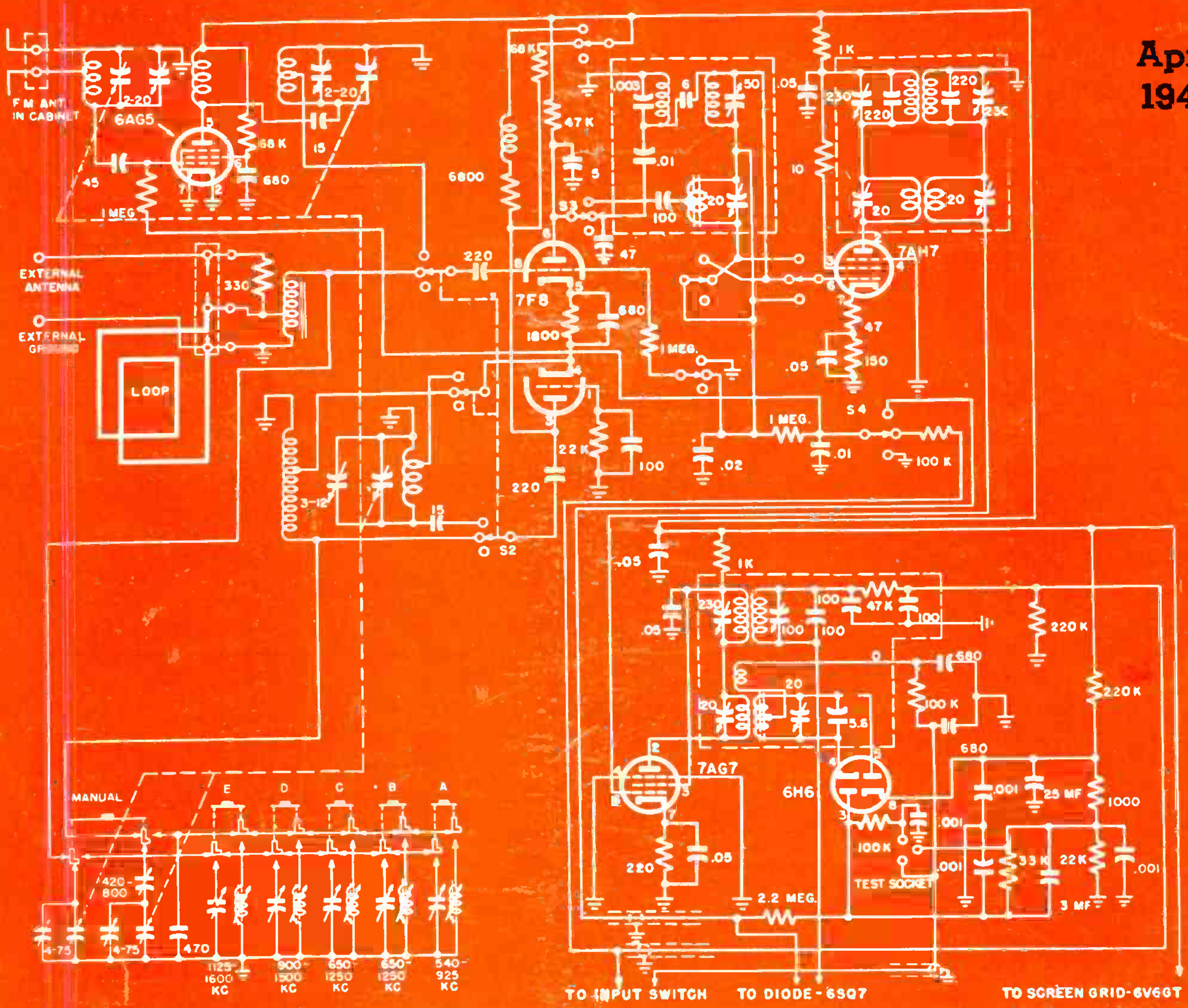
RADIO · TELEVISION · ELECTRONIC

SERVICE

April
1947



An f-m/a-m/phono receiver featuring a 6H6 ratio detector and a miniature 6AG5 r-f for f-m.

[See page 11]

THE TECHNICAL JOURNAL OF THE RADIO TRADE

TRIPLE-TEST ASSURES *Quality* IN GENERAL ELECTRIC RESISTORS

TESTED FOR
- ★ **CHARACTERISTICS**
- ★ **ENDURANCE**
- ★ **STABILITY**

What does triple-tested mean? It means that General Electric resistors have been subjected to the most rigid tests and inspection to make certain that they conform to high quality standards. Characteristics, endurance and stability have been checked in the laboratory and in the field, under actual operating conditions. These checks are assurance to you that General Electric resistors will stand up . . . will give greater customer satisfaction.

In designing this line of resistors, quality was the first consideration. But, along with quality, flexibility in application was demanded. The wide possible range of uses for each unit, extending from simple to complex circuits, can be met with minimum stock requirements. Your customer's needs can be supplied . . . your inventory can be kept down.

General Electric's complete line of high quality resistors also has a triple value for you. Since the customer's requirements can be supplied from one source, it saves his time. That means greater customer satisfaction, more sales, more profit. And remember, these resistors are easier to sell because they bear a name known for quality, General Electric.

Be sure to stock the entire line of General Electric universal parts.

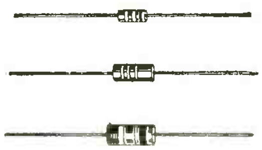
For complete information write: *General Electric Company, Electronics Department, Syracuse 1, N.Y.*

GENERAL ELECTRIC

169-F3

FIRST AND GREATEST NAME IN ELECTRONICS

COMPOSITION RESISTORS



½ watt, 1 watt, 2 watts

POWER WIRE-WOUND RESISTORS

Fixed 10, 20 watt — Adjustable 10, 25, 50, 100 watt

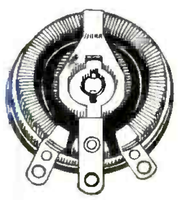
TUBE-TYPE WIRE-WOUND RESISTORS

COMPOSITION CONTROLS ATTACHABLE SWITCHES

SMALL WIRE-WOUND CONTROLS

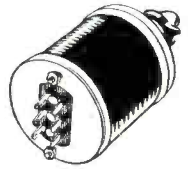
2 watt

POWER RHEOSTATS

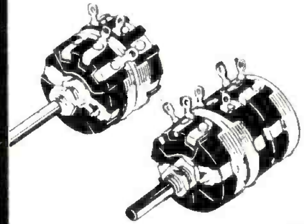


25 watt, 50 watt

CONSTANT IMPEDANCE ATTENUATORS



WIRE-WOUND L-PADS AND T-PADS



WIRE-WOUND CONTROLS

3 watts & 4 watts

EDITORIAL

THE COMPLETE TECHNICAL KNOWLEDGE Service Men must have to service today, stressed last month in our editorial and previously, too, has prompted many comments, which we are happy to say, support our views.

In a letter from an Australian reader, we note that the Service Man there must really *know* his business. And to be sure he does, he must taken an examination before he can become an accredited Service Man. Examination requires an explanation of such factors as cross-modulation, band-pass filter, class B amplifiers, space charge, cathode followers, as well as formulas for impedance, inductive reactance, capacitive reactance, *Q* of an inductance and frequency conversion. The prospective Service Man is also asked to make up a diagram of a vacuum-tube voltmeter and explain its applications. He is also asked to explain the action of tone controls in such systems as selective inverse feedback. And in another part of the examination, the Service-Man candidate is asked to draw a complete circuit of a 35-watt power amplifier, showing three input circuits for high and low impedance microphones, and a radio set tuner or phono pickup. He is also asked to state the reasons for his choice of tubes and type of input system.

How would you score on such an exam? High, we hope. Incidentally, we'll be running the answers to these questions and others that were asked in an early issue of SERVICE. We think you will find them interesting and hope you will be looking for them.

SERVICE MEN ARE RECEIVING QUITE A TRIBUTE these days in a series of national advertisements. The Service Man is being called: "A great guy.... A solid citizen. . . . The kind of a fellow people like to do business with—capable, trustworthy, skillful. A dependable fellow in every way whose skill keeps the radio working at its best. A dependable expert who uses good tools, and does an expert job at a price that's right."

Yes, it's quite a tribute, and we are quite sure that most Service Men can live up to it. We hope that *all* Service Men will be able to say "I'm that kind of a Service Man."

RADIO · TELEVISION · ELECTRONIC

SERVICE

Vol. 16, No. 4 April, 1947

LEWIS WINNER
Editorial Director

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Published monthly by Bryan Davis Publishing Co., Inc.
52 Vanderbilt Avenue, New York 17, N. Y. Telephone MUrray Hill 4-0170

ABC

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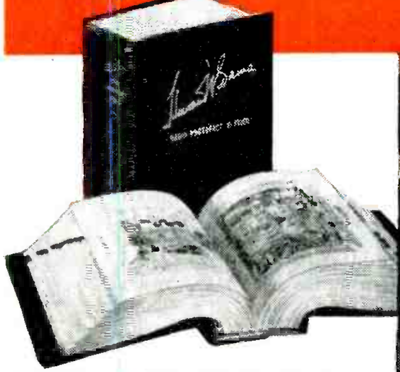
Entered as second-class matter June 14, 1932, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Subscription price: $2.00 per year in the United States of America and Canada; 25 cents per copy. $3.00 per year in foreign countries; 35 cents per copy.

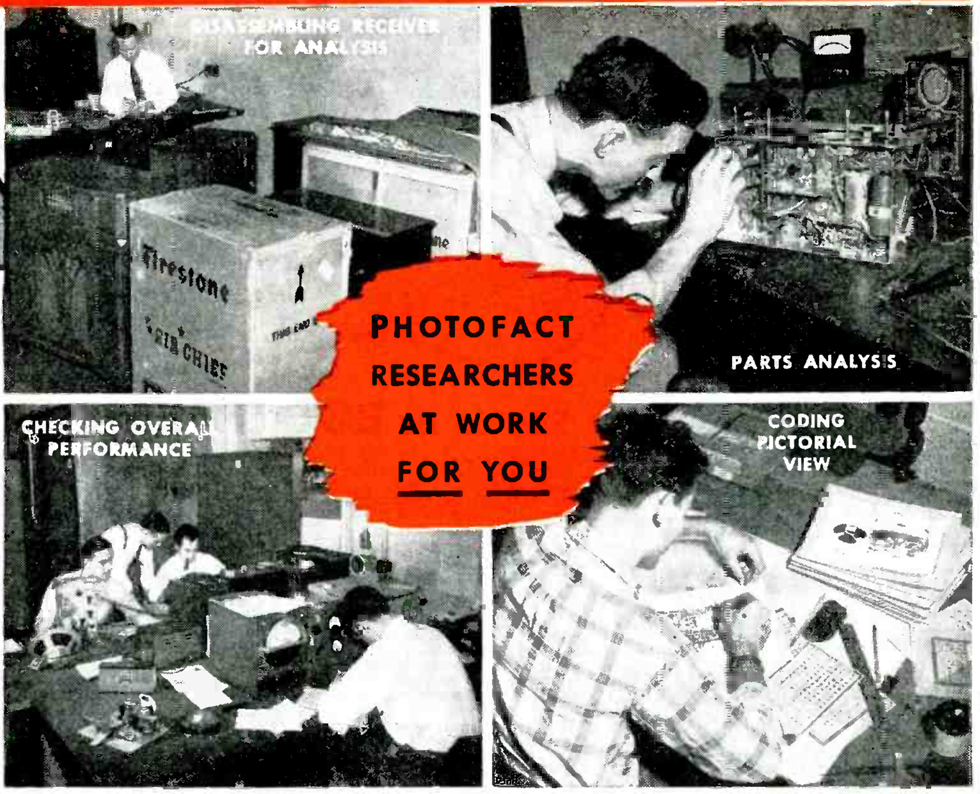
$400,000 WORTH OF RADIO SERVICE DATA

A Continuous Service for less than 9¢ a day in

PHOTOFACT* FOLDERS



VOLUME 1, containing first ten sets of PHOTOFACT FOLDERS in deluxe binder, $18.39. Individual sets Nos. 1 to 10, $1.50 each. De Luxe Binder alone, $3.39.



COMPLETE

Everything you need in one handy, unified form—large schematics, pictorials keyed to parts lists and alignment data, complete listings of parts values and replacements, alignment, stage gain, circuit voltage and resistance analysis, *coil resistances*, dial cord stringing, disassembly instructions, record changer analysis and repair.

ACCURATE

All sets are taken apart and analyzed by experts in the Sams laboratories. Every part is measured, tested and triple-checked for accuracy. All data is original. This means the data you get is *right*.

CORRECT

PHOTOFACT FOLDERS are issued twice monthly as the new receivers come off production lines. You don't have to wait for information. As receiver changes are made, you get correction and addition sheets for your files. Your data is always up to the minute.

EASY TO USE

All diagrams and pictures are coded to numbered parts lists. Everything is positively identified for fast work. All folders are set up in uniform, easy-to-follow style: big type, big illustrations—no hunting, guessing or eye strain—no more loss of time and temper.

$403,531.05†—that's what it actually cost us to create, print and distribute Volume 1 of Sams PHOTOFACT FOLDERS. Every penny of that money has been spent to bring the industry the most accurate, complete, up-to-the-minute data ever produced for radio servicemen. And this continuing service, designed to help you make up to *twice as many repairs daily*, actually costs you less than 9 cents a day.

PHOTOFACT FOLDERS could not be produced without the support of America's leading replacement parts manufacturers—without the support, too, of thousands of enthusiastic PHOTOFACT subscribers. With their cooperation, we will continue to place in your hands ALL the information you need to do a better job—facts, figures, photographs, full-page schematics—*information compiled from actual first-hand analysis of all new instruments*. PHOTOFACT FOLDERS cover *all* radios, phonographs, record changers, recorders, communications systems and power amplifiers—*and are timed to reach you as these instruments are released*. The cost is only $1.50 per set of 30 to 50 folders and includes membership in the Howard W. Sams Institute.

Set No. 17 will be ready for mailing April 10th. Set No. 18 on April 25th. Sets Nos. 11 to 16 inclusive, also priced at $1.50 each, are available for immediate order.

Start using PHOTOFACTS to make more profits. Remember, PHOTOFACT FOLDERS actually cost you nothing: *they pay for themselves over and over!* See your replacement parts distributor—or write us direct. In Canada, address A. C. Simmonds & Sons, 301 King Street East, Toronto, Ontario. Canadian price, $1.75.

* Trade Mark Reg.

†C.P.A. Statement Available

HOWARD W. **SAMS** & CO., INC.

2924 EAST WASHINGTON STREET, INDIANAPOLIS 6, INDIANA

PHOTOFACT SERVICE

"The service that pays for itself over and over again"

SPRAGUE TRADING POST

SWAP—BUY OR SELL

WANTED—Radio service business, including building with living quarters in rear; without equipment in central states, where modest living can be depended on. W. G. Eslick ,2825 E. 13th, Wichita, Kan.

WANTED—Cash for Radio Craft, Feb., 1943, or Service Magazine, July, 1943. Jones Radio Co., Douglassville, Penna.

FOR SALE—Closing out test equipment. Meissner analyst; Supreme 504-A combination tester; Radio City Products VTVM and Triumph 'scope. Special price. Radio Communications Service, 4475 Myrtle St., San Diego, Calif.

FOR SALE—Triplett 1175—comb. sig. generator—VOM, battery operated, perfect condition. Sig. gen. range 130KC-28MC, including audio output jack; ohmmeter 4-range 0-20 megohms; voltmeter A-C, D-C 5-range 0-1500. Mils 0-15 amps. 4-range; output meter 0-1500 5-range. G. Miller, 94 Holland Ave., Elmont, L. I., N. Y.

SWAP—Eveready, Federal table model radios, used, in working order for tube checker in working order. E. G. Guenther, 2384 Euclid Hts. Blvd., Cleveland 6, Ohio.

FOR SALE — Diagram for high-volume phone amplifier, 4-tube, A-C, D-C, parts easy to get. Diagram 20¢. M. Stellmach, 2009 N. 19th Ave., Melrose Park, Ill.

FOR SALE—Vedolyzer Supreme 160, $50, or portable typewriter; Supreme Diagnomoscope, 3" 'scope, sig. generator up to 60MC, A-1 condition; new recording level meter Rek-O-Kut V-M2, $25. Julius Hillenbrand, 5681 Metropolitan Ave., Ridgewood 27, L. I., N. Y.

FOR SALE—BR-44 A-C bridge analyzer, used very little, $25; Rider manuals XII and XIV, good as new, each $13. Raymond Lemmons, Lemmons Radio Service, Wakenney, Kan.

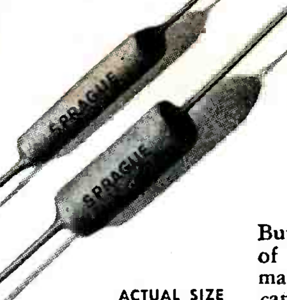
FOR SALE—Radio shop, only one in town, $1,600 takes all. 200 tubes, sig. gen., meter, tube tester, tools, parts, and complete stock. Open for most makes of radio repairs, good reputation. Leo's Radio Shop, Rib Lake, Wis.

WANTED—Urgently needed: Manuals, like Rider, RCA and GE manuals 1926-1942. Will buy, trade, or state your terms. 20th Century Radio Service, 412 N. 7th St., Paducah, Ky.

SITUATION WANTED—Summer, April to Sept. Radio operating, code speed 35 wpm on mill or teletype. Hold Radiotelegraph 2nd, Amateur licenses. 2 years' experience FCC, 2 years AACS. Prefer central U. S. E. V. Stolberg, 715 11th St., Rapid City, S. Dak.

FOR SALE — First 7 volumes Rider's manuals. Unabridged, full editions. Fine shape, like new. E. C. Entler, Bonaparte, Iowa.

WHAT'S THIS ABOUT MIDGET TUBULARS?



ACTUAL SIZE
Type 68P Capacitors . . . Ranges from .001 mfd. 400V to 0.5 mfd. 100V.

There's more about the new line of Sprague Type 68P Midget Tubular Capacitors than appears on the surface:

They're the smallest, most dependable midgets yet offered for normal applications. They're the direct result of Sprague engineering experience in developing capacitors for the famous VT fuse and other miniature wartime electronic assemblies. . . .

But, even more important, they offer concrete evidence of what you can expect from Sprague in the future. No manufacturer was called upon to engineer as many unique capacitor types for war equipment as was Sprague. The Type 68P Midgets are the first of these to be converted for everyday service and amateur radio use. Many more are coming.

Look to Sprague for the newest—and the best!

See us at BOOTH 89 at the Chicago Show!

FOR SALE—Rider's auto radio manuals 1 and 2, $2.50 each; Index for many Rider manuals, 50¢ to $1; 250 small assorted radio parts, $15. Beacon Radio Service, 142 E. 4th St., St. Paul 1, Minn.

FOR SALE—Model 803 R.C.P. tube and set tester with built in roller tube chart. Edw. Kloeh, 7811 S. Ridgeland Ave., Chicago 49, Ill.

WANTED—6-12-32 V. windcharger and/or gasoline motor-generator. Also want kerosene operated refrigerator. Cash or trade. Have very large stock of radio parts and tubes suitable for radio kits. A. G. Keller, 1975 Sedgwick Ave., Bronx 53, N. Y.

FOR SALE—The following tubes: 31—65¢; 33—86¢; 35—65¢; 37—47¢; 38—73¢; 39/44—65¢; 485—$1.32; 6A4—$1.08; 6A5—$1.93. Better price if all bought by same party. E. A. Shannon, c/o Karotkin Furniture Co., 221 W. Commerce St., San Antonio, Texas.

SELL OR SWAP—Late NRI course, $50, or will trade for signal generator or other test equipment. Also one luminous gas transformer, 110V-12,000V sec., 24MA, $10 or trade. R. Howe, 76 High St., Somersworth, N. H.

FOR SALE—Radio Amateur's Handbook, Collins, $1.50; Understanding Radio, Watson & Welch, $2; Electrical Engineer's Handbook, Pender, $4; Radio Engineering, Terman, $4. Dans Radio Shop, 4355 S. Honore, Chicago, Ill.

WANTED—New or used 25B8/GT tube in good condition; Rider's No. V. Davis Radio Service, Luverne, Minn.

WANTED—Urgently needed: 1—117N7/GT and 3A8/GT tubes. Will pay cash, all inquiries will be answered. C. B. Cooper, 58 Rhyl Ave., Toronto, Canada.

FOR SALE—Supreme 561 signal generator; Silver vomax 900 VTVM, both unused and practically new. Will sell the two together for $170. K. E. Stewart, 301 E. Lee St., Moberly, Mo.

FOR SALE—Two-post record changer, in homemade cabinet with cover, $12.50; Simpson 215 multi-meter, $25. Richard E. Holbrook, 7 Vine St., Montpelier, Vt.

FOR SALE—Mallory Radio Service Encyclopedia, 5th Ed., $1.25; 1942 Supreme Radio Diagrams, Vol. 5, $2. Both for $2 postpaid. A. A. Ghirardi's 972-page Radio Physics Course, $3.25 postpaid. John M. Hash, c/o J. H. Blair, Sprague, W. Va.

WANTED—Tubes, transformers, etc., for popular radios. Will trade new $95 Kodak 35 mm camera 2.5 lens, range finder. Camera will take 35 mm pictures in natural color, black and white. John A. King, Route 3, Kinston, N. C.

SELL OR SWAP—Philco signal generator, good condition. Will trade for battery operated signal generator in good condition. Marlin Sigler, Shady Grove, Ky.

SELL OR SWAP — Electrical supplies, wire, meters, books for books by Steinmetz and Julius Berg's "Electrical Engineering." Also want A-C voltmeter and ammeter. Have to trade meters, toggle switches, rubber multi-cords, etc. A. C. Liggera, 353 E. 84th St., Los Angeles, Calif.

FOR SALE—Supreme set analyzer 550 in excellent condition, $37; new Solar condenser analyzer CE-160, $52. Tony Zucco, 3rd St., Cresson, Pa.

FOR SALE—Clough-Brengle A-C bridge 230-A. Checks capacity 2 mmf. to 200 mf., power factor, leakage, resistance, 2 ohms-20 meg. Turns ratio in excellent condition. $28. Joseph Barreca, 233 E. 5th St., New York 3, N. Y.

FOR SALE OR TRADE—I am a crippled radio beginner, DeForest student C3164. Will trade rubber stamps for radio magazines, books, parts, etc., or sell them for 70¢ each. J. T. Cookson, Box O. Puxico, Mo.

FOR SALE—Tube tester and volt-ohm-milliammeter. New. Mahogany case. James W. Hoskins, 212 Middlefield Rd., Palo Alto, Calif.

FOR SALE—Supreme 506-C, Weston 682, tube testers. Excellent condition, very reasonable. Also sig. tracer with "B" eliminator, minus 22½, 4½ V, plus 45, 90, 180, 250 V. Write Johnnie's Radio Service, Rock Valley, Iowa.

FOR SALE—Philco batteries, 50% off list. P60-A-110; P87; 60A-4FG; 41-A40. Horn's Radio, 4749 W. Adams, Los Angeles 16, Calif.

SELL OR SWAP—311/CT's in original cartons. Cost $16.50 each. For use in David Borgen Diathermy units. Dave Otte, Moses Lake, Wash.

WANTED — High-voltage 'scope transformer like in "TAB" and Standard Parts Co. ads in Radio News. Have Hickok 2" 'scope chassis, repair parts or cash for this transformer. Geo. T. Keil, Huntress Radio, 840 Cottonwood, Freeport, Ill.

WANTED—Solar capacitor, resistor bridge CC-1-60 or Solar cap. analyzer CE-EXAMETER. Will trade Speco sig. tracer STAP, STP probe included. Dean E. Hull, Box 212, Philadelphia, Miss.

SWAP—Talkaphone recorder, record player; Operadio 50 watt, 6V-115V amplifier with record player. Want Hallicrafter SX-28A; Rider Chanalyst; 2 small transmitters, comm. typewriter. H. G. Hamilton, 45 E. Main St., Frostburg, Md.

FOR SALE—E200 Precision sig. generator, $55 f.o.b.; Hickok 19XD, $100 f.o.b.; both work OK, look new, used little. Radio Craft, News, Service, 10¢ each f.o.b. T. Wojciechowski, 2837 Fulton St., Brooklyn 7, N. Y.

