREX-TV Ch. 13  <b>INDIANA</b> Elkhart WTRC-TV Ch. 52 Evansville WFIE Ch. 62 Fort Wayne WKJG-TV Ch. 33  <b>IOWA</b> Cedar Rapids - - - - Ch. 20 - - - - Ch. 9  <b>KANSAS</b> Topeka WIBW Ch. 13  <b>KENTUCKY</b> Richmond WFTM-TV Ch. 60  <b>MARYLAND</b> Lewiston WLAM -ABC Ch. 17 Poland WMTW Ch. 8	<b>MARYLAND Cont' d.</b> Portland - - - - Ch. 6  <b>MASSACHUSETTS</b> Boston WGBH-TV Ch. 2 - - - - Ch. 44 Brockton - - - - Ch. 62 Lawrence - - - - Ch. 72 Worcester - - - - Ch. 20  <b>MISSISSIPPI</b> Jackson WSLI-TV Ch. 12 Meridian WTOK Ch. 11  <b>MISSOURI</b> Kansas City KCMO Ch. 5 Kansas City KMBC-TV Ch. 9 Kansas City WHB-TV Ch. 9 St. Louis KETC Ch. 9#  <b>NEBRASKA</b> Kearney KHOL-TV Ch. 13  <b>NEW HAMPSHIRE</b> Keene WKNE-TV Ch. 45  <b>NEW JERSEY</b> Trenton WTTM Ch. 41  <b>NEW MEXICO</b> Albuquerque KOAT-TV Ch. 7  <b>NEW YORK</b> Albany WPTR-TV Ch. 23 Rochester WGVA -ABC Ch. 15	<b>NEW YORK Cont' d.</b> Schenectady WTRI Ch. 35 Utica WFRB Ch. 19  <b>NORTH CAROLINA</b> Wilmington WMFD-TV Ch. 6 Winston-Salem WSJS-TV Ch. 12  <b>NORTH DAKOTA</b> Valley City - - - - Ch. 4  <b>OHIO</b> Cincinnati - - - - Ch. 54 Cleveland WERE-TV Ch. 65 Columbus WCSU-TV Ch. 34# Steubenville - - - - Ch. 9  <b>OKLAHOMA</b> Miami KMIV Ch. 58 Oklahoma City KWTW Ch. 9  <b>OREGON</b> Eugene - - - - Ch. 13 Portland KCIN-TV Ch. 6  <b>PENNSYLVANIA</b> Allentown WFMZ Ch. 67 - - - - Ch. 39 Harrisburg WCMB-TV Ch. 27 Lancaster WWLA Ch. 21 Lebanon - - - - Ch. 15 Pittsburgh WQED Ch. 13#  <b>PUERTO RICO</b> San Juan - - - - Ch. 4	<b>SOUTH CAROLINA</b> Camden WACA Ch. 14 Greenville - - - - Ch. 4 Spartansburg - - - - Ch. 17  <b>TENNESSEE</b> Knoxville - - - - Ch. 6 Nashville WSIX Ch. 8 - - - - Ch. 5  <b>TEXAS</b> Harlingen KGBS Ch. 4 Houston KXYZ-TV Ch. 29 Lubbock KFYO-TV Ch. 5 Marshall - - - - Ch. 16 Midland KMID-TV Ch. 2 Weslaco KRGV-TV Ch. 5  <b>VIRGINIA</b> Norfolk WTOV-TV Ch. 27  <b>WASHINGTON</b> Seattle KCMC-TV Ch. 4  <b>WEST VIRGINIA</b> Beckley - - - - Ch. 21 Fairmont WVWV-TV Ch. 35 Wheeling - - - - Ch. 7  <b>WISCONSIN</b> Milwaukee WOKY Ch. 19  <b>WYOMING</b> Casper KSPR-TV Ch. 2
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\* Shared Time.

# Educational.

Please turn to next page.

