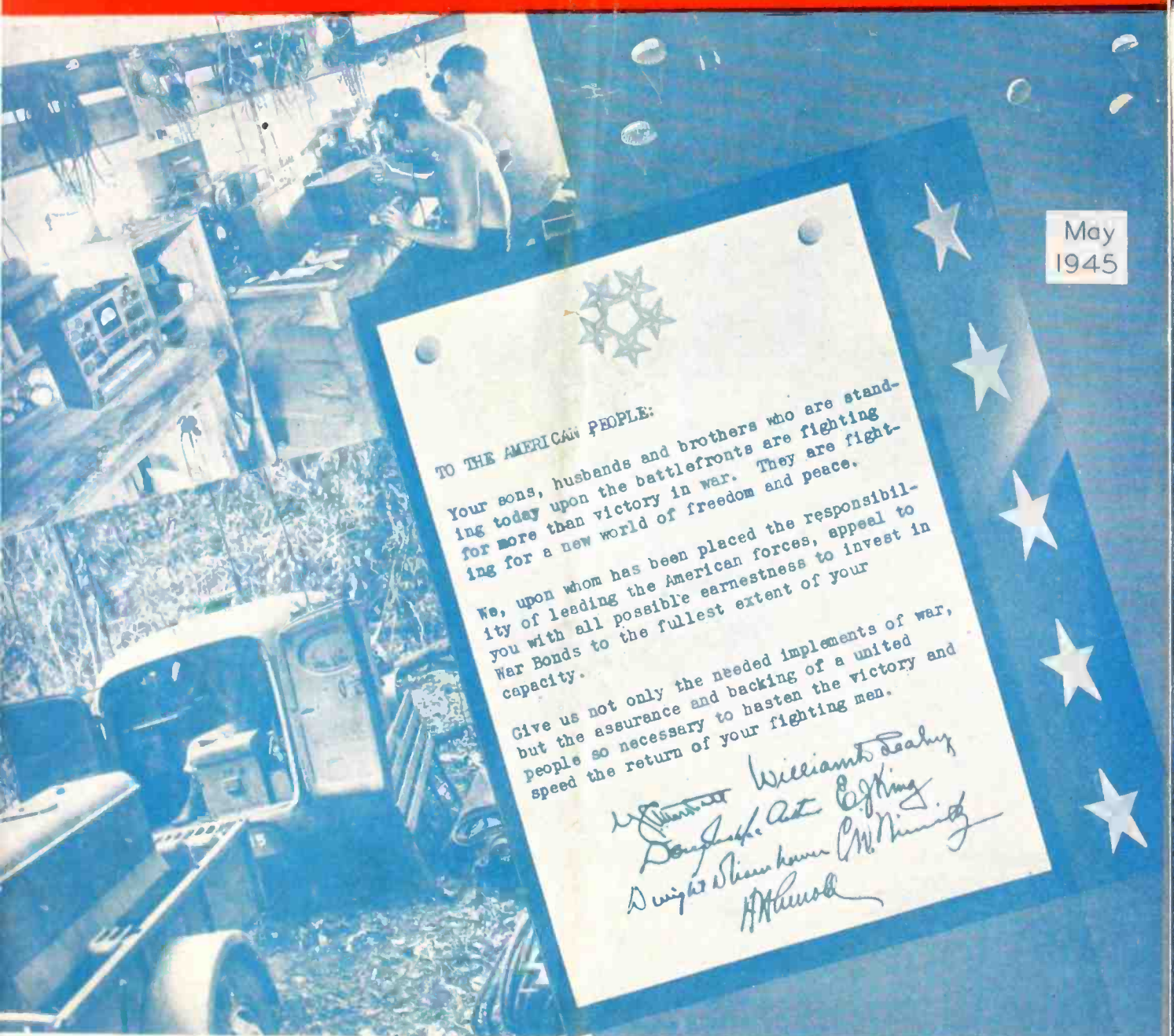
RADIO · TELEVISION · ELECTRONIC

SERVICE



May
1945

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE

ONLY MECK HAS THE COURAGE TO TELL THIS STORY

Surveys show—

That approximately 64% of the prospects for new radio sets in your community—have not yet decided where they will buy their postwar radios.