FOR SALE—G.E. UM-3 unimeter, 0-2500 V, A-C, D-C, 0-1 megohm, 0-10 amp. D-C, used 2 months, $30; General Industries 78 rpm recorder, playback unit, never used, $22 f.o.b. E. Kuligowski, 192 Henry St., Brooklyn 22, N. Y.

SELL OR SWAP—CQ5 recorder; test instruments; spare parts; few used tubes. Send card for list. Want Meissner sig. shifter. Oscar E. Hager, 1317 Chadbourne, El Paso, Texas.

FOR SALE — Replacement coils, Grunow fields—28435, 27213, 29042, 29242, 29506, 29697, 29726, 29758, 29768, 29774, 29778, 29783, 29786, 29964, 31279. Lamey's Radio Service, 407 Concord Ave., Monroe, N. C.

YOUR OWN AD RUN HERE FREE

The Sprague Trading Post is a free advertising service for the benefit of our radio friends. Providing only that it fits in with the spirit of this service, we'll gladly run your own ad in the first available issue of one of the six radio magazines in which this feature appears. Write CAREFULLY or print. Hold it to 40 words or less. Confine it to radio subjects. Make sure your meaning is clear. No commercial advertising or the offering of merchandise to the highest bidder is acceptable. Sprague, of course, assumes no responsibility in connection with merchandise bought or sold through these columns or for the resulting transactions.

Send your ad to Dept. S-47

SPRAGUE PRODUCTS COMPANY, North Adams, Mass.

(Jobbing distributing organization for products of the SPRAGUE ELECTRIC COMPANY.)

ASK FOR SPRAGUE CAPACITORS and *KOOLOHM RESISTORS *by name!*

*Trademark Reg. U. S. Pat. Off.

A SIGN OF SUCCESSFUL SERVICING

Radio Clinic has all fifteen RIDER MANUALS

The Radio Clinic, with two stores on Broadway in New York City, has long been recognized for the high efficiency of its radio servicing department. Like other successful operators, Radio Clinic has always depended upon the authoritative data in RIDER MANUALS to diagnose the troubles in ailing American-made receivers issued from 1930 to 1947. Also like thousands of others, Radio Clinic is still benefiting from RIDER MANUAL Volume I, bought 17 years ago!

From no other single source is such information available. In no other way can you have at your fingertips the facts you need to locate troubles in any and all receivers that come to your bench; receiver schematics, voltage data, resistance values, chassis layouts and wiring, and trimmer connections.

Volume XV, covering sets issued during 1946, includes the exclusive Rider "clarified-schematics" which break down the composite diagrams of hundreds of complicated multi-band receivers into *individual* schematics of each circuit as it exists with each turn of the wave band or equipment switch.

Also with each copy of Volume XV is included the 150 page "How It Works" book, a practical guide to the theory of operation of the new technical features in the latest receivers. These exclusives are but two of the many important features in Volume XV, which also includes all popular "Ham" communication receivers, Scott receivers, Magnovox RA combinations and record player combinations.

RIDER MANUALS provide a systematic, compact, indexed data service, always in order, always ready with the information you must have for efficient, time-saving, profitable servicing. Year after year, after year, RIDER MANUALS keep pouring out profits for servicemen.

In spite of greatly expanded production, demand for RIDER MANUALS still exceeds supply. Place your order today.

VOLUME XV — JUST OUT!

2000 pages, plus 150 page "How It Works" Book
$18.00 complete

Volumes XIV to VII (each volume)	15.00
Volume VI	11.00
Abridged Manuals I to V (one volume)	17.50
Record Changers and Recorders	9.00

OTHER RIDER BOOKS

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Radar Entertaining, revealing, in lay language	1.00
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The Meter at Work An elementary text on meters	2.00
The Oscillator at Work How to use, test and repair	2.50
Vacuum Tube Voltmeters Both theory and practice	$2.50
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A-C Calculation Charts Two to five times as fast as slide rule	7.50
Hour-A-Day-with-Rider Series— On "Alternating Currents in Radio Receivers" On "Resonance & Alignment" On "Automatic Volume Control" On "D-C Voltage Distribution"	$1.25 each

This new Rider Book, soon to be announced, will be of lasting usefulness to everyone interested in any phase of radio.

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RIDER MANUALS
MEAN SUCCESSFUL SERVICING

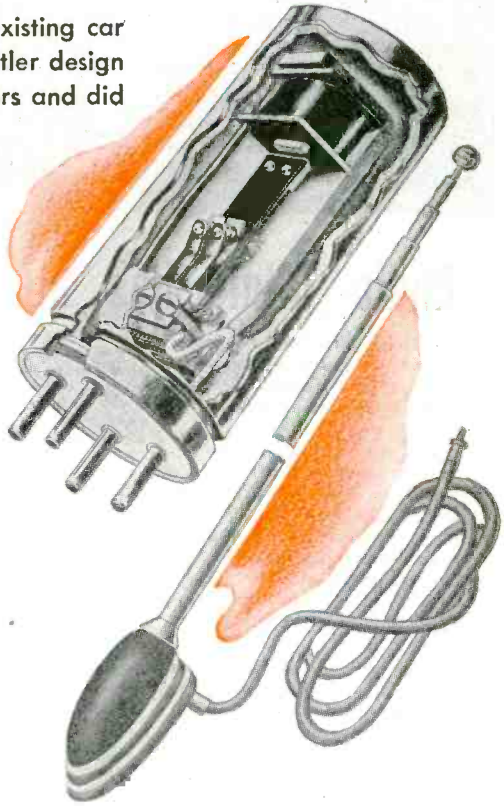
Radiart

MANUFACTURERS OF
QUALITY
VIBRATOR EQUIPMENT
SINCE 1932

From the very beginning, the history of Radiart has been closely allied with modern vibrator development. Back in 1932 this company, foreseeing the need for a complete line of correct replacement vibrators, was the first to design such a line and to place it on the market. Radiart pioneering may also be credited with many revolutionary changes in vibrator design. Floating center reeds, all-riveted assembly and hermetic sealing through the famous Red Seal process . . . all are exclusive innovations which came into being through Radiart research. Today over 76% of all popular replacements are serviced by 12 Radiart vibrators and more than six million of these units have been sold.

In 1936 Radiart developed the first streamlined aerial to match existing car contours. The first truly waterproof aerial; the first all-metal anti-rattler design and the new Plasti-Loom Lead were all evolved by Radiart engineers and did much to increase public acceptance for this type of equipment.

There has never been any change in Radiart's original policy of quality manufacture. The same high standards still govern Radiart production and are your assurance of obtaining a product which is as perfect as modern methods of engineering and manufacture can make it.



R A D I A R T, C L E V E L A N D, O H I O

ELECTRONIC DISTRIBUTOR AND INDUSTRIAL SALES DEPARTMENT

Radiart

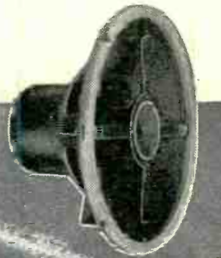
MAGUIRE INDUSTRIES, INC., 936 N. MICHIGAN AVENUE, CHICAGO 11, ILLINOIS
EXPORT SALES DIVISION • SCHEEL INTERNATIONAL INCORPORATED
4237-39 N. LINCOLN AVENUE, CHICAGO 18, ILL. U.S.A. CABLE ADDRESS—HARSCHEEL

Listen... IT'S A Jensen SPEAKER!

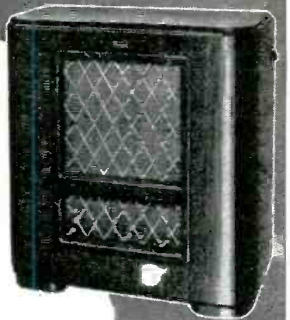

Model HNP-51
(15-inch)


Model JAP-60
(15-inch)


Model JHP-52
(15-inch)


Model JCP-40
(12-inch)

JENSEN BASS REFLEX* REPRODUCERS with COAXIAL SPEAKERS



TYPE "RD"

REPRODUCER NO.	STOCK NO.	CABINET NO	SPEAKER NO.	IMPEDANCE, OHMS	
RD-122	ST-159	D-121	JCP-40	6-8	
RD-151	ST-160	D-151	HNP-51	500-600	
RD-152	ST-161	D-151	JAP-60	500-600	
RD-153	ST-162	D-151	JHP-52	500-600	

TYPE "RA"

RA-124	ST-134	A-121	JCP-40	6-8	
RA-151	ST-136	A-151	HNP-51	500-600	
RA-153	ST-138	A-151	JAP-60	500-600	
RA-154	ST-139	A-151	JHP-52	500-600	

JENSEN BASS REFLEX* CABINETS

TYPE "D"

MODEL NO.	STOCK NO.	SPEAKER SIZE	DIMENSIONS			
			HEIGHT	WIDTH	DEPTH	
D-121	ST-156	12"	27⅞"	31⅜"	13⅜"	
D-151	ST-157	15"	27⅞"	31⅜"	13⅜"	

TYPE "A" (Finished)

A- 81	ST-123	8"	24"	18"	9¼"	
A-121	ST-124	12"	27"	24¾"	13½"	
A-151	ST-125	15"	32⅜"	27⅜"	13½"	

TYPE "A" (Unfinished)

A- 82	ST-145	8"	24"	18"	9¼"	
A-122	ST-146	12"	27"	24¾"	13½"	
A-152	ST-147	15"	32⅜"	27⅜"	13½"	

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Jensen SPEAKERS WITH ALNICO 5

SYLVANIA NEWS
RADIO SERVICE EDITION

APRIL *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1947

RADIO SERVICEMEN! SYLVANIA'S COLORFUL NEW CLOCK BIG AID IN SERVICE SALES

Specially Designed Famous-Make Clock Identifies Quality Stores Stocking Sylvania Tubes

- Bright white face . . . black numerals!
- Minute and hour hands in black . . . unique second hand in attractive red!
- The words "RADIO SERVICE" in green and black. The word "SYLVANIA" in identifying green!

- Fifteen-inch diameter!
- Radio tube in silver and black...design of carton in familiar green and black!
- Telechron movement sealed in oil; case in brown crinkle finish with silver-colored rim around face! Nominally priced at only $7.50!

Once you place this big, colorful Telechron electric clock—with its "Radio Service" face—in *your* window, you'll have an attractive sales aid that identifies your business . . . every second of the day . . . as carrying the finest line of tubes made.

Through far-reaching advertising campaigns, your customers are being advised of the advantages of placing Sylvania "quality-controlled" radio tubes in their equipment. By displaying this on-the-spot sales help you're telling them you sell these highest quality tubes. Get this wonderful sales aid now!

ORDER FROM YOUR SYLVANIA DISTRIBUTOR** or write **SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa.

SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

RADIO · TELEVISION · ELECTRONIC
SERVICE

F-M/A-M/PHONO Receiver

(See Front Cover)

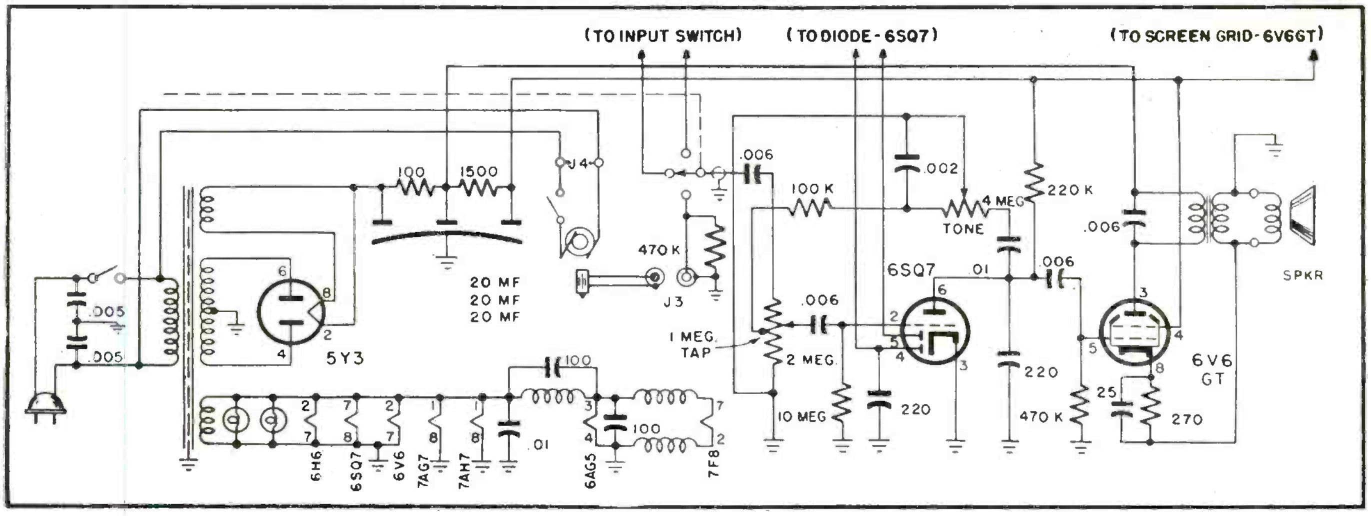


Fig. 1. The a-m modulator and first audio, power amplifier, and rectifier portion of the circuit shown on the front cover.

AN A-M/F-M PHONO model with many circuit innovations appears on the cover this month; Bendix 847B two-band eight-tuber.

In the f-m tuned r-f section a high-gain miniature 6AG5 is used. This is fed by a direct-coupled f-m doublet contained within the cabinet. The tuned input circuit is coupled to the 6AG5 grid through a 45-mmfd capacitor across a 1-megohm resistor from the avc bus. Another tuned circuit feeding the first detector is tapped down to reduce loading and is shunt fed by the r-f plate through 15 mmfd across an r-f choke.

A 7F8 high G_m dual triode serves as a first detector and oscillator for both f-m and a-m. To cover the broadcast band, a push-button circuit is used with a capacitive tuned detector and a shunt inductor-tuned oscillator. A grounded-grid type Hartley oscillator with the grid grounded through a 100-mmfd capacitor serves both bands, injection being obtained by connecting cathodes through 680 mmfd. A cathode bias, through a 1,800-ohm resistor on the detector, is supplemented by a grounded 1-megohm grid leak on f-m and avc on a-m.

In the a-m input appears a low-impedance loop and provision for an external-antenna. A 330-ohm resistor is shunted across the loop which is direct-coupled to an iron core antenna transformer.

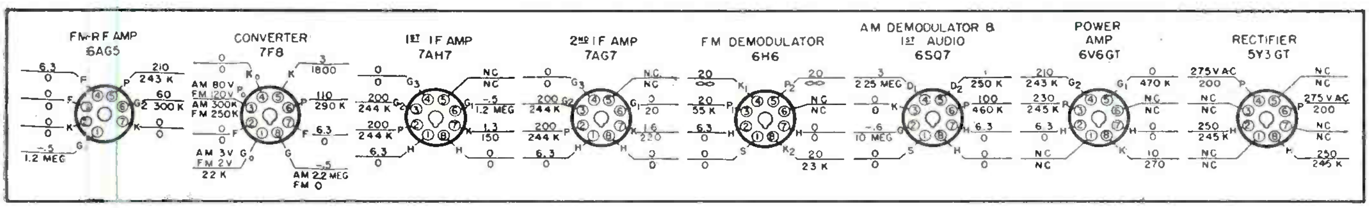
The discriminator circuit employs a 6H6 as a *ratio detector*.[1] Its design is different from the standard type of discriminator in that the cathode of one half of the diode and the plate of the other half are connected across the secondary of the discriminator transformer.

The first detector is resistance coupled to either a double-tuned 455 kc a-m i-f transformer or a single-tuned 10.7-mc f-m i-f transformer acting as an autotransformer. The coupling capacitors are 100 mmfd for f-m and .01 mfd for a-m. A 6-mmfd capacitor,

(*Continued on page* 35)

[1] A more complete analysis of the ratio detector system will appear in the May issue of SERVICE.

Fig. 2. Voltage data for the Bendix 847B. In making these measurements the signal input was zero; voltage control minimum; socket voltage/resistance to common ground, d-c 20,000 ohms-per-volt and a-c 1,000 ohms-per-volt.



Servicing Helps

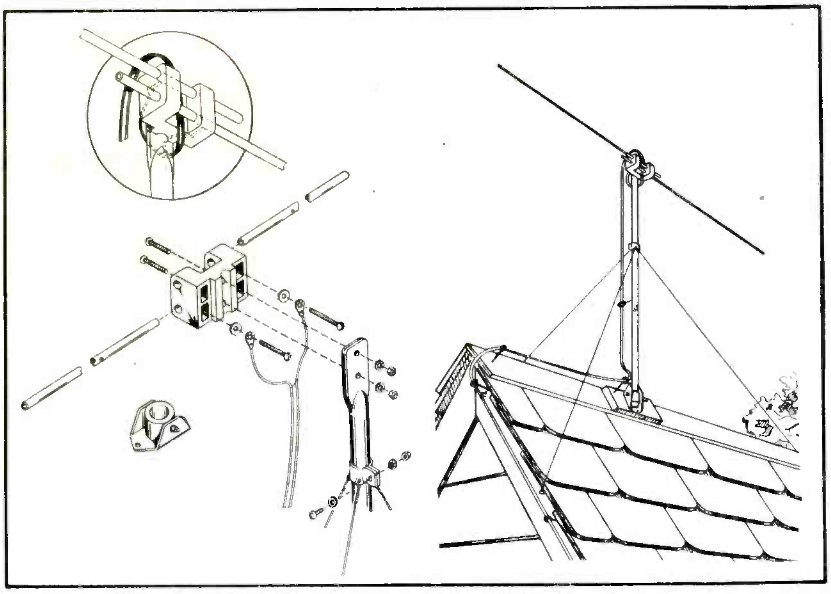


Fig. 3. View of an f-m dipole and its mounting. In detailed drawing at left appear the constructional features of the dipole antenna.
(Courtesy Bendix Radio)

OSCILLATOR COIL TRACKING

CONSIDERABLE DIFFICULTY is often experienced in getting replacement oscillator coils to track, particularly where the oscillator tuning capacitor is smaller than the r-f section. The problem is caused by the exacting design of the original oscillator coil. This involves such factors as the distributed capacity inherent in the coil. In the replacement coil it is usually quite difficult to duplicate the original characteristics exactly. Therefore, when replacing this coil, some compromise is necessary.

Best results are usually obtained when a coil with a slug tuner is used. This type has very low distributed capacitance, and may be compensated more easily.

Three points on the dial are usually used for alignment. These are a low, middle, and high frequency. Suggested frequencies are 550, 1,000 and 1,500 kc.

The dial is first turned to 1,500 kc, and the oscillator slug is set for this frequency without adjusting the oscillator trimmer capacitor. The r-f trimmer, however, is adjusted. The dial is then tuned to 550 kc, and the deviation in frequency is noted. If the actual frequency at this point on the dial is found to be, say, 530 kc, then the inductance of the coil is too high. The inductance of the coil should then be reduced and the oscillator trimmer capacitance increased so that the receiver still tunes correctly at 1,500 kc. The process is then repeated until both 550 and 1,500 kc are both received correctly. A check should then be taken at 1,000 kc to check the accuracy of the tracking. A 3-kc error is not considered high.

If the foregoing procedure doesn't solve the problem, two other methods can be used. One involves the use of a series trimmer, if none is used in the receiver, inserted as shown in Fig. 2. It has its maximum effectiveness at the low-frequency end of the dial. This trimmer should be a high capacitance, on the order of 1,200 to 1,600 mmfd.

The other alternative is to change the i-f frequency. If the actual tuning range is wider than the calibrated dial, decreasing the i-f frequency will tend to bring the two in line. The inverse is also true.

•

F-M ANTENNA INSTALLATIONS

WITH F-M RECEIVER production increasing daily, and models becoming available for immediate purchase, the Service Man will soon find himself with a crowded installation calendar. This will be particularly true for those installations in the rural or skyscraper areas where reception difficulties will demand a properly-installed external dipole antenna.

In preparing for the installation, several factors must be considered. For instance, since a high antenna will provide improved reception, a suitable high-mounting site should be sought. The site should be at least five feet from any object, such as roofs, chimneys, and trees. It will also be best if there is an open space between your antenna and the area of transmitting stations.

In addition, both antenna and trans-

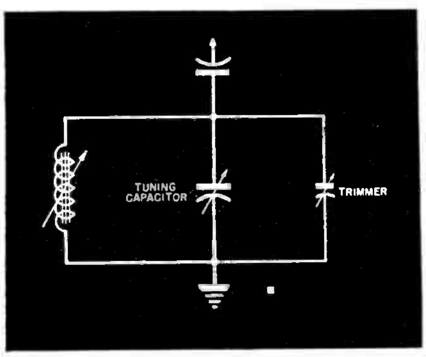


Fig. 1 (left). A typical adjustable-coil oscillator section of a receiver where coil-capacitor tracking is achieved by first aligning the coil with the tuning capacitor at the high frequency end, and then checking at the low-frequency end. Then the inductance is adjusted at the low-frequency end, and the trimmer at the high end.

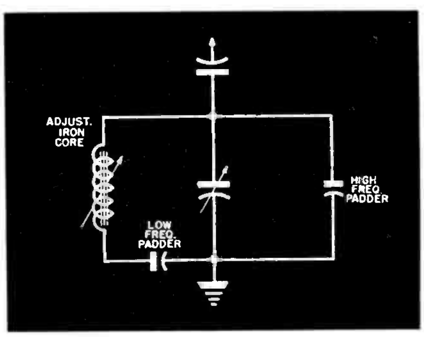


Fig. 2. Where other methods fail, the inclusion of a series trimmer may help. This is inserted in series with the ground end of the oscillator coil. Trimmer, usually a very high capacitance on the order of 1200 mmfd or more, is adjusted at the low end of the dial.

Oscillator Coil Tracking; F-M Antenna Installations; Replacing Electrodynamic with P-M Speakers; Service Hints For Firestone, Meck, Knight and G. E. Models

mission line should be kept away from metallic structures because their efficiency may otherwise be affected. (Since any transmission line is subject to some attenuation (weakening of the signal), the leadin must be as direct and short as possible. Surplus transmission line should not be folded or looped, but cut to proper length, and unused section discarded.)

Since direction is of utmost importance in f-m, the antenna must be so placed that the dipole members will be about broadside to the area of transmitting stations. However, where possible, the position giving best reception should be determined by experiment rather than merely placing broadside to the transmitting station. This may be done by temporarily connecting the dipole to an f-m receiver and listening to the desired stations as the antenna is rotated.

(Data Courtesy Bendix Radio)

REPLACING ELECTRODYNAMIC WITH P-M SPEAKERS

The improved types of p-m speakers recently announced have prompted wide application of the units in midget and console receivers.

The new types of p-m speakers are also excellent for replacements of the older electrodynamic types, since they provide a strong and more uniform field (for improved signal), eliminate hum troubles and minimize problems caused by heat in field coils of the e-m speakers.

In view of this trend, one manufacturer[1] has prepared data revealing how Service Men may use the newer p-m speakers in place of the e-m speakers; Figs. 4 and 5.

In Fig. 4 appears the conventional hookup for a field dynamic speaker with a 450-ohm field, and in Fig. 5 appears the replacement-speaker circuit. A 1,200-ohm resistor is used to replace the 450-ohm field. Where a capacitor is connected from plate of output tube to ground, the capacitor should be run to rectifier cathode, not ground. The cathode self-bias resistor of the output tube should not be bypassed. Where there is a capacitor from grid of output tube to ground, or from plate of preceding tube to ground, the capacitor should be removed.

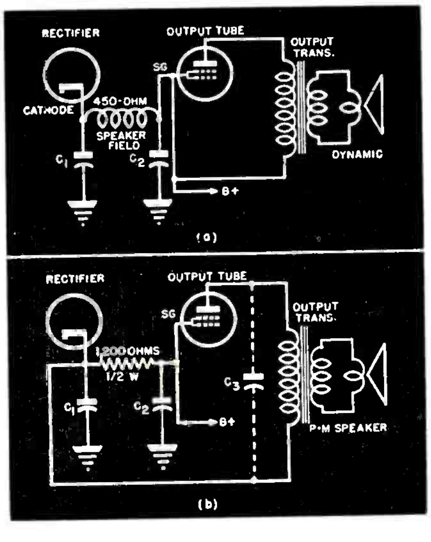
[1]Wright, Inc.