STATUS OF TV BROADCAST OPERATIONS Continued

STATIONS NOW ON THE AIR FROM APRIL 19, 1953 THROUGH AUGUST 15, 1953				
<b>ALABAMA</b> Montgomery WCCV-TV Ch. 20	<b>IDAHO</b> Boise KIDO-TV Ch. 7 Nampa KFXD-TV Ch. 6	<b>MINNESOTA</b> Cont' d. Rochester KROC-TV Ch. 10	<b>NORTH CAROLINA</b> Cont' d. Raleigh WNAO-TV Ch. 28	<b>SOUTH CAROLINA</b> Cont' d. Columbia WCOS-TV Ch. 25 Greenville WGVL Ch. 23
<b>ARIZONA</b> Mesa KTYL-TV Ch. 12	<b>ILLINOIS</b> Decatur WTVP Ch. 17	<b>MISSOURI</b> Kansas City KCTY Ch. 25 KMBC-TV Ch. 9 WHB-TV Ch. 9 St. Louis WTVI Ch. 54	<b>NORTH DAKOTA</b> Fargo WDAY-TV Ch. 6	<b>SOUTH DAKOTA</b> Sioux Falls KELO-TV Ch. 11
<b>ARKANSAS</b> Ft. Smith KFSA-TV Ch. 22	<b>INDIANA</b> Lafayette WFAM-TV Ch. 59 Muncie WLBC-TV Ch. 49	<b>MONTANA</b> Butte KXLF-TV Ch. 6	<b>OHIO</b> Akron WAKR-TV Ch. 49 Zanesville WHIZ-TV Ch. 50	<b>TEXAS</b> Houston KUHT Ch. 8# Lubbock KCBD-TV Ch. 11 San Angelo KTXL-TV Ch. 8
<b>CALIFORNIA</b> Fresno KMJ-TV Ch. 24 Los Angeles KUSC-TV Ch. 28 San Luis Obispo KVEC-TV Ch. 6 Santa Barbara KEYT Ch. 3	<b>KANSAS</b> Hutchinson KTVH Ch. 12	<b>NEBRASKA</b> Lincoln KFOR-TV Ch. 10	<b>OREGON</b> Medford KBES-TV Ch. 5	<b>WASHINGTON</b> Bellingham KVOS-TV Ch. 12 Tacoma KMO-TV Ch. 13 Yakima KIMA-TV Ch. 29
<b>COLORADO</b> Pueblo KCSJ-TV Ch. 5	<b>LOUISIANA</b> Monroe KFAZ Ch. 43	<b>NEVADA</b> Las Vegas KLAS-TV Ch. 8	<b>PENNSYLVANIA</b> Bethlehem WLEV-TV Ch. 51 Easton WGLV Ch. 57 Harrisburg WTPA Ch. 71 Pittsburgh WKJF-TV Ch. 53 Scranton WGBI-TV Ch. 22	<b>WISCONSIN</b> Madison WMTV Ch. 33 WKOW-TV Ch. 27 Oshkosh WOSH-TV Ch. 48
<b>FLORIDA</b> St. Petersburg WSUN-TV Ch. 38	<b>MICHIGAN</b> Battle Creek WBKZ-TV Ch. 64 Lansing WILS-TV Ch. 54	<b>NEW MEXICO</b> Roswell KSWs-TV Ch. 8	<b>NEW YORK</b> Elmira WTVE Ch. 24	
<b>GEORGIA</b> Macon WETV Ch. 47 Rome WROM-TV Ch. 9	<b>MINNESOTA</b> Austin KMMT Ch. 6 Duluth WFTV Ch. 38	<b>NORTH CAROLINA</b> Asheville WISE-TV Ch. 62	<b>SOUTH CAROLINA</b> Charleston WCSC-TV Ch. 5	

# Educational

TV CHANNEL SHIFTS

CITY, STATE	STATION	OLD	NEW	CHANGE DATE	CITY, STATE	STATION	OLD	NEW	CHANGE DATE
Atlanta, Ga.	WLWA	8	11	Fall	New Haven, Conn.	WNHC-TV	6	8	Spring
Bloomington, Ind.	WTTV	10	4	Indefinite	Norfolk, Va.	WTAR-TV	4	3	July
Cleveland, Ohio	WXEL	9	8	Summer	Rochester, N. Y.	WHAM-TV	6	5	July
Cleveland, Ohio	WNBK	4	3	Indefinite	Schenectady, N. Y.	WRGB	4	6	Indefinite
Davenport, Iowa	WOC-TV	5	6	Indefinite	Syracuse, N. Y.	WSYR-TV	5	8	Summer

## A STOCK GUIDE FOR TV TUBES

The figures in the chart below have been revised to include production of TV receivers since the compilation of the chart which appeared in PF INDEX and Technical Digest for July-August, 1953.