There is still time for independent radio and electrical dealers to keep the radio business where it belongs. Tie in now with the Meck program—the only consumer advertising program devoted to selling the public on the DEALER.

Ask about the Meck Preferential Dealer Plan.

John Meck

JOHN MECK INDUSTRIES, INC., PLYMOUTH, INDIANA

EDITORIAL

A SUBSTANTIAL allotment of replacement parts and tubes in the fourth quarter of this year appears possible according to surveys completed by department store executives and industry specialists. Production depends on when reconversion begins. WPB has revealed that unrestricted production of parts and tubes will begin when military requirements fall below 90 per cent. Some specialists believe that the latter part of this summer may see the beginning of reconversion. If such programs are initiated, many types of parts would be available around November. And December would also see tubes being shipped in larger quantities.

The battery picture is also expected to improve considerably. As a result of cutbacks, we can expect dry cell production for the current quarter to be at least two and one-half times greater than the first quarter.

In the meanwhile, WPB has warned that wartime regulations still in effect must be obeyed. Many flagrant violations have been reported in the sound system field. WPB has disclosed that many have been selling and installing intercommunication and p-a systems on the basis of MRO (maintenance, repair) ratings. This rating can only be used to effect unit replacement when the equipment has been damaged beyond repair. Other parts of sound systems, such as speakers, microphones and parts, are subject to replacement on an MRO certificate. If you are in doubt on MRO use, check with your local field office or contact H. B. Esterly, Radio and Radar division, WPB, Washington, 25, D. C.

MISREPRESENTATIVE, *bait*-type inspection - checkup advertisements still appear to be the pet sales promotion plan of some service shops. Recently we received several folders and cards offering a checkup of tubes, alignment, inspection of chassis, speaker, coils and ground system, minor adjustments, and a free estimate for additional repairs . . . *all for* 50c! Certainly this is not a very profitable charge, nor is it very conducive to good business. The customer's usual revolt at learning the real charges, does little to encourage sales. Such teaser programs are destructive. . . not constructive. They destroy complete faith in the Service Man. Service shop promotional programs can produce results. . . . profitably . . . without subterfuge!

SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office

Vol. 14, No. 5 May, 1945

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Managing Editor

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RAYTHEON TUBES RECOMMENDED FOR POSTWAR *Chris-Craft*

Chris-Craft, world's largest maker of speedboats, cruisers and motor yachts, has a line of new streamlined beauties on the drawing boards that are sure to be seen on every lake and river in the peacetime years to come. Their refinements, as compared with prewar models, are almost too numerous to count . . . and one of the most important available accessories is ship-to-shore radio, for which Chris-Craft will recommend famous Raytheon High-Fidelity Tubes.

Radio equipment for marine use must be able to take plenty of battering abuse, and Chris-Craft's recommendation of Raytheon Tubes is based on their splendid wartime performance under the most gruelling battle conditions on land, sea, and in the air.

The moral of this story for you, the radio service dealer, is that Raytheon Tubes, capable of absorbing the punishment of war, are the *best* bet for giving your customers the dependable, rich reception they rely on you to provide. Their consistent performance . . . plus a post-war Raytheon merchandising program that will revolutionize the radio service industry . . . are the two big reasons why you should feature Raytheon Tubes *now!*

Increased turnover and profits . . . easier stock control . . . better tubes at lower inventory cost . . . these are benefits which you may enjoy as a result of the Raytheon standardized tube type program, which is part of our continued planning for the future.

Raytheon Manufacturing Company
RADIO RECEIVING TUBE DIVISION
Newton, Mass. • Los Angeles • New York • Chicago • Atlanta

All Four Divisions
Have Been Awarded
Army-Navy "E" With Stars

RAYTHEON

High Fidelity

ELECTRONIC AND RADIO TUBES

Listen to
"MEET YOUR NAVY"
Every Saturday Night
AMERICAN BROADCASTING CO.
Coast to Coast
181 Stations

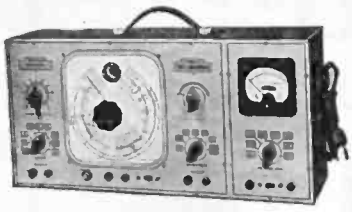
DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES FOR THE NEW ERA OF ELECTRONICS