IMPROVING V-C RESPONSE
(Firestone R-178)

On Firestone Auto set R-178 chassis (Stewart-Warner), and others of this series, it is often impossible to decrease volume sufficiently with volume control turned full counter-clockwise. This is not due to a defective control, but rather to an open electrolytic bypass capacitor from the 6Q7 cathode to ground.

Figs. 4a (above) and b (below). In a, we have a conventional hookup for a 450-ohm field dynamic speaker. A p-m replacement circuit is shown in b. C_1 and C_2, in both circuits, are filter capacitors. Where there is a capacitor from the plate of the output tube to ground, the capacitor (C_3) should be brought to the rectifier cathode. The cathode self-bias resistor of the output tube should not be bypassed. Where a capacitor has been connected from grid of the output tube to ground, or from the plate of the preceding tube to ground, the capacitor should be removed.

(Courtesy Wright, Inc.)



INTERMITTENT GROUND
(Meck-1946 Models)

Some of these models use a fibre and metal fastener to secure line cord to the chassis. The metal on this fastener often grounds resistor intermittently when cord or set is moved, causing noise. To remedy, move affected parts aside or remove fastener and knot line cord.

DIAL-DRIVE RUBBER REPLACEMENT
(Knight EA10866)

To replace the odd-sized dial-drive rubber on this model, remove the old rubber, and put service cement on the inside of a ½" rubber *screw-on* foot or bumper, and force on tuning shaft.

REMOVAL OF PILOT LAMP
(G.E. 100)

To secure the pilot lamp so that it does not work loose in shipment or operation, the factory was instructed to use a drop of glyptal cement between the base and socket. It has been found in a number of cases that the quantity used was excessive, making it practically impossible to remove the pilot lamp. If this condition is encountered, repeated applications of acetone or nail polish remover between the lamp and socket will soften the cement sufficiently to permit removal.

OSCILLATOR ADJUSTMENT
(G.E. 250)

A Quantity of Receivers was shipped with the oscillator adjustment plug not locked after alignment, causing the low-frequency calibration to be considerably in error and reducing sensitivity at this end of the band.

The oscillator adjustment (adjacent to first i-f transformer), should be realigned as described in the service data sheet, ER-S-250, locknut should then be tightened.

Incidentally, it is important that the battery filler cap be sufficiently tight so that the washer is compressed, otherwise battery acid will leak out and damage the set. The washer should be replaced when the cap is removed. Service Men should note that possible thread burrs may prevent the cap from being tightened completely. A screwdriver should be used to tighten the cap.

MOTOR *maintenance and repair*

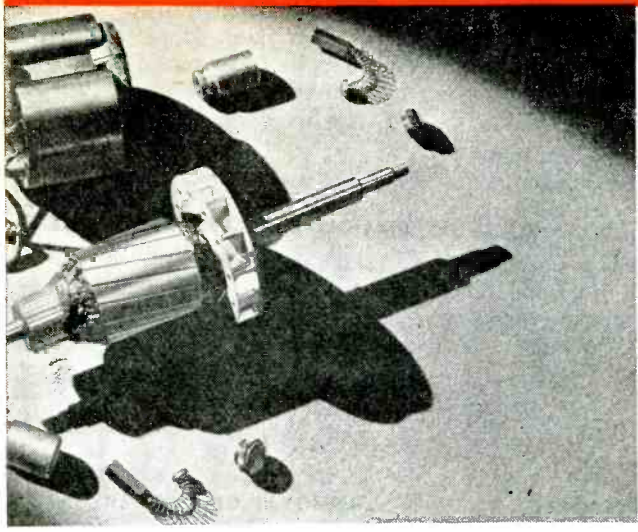


Fig. 2. Components used in a series motor that appears in vacuum cleaners, mixers, reamers, etc. (*Courtesy G. E.*)

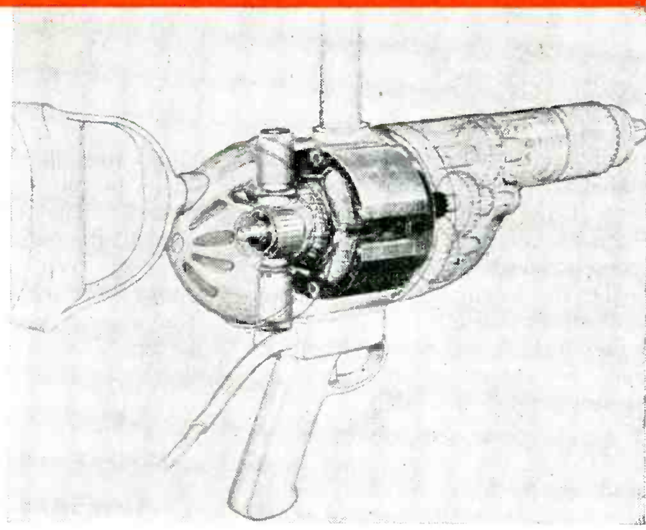


Fig. 1. A typical series-wound motor, as applied to a portable electric drill.

by ROBERT ROSENBERG

Instructor in Armature Winding and Motor Repair
George Washington Vocational High School

THE UNIVERSAL MOTOR which can be operated on either d-c or single-phase a-c at approximately the same speed, is the most commonly used type of household appliance motor. These motors have a high starting torque and a variable speed characteristic, and since they run at a dangerously high speed without a load, they are usually built into the device they drive.

Construction of the Universal Motor

The main parts of the universal motor are: (*1*) frames; (*2*) field core; (*3*) armature; and (*4*) end plates or brackets.

The frame is a rolled steel, aluminum or cast iron shell and large enough to hold a field core lamination snugly. The field poles are generally held in the frame by means of through bolts. Very often the frame is constructed to form an integral part of the machine it supports.

The field core, shown with other components of the motor in Fig. 2, is constructed of laminations which are tightly pressed together and held together by rivets or bolts. Laminations are designed to contain both field poles of a 2-pole motor; Fig. 3.

The armature, shown in Fig. 4, consists essentially of a laminated core having either straight or skewed slots to hold the armature winding, and a commutator to which the leads of the windings are connected. Both the core and the commutator are pressed on the shaft. As in other motors the end plates are located on the ends of the frame and held in place by screws. The plates house the bearings, usually of the ball or sleeve types.

Many universal motors contain an end plate which is cast as part of the frame, and only one plate can be removed from this type of motor. Brush holders are usually bolted to the front end plate, as illustrated in Fig. 5.

Neighborhood Service Shops are rapidly becoming the repair center for small household appliances, such as food mixers, vacuum cleaners, drills, sewing machines, etc. With many of the appliance breakdowns caused by faults or defects in the electric motor, it is naturally important that the Service Man be very familiar with motor design and operation and the methods required to locate and repair the troubles.

We have thus arranged for a series of articles on this vital subject by Robert Rosenberg, author of the book,[1] "Electric Motor Repair," the first installment appearing in this issue. Presented is a complete analysis of motor construction and operation, and methods and accessories used to locate and remedy the fault or defect.—Ed.

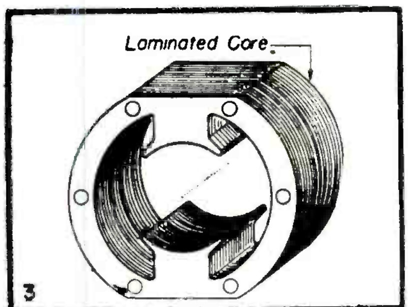
[1]Murray Hill Books, Inc.

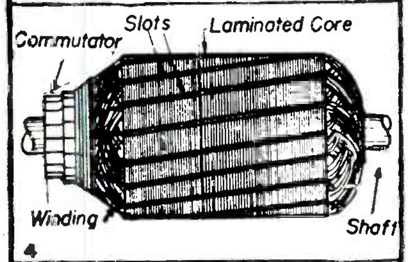
Universal Motor Operation

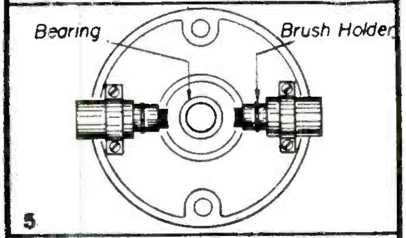
The universal motor is so constructed that when the armature and field coils are connected in series and current is applied, the magnetic lines of force created by the fields will react with the lines of force created by the armature and cause rotation. This is true regardless of whether the current is alternating or direct.

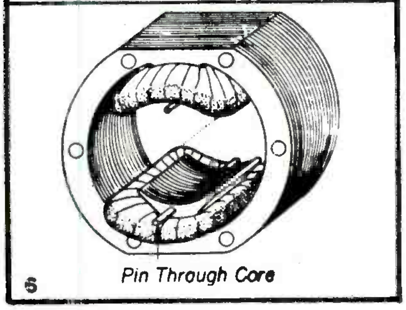
Dismantling the Motor

Before a universal motor or any motor is disassembled, it is extremely important that the end plates and frame be marked so that it may be reassembled properly. This may be done by making one center punch mark on the front or commutator end and adjacent frame, and two center punch marks on the back plate and adjacent frame. It is also important to inspect the motor, before it is dismantled, for such mechanical troubles as broken or cracked

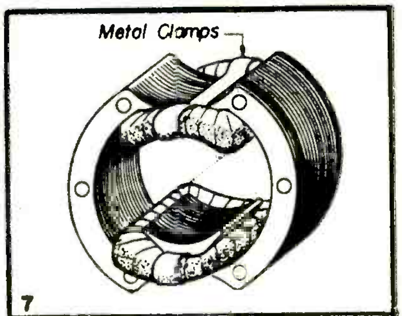


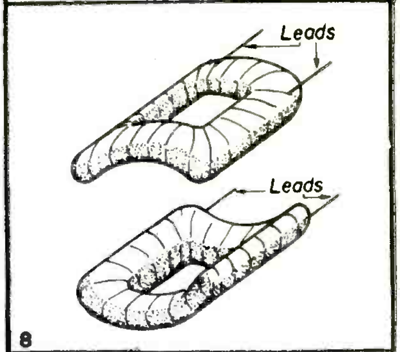


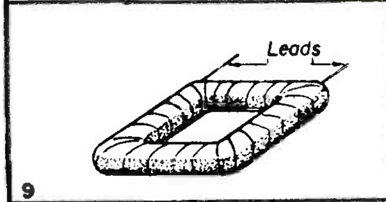


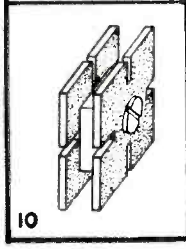


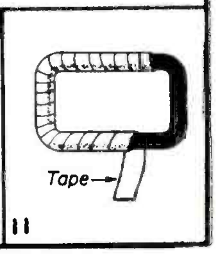
Figs. 3, 4, 5 and 6. In Fig. 3, we see how laminations are designed to contain field poles for a 2-pole motor. An armature is shown in Fig. 4. Brushholders bolted to front end plate are shown in Fig. 5. One way in which field coils are secured to a core is shown in Fig. 6.











Figs. 7, 8, 9, 10 and 11. A method of mounting a field coil to a core is shown in Fig. 7. Shape of coils when removed from core is shown in Fig. 8. In Fig. 9 appears a flattened coil which serves as a form for a new coil. In Fig. 10 is an assembly view showing coil in mounting position with side pieces bolted to frame. A coil taped with cotton tape appears in Fig. 11.

end plates, badly bent shaft, broken or burned leads. The bearings should also be tested for defects, as will be described later. It is also important to record whether or not the shaft of the armature can be turned without difficulty. After these tests have been made, the motor may be dismantled, being careful to first remove the brush springs and caps, and other parts which may have to be removed before the end plates are taken off. All parts should be placed in a container so that they will not be lost. When the bolts and screws, which hold the motor together, are taken off the end plates and armature should be removed, leaving the fields in view.

The Field Coils

Nearly all universal motors are two-pole machines and therefore have two field coils. The field coil windings consist usually of several hundred turns of small sized enameled wire.

In Figs. 6 and 7 appear several ways in which the field coils are secured to the core. When removed from the core, the coils have the shape shown in Fig. 8.

Quite frequently new field coils must be made because the old ones are burned or shorted. In making field coils the old coils are removed from the core and then the tape which binds the turns together is removed. The wire size and number of turns in each coil should then be recorded. The coil is then flattened, Fig. 9, to make a form for the new coil. A piece of wood is then cut to the dimensions of the inside of the coil to provide a form on which the new coil will be wound. To facilitate removal of the coil after it is wound the sides should be taped slightly. To hold the coil in position while winding, two sidepieces must be bolted to the frame, as in the assembly view of Fig. 10. The coil is wound by placing the frame in a small lathe, winding machine or other similar device, and winding the proper number of turns of the right size of wire on the frame. The coil should be tied up before removing, using the slits cut in the sidepieces as guides.

Flexible leads are spliced to the ends of the coil. The coil is then taped as in Fig. 11, with cotton tape, and painted and placed in the core. If the coil fits tightly, you must avoid scraping the corners of the core otherwise the wires may ground or break.

Connecting Field Coils and Armature

The field coils of a universal motor are connected in series for opposite polarity. This means that one pole must be *north* while the other must be *south*. There are several ways of determining whether correct polarity has been obtained.

In one method, Fig. 12, the coils are connected in series and a low voltage is applied. The head of a nail is placed against one pole. If the polarities are correct the other end of the nail is attracted to the next pole. If incorrect it is repelled.

In another test method a compass is used. The coils are connected in series as before and a low voltage direct current applied. A compass is placed near a pole on the inside of the motor or alongside the field coil. A notation is made of the pole to which the needle points. When the compass is moved to the next pole, the other end of the needle should be attracted. If the same end of the needle is attracted the leads of the pole have to be reversed.

As stated previously most universal motors are two-pole affairs. In these types both field coils are connected in series, and then in series with the armature, as shown in Figs. 13 and 14. These illustrations show that one line lead is brought from the armature and the other line lead from the field.

Another method of connecting the universal motor is shown in Fig. 15; the armature is connected between two field coils. The end of the first field coil is connected to one side of the armature, and the other side of the armature is connected to the next field coil.

Reversing the Universal Motor

In a universal motor the direction of rotation is changed by reversing the flow of current through either the armature or field coils. The usual method is to interchange the leads on the brush holders; Fig. 16 shows a motor connected for one direction, and Fig. 17 for the opposite direction.

On many universal motors, especially those in which the brush holders cannot be shifted, reversing the rotation will cause severe sparking at the brushes, because most of these motors are made for specific application and are wound for operation in only one direction. The only way in which these motors can be reversed, without causing sparking, is to relocate the leads on the commutator. This necessitates a knowledge of armature winding which will be discussed in another installment.

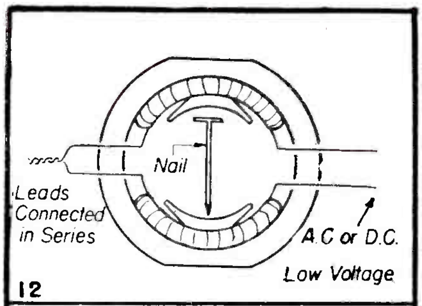
Speed Control of Universal Motors

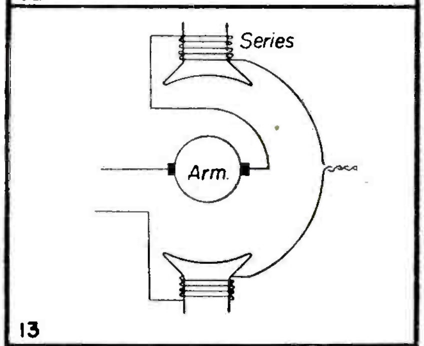
The speed of a universal motor can be regulated by inserting resistance in the motor, by using a tapped field or means of a centrifugal device.

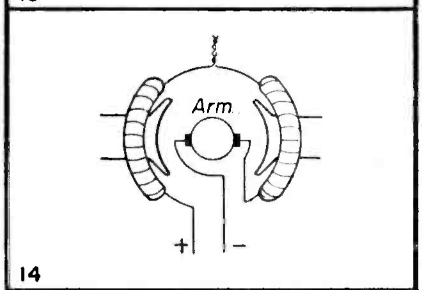
Resistance method: The speed of small universal motors, such as those used on sewing machines, is varied by a small variable resistance connected in series with the motor; Fig. 18. The amount of resistance in the circuit is varied by means of a foot pedal and may consist of a carbon pile or resistance wire. Another type of speed control on small size universal motors consists of two small carbon blocks which are pressed tightly together for high speed operation. As these blocks are slowly moved apart the resistance is increased, less current is allowed to flow, and the motor slows down. An external switch separates the carbon blocks, and when the blocks are separated entirely, a fixed resistance remains in the circuit, as shown in Fig. 19. A capacitor is used to reduce arcing.

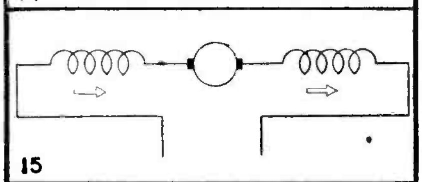
Tapped Field: The speed of some universal motors is controlled by tapping one field at various points, Fig. 20, thereby varying the field strength and consequently the speed. The field pole is wound in several sections with different sizes of wire and taps brought out from each section. In another method nichrome resistance wire is wound over one field pole and taps are brought out from this. The lowest speed is obtained when the entire winding is in the circuit, medium speed when parts of the field is out, and high speed when this winding is eliminated.

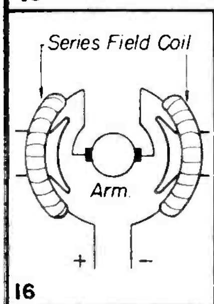
Centrifugal Device: Many motors, such as those used for home mixers have a large number of speeds. Selection is usually made by a centrifugal

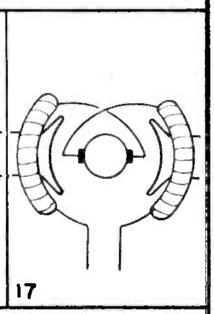


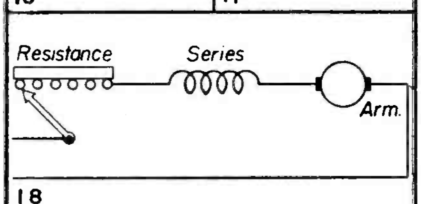


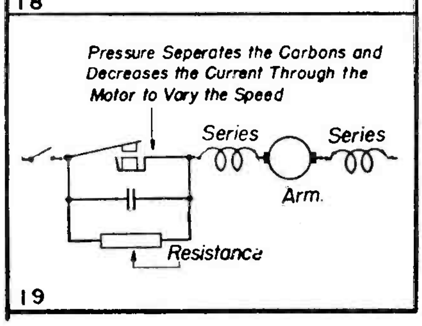












mechanism located inside the motor, and connected as shown in Fig. 21. The switch can be adjusted by means of an external lever. If the motor runs above the speed set by the lever, the centrifugal mechanism will open two contacts and insert resistance in the circuit which, will in turn, cause the motor speed to decrease. When the motor slows, the two contacts close and short the resistance so that the motor runs faster. This process is repeated so rapidly that the variation in speed is not noticeable. The resistance is connected across two governor contacts. Since sparking will occur with the opening and closing of these contacts, a small capacitor is connected across them. This capacitor not only reduces the sparks but prevents pitting of the contacts.

Testing the Universal Motor

It is essential that Service Men know how to test the armature and the field coils for defects. The defects usually found in the windings are grounds, shorts and opens. A winding is said to be grounded when it makes electrical contact with the iron of the motor and is usually the result of insulation failure.

In test for grounds, Fig. 22, test leads, consisting of a lamp connected in series with a 110-volt line wire, are used. One test lead is placed on the commutator, the other on the shaft. If the lamp lights a ground is indicated. To repair a grounded winding it is first necessary to locate the exact position of the ground and then eliminate it. Unless the grounded points are visible, it may be necessary to use a meter test set to locate the point of ground. It is usually advisable to rewind a grounded armature.

A grounded field coil is located in much the same way. A test set is used with a lamp with one test lead placed on the frame of the motor and the other test lead on the field leads. If the lamp lights a ground is indicated. Fig. 23 illustrates positions

[Figs. 20 to 25 appear on page 45]

(*Continued on page* 45)

Figs. 12, 13, 14, 15, 16, 17, 18, and 19. In Fig. 12, we have a method of determining polarity. Figs. 13 and 14 illustrate series connection of a 2-pole a-c motor. Another method of connecting a universal motor, with the armature between two field coils is shown in Fig. 15. How to interchange leads on brushholders to change the rotation direction are represented in Figs. 16 and 17. Fig. 18 shows a variable resistor in series with a motor for speed control. Fig. 19 shows fixed resistance that remains in circuit when carbon blocks used for speed control are separated entirely.

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WRITE FOR LITERATURE

PYRAMID
ELECTRIC COMPANY

JERSEY CITY 6, N. J.

PYRAMID "LONG-LIFE" Dry Electrolytic Capacitors

TUBE *News*

THE DEVELOPMENT OF THE 6SB7-Y single-ended metal pentagrid converter, with its high conversion trans-conductance, high oscillator transconductance and mica-filled phenolic base, has permitted the design of very effective conversion circuits which are particularly useful on f-m in the v-h-f 88 to 108-mc bands; Figs. 1 and 2.

The tube has also proved itself quite efficient at the lower frequencies for a-m and h-f international broadcast service, Fig. 3. In circuits of this type, a dynamic type of biasing is supplied by the oscillator section, which prevents d-c from flowing in the signal grid circuit. Here the cathode is not at r-f ground potential. Therefore the cathode current cut-off potential or the voltage on grid *1* necessary to cut off cathode current will swing up and down with the cathode when considered with respect to ground. Cathode current flows during a portion of the oscillator grid cycle. However, during this time the potential of the cathode is positive with respect to grid *3*. As soon as the cathode potential swings through zero and into the negative region, the oscillator grid cuts off cathode current, and so under this condition no current can flow to grid *3*.

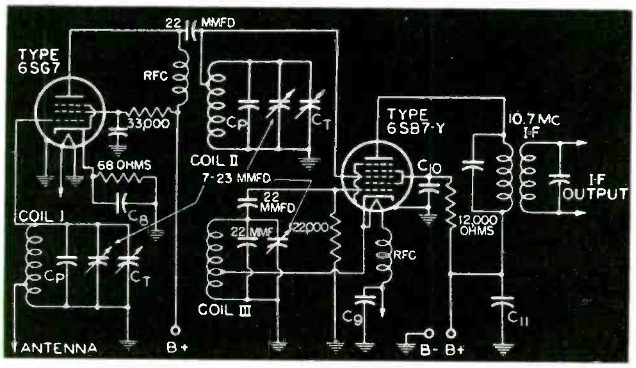
On the international s-w bands an appreciable phase shift can exist in long cathode or grid leads. If this phase shift is large enough, there will be a shift of the cathode voltage with respect to the oscillator grid voltage. Thus, biasing action is partially lost and we have d-c flowing in the grid *3* circuit. Such current flowing through the avc resistance may develop a fairly high bias which will appear on all the tubes in the avc string resulting in a serious reduction in receiver sensitivity. It is important therefore that the cathode and oscillator grid leads are kept quite short at these higher frequencies.

In the v-h-f bands, the foregoing effect is much more pronounced. At these frequencies, even with the cathode tap of the oscillator coil connected directly to the tube socket, the signal grid current cannot be reduced to zero, even when extreme care is used to shield the input circuit from the output circuit. It has also been

(*Continued on page* 44)

Fig. 1 (below). A typical self-excited 88-108-mc converter circuit for a 6SB7-Y, with an r-f stage. The C_7, C_8, C_9, C_{10} and C_{11} symbols indicate bypass capacitors; C_p, padding capacitor; and C_t, trimming capacitor.

(*Courtesy RCA*)



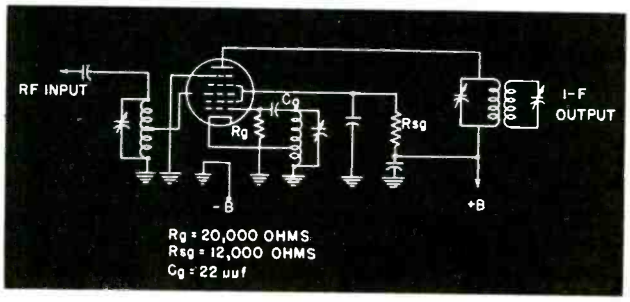


Fig. 2 (right, top). Converter circuit for a 6SB7-Y where the signal frequency is 108 mc and the oscillation frequency 118.7 mc.