For additional information on the recommended use of this chart, refer to PF INDEX and Technical Digest for May-June, 1953.

46-53 Models	52 & 53 Models								
1AX2 *		6AQ5	13 13	6BK5	3 1	6SH7	1	12AU6	1
1B3GT	39 44	6AQ7GT	2 2	6BK7	3 6	6SL7GT	4 3	12AU7	45 27
1V2	1	6AS5	2 3	6BL7GT	5 9	6SN7GT	80 89	12AX4	2 4
1X2	6 2	6AT6	4 3	6BN6	2 2	6SQ7	3	12AV7	4 5
1X2A	4 6	6AU5GT	4 5	6BQ6GT	16 25	6SQ7GT	3	12AX7	3 5
5U4G	44 47	6AU6	138 127	6BQ7	6 14	6T8	15 15	12AZ7	3 5
5V4G	8	6AV5GT	3 4	6BQ7A *		6U8	3 7	12BH7	7 12
5Y3GT	3 1	6AV6	14 17	6C4	11 10	6V6GT	23 21	12BX7 *	
6AB4	3 3	6AX5GT	2 3	6BZ7	2 3	6V3	2 3	12BY7	7 2
6AC7	9 9	6AX4	2	6CB6	88 138	6W4GT	33 35	12SN7GT	7 5
6AF4 ♦		6BA6	16 11	6CD6G	7 9	6W6GT	7 11	25BQ6GT	3 5
6AG5	39 11	6BC5	11 8	6CL6 *		6X5GT	1 1	25L6GT	6 6
6AG7	3 3	6BE6	4 6	6J5	3 3	6X8	2 4	25W4GT	2 2
6AH4GT	1 2	6BF5	1 1	6J5GT	2 1	6Y6G	4 1	25Z6	1
6AH6	7 10	6BG6G	15 6	6J6	34 31	7C5	1	5642	2 3
6AK5	5 4	6BH6	9	6K6GT	17 10	7N7	3 1		
6AL5	78 80	6BJ6	1	6S4	8 10	12AT7	15 14		

♦ A stock of these tubes should be maintained in UHF areas \* New tubes recently introduced.