(*Courtesy G. E.*)

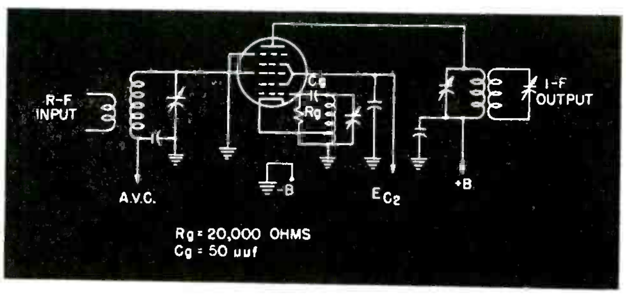


Fig. 3. A typical a-m broadcast and international broadcast circuit for the 6SB7-Y.

(*Courtesy G. E.*)

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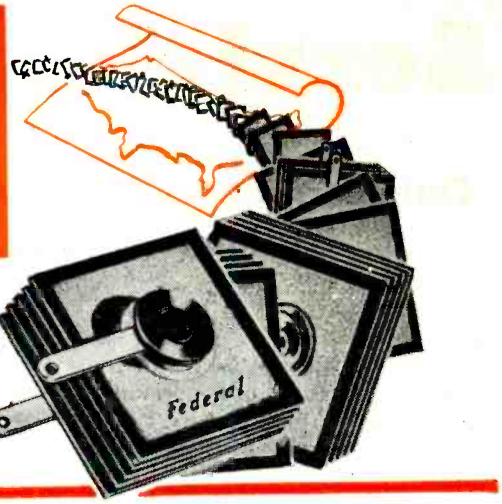

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Rodefield Co.
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South Bend—Colfax Co., Inc.
Terre Haute—Terre Haute Radio

KANSAS
Wichita—Radio Supply Company

KENTUCKY
Louisville—P. I. Burks & Co.
Universal Radio Supply Co.
Owensboro—General Electronic Supply

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New Orleans—Radio Parts, Inc.
Shuler Supply Co.
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Walther Bros. Company

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Auburn—Radio Supply Co., Inc.
Bangor—Radio Service Laboratory of New Hampshire & Maine
Portland—Radio Service Laboratory of New Hampshire & Maine

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Cumberland—Radio Wholesaler

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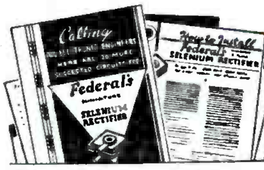

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Servicing OLD TIMERS

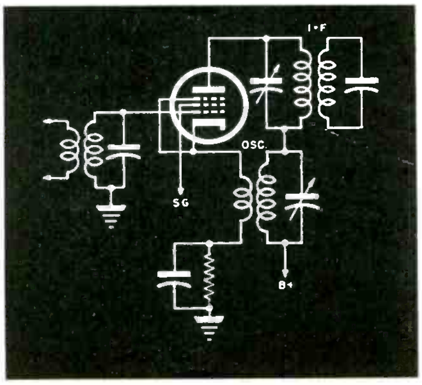
Cures for Troubles That Are Usually Encountered in Servicing Emerson 23, Majestic 400, 370 and 15, and Macy MB 58 Models

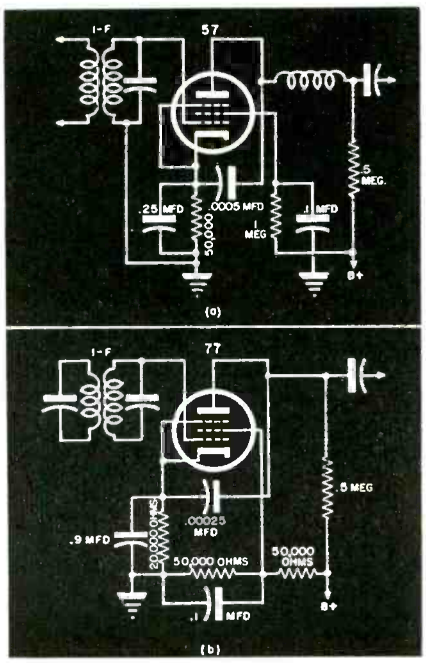
by G. L. P. MEREDITH

MOST NEWCOMERS TO SERVICE, who have trained carefully, have little trouble in servicing most of the prewar receivers, that is, those receivers which reached the retail market between 1938 and 1942. Practically all of these receivers employed similar circuits for conversion, detection, and audio amplification.

However, occasionally, a real old-timer of the early thirties, with odd circuits that are not too familiar, will be brought to the Service Shop. And the Service Man is usually faced with a bit of a problem.

Many of these receivers employ circuits which were either the forerunners of modern circuits, or were discarded for better and simpler design.





The Plate Detector

A favorite circuit of the first table-model receivers was the plate detector. The greatest advantage of this form of detection was its ability to amplify as well as detect.

In this type circuit the tube is biased to cutoff. Thus, only the positive half of the incoming r-f signal will cause plate current to flow. Bypassing this current through an audio system, these pulses are converted into an audio signal. An r-f filter network is usually employed in the plate circuit to filter out any residual r-f voltage.

Figs. 1*a* and *b* show typical plate-detector circuits in two oldtimers, Majestic 400, and Emerson 23, respectively. While both of the receivers shown are superheterodynes, this type of detection is most often employed in t-r-f receivers.

The salient characteristics of this type of detector are high bias voltage and low screen grid voltage. Cathode resistors will vary from 20,000 to 50,000 ohms, while screen grid resistors will vary from 1 to 3 megohms.

The plate bypass is very important, and will usually be found to vary in value from .00025 to .002 mfd. An open plate bypass capacitor will usually cause squealing and whistling, while an incorrect value of screen grid or cathode resistor will cause low volume, distortion at high volume levels, or low sensitivity.

Fig. 1 (left). Two examples of plate detection. In *a*, detector circuit of the Majestic 400. The choke and .0005-mfd capacitor form a filter network for r-f, permitting only the audio component to pass into the audio system. In *b*, circuit used in Emerson 23. Here, the choke has been omitted and only the capacitor is used. Note the high value of cathode resistance used in both circuits.

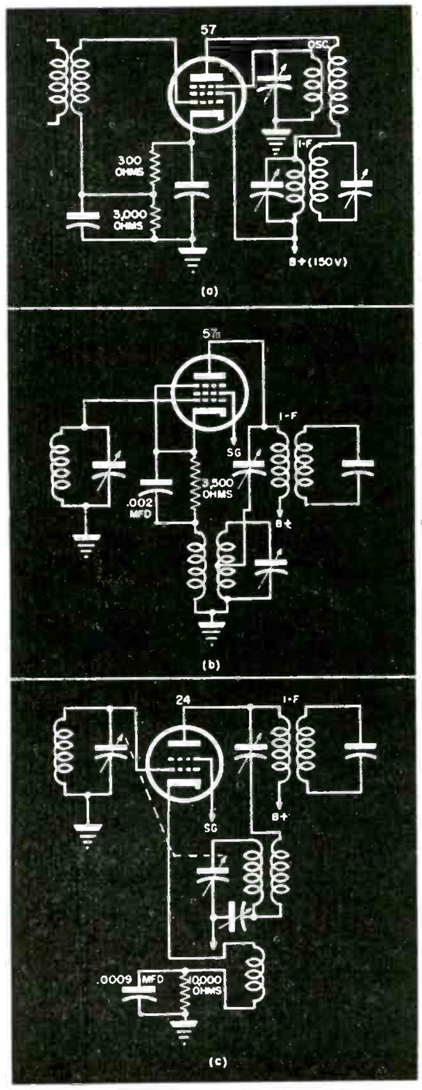
Fig. 2 (top, left). Basic circuit of the *autodyne* circuit. This circuit was the forerunner of the modern converter. Many variations of this basic design were used in receivers produced around 1930.

Fig. 3 (right). Three variations of the autodyne. In *a*, the oscillator coil has been placed between the plate and suppressor grid. In *b*, the oscillator coil is connected in the plate and cathode circuits. In *c* appears an early version of the autodyne, employing a 24 tube. Note that in *b* and *c* the primary of the i-f transformer is untuned.

Oscillator Circuits

Before the advent of the converter tube, the general practice was to use a separate tube as an oscillator in superheterodyne receivers. When the super-control pentode appeared, the autodyne circuit was used extensively, although

(*Continued on page 42*)



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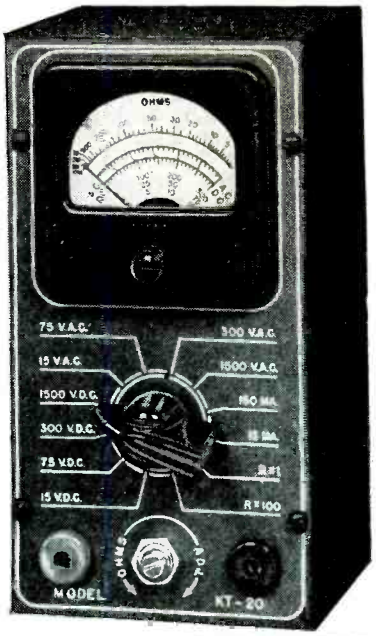

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- 2 D.C. CURRENT RANGES: 0-15/150 MA.
- 2 RESISTANCE RANGES: 0-10,000 ohms; 0-1 Megohm.

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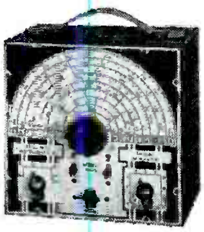

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A.C. VOLTS: 0 to 15/30/150/300/1500/3000 Volts.
OUTPUT VOLTS: 0 to 15/30/150/300/1500/3000 Volts.
D.C. CURRENT: 0 to 1.5/15/150 Ma.; 0 to 1.5 Amperes.
RESISTANCE: 0 to 500/100,000 ohms 0 to 10 Megohms.
CAPACITY: .001 to .2 Mfd., .1 to 4 Mfd. (Quality test for electrolytics).
REACTANCE: 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms.
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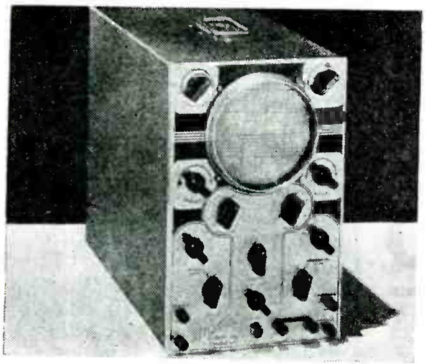
NEW PRODUCTS

HICKOK OSCILLOGRAPH

An oscillograph, type 195, with a 5" screen, featuring sinusoidal sweep with phasing control, has been announced by the Hickok Electrical Instrument Co., 10521 Dupont Avenue, Cleveland 8, Ohio. Instrument contains high-gain vertical amplifiers allowing deflection of one inch for each .05 volt input.

The 5UP-1 cathode-ray tube is used. Phasing control facilitates i-f, r-f, and discriminator alignment.



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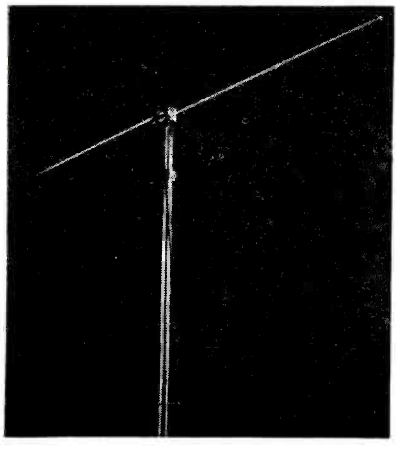
UNIVERSAL MICROPHONE VEST POCKET WEIGHT SCALE

A vest-pocket type weight scale, 5" long and ½" diameter, type A178, that can be used to determine needle pressure applied to the record groove by the phonograph pickup or recording head, has been announced by the Universal Microphone Co., Inglewood, California. Readings are given in half ounce steps from zero to eight. A zero adjustment is provided under the small screw cap at the upper end of the case.

* * *

WESTINGHOUSE F-M RECEIVER ANTENNA

A f-m dipole antenna with a swivel-base for multi-position mounting has been announced by Westinghouse. Has aluminum masts and elements. Swivel mounting bracket is said to make installation possible on a flat or peaked roof or on the side of a building.

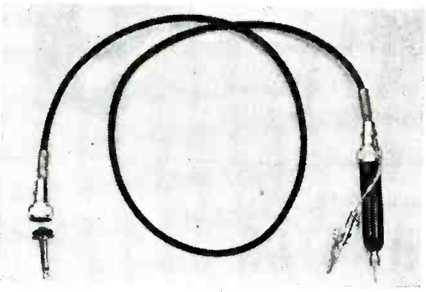


RCA GERMANIUM CRYSTAL PROBE

A miniature germanium crystal rectifying probe, MI-8263, which adapts the voltohmyst and chanalyst for circuit testing of television, frequency-modulation, and other v-h-f applications, has been announced by the test and measurement section of the RCA engineering products department.

The probe employs the crystal to rectify applied a-c voltages which are then measured by the d-c circuit of the meter. The meter reading is proportional to the positive peak of the applied a-c voltage.

The probe body, constructed of insulating material, is reinforced at the end with a metal shield to eliminate capacity effects when held for testing. A detachable ground lead with an alligator clip is provided for use at the highest frequencies, where the lead length becomes an important factor in overall accuracy.



* * *

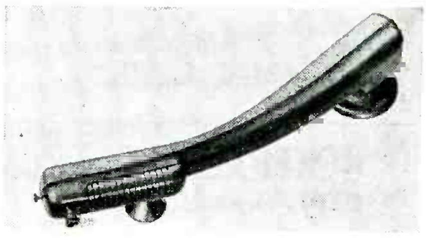
FLUORESCENT-LAMP NOISE FILTER

A fluorescent-lamp interference filter, Aerovox IN-23, has been developed by the Aerovox Corporation, New Bedford, Mass. Connects across two lines of the fluorescent lamp. A slotted mounting bracket facilitates mounting and grounding on the frame of the fixture.

* * *

ASTATIC PICKUP ARMS

Two phono pickup arms, designed to accommodate a nylon cartridge, have been developed by the Astatic Corp., Conneaut, Ohio. Cartridge (1-J type) employs a nylon chuck and matched, replaceable, knee-action, nylon needle with jewel or precious metal tip. One pickup arm (Nylon-508) is intended for use with the new manually-operated electrical record players. Other type (Nylon-400) studio master, is a professional type reproducer for use with lateral transcriptions of all sizes.



GENERAL ELECTRONIC VOLT-OHM-MILLIAMMETER KIT

A volt-ohm-milliammeter unit kit, containing all parts required for construction, is now being distributed by General Electronic Distributing Co., N. Y. City.

Kit, model KT-20, comes assembled provides four a-c voltage ranges, 0-15/75/300/1500; four d-c voltage ranges, 0-15/75/300/1500; two a-c ranges, 0-15/150 ma; and two resistance ranges, 0-10,000 ohms and 0-1 megohm.

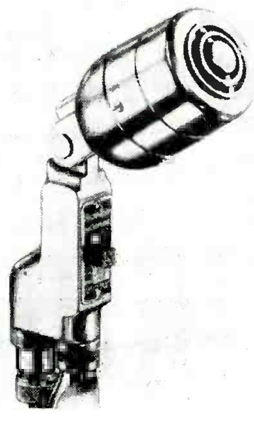
* * *

ELECTRO-VOICE DYNAMIC ACOUSTALLOY DIAPHRAGM MICROPHONE

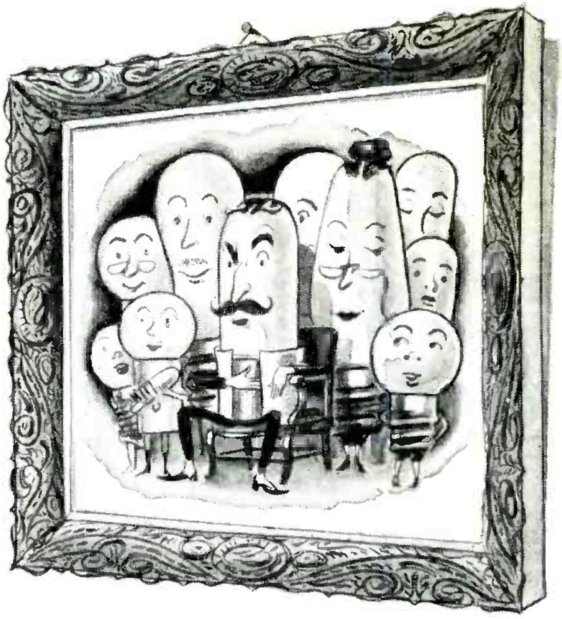
Dynamic microphone, model 630, using as acoustalloy diaphragm, has been developed by Electro-Voice, Inc., Buchanan, Michigan. Frequency response is said to be substantially flat, 40-9000 cps; output level, 53 db below 1 volt/dyne/cm², open circuit. Acoustalloy diaphragm is said to withstand high humidity, extremes of temperature, corrosive effects of salt air, and severe mechanical shocks. Alnico V and armco magnetic iron ore utilized in mike in a non-welded magnetic circuit.

Built-in cable connector permits vertical tilting of microphone head in a 90°

(Continued on page 24)



Little lamp with a big family



EACH TINY G-E DIAL LAMP that you sell or install is a "kid brother" in the big family of 10,000 different types and sizes of lamps made by General Electric. Despite their small size, G-E miniature lamps benefit from the same General Electric research that works constantly to make all G-E lamps *Stay Brighter Longer.*

Our scientists have devoted exhaustive study to the special conditions of vibration and shock which affect dial lamp life. Their findings have resulted in improved filament designs which greatly reduce lamp failures and increase lamp life.

Research has made G-E miniature lamps the leaders in quality and service. Features like these assure satisfied customers and satisfying profits when you sell G-E lamps for radio dial lights and similar uses.

1. Dependable, trouble-free performance.
2. High level of maintained light output.
3. Low current consumption.
4. Long life.
5. Profitable to handle.
6. Greater dealer acceptance.

FOR INFORMATION *on prices and types of G-E miniature lamps, see your nearby G-E Lamp Office. Or write to General Electric Co., Div. 166-S-4, Nela Park, Cleveland 12, Ohio.*

G-E LAMPS
GENERAL ELECTRIC

NEW PRODUCTS

(Continued from page 22)

arc, for directional or non-directional pick-up. Standard ⅝"-27 thread for stand mounting.

* * *

G. E. RESISTOR TUBES

Universal wire-wound resistor tubes, to supply voltage for pilot-lamp operation in a-c and d-c receivers and to aid voltage-reduction functions, have been announced by the specialty division of G. E.

Tubes feature a high leakage resistance between helical resistance element (supported on high grade mica form) and chassis, which is said to permit use in sensitive circuits without the introduction of a-c hum.

To insure against overheating of other components beneath the chassis, the resistors provide connections to the *hot* leads under the chassis and, at the same time, dissipate the heat above it. Resistor tubes are ½" in diameter and 2⅝" high and have a maximum safe power dissipation of 20 watts.

* * *

G-C FLOCK FINISH SPRAY KIT

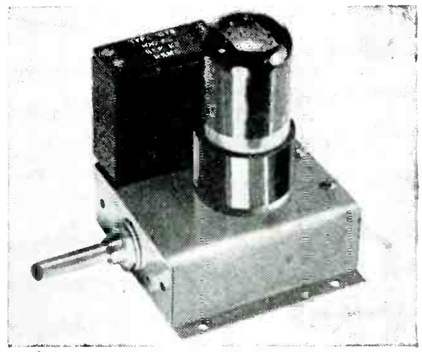
A blower spray gun that is said to distribute flock evenly and blow each fibre into the undercoat vertically has been included in a kit announced by General Cement Manufacturing Co., 919 Taylor Avenue, Rockford, Illinois.

Besides gun, kit includes 1 can brown flock, 1 can ivory flock, 1 can thinner, 1 brush and instructions and 1 can brown undercoat.

* * *

RADIO SPECIALTY OSCILLATOR UNIT

A small calibrating oscillator unit featuring a 100-kc crystal in an oscillator circuit which provides harmonic check points every 100 kc up to about 100 mc has been produced by Radio Specialty Mfg. Co., Portland 14, Oregon.



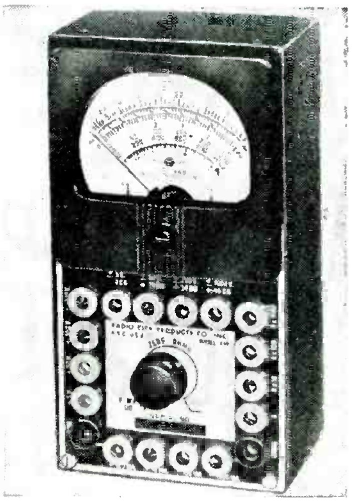
* * *

RCP MULTITESTER

A multitester, model 449A, with a d-c sensitivity of 5,000 ohms-per-volt, has been announced by Radio City Products Company, Inc., 127 West 26th Street, New York 1, N. Y.

Model uses a germanium crystal rectifier which permits a-c measurements from 30 cps to 50 kc. Has a 3" meter that is said to be accurate to 2%.

Also uses matched metallized voltage multipliers that are said to have a tolerance of 1%.



* * *

CLARK 10-WATT P-A AMPLIFIER

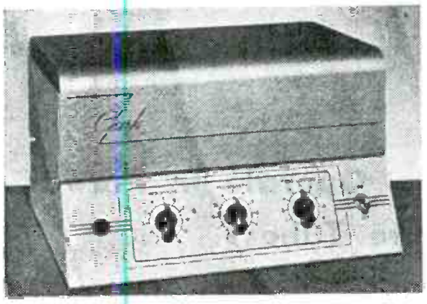
A 10-watt p-a amplifier has been announced by the Clark Radio Equipment

Corp., 4636 Ravenswood Ave., Chicago 40, Ill.

Features two controlled input channels of 500,000 ohms impedance; each accommodate a microphone and phono pickup. Tone control attenuates 18 db at 10,000 cps. Output is tapped for 4, 8, 16 and 500 ohms impedance.

Uses two 6SJ7, one 6J5GT, two 6V6GT, and one 5Y3GT. Response said to be flat from 50 to 10,000 cycles with less than 3% harmonic distortion at 10 watts output.

Complete information available in bulletin 134.

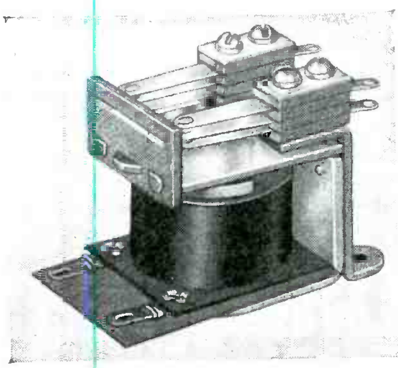


* * *

GUARDIAN ELECTRIC MIDGET RELAY

A relay, series 600, comprised of two basic parts, a coil assembly and a contact assembly, with each basic part interchangeable, has been announced by Guardian Electric Mfg. Co., Dept. 600, 1617 West Walnut Street, Chicago 12, Illinois. For example, the contact assembly can be used with any of the standard series 600 or 605 coils whether the operating voltage is 3, 6, 12, 18, 24, 32, 50, 115, 230 a-c or 3, 6, 12, 18, 24, 32, 50, 110 d-c. The maximum contact current capacity is 8 amperes and power consumption is 6 va.

Relay can be furnished with contact switch combinations up to and including four pole, double throw.



Guardian 600 relay; 1⅛" w; 2⅛" l; 1½" h.

* * *

INSULINE INTERFERENCE SUPPRESSOR SET

An interference suppressor set has been announced by the Insuline Corporation of America, 36-02 35th Avenue, Long Island City, N. Y.

* * *

REPUBLIC TELEVISION KITS

An 18-tube 7" picture-tube television receiver kit has been announced by Republic Television, Inc., 7 East Madison Avenue, Dumont, New Jersey.

Kit features pre-tuned i-f's operating at the new frequencies and a 5-channel (Continued on page 54)

TELEVISION RECEIVER R-F Amplifiers

How Wideband Amplifiers, Required for TV Receivers, Operate in Prewar and New Models Which Feature Miniature Tubes

by EDWARD M. NOLL

Instructor in Television
Temple University

R-F AMPLIFIERS OF TELEVISION receivers feature broadband high-frequency amplifying circuits requiring critical control of chassis layout, components and particularly tubes. Prewar r-f amplifiers did not offer too much gain because the available tubes were not able to effectively amplify the necessary wide bands. Today, however, thanks to miniature tubes with high G_m and low capacity, and improved circuit design, unusually high gain broadband amplification is possible.

Tube and Circuit Capacity

Tube and circuit capacity is an important factor in broadband h-f amplification because the value of the distributed shunt capacity limits the size of the plate load resistor of the tuned circuits. Thus the higher the distributed capacity the lower the L to C ratio of the tuned circuit. Consequently, we must use a low value load resistor to broaden the characteristic of the tuned circuits. However, since the approximate gain of a broadband amplifier is equal to G_M times the value of the load resistor, any reduction in the value of the load resistor means a reduction in stage gain. Therefore, to keep the gain up we must keep the capacity down. In addition the mutual conductance or G_m of a tube, which is a measure of how effectively a tube converts a small change in grid voltage to a substantial change in plate current, must be set high to produce an appreciable current variation across the small value of load resistor. That is the reason for the importance of the new type high G_m low-capacity in wideband television service.

Use of Distributed Capacity

To keep the stage gain high most r-f amplifiers have no physical capacity shunted across them. Instead the tube circuit is resonated to the proper frequency with the distributed circuit capacity and is tuned over a limited range by some variable inductance arrangement. Thus most schematic diagrams of television r-f amplifiers appear to have no physical capacity and consequently no tuned circuits. This, of course, is not the case, since

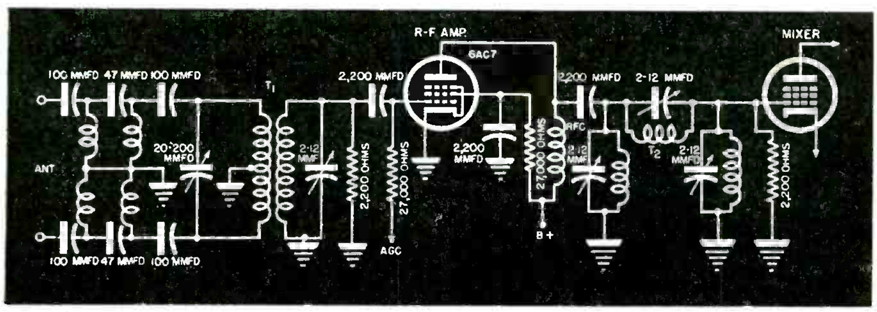
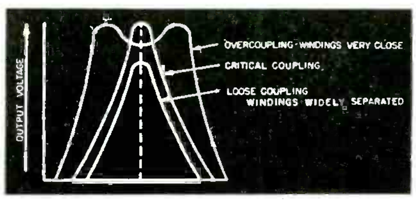


Fig. 2. The tv r-f amplifier of the G. E. 90.

Fig. 1 (below). Coupling response of three types of tuned circuits



each inductor resonates with the total distributed capacity of the circuit. With this arrangement circuit distributed capacity has a fixed value, which is low.

Close Coupling

Another circuit requirement of wide-band amplifiers is close coupling of transformers; when the primary and secondary windings are coupled very closely to each other, we have a double-humped characteristic that widens the band of frequencies; Fig. 1.

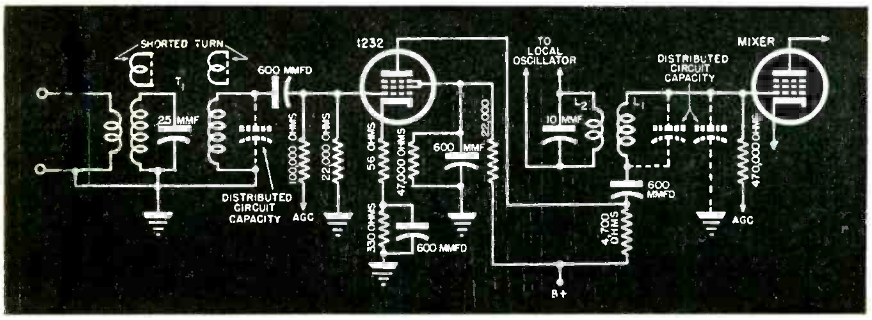
G. E. 90 R-F Circuit

In the r-f systems of some circuits, such as the G. E. 90 (Fig. 2), a balanced antenna and transmission system is coupled to the antenna input through a high-pass filter. This high-pass filter will pass those frequencies in the television channels but will reject or shunt those frequencies below approximately 40 mc. In particular, it will shunt out those frequencies around the i-f frequencies of the sound and picture channels of the receiver, because the receiver would be sensitive to all signals in that frequency spectrum which would reach the grid of the mixer tube. Thus the high-pass filter will shunt out any signals in the 7 to 15-mc range which may be strong enough to excite the antenna or transmission line. Many of the model 90 tuned circuits are tuned by very small trimmer capacitors. The antenna input coil is overcoupled and is broadened in response by a resistor which is only 2,200 ohms. The grid of the r-f amplifier is also connected to an automatic gain control circuit. Voltage output is developed across a plate inductor and from there is coupled to another tuned transformer.

Mutual Tuned Circuits

It is also possible to overcouple between two circuits by means of some mutual element which, in this case, is a mutual tuned circuit connected between the high sides of the primary and secondary windings. This tuned transformer is also loaded down by a resistor to flatten the frequency response, the value of which is also 2,200 ohms. To obtain a maximum performance on all channels, a switching arrangement switches in an entirely

(*Continued on page 28*)



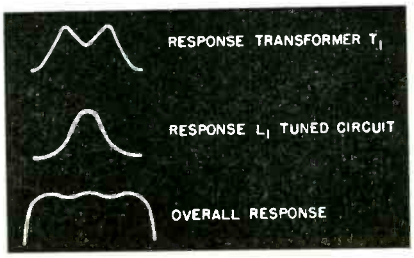


Fig. 3 (left). Philco 10TK r-f amplifier.

Fig. 4. Overall response characteristics of the r-f stage used in the Philco model.

different transformer for each channel. On any one channel, once the trimmer capacitors have been adjusted for a maximum amplitude, it is not necessary to tune the r-f stage, because it is inherently broad. And on any one channel, fine tuning is accomplished by varying the local oscillator frequency over a limited range. The r-f amplifier tube is a 6AC7 which, along with the 1232, were the best prewar tubes available for broadband, high-frequency service.

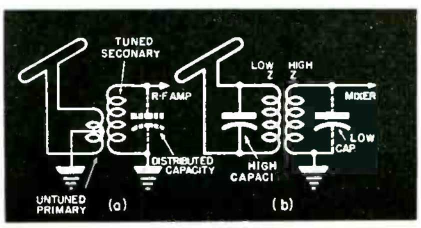
Philco 10TK R-F System

In Fig. 3 we have the r-f amplifier of the Philco 10TK television receiver. The antenna input coil in this receiver consists of a double-tuned transformer, in addition to a small untuned winding which matches the low-impedance antenna and transmission line to the transformer. Overcoupling of the windings is again used to pass a broadband of frequencies. No physical capacity shunts the secondary of this transformer, because it is resonated to the proper frequency with the distributed capacity of the input circuit, shown by the dotted lines. The frequency of the primary and secondary tuned circuits are changed by means of a small loop of wire, called a *shorted turn*, which can be moved toward or away from the high side of the tuned circuit. The inductance of the winding is varied by this shorted turn over a limited range. Automatic brightness voltage is also applied to the grid of this r-f amplifier. A portion of the cathode resistance is also unbypassed to broaden the band of frequencies passed and at the same time to reduce any tendency to oscillation. The plate load for the r-f amplifier is a resistor which is connected through a capacitor to coil L_1 and then to the grid of the mixer. Here again, L_1 resonates with the total distributed capacity of the circuit, as shown, at the proper frequency. Inasmuch as only a single tuned circuit is used in the grid it is resonant to just one frequency. Consequently the combination of the double-humped characteristics of the r-f amplifier in this stage and the single resonant peak of the mixer grid tuned circuit form an overall response that is reasonably linear over the frequency spectrum of the channel; Fig. 4. Local oscillator signal is injected into the grid of the mixer through the mutual coupling between the oscillator tuned circuit and L_1.

Matching

To obtain the highest gain and the best signal-to-noise ratio it is necessary to precisely match the antenna and transmission line system to the input of the r-f amplifier or, in the case in which the antenna excites the mixer to the mixer grid. Consequently, the input transformer would match the low impedance of the antenna and transmission line system to the high impedance of the input circuit of the tube. One simple method of matching antenna to grid input circuit is shown in Fig. 5*a*. Here the antenna is coupled to a low-impedance portion of the grid input circuit through a few turns of wire located near the ground end of the tube circuit. A higher gain method is shown in Fig. 5*b*. This circuit utilizes a tuned primary and tuned secondary. This is a method commonly used in the RCA television receivers to couple antenna to the mixer. In this system the impedance match is a function of the *L* to *C* ratios of the primary and secondary tuned circuits. The secondary has a high *L* to *C* ratio and therefore a high impedance to match the grid circuit of the tube, while the primary has a low *L* to *C* ratio and consequently a low impedance which matches the antenna and transmission line system. Thus, the secondary is resonated to the proper frequency by means of the distributed capacity of the circuit which, of course, is very low. The primary has an actual capacitor shunted across it. This capacitor has a substantial capacity and lowers the *L* to *C* ratio of the primary. In switching bands in the RCA receivers both the primary and secondary tuned circuits are replaced by other sets of primary and secondary tuned circuits.

Fig. 5. Antenna matching methods. At *a* is an antenna coupled to a low-impedance portion of the grid input through a few turns of wire near the grounded end of the tube circuit. At *b* we have a higher gain method using a tuned primary and secondary; system used by RCA.



Dual Mutual Couplings

A third method is employed in Philco receivers, Fig. 3. This system has still higher gain and consists of two mutual couplings. First, the small antenna winding is coupled to the primary tuned circuit by means of a few turns located at the lowest impedance end of the primary tuned circuit. Primary and secondary windings are then overcoupled to obtain the double-humped broadband characteristic. Consequently, the coupling between the untuned antenna winding in the primary constitutes the impedance match, while the coupling between the primary and secondary windings is a control of the bandwidth of the tuned circuits.

300-Ohm Lines

Present television receivers are designed to match a 300-ohm transmission line. Prewar receivers were made with a 75-ohm termination. Thus, the new television receivers are designed to match a 300-ohm antenna and a 300-ohm transmission line. Therefore the ideal antenna is a folded dipole, although a straight dipole can be used. Proper antenna match is important to obtain the strongest signal, the highest signal-to-noise ratio, and the proper bandwidth and picture resolution.

•

Miniature Tubes

As mentioned earlier, the new television receivers employ miniature tubes in the r-f section because of their higher G_m, lower capacity and improved performance at these frequencies. The miniature tubes ideally suited for broadband high-frequency operation are the 6AK5, 6AG5, 6J4 and 6J6. A miniature which functions well as a high-frequency oscillator is the 6C4.

6AK5 R-F Amplifier

A typical r-f amplifier using a miniature 6AK5 is shown in Fig. 6. This type amplifier will be found in the newer tv receivers. Here a double-tuned over-coupled input transformer is also used with a physical capacitor shunting the primary for proper impedance match, while the secondary resonates to the same frequency with the distributed capacity of the grid input circuit. The output of the single tuned circuit can be coupled to the receiver input through a pick-up link and cable. A small amplifier such as this can be conveniently mounted on a small sub-chassis and mounted right on the main television chassis.

The 6AK5 has a mutual conductance of 5,100 µmhos, a grid-plate capacity of .02 mmfd, a grid-cathode capacity of 4 mmfd, and a plate-cathode capacity of only 2 mmfd.

Inasmuch as we have to load most of the tuned circuits with shunt resistance to broaden the bandwidth, we cannot fully utilize the high-impedance characteristics of the pentode. Consequently, for broadband high frequency amplification, a triode functions well as an r-f amplifier and has a better signal-to-noise ratio, because of the absence of other grids in the tube. However, if the grid and plate tuned circuit are used, there is always the danger of triode oscillation. This difficulty can be circumvented by using a grounded-grid amplifier in which the grid is grounded and acts as a shield between the input and output circuits preventing oscillation; a grounded-grid amplifier using a 6J4 is shown in Fig. 7.

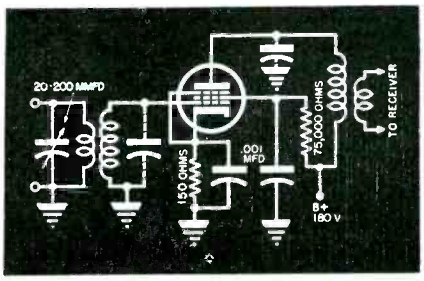


Fig. 6. R-f amplifier for a 6AK5 miniature tube.

Fig. 7. Grounded grid r-f amplifier.

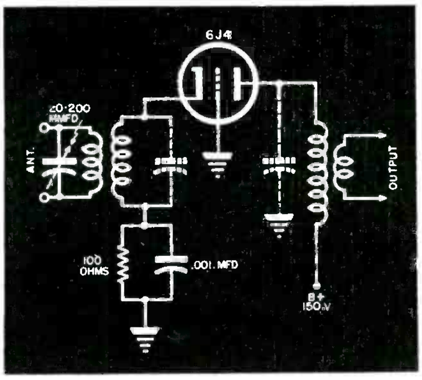


Fig. 8. Cathode-coupled amplifier which will be found in some of the new tv receivers.

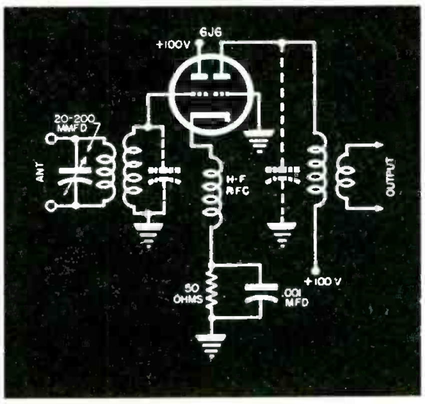
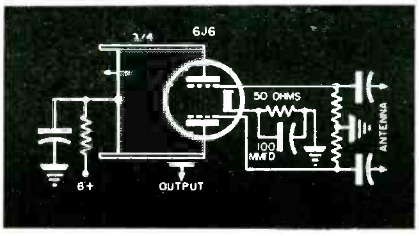


Fig. 9. A pushpull type of r-f amplifier.



Low-Impedance Virtues

Another advantage of the triode r-f amplifier is its inherently lower impedance which means it has an inherently broader bandwidth, making it unnecessary to load the two circuits as severely. One set of coils can be designed to cover a number of the television channels using this type of an amplifier. The advantages of the grounded-grid amplifier are simplicity of construction, few components, low capacity, broad bandwidth, high signal-to-noise ratio, and an appreciable gain.

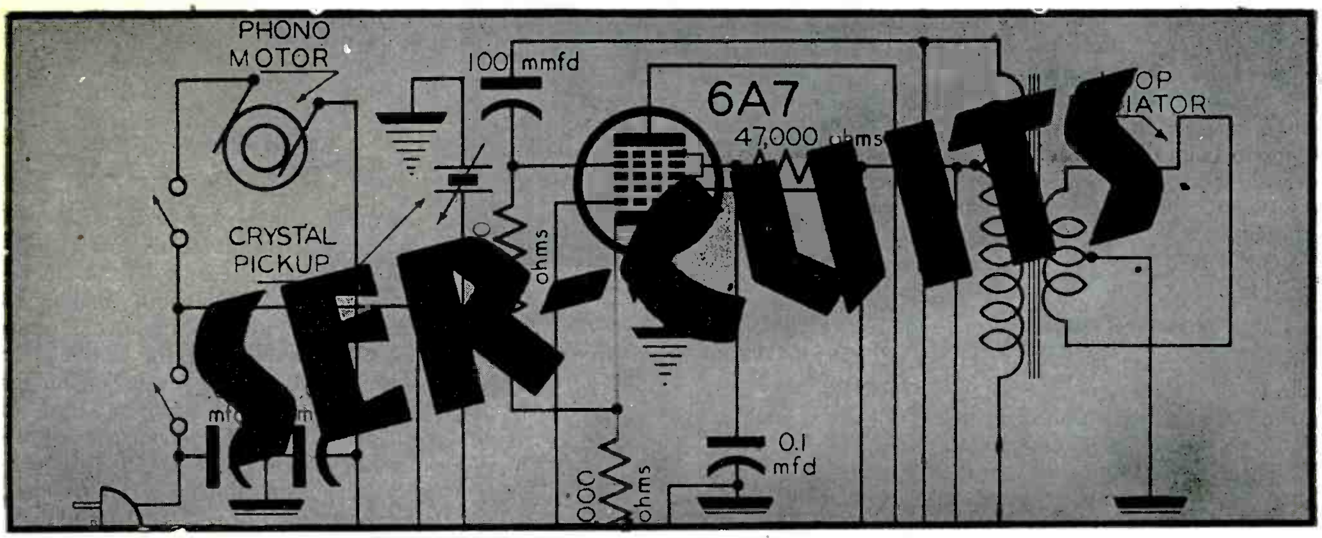
Cathode-Coupled Stages

Another new circuit that will be found in the new television receivers is the cathode-coupled stage designed by Sziklai and Schroeder. The cathode-coupled stage has an extremely low input capacity because the first section used is a cathode follower. Generally a dual triode such as a 6J6 is connected in a cathode-coupled circuit, as shown in Fig. 8. The first section is the cathode follower input stage, while the second section is a grounded-grid amplifier. The cathode-coupled amplifier has approximately the same gain as a single pentode and uses approximately the same number of component parts. However, it does have a number of additional advantages, such as low input capacity and broad bandwidth, low tube noises and an extremely stable circuit under line voltage fluctuations. Signal is conveyed from the first section to the second section by the inductor which is common to both cathode circuits.

Push-Pull R-F

Still another stable circuit at high-frequencies is the push-pull r-f amplifier; Fig. 9. In this circuit the plate-tuned circuit is a quarter-wave section of transmission line (shorted quarter-wave equivalent to a high *Q* parallel-tuned circuit). Advantages of this type of r-f amplifier are its stable symmetrical layout, low capacity, and excellent gain. Channel-switching can be accomplished by changing the position of the shorting bar.

[To Be Continued]



BUILDING AT HOME IS once more becoming popular, with attention now being focused on television receivers such as the one in Fig. 1 (page 32), which is now available in kit form; Transvision model.

The r-f section of this kit features a 6AC7 mixer and a 6C4 local oscillator designed for flat response on 6.5 mc for the tv channels.

In the video i-f section are three stages, each using a 6AC7. Audio intelligence is picked off of a second i-f transformer by a trap tuned to 21.9 megacycles, and fed into a sound i-f stage that uses another 6AC7.

A 6SQ7 demodulator-amplifier and a 6V6 power amplifier comprise the audio section, while video detection and amplification are achieved by a 6H6 and 6AG7, respectively.

A 6AC7 is also used as a sync separator, activating 6N7 multivibrators in both vertical and horizontal sweep circuits. The 6SN7's that follow are push-pull amplifiers.

Low voltage rectification employs a 5U4G, while a 2X2 (or 2Y2) rectifies the high voltages. The picture tube is a type 7EP4.

Fixed, double-tuned trap coupling used in the i-f section affords a satisfactory gain over a 3.5-mc bandpass. With this method, the trimmers can be used for tuning. In the second i-f can, for example, the 21.9 megacycle trap can be adjusted for maximum audio output, while remaining trimmers are set for greatest brightness.

The video circuits employ straightforward design, with low resistance in the detector circuits and a series-shunt peaking arrangement in both the input and output of the section.

In the audio section, demodulation is accomplished by means of slope detection.

To provide the kinescope with an extra 350 volts, a special rectifier circuit was used. Generally, the low side of the high voltage rectifier is returned directly to ground. But since this procedure has the disadvantage of losing the potential available in the low voltage section, two rectifier circuits were connected in series. As a precaution against noise pickup, the low side of the high-voltage supply is tied to a 350-volt terminal point distant from the r-f unit.

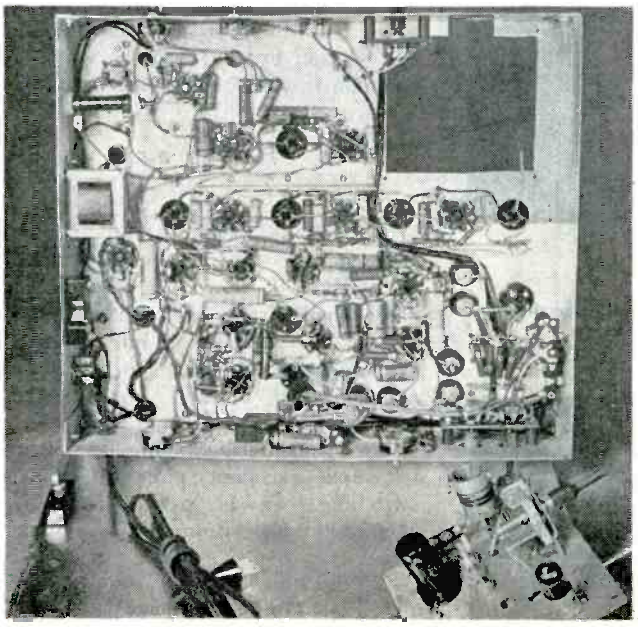


Fig. 1.
Underside view of the television receiver.

G. E. 417

A new model 10-tube a-m/f-m/s-w receiver (G. E. 417) featuring a unique tuning system is shown in Fig. 3 (page 36); variable inductance tuning is used with guillotine type tuners.

This set has an a-m broadcast range of 540 to 1,600 kc and f-m ranges of 42 to 50 mc and 88 to 108 mc. It also has two short-wave ranges; 9.4 to 9.9 mc and 11.6 to 12.1 mc. Audio power output is 4 watts.

Tuning System

The tuning is accomplished by means of an *elevator* which consists of a rigid plastic horizontal plate raised and lowered by means of a windlass controlled by the tuning knob. From this plate are suspended three powdered iron cores which tune the broadcast r-f, converter, and oscillator coils; and three tuning *vanes* which tune three low-inductance circuits are employed in both f-m bands and both short-wave bands.

Tuners are designed primarily for the 88- to 108-mc band where special techniques are needed to realize high gain and circuit stability. Coils, tuned by variable capacitors, are usually inefficient at these frequencies; first, because of the low inductances required to reach these frequencies, and second, because shunt capacity reduces the gain of the amplifier circuit and also restricts tuning range. Still another disadvantage of standard tuning arrangements at these frequencies is that common coupling is obtained through the shaft of a ganged tuning capacitor unless insulated single sections are used. Such sections are cumbersome, not to mention high cost. Further, common coupling of this type tends to cause oscillation or general instability. The guillotine units make it possible to use short leads in wiring, achieve isolation of sections, secure stable tuning and high Q circuits with small shunt capacity, and also make it possible to locate each tuner in the best physical and electrical position of the assembly. As the shunt capacity is small and the inductance is consequently at its highest corresponding value, the additional unavoidable inductance introduced in the wiring, bandswitch, etc., produces a minimum of circuit losses and unbalance.

Tuner Operation

The guillotine tuner (T_2, T_4 and T_5 in circuit) consists of a heavy silver-plated two-turn square coil rigidly supported between two plastic posts. A flat, solid *vane* slides up and down between the two turns and is guided in grooves in the plastic posts so that it passes between the two sections of the coil without touching them. The posts are so molded and the coil so constructed that the whole assembly is held rigidly at a predetermined setting or spacing. The tuning vane is raised and lowered by the tuning elevator. When the elevator is all the way up, set tuned to lowest frequency, the vane is completely above the coil which then acts as a simple two-turn coil. As the set is tuned toward the higher frequencies, the vane moves downward into the field of the coil until finally it is all of the way in. The vane reduces the inductance of the coil since it acts as a shorted turn and thus reduces the inductance directly and also provides a barrier between the two turns of the coil which reduces the mutual coupling and thus reduces inductance.