# TV SUPPLEMENTARY SHEET NO. 5

MODEL & CHASSIS	PART #	CATALOG #	FUNCTION	DESCRIPTION	LIST PRICE
MOTOROLA 17F12, A, B, BA 17K12, A, B, BA, W, WA, 17T7, A 17T8, A, B, BA	1X711613	Order From MFR.	Hor. Cent.	50 Ω 1W-W.W.	
	18A702441	AG-85-5 RS-2	Bright	5 Meg. Ω carbon	\$1.25
	18A702443	AG-85-5 RS-2	Height	5 Meg. Ω carbon	\$1.25
	18A702468	AG-49-5 RS-2	Hor. Hold	100K Ω carbon	\$1.25
	18A702475	AG-8-5 RS-2	Vert. Lin.	750 Ω carbon	\$1.25
	18A711225	AG-61-5 KSS-3	Focus	1 Meg. Ω carbon	\$1.25
	18A711999	AG-61-5 RS-2	Tone	1 Meg. Ω carbon	\$1.25
	18K702864	RTV-344	Contrast/ Vol./Sw.	2500 Tap 2000/1 Meg. Tap 300K Ω Conc. Dual carbon--SPST	\$4.90
18K711278	Order From MFR.	Vert. Hold	850 Ω carbon		
20K6 20K6B 20T2A 20T2AB 20T3 20T3B	18A702441	AG-85-5 RS-2	Bright	5 Meg. Ω carbon	\$1.25
	18A702443	AG-85-5 RS-2	Height	5 Meg. Ω carbon	\$1.25
	18A702468	AG-49-5 RS-2	Hor. Hold	100K Ω carbon	\$1.25
	18A702475	AG-8-5 RS-2	Vert. Lin.	750 Ω carbon	\$1.25
	18K703326	A10-2000 RS-2	Focus	2000 Ω 4W-W.W.	\$1.85
	18K702854	RTV-344	Contrast/ Vol./Sw.	2500 Tap 2000/1 Meg. Tap 300K Ω Conc. Dual carbon--SPST	\$4.90
CHASSIS TS-307	18K711278	Order From MFR.	Vert. Hold	1 Meg. Fixed Stop 300K	
OLYMPIC 17C24 17K31 17K32 17T20 17T33	PT-2268	AG-44-5 KSS-3	Hor. Hold	50K Ω carbon	\$1.25
	PT-2269	AG-61-5 KSS-3	Vert. Hold	1 Meg. carbon	\$1.25
	PT-2269	AG-61-5 KSS-3	Focus	1 Meg. carbon	\$1.25
	PT-2270	AG-58-5 KSS-3	Bright.	500K Ω carbon	\$1.25
	PT-2271	AG-19-5 KSS-3	Vert. Lin.	5000 Ω carbon	\$1.25
	PT-2272	AG-84-5 KSS-3	Height	2.5 Meg. Ω carbon	\$1.25
	PT-2634	RTV-353	Contrast/ Vol./Sw.	1500/1 Meg. Conc. Dual carbon--DPST	\$3.85
	21C28 21D29 21K26 21T27	PT-2267	RTV-100	Contrast/ Vol./Sw.	5000/1 Meg. Conc. Dual carbon--SPST
PT-2268	AG-44-5 KSS-3	Hor. Hold	50K Ω carbon	\$1.25	
PT-2269	AG-61-5 KSS-3	Vert. Hold	1 Meg. Ω carbon	\$1.25	
PT-2270	AG-58-5 KSS-3	Bright.	500K Ω carbon	\$1.25	
PT-2271	AG-19-5 KSS-3	Vert. Lin.	5000 Ω carbon	\$1.25	
PT-2272	AG-84-5 KSS-3	Height	2.5 Meg. carbon	\$1.25	