S-W Bandspread Ranges

Bandspread tuning in the s-w ranges is obtained in the converter and oscillator circuits by inserting the guillotine tuners in series with a higher inductance so that the two inductances together form the L part of the short-wave tuned circuit. The small percentage change in inductance obtained in the tuner provides smooth, wide and

(*Continued on page* 34)

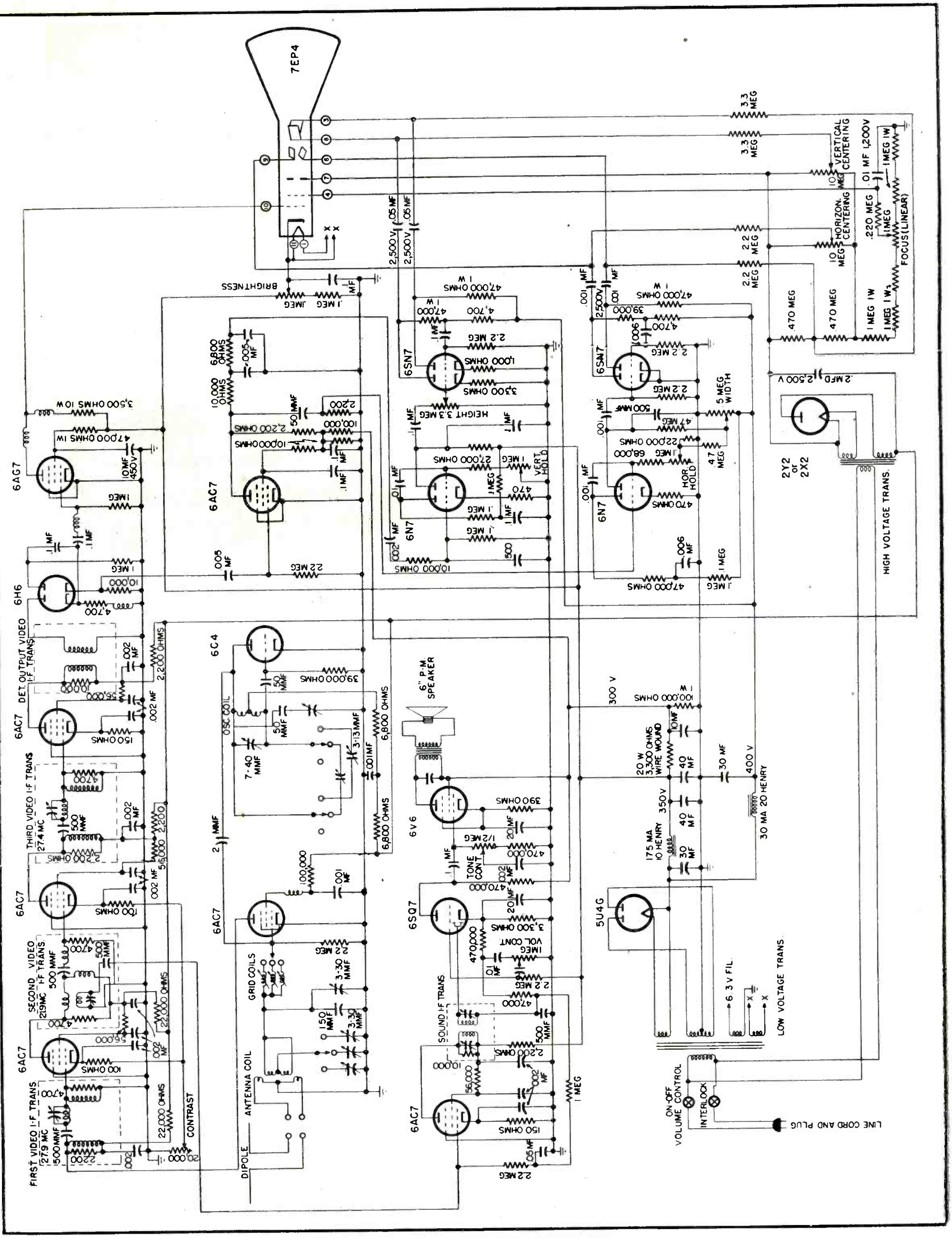
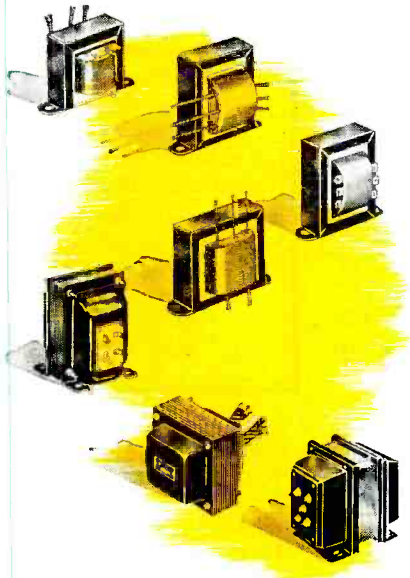


Fig. 2. Circuit of the Transvision television kit.

when you order a STANCOR product you order the FINEST



The big black-and-yellow STANCOR catalog is the logical place for the radio serviceman to turn for a transformer to meet any standard need. . . . For there you will find the most complete selection of Replacement and General Purpose Transformers. . . . And there you'll find the FINEST. . . . For the most exacting quality is built into every STANCOR product. . . . Quality plus advanced design and universal application. . . . Yes, reach for the well-thumbed STANCOR catalog . . . for behind it are STANCOR's new streamlined plant facilities to give you better products and better service . . . to help you give your customers complete and lasting satisfaction.

standardize on STANCOR TRANSFORMERS

STANDARD TRANSFORMER CORPORATION • ELSTON, KEDZIE AND ADDISON, CHICAGO, ILL.

SER-CUITS

(*Continued from page* 31)

stable tuning. The *C* part of the tuned circuit consists primarily of a shunt trimmer. Switching from one short-wave band to the other is accomplished by selecting a different shunt trimmer. The converter-grid circuit, as an example, includes L_7 and T_6 in series in both the SW_1 and SW_2 bands. Tuner T_6 is in the ground end of the circuit and the signal is fed into the grid end through C_{10}. The shunt tuning capacity is either C_{56} or C_{57}, depending upon which of the two short-wave bands is used.

Additional oscillator coupling capacitors, C_{72} or C_{73}, are also added to compensate for the lower coupling through C_{67} when the higher shunt capacitors are in the circuit. In the r-f stage a section of the loop is used as the grid circuit. It is tuned for resonance by a shunt capacitor (C_{54} and C_{55}) and a shunt inductance (L_{20}). Because a tuned circuit of this type is inherently broad, tuning through the relatively narrow spread-band offers little advantage and is not applied.

A-M Band Features

When manual tuning is employed (bandswitch in *STD* position), the receiver employs an r-f stage, converter, and oscillator, all of which are

(*Continued on page* 36)

•

COVER CIRCUIT

(*Continued from page* 11)

connected from the high side of the primary to the grid end of the secondary, supplements the magnetic coupling in the a-m transformer.

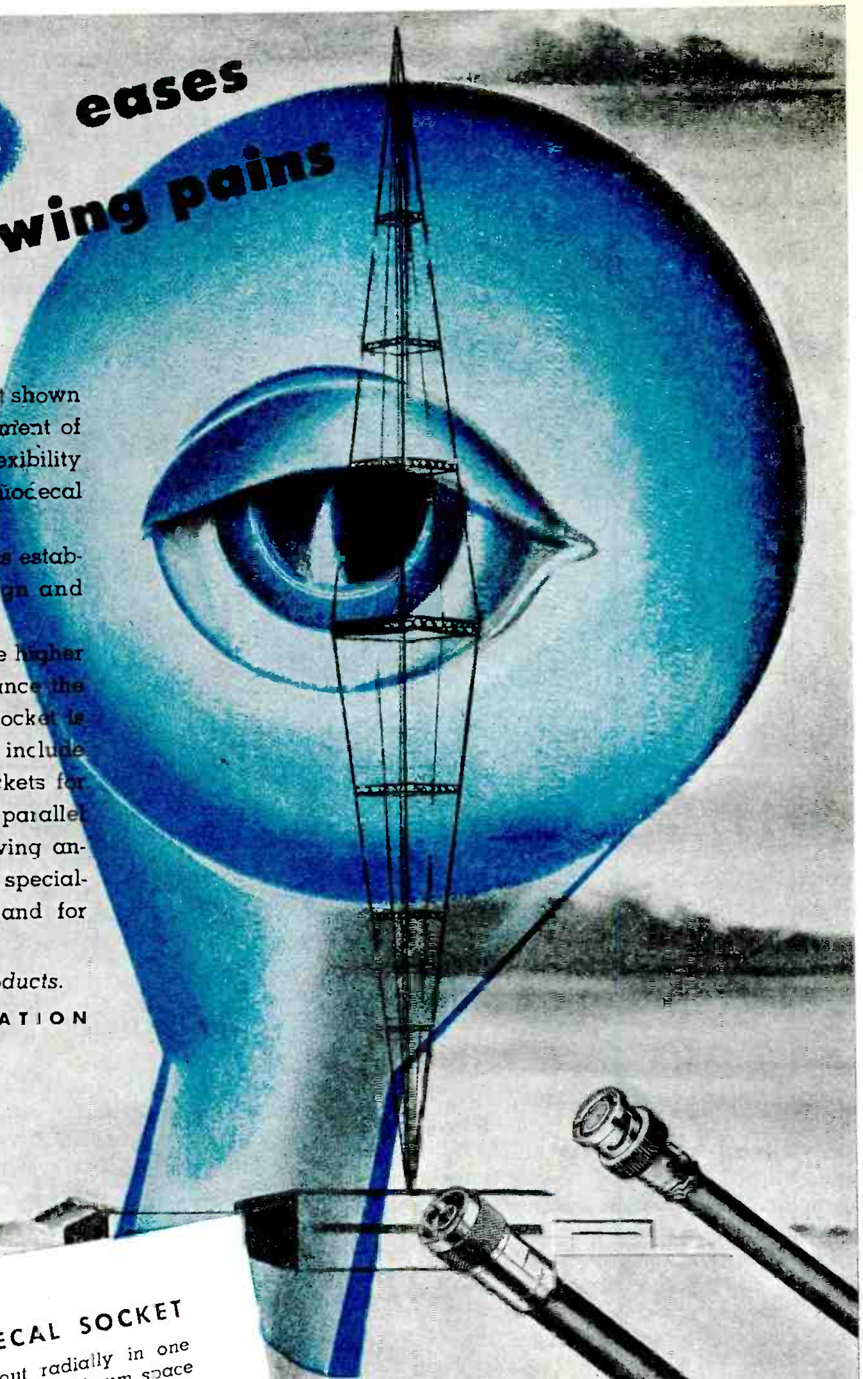
The first i-f amplifier, using a 7AH7, delivers its output to two i-f transformers in series, similar to the old 4.3-mc i-f amplifiers in a-m/f-m sets. The impedance of the 10.7-mc primary is very small compared to the impedance of the a-m transformer and thus little loss is introduced. Conversely, a 220-mmfd fixed capacitor shunted by 230-mmfd adjustable capacitor in the circuit present a very low reactance to 10.7 mc, acting as a bypass for the f-m i-f. Incidentally degeneration is introduced by an unshunted 47-ohm cathode resistor in series with a bypassed 150-ohm resistor.

A 7AG7 is used as a second i-f amplifier to deliver a-m signals to a standard 6SQ7 detector-audio-avc stage, followed by a 6V6 with its cathode circuit grounded through a voice coil for inversed feedback. The f-m signals are delivered to the 6H6 demodulator, then switched to a 2-megohm volume control of a 6SQ7.

The stability of this receiver is enhanced by the many individual filters; plate r-f choke and screen *R/C* filter in the 6AG5 r-f stage, r-f choke in addition to 6,800 ohms in the f-m oscillator plate, 1,000 ohms and .05-mfd capacitor in first i-f plate plus 10 ohms in the screen, and 1,000 ohms and .05-

(*Continued on page* 50)

how AMPHENOL eases television's growing pains



A glance at the new Duodecal socket shown below will demonstrate the complete fulfillment of television's demand for a socket of full flexibility and highest quality for the new series Duodecal base television viewing tubes.

This is typical of the pioneering which has established Amphenol leadership in the design and manufacture of TV and FM components.

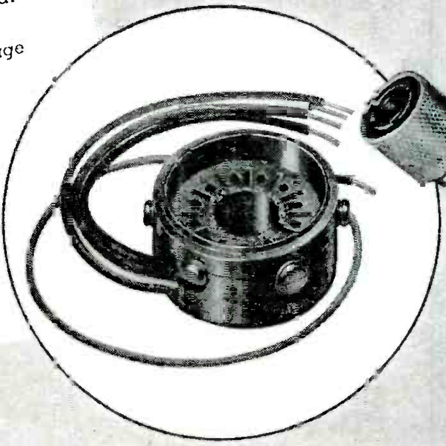
The activity of Amphenol engineers in the higher frequencies enables them to sense in advance the needs in these fields. The new Duodecal socket is but one of many such Amphenol firsts which include efficient Hi-Q tube sockets, octal angle sockets for cathode-ray and other tubes, Twin Lead parallel transmission line, FM and television receiving antennas, solid dielectric coaxial cables, and special-use cables for television color cameras and for facsimile.

Write for Data Sheets on these new products.

AMERICAN PHENOLIC CORPORATION
CHICAGO 50, ILLINOIS

FEATURES OF THE DUODECAL SOCKET

- Six locations for bringing leads out radially in one bundle assure a neat wiring harness, and minimum space requirement.
- Rear socket cap totally encloses connections, eliminating breakage at solder terminals due to flexing. Electrical shock hazard is minimized.
- An extra opening is provided for bringing high-voltage grid lead out separately when this is desirable.
- Latest wrap-around type cadmium-plated phosphor-bronze contacts provide four lines of contact on each tube pin.
- Cap and body of socket are molded black electrical bakelite.
- Spring-ring assembly eliminates screws and drive pins.



COAXIAL CABLES AND CONNECTORS · INDUSTRIAL CONNECTORS, FITTINGS AND CONDUIT · ANTENNAS · RADIO COMPONENTS · PLASTICS FOR ELECTRONICS

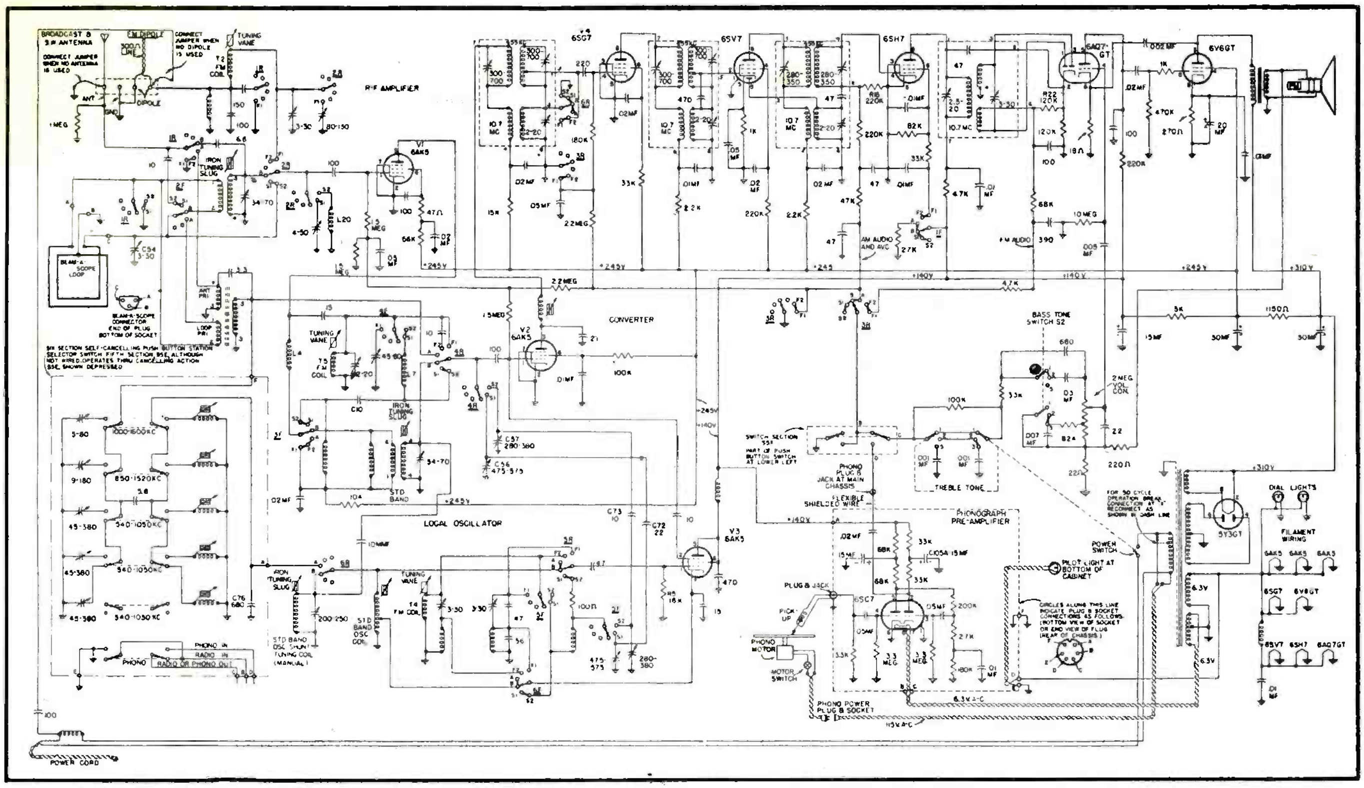


Fig. 3. Circuit of the a-m/f-m/s-w 10-tube G. E. 417 receiver, using guillotine-type tuners. Receiver covers 42-50 and 88-108-mc bands, as well as the 9.4 to 9.9 and 11.6 to 12.1-mc s-w bands.

(*Continued from page* 34)

tuned by iron slugs suspended from the tuning elevator. In the automatic position (bandswitch in auto position), the r-f stage is not used. Instead, a separate antenna coil is used which couples the antenna and loop directly into the converter. A separate coil is used to make the tuning circuit independent of the dial tuning mechanism so that it may be used by trimmers in the push-button assembly. Switching from manual to automatic tuning is accomplished in the oscillator by using an oscillator coil which is tuned by a separate shunt inductance. In manual tuning, the inductance is one which is tuned by the tuning elevator. In automatic tuning, a fixed shunt capacity (C_{76}) plus one of a series of push-button selected coils tunes the oscillator.

The i-f amplifier consists of a composite 455-kc and 10.7-mc circuit. The electrical changes required to transfer between a-m and f-m service are made by a bandswitch.

RCA QB11

A table model receiver designed for 6-volt storage battery operation with a normal drain of 3.35 amperes is shown in Fig. 5; RCA QB11. Frequencies covered are b-c, medium wave (2.9-9.5 mc), and three s-w spread bands.

The low drain tube lineup includes a 6SA7 converter, 6S7 i-f, 6T7 second detector avc-audio, 6J7 pentode driver and 6Z7G dual triode class *B* output. A synchronous vibrator eliminates the need for a rectifier.

Westinghouse H-110, 111, 137 and 138

Two-band phono models featuring a 6SK7 r-f amplifier with an untuned converter for b-c and direct converter feed through the antenna transformer for s-w are shown in Fig. 6; Westinghouse 110, 111, 137 and 138. The low side of the loop antenna returns to ground through the primary of the s-w antenna transformer, acting as an internal s-w antenna. The high side of the loop is connected to a loop loading coil.

Oscillator pushbuttons are permeability tuned. A 6SF7 acts as detector-first audio supplying a pair of 6Y6Gs in parallel for power output.

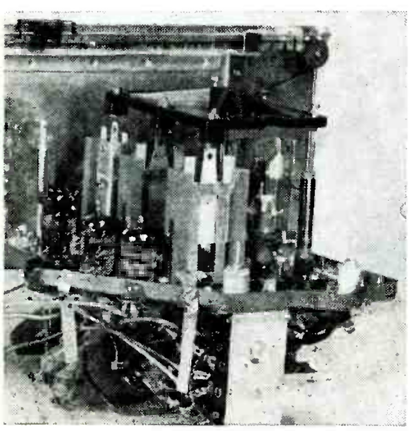
Fig. 4*a* (below). Voltage values for tubes used in G. E. 417.

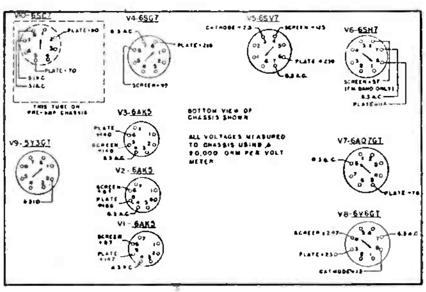
Fig. 4*b* (left, below). View of the guillotine type tuner used in the G. E. 417.

Fig. 5 (page 37, top). The RCA QB11 6-volt battery table model designed to cover the broadcast band and the 2.9 to 9.5-mc bands. Spread-band tuning is provided for the s-w bands.

Fig. 5*a* (right, below). Alignment data for the RCA QB11.

Fig. 6 (page 37, bottom). Westinghouse H110, 111, 137 and 138 two-band phono model.





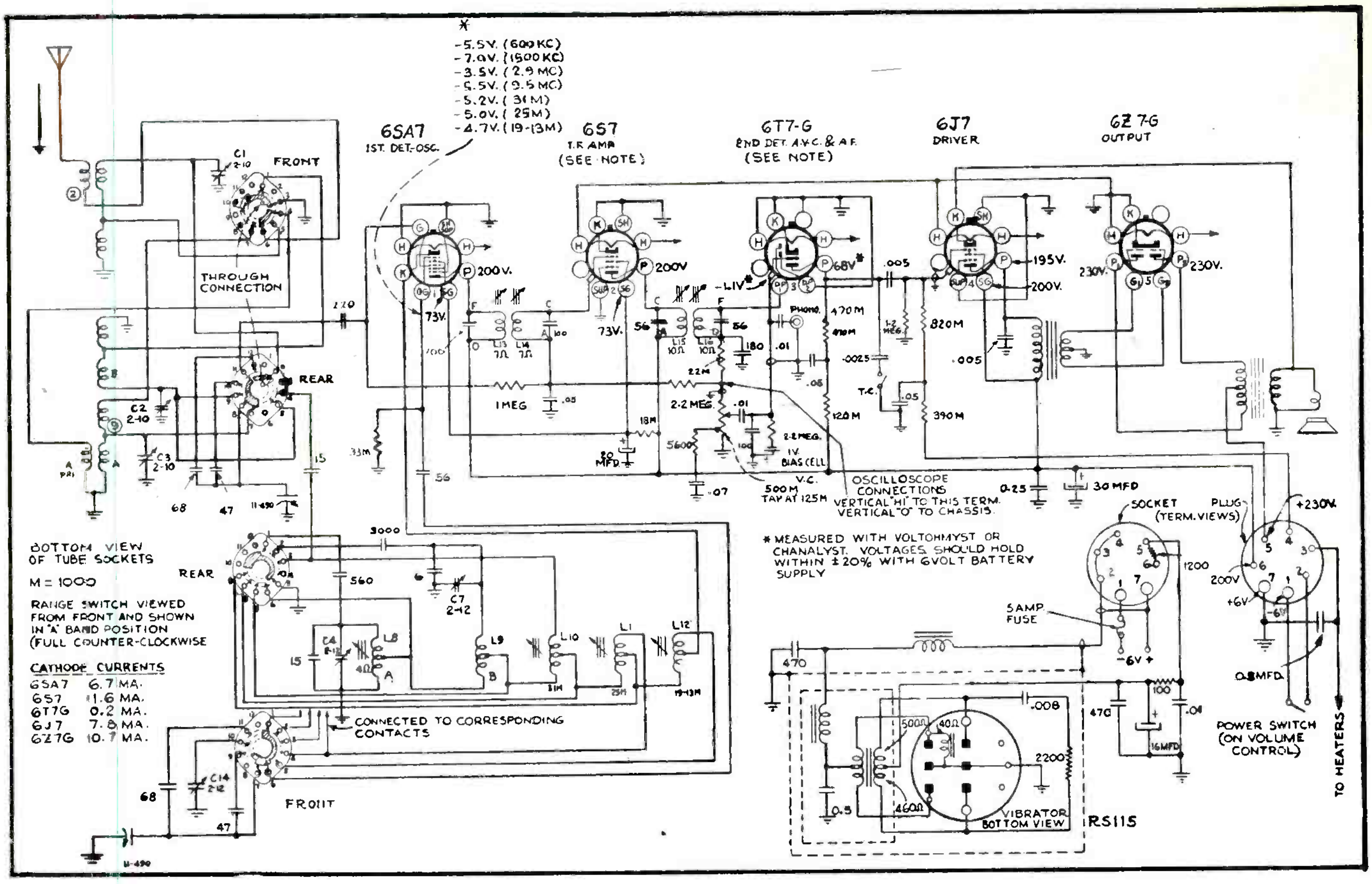
Steps	Connect the high side of the test-osc. to—	Tune test-osc. to—	Range switch	Turn radio dial to—	Adjust the following for max. peak output
1	I-F grid cap, in series with .01 mfd.	455 kc	A	Quiet point near 180°	L16—L15 2nd I-F transformer
2	1st Det. grid, in series with .01 mfd.				L14—L13 1st I-F transformer
3	Ant. lead in series with 300 ohms	11.8 mc	25M	138.5°	L11 (osc.)* C1 (ant.)
4		15.2 mc		17°	C14 (osc.)***
5		Repeat steps 3 and 4.			
6		15.2 mc	19-13M	156°	L12 (osc)*
7		9.5 mc	31M	156°	L10 (osc.)* C2 (ant.)
8		9.5 mc	B	11.5°	C7 (osc.)**
9	Ant. lead in series with 200 mmf.	1,500 kc	A	26°	C4 (osc.)** C3 (ant.)
10		600 kc		150°	L8 (osc.)* (Rock gang.)
11	Repeat steps 9 and 10.				

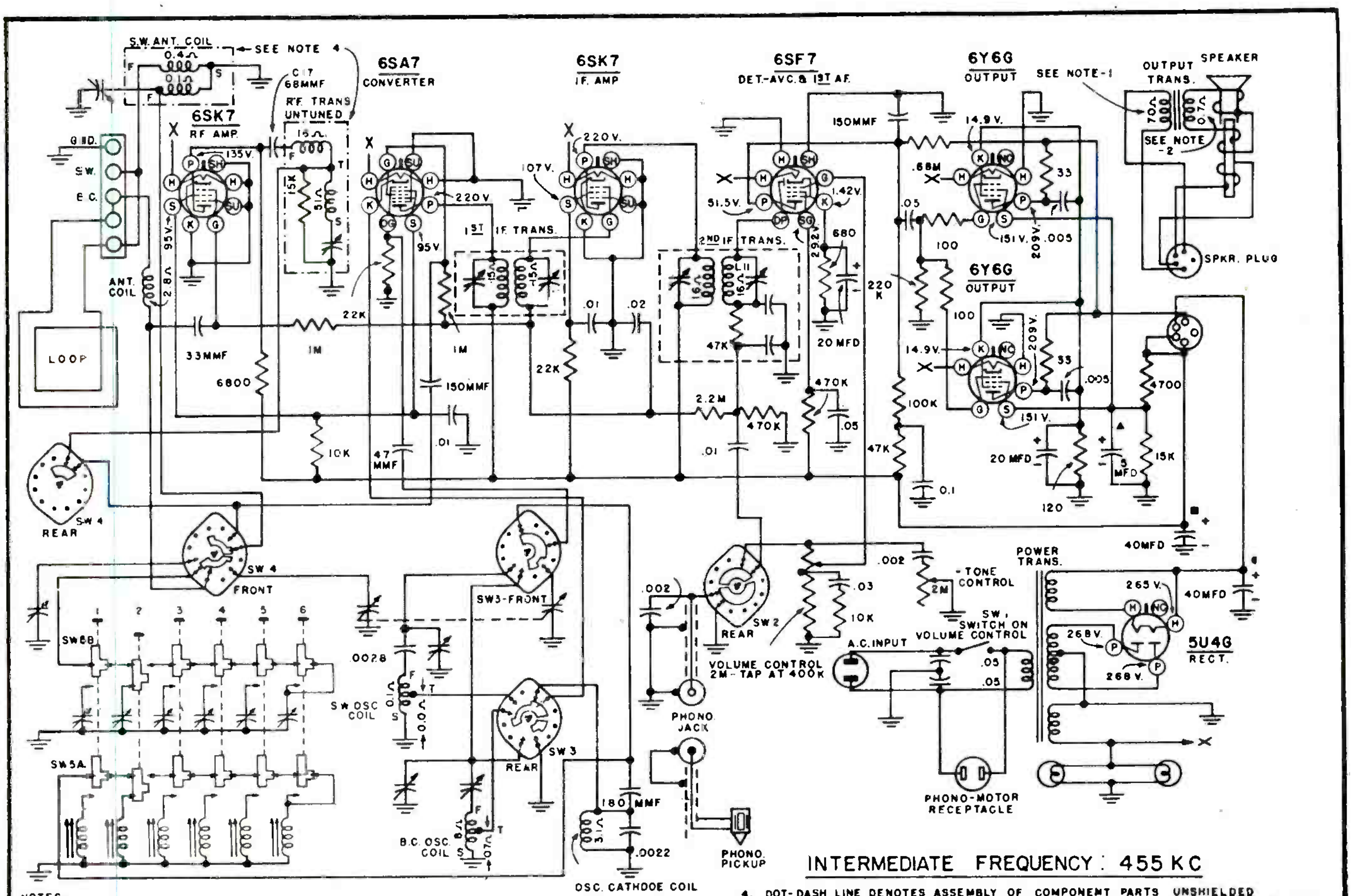
*If two peaks can be obtained, use the one obtained when the core screw is farthest out (counter-clockwise).

**Use minimum capacity peak if two can be obtained.

***Use minimum capacity peak if two can be obtained. Check image to determine that C14 has been adjusted to the correct peak by tuning receiver to approximately 14.29 mc (29°) where a weaker signal should be received

NOTE: Oscillator tracks above signal on all bands.





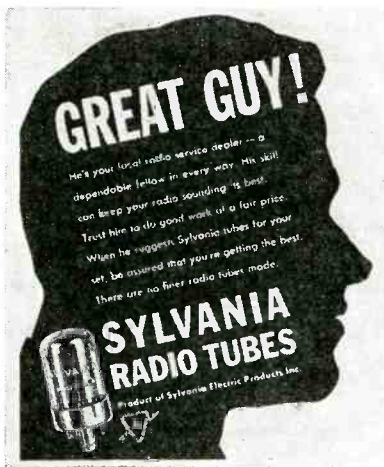
NOTES—
1. SPEAKER PLUG REMOVED.
2. VOICE COIL DISCONNECTED.
3. SWITCH SW2-3 & 4 SHOWN AS VIEWED FROM FRONT OF SET IN P.B-B.C POSITION. EXTREME COUNTER CLOCKWISE POSITION IS PHONO. SECOND POSITION CLOCKWISE IS PB-B.C. BAND. THIRD POSITION CLOCKWISE IS MANUAL B.C. BAND. FOURTH POSITION CLOCKWISE IS S.W. BAND.
4. DOT-DASH LINE DENOTES ASSEMBLY OF COMPONENT PARTS UNSHIELDED.
5. ALL VOLTAGES MEASURED FROM CHASSIS (GND.) USING 20,000 OHMS/VOLT METER. LINE VOLTAGE 117 V.A.C. MAX. VOLUME CONTROL SETTING AT NO SIGNAL CONDITIONS FOR THE BROADCAST BAND. READINGS SHOULD APPROXIMATE THE VALUES SHOWN WITHIN 20 PERCENT.

NEWS

SYLVANIA SERVICE MAN AD CAMPAIGN

A national consumer ad campaign to promote good-will for Service Men and stimulate sales of replacement tubes has been announced by the radio tube division of Sylvania Electric Products, Inc.

Ads will be patterned with brief and to the point copy emphasizing the dependability, honesty and skill of the local Service Man. The campaign will be merchandised through the distribution of easel-mounted reprints suitable for window and counter displays, 6½" x 9" window stickers and direct mail pieces. Merchandising aids will tie in directly with the appearance of the first, second and third series of ads.



* * *

ROTHENBERGER NOW RCA RENEWAL TUBE S-M

W. L. Rothenberger has been named manager of renewal sales in the RCA tube department.

Mr. Rothenberger will supervise the sale of tubes, batteries, test equipment, and component replacement parts sold through distributors and retailers.

* * *

INDUSTRIAL TELEVISION, INC., FORMED

Industrial Television, Inc., 36 Franklin Ave., Nutley, N. J., has been formed by a group formerly associated with DuMont Labs to design, manufacture and install television equipment and other electronic devices. Horace Atwood, Jr., is president and chief engineer; Robert L. Ringer, Jr., secretary-treasurer; Louis

Rehak, factory manager; and Charles M. Puckette, Jr., production engineer.

* * *

G.E. SALES AIDS

Two booklets telling how to make more money and a series of 20 sales-aids have been released by the tube division of G. E.

Window displays, signs, counter cards and decalcomanias, letterheads, blotters, postcards for mail advertising, newspaper mats, job tickets, shipping labels and radio chassis stickers are included in the sales-aids program.

* * *

LESCARBOURA HONORED BY FRANCE

Austin C. Lescarboura, industrial advertising consultant of Croton-on-Hudson, N. Y., has been awarded the coveted order of "Officier de l'Instruction Publique." The citation, carrying the Paris date of January 15th, 1947, was in recognition of technical services rendered for many years past.

The present honor is a promotion from the order of "Officer d'Academie" and the decoration of Academic Palms, awarded for services to France and the Allies in World War I in 1919, to the highest French recognition of achievement in liberal arts.

* * *

JFD WINS SAFETY CONTEST AWARD

The JFD Manufacturing Co., Brooklyn, New York, recently received a first place bronze plaque in the 1946 Accident

Reduction contest in the Light Metal Products Group (Group N-3).

The award, offered by the State Insurance Fund of New York, was received by Julius Finkel, president of JFD, who instituted the plant safety measures.

Julius Finkel and safety-award plaque.

* * *

JESSUP JOINS CORNISH WIRE

W. F. Jessup, until recently chief of the Wire Mill branch, Copper Division, Civilian Production Administration, has been named sales manager of the Cord division of the Cornish Wire Company, 15 Park Row, New York City.

* * *

ALLIED RADIO CATALOG

A 164-page catalog listing parts, test units, batteries, phonos, public address and intercommunication equipment, records and accessories, receivers, kits, record changers, etc., has been released by Allied Radio Corp., 833 West Jackson Boulevard, Chicago 7, Illinois.

* * *

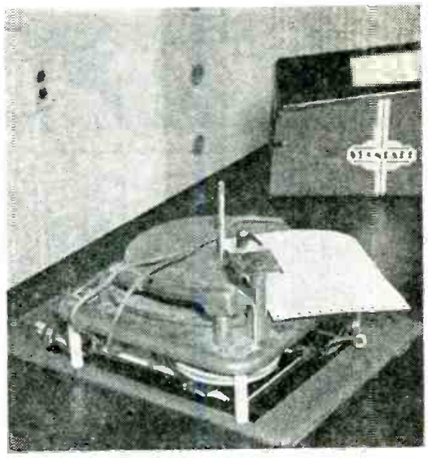
OVER 2000 TO ATTEND CHICAGO RADIO PARTS SHOW

An attendance of over 2,000 at the Radio Parts Show, to be held at the Hotel Stevens in Chicago during the week of May 11, has been indicated by the advance registration. Thus far 885 member-exhibitors, 39 guest exhibitors, 489 NEDA members, 274 non-NEDA

(Continued on page 43)

Taking the Service call order down on the 'phone.

Taking a Service call order in the shop and receiving a signed order from the customer to proceed with the repair.



Receipted repair job ready for delivery.

Get All the Facts!

Complete Repair and Charge Records Always Pay Dividends

TOO OFTEN CUSTOMERS' COMPLAINTS go unheeded and unnoticed for not very substantial reasons, but simply a lack of record. When the Service Man relies on memory to give a complete, clear picture of why that receiver's actual repair bill was so much higher than the estimate, he usually finds memory is a poor bookkeeper. He can't remember every part, every item.

The problem is more acute today with an overflow of customers and repairs. Record-keeping is vital if the shop's activities are to run smoothly and profits are to be made.

The itemized bill, for instance, while a small item is quite an important record. No repair should leave the shop unless it carries an itemized bill with such information as the exact number of parts used on the job, actual labor time involved, and a complete description of everything being charged.

Repairs and service on small parts as motors and appliances, because of the fact that they lend themselves to a lot more work and the addition of parts that don't seem to be indicated on the surface, definitely require *written* records to support every operation from start to finish. Customers may not all demand them, but they have a perfect right to do so, and they are, increasingly, right now.

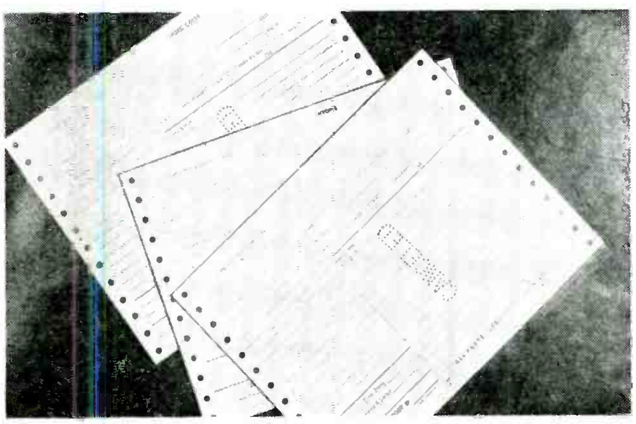
The automatic register system[1] provides one method of preparing the records. In this procedure specially printed three-part forms are used. All of the copies are written at one time on the surface of a machine, which is so constructed that carbons remain in place at all times and do not have to be interleaved for individual repair orders, as is necessary with padded books. One of the copies is used for audit or office bookkeeping, another is given to the customer and the third is placed in the case-history customer file.

So that complete protection is assured for all parties involved in a transaction, some Service Shops use a legal form of contract when a repair

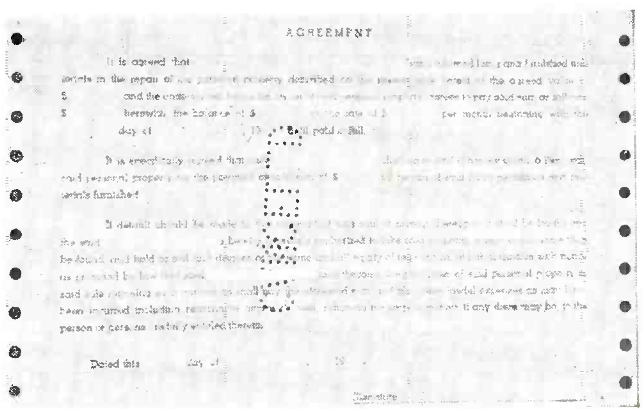
(*Continued on page* 55)

[1]Standard Register System.

The three forms appearing in a typical recording system: work form, invoice and customer's receipt.



Typical shop-customer agreement used to avoid disputes after the equipment has been repaired.



OLD TIMERS

(*Continued from page* 20)

some early receivers used the screen grid tube for the same purpose. In this circuit (Fig. 2) the cathode returns to ground through the primary of the oscillator coil. This effectively places the control grid in the oscillator circuit through the primary, with the plate circuit of the tube passing through the secondary. Therefore, the oscillator voltage will appear across the input of the control grid. Thus, both oscillator and signal voltages will appear on the plate of the tube. Since the i-f transformer is tuned to the difference frequency, this will be the only signal voltage which will be amplified in subsequent stages.

Some typical variations of this circuit are shown on Fig. 3. In *a* we have the circuit used in the Majestic 370. Here the oscillator circuit is established between the plate and suppressor grid. It will be noted that the oscillator plate coil is untuned, and connected directly to the plate ahead of the i-f transformer.

The autodyne circuit used in the Macy MB58 appears in *b*. Here, the cathode is returned to ground through the primary of the oscillator coil.

Fig. 3*c* shows an autodyne circuit (Majestic 15) employing a 24 tube. Here the primary of the first i-f transformer is untuned. This was a general practice at the time due to coupling and feedback factors.

Common Trouble

One trouble common to all receivers with these circuits is failure to oscillate over the entire tuning range, usually evident at the low-frequency end of the dial. The cause can generally be traced to the cathode resistor. Lowering the value of cathode resistance will usually cure this trouble. Sometimes, replacing the tube may effect a cure.

If the first i-f transformer needs replacing, it is wise to check the primary of the transformer being replaced. If it is untuned, it will be necessary to remove the tuning capacitor from the new transformer. Two other important factors are the coupling between primary and secondary, and the value of inductance in the primary where it is untuned. Extreme variations from original values may cause spurious oscillation, weak signal response, or even detuning.

NEWS

(Continued from page 39)

distributors, and 367 representatives have stated they would attend.

J. A. Berman, Shure Brothers, is president of the show; Charles Galenpaul, Aerovox Corp., vice president; J. J. Kahn, Standard Transformer, secretary; Sam Poncher, Newark Electric, is show treasurer; and R. J. Sherwood, Hallicrafters, and R. C. Sprague, Sprague Electric, are directors.


J. A. Berman


Charles Galenpaul


J. J. Kahn


Sam Poncher


R. C. Sprague


R. J. Sherwood

* * *

RCA BATTERY CARTON DISPLAYS

A carton display unit holding twenty-four standard flashlight battery cells has been announced by RCA. Cartons open into counter displays occupying 5½" x 8" of counter space standing 6" high.

* * *

JFD BULLETIN

A four-page leaflet covering dial pointers and knobs, replacement phono radio switches, phonograph pickup adapters, jacks and plugs, microphone connectors, stroboscope discs, connectors, lead cables, toggle, snap, and rotary switches, fluorescent light noise suppressors, interference filters, antenna loops, etc., has been prepared by JFD Manufacturing Co., Dept. Y, 4117 Fort Hamilton Parkway, Brooklyn 19, New York.

* * *

SYLVANIA RECEIVING TUBE DATA BOOK

A 378-page technical manual containing basic application data for 545 types of radio receiving tubes used by circuit designers and Service Men has been announced by the radio tube division of Sylvania Electric Products, Inc., Emporium, Pa.

Data supplied includes characteristic curves for types in common use; resistance coupled amplifier data; interchangeable tube charts; connectors for standard RMA internal and external shields; typical receiver and amplifier circuits; directory of tube, circuit and f-m terms; and instructions on the use of characteristic curves.

It is priced at eighty-five cents and is available from Sylvania distributors or from Sylvania Electric, Emporium, Pa.

CHECKING UP ON CALIF. POLY. LAB.


Catherine Dupont, San Diego State College sophomore, in the electronics lab of Calif. Polytechnic College. Miss Dupont reigned as queen over the Calif. Poly all-male student body during a recent county fair on the Calif. Poly campus.

TUBE NEWS

(*Continued from page* 18)

found that the oscillator frequency is affected considerably by the magnitude of avc voltage used. It is thus necessary to use the tube in a circuit of the type illustrated in Fig. 2. It will be noticed that avc is dispensed with on the converter signal grid. For maximum gain the grid circuit should be operated with considerably less oscillator grid current than the lower frequency circuit of Fig. 3. Incidentally, excessive regeneration sometimes appears when the signal grid is connected directly to the top of the input coil. This can be reduced by connecting the grid to a tap somewhere down on the coil.

In the circuit of Fig. 1 we have a typical self-excited converter with an r-f stage. In this circuit, coil 1, which is the antenna coil, consists of two turns of No. 14 wire, plus a 1¼-in. lead of No. 20 wire, with a tap at one turn; the interstage coil (coil *2*) is identical to coil *1* except that the tap is at the 1¼ turn. Coil *3* is the oscillator coil and consists of 1⅞ turns of No. 14 wire, tapped at ⅝ turn. There is no added lead to this coil. All coils are ⅝ inches long approximately. The tap positions are approximate and are to be adjusted for stable operation. To prevent oscillation at the signal frequency, a non-inductive resistor of about 3 ohms can be inserted at the grid *3* terminal of the 6SB7-Y.

Typical Ratings

The absolute plate voltage for the 6SB7-Y is 330. Voltages for the *2* and *4* screen grids are 110 (absolute). The signal voltage at grid *3*, which is always negative, is 110; there is no positive voltage on this grid.

In the self-exciter converter circuit the plate voltage becomes 250, and the voltage for the *2* and *4* grids becomes 100. The heater voltage is, of course, 6.3.

(*Data and circuits courtesy General Electric and RCA*)

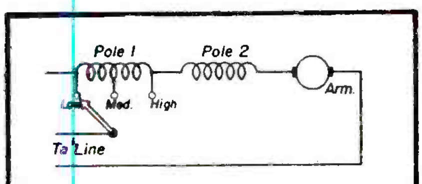
•

SAMS INSTITUTE BULLETINS

Bulletins recently released by the Howard W. Sams Institute, covering discussions of the value of labor, repairing cabinets, accounting, and building of a successful service business.

MOTOR REPAIR

(*Continued from page* 16)



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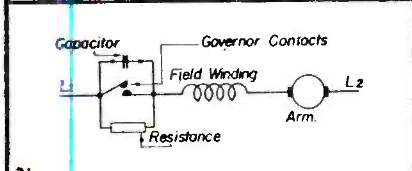

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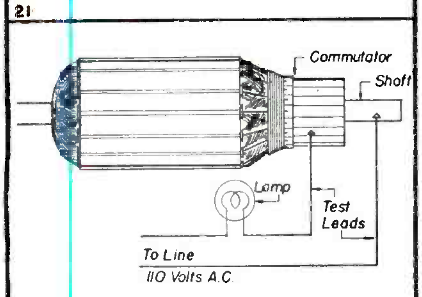

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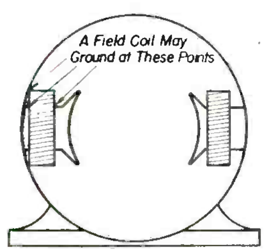

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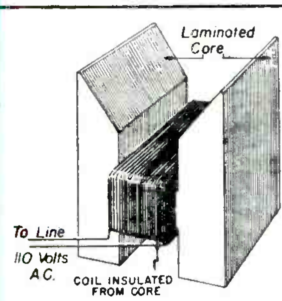

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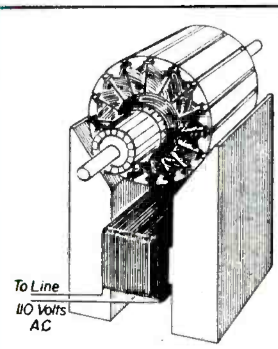


25

where grounds are most likely to occur.

It will probably be necessary to test each field separately to determine which one is grounded. When the defective one is found it should be removed from the pole piece and inspected carefully for broken and burned wires. If on inspection these defects are not revealed the coil should be retaped and replaced on the core, being careful not to scrape the coil on the iron core. If the coil is seriously damaged, it should be rewound.

Figs. 20, 21, 22, 23, 24 and 25. Fig. 20 illustrates a method of controlling speed by tapping the field. In Fig. 21 we have a centrifugal mechanism used for speed control. A method used for testing the armature for grounds is shown in Fig. 22. Fig. 23 illustrates the positions where grounds are most likely to occur. Fig. 24 illustrates a *growler* test device for checking of shorted coils in an armature. In Fig. 25 we have the H-shape core used to make up a growler.

Tests for Shorts

Shorted coils in an armature may be attributed to a breakdown of the insulation on the wire. This, in turn, may be caused by overload, shorted commutator, excessive heat, etc. In testing an armature for shorts a *growler* is usually employed, Fig. 24. This unit consists of a coil of wire wound around on iron core, connected to a 110 volt a-c line.

The growler iron core is generally *H* shaped and cut out on top so that

(*Continued on page* 46)

(*Continued from page* 45)

the armature can fit on it, as shown in Fig. 25. When a-c is applied to the growler coil voltage is induced into the armature coils by transformer action. Thus to test for shorted armature coils, the armature is placed on the growler and the current turned on. Then a thin piece of metal, such as a hacksaw blade is held over the top slot of the armature, as shown in Fig. 26, the blade being held so that it is directly over the slot and along the length of it. If the coil in this slot is shorted the blade will vibrate rapidly and create a *growling* noise. A stationary blade means, of course, that no short exists in the coil under test. The procedure is repeated for the next slot of the armature and continued for the entire armature. If any of the coils indicate shorts, you should check for dirt lodging in the mica between commutator bar. Dirt should be scraped out with a knife. If the armature coils are really shorted, it will be necessary to rewind the entire armature.

Shorted field coils can be tested by measuring the resistance of each field coil with an ohmmeter. The shorted field coil will obviously have less resistance. Another method utilizes a drop in voltage test. This is accomplished by applying a low voltage direct current to the field coils and then measuring the voltage across each. If one field coil has a lower voltage drop than the other, a short is indicated. Usually this requires rewinding.