MODEL & CHASSIS	PART #	CATALOG #	FUNCTION	DESCRIPTION	LIST PRICE	
	PT-2273	RTV-319	Focus	2250 Ω 4W-W.W.	\$1.85	
PHILCO 52-T1820 52-T1821 52-T1822 52-T1845 52-T2120 52-T2150,W 52-T2151,L 52-T2252 53-T1824 53-T1825 53-T1826 53-T1852 53-T2152	33-5546-43	A10-20K FKS-1/4	Width	20K Ω 4W-W.W.	\$2.20	
	33-5563-42	RTV-345	Contrast/ Bright.	2500/10K Ω 2W-W.W./ 2W-W.W. Conc. Dual	\$3.10	
	33-5563-43	RTV-241	Hor./Vert. Hold	75K/250K Ω Conc. Dual carbon	\$3.10	
	33-5564-14	AT-116 FS-3/SWA	Vol./Sw.	2 Meg. Tap 1 Meg. carbon--SPST	\$1.85 .60	
	33-5565-30	AG-44-5 FKS-1/4	Hor. Osc.	50K Ω carbon	\$1.25	
	Code 124	33-5565-32	AG-84-5 FKS-1/4	Height	2.5 Meg. Ω carbon	\$1.25
	33-5565-32	AG-84-5 FKS-1/4	Vert. Lin.	2.5 Meg. Ω carbon	\$1.25	
	52-T1882 52-T1883 52-T145X 52-T182 52-T2245 52-T2253 52-T2282 52-T2283	33-5546-43	A10-20K FKS-1/4	Width	20K Ω 4W-W.W.	\$2.20
	33-5563-42	RTV-345	Contrast/ Bright.	2500/10K Ω 2W-W.W./ 2W-W.W. Conc. Dual	\$3.10	
	33-5563-43	RTV-241	Hor./Vert. Hold	75K/250K Ω Conc. Dual carbon	\$3.10	
CHASSIS D-4 44	33-5563-44	RTV-360	Tone/Vol./Sw.	5 Meg./2 Meg. Conc. Dual carbon--SPST	\$4.30	
Code 121 125	33-5565-2	AG-58-5 FKS-1/4	Vert. Lin.	500K Ω carbon	\$1.25	
33-5565-30	AG-44-5 FKS-1/4	Hor. Osc.	50K Ω carbon	\$1.25		
33-5565-31	AG-85-5 FKS-1/4	Height	5 Meg. Ω carbon	\$1.25		
* Some Models Use 15 Meg. Parpl Element.						
52-T2106 52-T2108 52-T2110 52-T2140 52-T2144 52-T2244	33-5546-43	A10-20K FKS-1/4	Width	20K Ω 4W-W.W.	\$2.20	
33-5563-42	RTV-345	Contrast/ Bright.	2500/10K Ω 2W-W.W./ 2W-W.W. Conc. Dual	\$3.10		
33-5563-43	RTV-241	Hor./Vert. Hold	75K/250K Ω Conc. Dual carbon	\$3.10		
33-5565-2	AG-58-5 FKS-1/4	Vert. Lin.	500K Ω carbon	\$1.25		
33-5565-14	AT-116 FS-3/SWA	Vol./Sw.	2 Meg. Tap 1 Meg. carbon--SPST	\$1.85 .60		
33-5565-30	AG-44-5 FKS-1/4	Hor. Osc.	50K Ω carbon	\$1.25		
33-5565-31	AG-85-5 FKS-1/4	Height	5 Meg. Ω carbon	\$1.25		
52-T2110 52-T2144 52-T2182L 52-T2145X	33-5546-43	A10-20K FKS-1/4	Width	20K Ω 4W-W.W.	\$2.20	
33-5563-42	RTV-345	Contrast/ Bright.	2500/10K Ω 2W-W.W./ 2W-W.W. Conc. Dual	\$3.10		
Code 121 125	33-5563-43	RTV-241	Vert./Hor. Hold	75K/250K Ω Conc. Dual carbon	\$3.10	
CHASSIS 41 44 D-1 D-4	33-5563-44	RTV-360	Vol./Tone/Sw.	5 Meg./2 Meg. Top 1 Meg. Conc. Dual carbon SPST	\$4.30	
33-5565-2	AG-84-5 FKS-1/4	Vert. Lin.	500K Ω carbon	\$1.25		
33-5565-30	AG-44-5 FKS-1/4	Hor. Freq. Adj.	50K Ω carbon	\$1.25		
33-5565-31	AG-85-5 FKS-1/4	Height	5 Meg. Ω carbon	\$1.25		

Form No. 752724010-5M-12/52



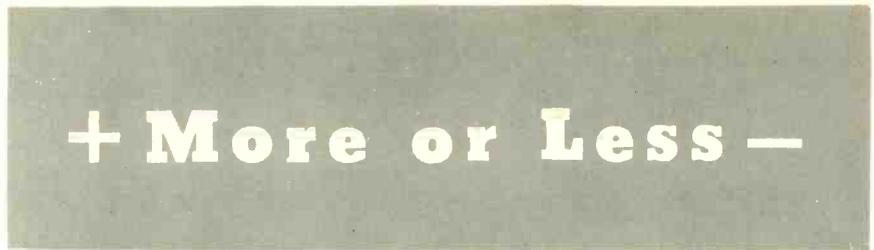
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This supplementary sheet is for use as an up-to-the-minute addition to your Clarostat TV Manual. Manuals are available through your distributor or directly from Clarostat. Price \$1.00.

**CLAROSTAT MFG. CO., INC.**  
**DOVER, NEW HAMPSHIRE**

INDEX TO ADVERTISERS  
September-October 1953 Issue

Advertiser	Page No.
Aerovox Corp.	104
American Phenolic Corp.	14
American Television & Radio Co.	102
Arco Electronics, Inc.	122
Theo Audel & Co.	104
Bud Radio, Inc.	116
Burgess Battery Co.	90
Bussmann Mfg. Co.	16
Carter Motor Co.	88
CBS-Hytron	30, 98 & 99
Centralab (Div. Globe-Union, Inc.)	12
Chicago Transformer Co.	86
Clarostat Mfg. Co., Inc.	125
Conrac, Inc.	116
Davis Electronics	122
DuMont Labs., Inc., Allen B.	8
Duotone Co., Inc.	112
Electro Products Labs.	112
Electro-Voice, Inc.	18
Electronic Instrument Co., Inc. (EICO)	121
Electronic Measurements Corp.	116
Electrovox Company, Inc.	96
Equipto.	120
Erie Resistor Corp.	92
General Cement Mfg. Co.	120
Hickox Electrical Instr. Co.	44
Insuline Corp. of America	104
International Resistance Co.	2nd Cover
Jackson Electrical Instr. Co.	84
Jensen Industries	102
JFD Manufacturing Co.	110, 120
LaPointe Electronics, Inc.	106
Leader Electronics, Inc.	64 & 65
Littelfuse, Inc.	4th Cover
P. R. Mallory & Co., Inc.	26
Merit Transformer Corp.	24
Ohmite Mfg. Co.	84
Planet Manufacturing Corp.	113
Precision Apparatus Co., Inc.	32
Quam-Nichols Company	94
Radelco Mfg. Co.	88
Radiart Corporation	36
Radio City Products Co., Inc.	40
Radio Corp. of America	6
Radio Electronics	120
Radio Receptor Co., Inc.	96
Ram Electronics Sales Co.	104
Rauland Corporation, The	118
Regency Div., I. D. E. A., Inc.	4
Sams & Co., Inc., Howard W.	50
Walter L. Schott Co. (Walsco)	22
Shure Bros., Inc.	90
Simpson Electric Co.	60
Sola Electric Co.	122
Sprague Products Company	48
Standard Coil Products Co., Inc.	42
Standard Transformer Corp.	28
Sylvania Electric Products, Inc.	3rd Cover
Sarkes Tarzian, Inc.	114
Technical Appliance Corp.	34 & 35
Telrex, Inc.	38
Triplett Electrical Instr. Co.	20
T-V Products Company	112
Valpey Crystal Corp.	116
Videon Electronic Corp.	96
V-M Corporation	92
Waldom Electronics, Inc.	120
Ward Products Corp.	72
Westinghouse Electric Corp.	46, 86
Xcelite, Inc.	116

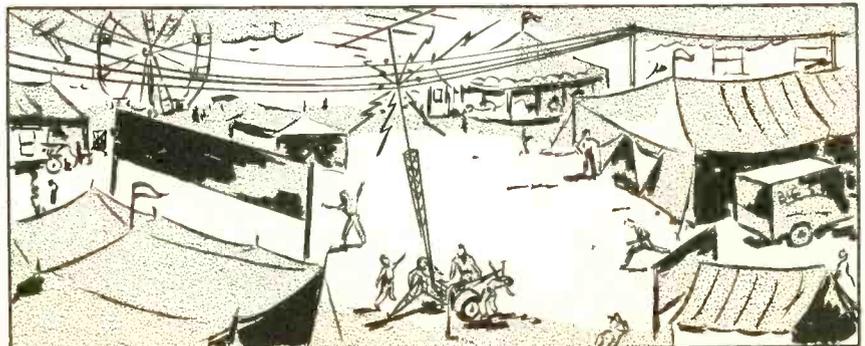


One Friday afternoon early in August, crowds were gathering at a fair being held in a small town in north-central Indiana. People had come to see the horse show, the tractor-pulling contest, displays of prize stock and crops of their neighbors, as well as new farm machinery and appliances for the home. One particular display called for a demonstration of television receivers. The nearest television transmitter was a considerable distance away which necessitated a rather elaborate antenna installation. Since the installation was to be used for only a few days, it was decided to employ an antenna trailer tower to raise the antenna to the required height. The available space for setting up the trailer was limited as it was necessary to place the trailer so that it was not in the way of the spectators. A site was selected and the crew set about the task of completing the installation. Much thought was given about the type of antenna to be used in order to be assured of obtaining the best possible picture on the TV sets being demonstrated. The men made sure that the lead-in was securely attached to the terminals on the antenna. The best method for securing the lead-in also considered. Yes, no detail was to be overlooked.