Test for Opens

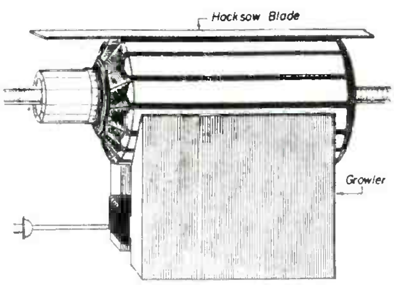
Open circuits in an armature may be caused by a poor connection of leads in the commutator bars or by a broken wire in an armature coil. In either case, the condition will cause sparking at the brushes.

Poor connections and broken wires can often be detected visually. When this is not possible a growler may be used for this purpose. The armature on the growler should be set up in the usual manner, and the top two bars shorted with a piece of wire, as shown in Fig. 27. A small spark will indicate a complete circuit through the coil and absence of a spark will indicate that the coil is open. The open may be at the commutator bar or in the coil itself. If the open is at one point only it can be remedied by placing a small amount of solder between the two bars which indicate open.

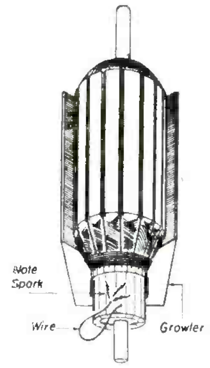
Open circuits in the field coils are tested by means of test lamp set. Figs.

(*Figs. 25 to 28B on facing page; text*

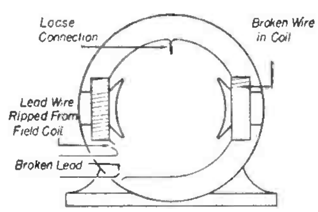
(*Continued on page* 48)



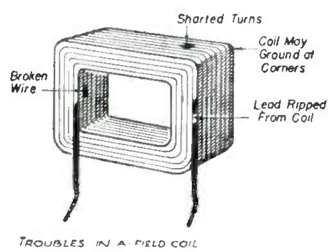
26



27



28A



28B

Figs 26, 27, 28*a* and *b*. Fig. 26 illustrates how a small piece of metal, such as a hacksaw blade, is placed over the top slot of the armature when testing for shorts with a growler; blade will vibrate if short exists. A method of testing an armature for an open with a growler is shown in Fig. 27. In Fig 28*a* and *b* are illustrated points where opens may occur in field coils.

(*Continued from page* 46)

28*a* and *b* illustrate several places where opens may occur. Sometimes the opens take place in the leads connecting to the fields. These leads are broken off easily if they are not tied securely to the coil. The open may also be in the lead extending out of the motor or, it may be due to a poor connection of the field poles.

To repair an open field, the coil must be removed from the core and the tape covering cut away. If the break is on the top layer of the coil, these few turns should be removed and a lead connected to this point. If the break cannot be located, the entire coil will have to be rewound.

Trouble Shooting and Repairs

Many troubles can be detected by using the senses of touch, smell and sight. For instance burned insulation or wire has an odor easily detected by any one. By the same token the sense of touch also warns of an overheated motor. If you can hold your hand on the motor, overheating can be eliminated as a trouble. Undue noise will immediately warn the user that something is wrong with the motor.

Symptoms, Troubles and Cures for Defective Universal Motors

(*1*) If the motor fails to run when the switch is turned on, the trouble may be:

A—Burned out fuse. Current should be checked at the outlet by using the test lamp set described earlier. If the lamp does not light when the test leads are inserted, a blown fuse is indicated. It should be replaced with one of the same size and tested again.

B—Dirty or clogged bushes. Carbon brushes should press against the commutator with a pressure applied by a spring, which is generally behind the brush. For the spring action to be effective the brush must be free to move in the brush holder. However there must be as little space as possible between the brush and brushholder. If too much room is allowed the brushes will chatter while the armature is turning. If the brush becomes so jammed in its mounting as to render the spring useless, the brush will not press on the commutator and consequently the armature will not turn.

C—Open armature circuit. This may result from numerous causes such as a poor brush contact, broken wire leading to the brushholder, two or more open coils in the armature and a dirty commutator. These faults are located either by visual inspection or by means of test lamp. A dirty commutator should be cleaned with a dry cloth and then sandpapered. If the commutator is undercut, the dirt between the bars should be scraped out with a hacksaw blade ground to fit the slot.

D—Open field circuit. An open field circuit will prevent the motor from starting. Sometimes the open takes place in the leads connecting to the fields. These leads break off easily if they are not tied securely to the coil. The open may also be in the lead extending out of the motor. These are located either by inspection or testing.

E—Shorted armature or fields. If there are many shorted coils in the armature, the armature may not rotate. In some motors the armature will revolve a half turn or turn over very slowly. A shorted armature coil manifests itself by heating and smoking. It should be tested by using the growler and if shorted, the armature should be rewound. A completely burned out field coil can be found by visual inspection, the odor of burned coils being quite evident. If the coil is partially shorted it will be necessary to test it by means of a drop test.

F—Worn bearings. When the bearings are so worn that the armature core rests on the field poles, the armature probably will not rotate. If it does it will be noisy in operation. To test for worn sleeve bearings you should try to move the shaft of the armature up and down in the bearings. Motion in this direction indicates worn bearings. If ball bearings are used you should try wobbling the bearing. If this can be done worn bearings are indicated. If both cases the bearings should be replaced.

G—Broken wire in the line cord. This quite often happens in household appliances. Sometimes the open can be found by visual inspection. More often it is necessary to test the cord for opens using the test lamp set.

H—Dry bearings. Due to laxity in oiling the bearings, the armature shaft will not turn freely in the bearing and consequently may cause a fuse to blow. To remedy, armature should be removed, shaft polished with fine emery cloth and the shaft oiled before reassembly. In addition the oil hole should be cleaned out so that oil may freely enter to the bearing.

(*2*) If the motor sparks, the trouble may be:

A—Poor brush contact on the commutator. Sparking at the commutator is a common occurrence and one of the chief causes is poor brush contact on the commutator. This may be due to worn brushes, clogged brushholder, insufficient spring pressure, loose pigtail connection, a rough, grooved or eccentric commutator, and a dirty commutator. All of these can be detected visually.

B—Shorted field coils. Quite often a shorted field coil will cause the motor to run at abnormal speeds and produce sparking at the brushes. Detection is by means of a field test and the remedy is, of course, to rewind the field.

C—Open armature coils. An open armature coil will cause vicious sparking at the commutator and will prevent the motor from running at normal speed. Examination will reveal badly burned spots on the commutator bars to which the open coil is connected. The open may be caused by loose leads on the commutator bars or by a broken wire in the coil. If it is the latter the two bars on either side of the burned spot should be jumped.

D—Shorted armature coils. This will cause the armature to run at lower

(*Continued on page* 50)

(Continued from page 49)

than normal speed and may cause excessive sparking. Test for shorts with the growler.

E—Worn bearings. If the bearings are badly worn the motor will run slowly and spark. Smooth worn spots on the armature will indicate that the armature has been rubbing on the field cores. Worn bearings should be replaced.

F—High mica. High mica is usually due to faster wear of the copper bar than of the mica. Pronounced sparking accompanies this because the brushes cannot make perfect contact with the commutator. High mica is recognized by a blackening of the entire commutator and the mica will feel rough to the touch and higher than the bars. The remedy is to turn the commutator down on a lathe and undercut the mica.

(3) If the motor runs hot, the trouble may be:

A—Worn bearings.
B—Dry bearings.
C—Shorted coils.
D—Overload.
E—Shorted fields.

(4) If the motor smokes, the trouble may be:

A—Shorted armature.
B—Shorted fields.
C—Worn bearings.
D—Wrong voltage.
E—Overload.

(5) If the motor runs slowly, the trouble may be:

A—Shorted armature.
B—Worn bearings.
C—Open armature coils.
D—Overload.
E—Wrong voltage.

•

COVER CIRCUIT

(Continued from page 34)

mfd unit in the common plate-screen supply of the second i-f. The 6AG5 and 7F8 heaters are separately filtered by r-f chokes and bypass capacitors.

Quite an elaborate bandswitching system is used for f-m, a-m and phono with a three-position switch. In operation the switch provides for connection of the 7F8 converter input from the a-m antenna transformer or r-f amplifier f-m output; converter grid bias through 1-megohm resistor to ground or avc; oscillator cathode to tap on either coil; oscillator plate to either coil; oscillator *B+* through 68,000 ohms for a-m or through a resistor and choke for f-m; converter output to a-m or f-m i-f transformers with 7AH7 input selection to either of these; avc bus to a-m, f-m or ground; and audio input from a-m, f-m or phono to the 2-megohm volume control and 6SQ7.

MATH and the Service Man

Part II of a simplified discussion of the basic laws most commonly used; typical problems and answers are supplied

by L. A. MOHR

CONTINUING OUR DISCUSSION of the use of numerators and denominators, if the numerator and denominator are divisible by the same number, a fraction may be reduced. For example, the fraction 10/5 may be reduced by dividing both numerator and denominator by *5*. This does not affect the value of the fractional quantity, since both numbers have been reduced according to their ratio.

Example: $\frac{9}{6} = \frac{3}{2} \left(\div \text{ by } \frac{3}{3} \right)$;

$$\frac{28}{42} = \frac{4}{6} = \frac{2}{3} \left(\div \text{ by } \frac{7}{7}, \text{ then } \frac{2}{2} \right)$$

Extended equations involving more than single numbers in the numerator and denominator may be solved in a similar manner; the cancellation method. This procedure may only be used where all the terms in both the numerator and denominator are connected by *times* signs. If a single plus or minus sign appears, the method cannot be used.

When fractions are divided by fractions, the rule is to invert the denominator, and then proceed as though the problem were the multiplication of two fractions.

Example: $\frac{1/2}{3/4} = 1/2 \cdot 4/3 = 4/6 = 2/3$;

$$\frac{3/7}{6/14} = 3/7 \cdot 14/6 = 42/42 = 1$$

The equal sign is used to indicate that two numerical quantities are of the same value.

Example: $9 \cdot 2 = 6 \cdot 3$; $6 + 5 = 10 + 1$; $7 - 4 = 2 + 1$

Where a mathematical problem involves the foregoing, numbers may be

(*Continued on page* 52)

(Continued from page 51)

transferred from one side of the equal sign to the other without changing the truth of the expression, provided that certain rules are followed. Where a plus or minus quantity is changed, the sign is reversed.

Example: $9 - 7 = 2$, or $9 = 2 + 7$, or $9 - 7 - 2 = 0$

It will be noted that the minus sign of the *7* became plus when transferred to the right side of the equation, and that the *2* became negative when transferred to the left side of the equation.

When *times* signs are used, a *numerator* figure on one side of an equation becomes the denominator when transferred to the other side.

Example: $9 \times 2 = 6 \times 3$, or $2 = \frac{(6 \times 3)}{9}$

$$8 \times 4 = \frac{16 \times 4}{2} \text{ or } 2(8 \times 4) = 16 \times 4$$

It will be noted now that when transferring a number from one side to the other, all the terms on the other side are divided by the transferred number. The rules also operate under more complex conditions.

Example:

(*1*) $6(9 + 2) + 7 = \frac{8 \times 6 \times 3}{4 + 2} + 49$

or $6(9 + 2) + 7 - 49 = \frac{8 \times 6 \times 3}{4 + 2}$

or $(4 + 2) \times \{6[9 + 2] + 7 - 49\} = 8 \times 6 \times 3$

(*2*) $7 + 3 = \frac{8}{4} + 8$, or

$4(7 + 3) = 8 + 4(8)$

(*3*) $6(7 - 3) = 6 + 4(7 - 5) + 10$

or $(7 - 3) = \frac{6 + 4\,(7 - 5) + 10}{6}$

It will be noted that in the second example, the figure *4* multiplied not only the terms on the other side of the equation, but also the figure *8* on its own side. This procedure is necessary when not all of the terms other than the numerator or denominator of the figure being transferred is first transferred. Actually all the terms in the equation are being multiplied by or divided by the same number, thereby keeping the ratio constant. For example, in the problem $8/2 = 4$, if both sides of the equation were multiplied by 2, the balance between the two sides would then appear as $8/2 \times 2 = 4 \times 2$. The two *2s* on the left side of the equation would cancel and the equation would reduce to $8 = 4 \times 2$. Therefore, all the terms in an equation must be affected in any such operation. If the problem were $\frac{8}{2} + 6 = 10$, and it was decided to transfer the figure *2*, then the problem would become

$$\frac{8}{2} \times 2 \quad + (6 \times 2) = 10(2).$$

This would reduce to $(8) + 12 = 20$.

When fractions are involved, they may be converted to whole numbers by cross multiplication, which is an extension of the above method.

Example: $2/5 = 4/10$ or $2 \times 10 = 4 \times 5$;

$4/16 = 7/28$ or $4 \times 28 = 7 \times 16$

Where a combination of signs is used, care must be exercised in applying this rule.

Example: $$\frac{7+5}{3} = \frac{26-6}{3+2} \text{ or}$$

$$(3+2)\ (7+5) = 3(26-6)$$

We note here that all terms involving *plus* or *minus* signs are enclosed in parentheses so as to constitute them as single terms.

Fractions in complex equations cannot be added together, unless they have a common denominator.

Example: $1/2 + 1/4 = 2/8 + 4/8$; (the least common denominator here is 8.)

Each term may therefore be multiplied by appropriate figures so as to convert it to some new fraction whose denominator is *8*. This is accomplished simply by multiplying the fraction by *8/8*.

Example:

$1/2 \times 8/8 = 4/8$, $1/4 \times 8/8 = 2/8$, etc.;

Substituting in the original problem,

$4/8 + 2/8 = 2/8 + 4/8$, or $6/8 = 6/8$

When adding fractions with a common denominator, only the numerator figures are added, the denominator remaining constant.

Example: $1/8 + 2/8 + 3/8 + 4/8$

$$= \frac{1+2+3+4}{8} = \frac{10}{8}$$

Quite often, in mathematical operations, the figure *0* is encountered. Definite rules have been established as to the procedure to follow where a zero quantity is involved. These are:

$$6 + 0 = 6$$
$$6 - 0 = 6$$
$$6 \times 0 = 0$$

(*Continued on page* 55)

r-f tuner. Tuner is supplied wired for three channels and the other channels are ready to be wired in to accommodate new stations. Coil forms are mounted as well as the trimmers for these extra channels. Antenna is also supplied with the necessary mounting brackets and hardware.

* * *

FTR DUAL-CONDUCTOR F-M LEADIN

A twisted dual conductor h-f cable, KT-51, specially designed for f-m and television receivers has been developed by Federal Telephone and Radio Corporation, Newark, N. J.

Characteristic impedance is 95 ohms while its attenuation is 1.7 db at 30 mc, 3.6 db at 100 mc, and 10 db per 100 foot at 400 mc.

* * *

SPRAGUE MINIATURE CAPACITORS

Miniature capacitors, 63P and 64P, in round and flat types, and available in

NEW PRODUCTS

(*Continued from page 25*)

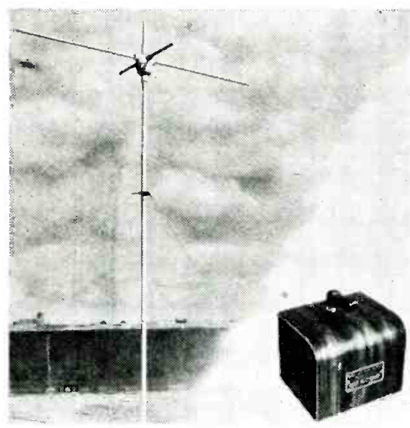
capacities ranging from .00025 to 1.0 mfd, have been announced by Sprague Electric Co., North Adams, Mass. A typical capacitor rated .005 mfd at 150 volts is ¾" long x 3/16" diameter.

* * *

KINGS ROTO BEAM ANTENNA

A roto-beam tv antenna, which rotates clockwise or counter-clockwise in a complete 360° circle, is now being made by the Kings Electronics Co., 372 Classon Ave., Brooklyn 5, N. Y.

Antenna is operated by a 24-volt motor, which is controlled by a double-pole, double throw, spring-loaded switch located in the control box at set. Weatherproofed, with a neoprene de-icing skirt around the head.



* * *

D & M PHONO OSCILLATOR

A one-tube phono oscillator using a 12SL7 has been produced by the D & M Mfg. Co., 51 Lincoln Ave., Midland Park, N. J.

Transmitting frequency may be permeability tuned, by means of a slotted screw, through a range from 550 to 1550 kc. Units are shipped tuned to 600 kc. Includes a built-in scratch filter.

* * *

SIMPSON ILLUMINATED METERS

Illuminated meters in 2-in. and 3-in. sizes and in both rectangular and round cases, have been announced by the Simpson Electric Company, Chicago, Illinois.

In a patented method of illumination, a Lucite cone carries the light from a recessed bulb in the back of the instrument through the front edge of the cone which entirely surrounds the dial face. This makes possible the use of the standard metal dial.

* * *

JFD STEP-DOWN RESISTOR BALLAST

A plug-in type step down resistor ballast, designed to convert 110-volt receivers and electrical appliances for use on 220-volt circuits, has been designed by the JFD Manufacturing Co., Dept. Y, 4117 Fort Hamilton Parkway, Brooklyn 19, New York. Ballasts come with American, British and Continental male plugs; female sockets are American.

SERVICE MAN MATH

(*Continued from page* 53)

$$\frac{6}{0} = 0$$

$$0 - 6 = -6$$

$$\frac{0}{6} = 0$$

Most of the preceding material can be used in the determination of unknown quantities, specifically, in using Ohm's law and Kirchhoff's laws. When so used, the unknown quantity is placed on the left side of the equation, and the known quantities on the right. For example, suppose the voltage drop across a resistor of 100 ohms is 10 volts, and we wanted to determine the current through it.

$$I = \frac{E}{R} \quad \text{where} \quad E = 10 \quad \text{and} \quad R = 100.$$

$$\text{Then} \quad I = \frac{10}{100} \quad \text{or} \quad I = \frac{1}{10} \text{ ampere}$$

The solution of resistive networks requires a knowledge of mathematics, too. For resistors in parallel, the formula is

$$R_{total} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}, \text{ etc.,}$$

where: R_1, R_2, R_3, are the paralleled resistors

For resistors in series, the formula is

$$R_{total} = R_1 + R_2 + R_3, \text{ etc.}$$

where: R_1, R_2, R_3, etc., are the series resistors

An alternative formula for paralleled resistors is

$$R_{total} = \frac{R_1 \times R_2}{R_1 + R_2}.$$

However, this second formula can only be used for two resistors in parallel.

The formulas given may be used in combination to solve resistive network problems. For example, suppose two resistors of 10-ohms resistance were in parallel, and, in turn, in series with a 20-ohm resistor, and we wanted to determine the total resistance of the network. The equation would then be

$$R_{total} = \frac{R_1 \times R_2}{R_1 + R_2} + R_3$$

where: $R_1 = 10$ ohms, $R_2 = 10$ ohms, and $R_3 = 20$ ohms

GET ALL THE FACTS

(*Continued from page* 41)

order is taken. A basic contract form is in many cases preprinted on the back of the repair order itself and signed by the customer at the Shop when the pickup is made or before the work is done on the customer's premises. This, too, goes a long way towards reducing misunderstanding.

•

CORRECTION

The coupling capacitor between the 12SK7 plate and 47,000-ohm grid resistor, in the front cover diagram of February SERVICE, is a 25-mmfd unit. The value had been omitted from the circuit.

•

CIRCUIT MODIFICATION

A revised model of the Collins 75A, discussed in the circuits pages of March SERVICE, has been released. The new model uses a 6SJ7 in place of a 6AK5 for the crystal oscillator, and 6SG7 tubes in place of the 6SK7s in the i-f amplifier. No changes were made in the circuit design.

JOTS AND FLASHES

Wire Recorders, with Playback, are beginning to come off the production line of many manufacturers, as separate units and in receiver consoles. Many models provide for from one-half to one hour of continuous recording, with prices ranging from $2.50 to $5.00 for the one-half or one hour spools. Watch for a complete analysis of wire recorders in the June issue of Service. . . . Manufacturers are continuing to stress the importance of service clinics. Stromberg-Carlson has recently set up a traveling service clinic that will visit the major cities throughout the country. F. Leo Granger, Stromberg-Carlson service department manager, is in charge of the clinic. . . . Charles W. Robbins is no longer representing the Viewtone Television & Radio Corp. . . . Edward R. Taylor has resigned as advertising director of Zenith Radio Corp. William E. Macke has succeeded Mr. Taylor. . . . There are now 6,000 members in the National Radio Institute Alumni Association which was organized in 1929. Chapters are located in New York, Baltimore, Philadelphia, Camden, Detroit, and Chicago. . . . Clint Bowman has been named to handle the P. R. Mallory & Co. territory in Chicago, northern Illinois, Iowa and Wisconsin. Allen Shaw will represent Mallory in Pennsylvania, Maryland, Delaware, Virginia, District of Columbia and eastern New York. Ray Bridge will cover the New England States for Mallory. . . . L. C. Truesdell, formerly with Bendix as general sales manager of the radio division, is now with Hotpoint, Inc., Chicago, as vice president in charge of marketing. . . . David Cathcart, formerly advertising manager of the home instrument division of RCA Victor, is now assistant to the general manager of Magnavox. . . . The Hallicrafters cabinet factory at Shelbyville, Indiana, has been purchased by the Admiral Corporation of Chicago. . . . Gerald Light is now assistant director of sales and advertising of Emerson Radio. . . . Concord Radio Corp. recently opened its second store at 229 W. Madison Street, Chicago. Many personalities in the business and entertainment world attended the opening. . . . Harold Shonberg, president of Alpha Metals, Inc., Brooklyn, who developed the three-core rosin flux solder, will attend the Radio Parts Show in Chicago. . . . Elmer D. Eades is now regional manager of the southern regional office of RCA Victor. . . . Donald MacGregor, former executive vice president of Webster-Chicago, has been elected vice president in charge of production for Zenith. . . . E. J. Conlon is now director of advertising and sales promotion of Aero Needle, Chicago. . . . Loyd Dopkins has become radio sales manager of Majestic Radio & Television Corp., Chicago. He succeeds C. V. Mercado who has become head of the international division of Majestic. . . . Terminal Radio, 85 Cortlandt Street, N.Y.C., are now distributors for the Pickering Pickup and Brook High Fidelity Amplifier. F. Sumner Hall is national sales engineer for Pickering and Brook. . . . Edward R. McCarthy is now general sales manager of Sorensen & Co. . . . Kenneth B. Shaffer has been named by RCA to supervise the sale of parts to tube and parts distributors.

ADVERTISERS IN THIS ISSUE

SERVICE INDEX—APRIL, 1947

What's The Indian Rope Trick Got To Do With MALLORY CAPACITORS?

MALLORY originated and produced the first type "FP" capacitor. These have been famous for performance for so long—have been so consistently preferred for original equipment—it follows they naturally become first choice of radio servicemen. You might imagine there was some special magic in their making.

The popularity of FPs, however, has never depended on tricks of engineering or manufacture. Yesterday, as today, it has been a matter of *quality*. Careful control of materials . . . painstaking manufacturing methods that keep impurities down to a fraction of a part per million . . . rigid standards of testing and inspection . . . explain why Mallory FPs are preferred.

They are the reasons why Mallory FP capacitors *last* . . . why millions are in use all over the world . . . why they can be counted upon for service beyond the normal. They are your assurance that when you install a Mallory FP, the customer can depend on a job well done.

YOU EXPECT MORE AND GET MORE FROM MALLORY

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OVERWHELMING ACCEPTANCE...

because they're Radio-Engineered for Extra listening hours

THE VERY FACT that RCA Batteries are designed *for* radio *by* radio engineers, is the reason why dealers and servicemen everywhere are turning to RCA *Preferred Type* Radio Batteries for greater profit and customer satisfaction.

Each radio-engineered battery type has the right capacity for the current drain of the sets it is designed for. And all "A-B" types are engineered so that *both* sections deliver effective voltage for the *full* life of the battery pack.

Add this to the fact that RCA is the greatest name in radio, and you'll understand why the smartly packaged and competitively priced RCA Radio Batteries lead the way today. You can get your stock conveniently and quickly from the same RCA Distributor who supplies you with RCA tubes, parts, and test equipment.

Flashlight | Portable A's | Portable B's | Portable AB's | Farm A's | Farm B's | Farm AB's | Industrial

RCA

TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.