The tower was then raised to the upright position and one of the men started cranking up the tower. Whatever the plans were for the final installation will never be known, for the men had failed to take into account the most important consideration of all. The tower was being raised only a few feet from the power lines. This set the stage for disaster. For some reason, the weight shifted and the tower fell against the power lines. One of the men was electrocuted on the spot. The other man was knocked unconscious and was rushed to the hospital. He, too, died shortly after arriving there. Whether the trailer was not properly leveled before the tower was raised or whether the ground was soft, allowing the weight to shift, seems unimportant after so great a loss.

A very important lesson to learn from this experience is that no risk of any kind should be taken where personal safety is involved. It's true, very few technicians will be called upon to make an installation similar to this one. How many times, though, has the installer been guilty of raising a tower at a point where it could fall across power lines should it get away. These possibilities should be taken into account on any installation. If it is necessary to work around power lines, consider the advisability of having the power shut off during the installation. Anyone who has made antenna installations knows how unwieldy some antennas can be. No matter how careful one might be, there is always the possibility that one of those long elements might come in contact with a live wire. Survey the situation carefully before each job. You won't be sorry, you'll be safe.

W.W.H.



# 12 reasons why it pays to replace with SYLVANIA PICTURE TUBES

## Independent laboratory tests show these 12 outstanding qualities of Sylvania Picture Tubes

- |                                                           |                                         |
|-----------------------------------------------------------|-----------------------------------------|
| 1. No tube failures (after 1500 hours).                   | 7. No stray emission.                   |
| 2. No trend toward slumping emission or low light output. | 8. Low electrical breakdown.            |
| 3. No excessive leakage.                                  | 9. Very good color control.             |
| 4. No excessive gas present.                              | 10. Excellent spot centering.           |
| 5. Excellent grid control.                                | 11. Low screen burning (no rejections). |
| 6. Excellent emission characteristics.                    | 12. Excellent physical conditions.      |

**Only Sylvania showed  
no tube failures**

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Set owners everywhere are being told again and again about Sylvania's superiority on the big, nationwide TV show "Beat the Clock."

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Of course, the name Sylvania has always stood for highest quality. Now, more than ever before, Sylvania Picture Tubes mean better business for jobbers and service-dealers alike. If you would like the full story of these recent tests to show your customers how Sylvania Picture Tubes won over all others tested, write to Sylvania today!



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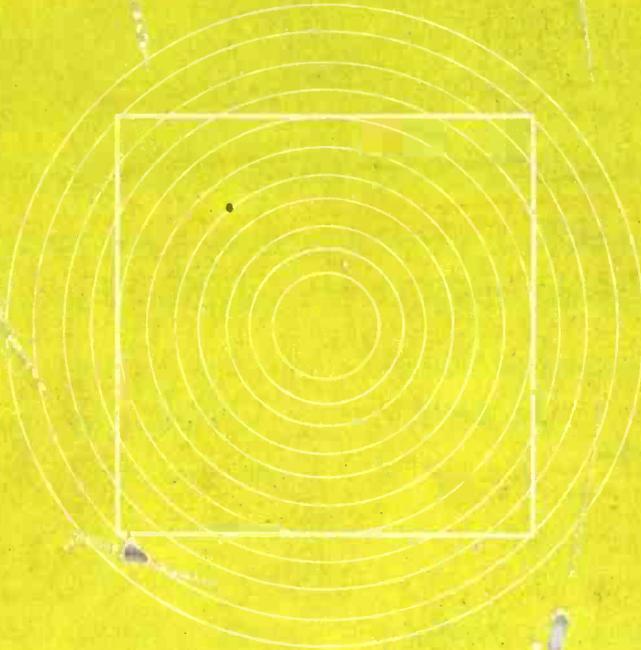
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*things are NOT as they seem...*

This is a perfect square within the circle  
— it is an optical illusion that the sides bend.



Things are not as they seem . . .  
These two fuses look alike . . .  
*But they are not.*



This fuse may burn out anywhere along the length of the filament even in the cap—this blown fuse is impossible to detect visually.



This Littelfuse has a controlled blowing point—the filament is plated throughout its length except in the very center—the fuse will always blow here. A blown Littelfuse can be detected immediately—a Littelfuse feature.

*Littelfuse holds more design patents on fuses than all other manufacturers combined.*

**LITTELFUSE**

DES PLAINES, ILLINOIS