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

ARMY E NAVY

CONDENSER-RESISTOR TESTER *de luxe!*



EVERY basic characteristic of EVERY type of condenser and resistor can be read quickly and accurately on direct reading scales on the Sprague de luxe Tel-Ohmike. Measures capacitance from .000010 to 2000 mfd.; d-c resistance from .5 to 5,000,000 ohms; and insulation resistance to 10,000 megohms. Contains built-in d-c volt-milliameter. Power factor and leakage current of electrolytic condensers are read directly. Built-in power supply permits all characteristic measurements under actual working conditions up to 1,000 volts DC. A "magic eye" indicator shows bridge circuit balance.

FOR SALE—Weston #682 tube tester, very little used, cost $40. James Knox, 125 State Rd., Upper Darby, Pa.

WANTED — Rider chanalyst. Cash. Also Rider manual #5. Albert Lalik, 151 Diamond St., Brooklyn 22, N. Y.

FOR SALE—RCA electronic sweep oscillator #150; RCA #151-2 cathode ray 2" oscillograph, both in good condition complete with harness & instructions, $70. Have 6 new 3Q5 tubes in sealed cartons at OPA price. Jacks Radio Service, 34 W. Hoffman Ave., Lindenhurst, N. Y.

WANTED—Late tube tester & signal generator, also 6K7; 25Z5; 70L7; 35Z5; 35Z6; 12K7; 50L6; and 35L6 tubes. Bodle Mikus Radio, 10334 Torrence Ave., Chicago, Ill.

FOR SALE — Crosley phono motor with condenser, 25 cy., no pickup, $15; two RCA phono motors with condensers, 25 cy., no pickup, $15 ea.; Philco AR-10 car radio, $25. Reth's Radio Service, 100 South St., Milltown, Me.

FOR SALE—Brand new 1941 Meissner Signal Shifter complete with tubes & coils for 40, 80, and 160 meter bands. Capt. H. Miller, Lubbock Army Air Field, Lubbock, Texas.

WANTED—Howard #490 receiver. Cash, or will trade 450A and cash. Carl L. Horton, 16 Auburn Pl., Athol, Mass.

WANTED—One 1LD5 and one 7C6 tube. W. T. Bridges, Maplewood, La.

FOR SALE — Wilcox-Gay Recordia Pro radio and record maker, 2 mikes, cords, 2 head set, and 20 glass base record blanks, $350. Charles Goff, 1319 Ave. A, Brownwood, Texas.

FOR SALE—$500 worth of radio tubes, all types. Whole lot only. Write for list. Geo. De Marco, 58 King St., Santa Cruz, Calif.

WILL TRADE—A-F sig. generator 75 to 75,000 cy., hi- and low imp. with built-in calibrated V-T-V-M for scope or test eqpt. Ben L. Sandberg, 36 Washington Village, Asbury Park, N. J.

FOR SALE—Brand new 5" RCA oscilloscope $160 B, used very little, $140. Radio & Television Service, 821 Porter St., Philadelphia 48, Pa.

WANTED—Echophone EC-1 or any similar small receiver. Also want r-f tuning coils with matching tuning condenser. Prt. E. A. Gerhart, 35315881, 423 AAFBU, Squdn. F, Walla Walla, Wash.

WANTED—Sig. generator, tube tester & Rider manuals. Elmo's Radio Service, 1901 Lynch St., St. Louis 18, Mo.

FOR SALE—Latest Hallicrafters SX-25 Super Defiant, good as new. Complete with matching speaker, crystal and aluminum phones, $90. George Hugo, 1141 Townsend Ave., New Haven, Conn.

WANTED—Tube tester, sig. generator, and voltohmeter, also 1A7G, 1C7G, 1D5GT, 1H4G and 1H5GT tubes. Cash. Harold E. Babe, Bebee, W. Va.

WANTED—Record cutter with automatic feed. Will trade autographic Kodak 122; Davrad tube checker; 37 watt, P. A. amplifier with mike & speakers; Solar condenser checker. Boley's Radio Service, Wintield, Ala.

WANTED—Used tube tester and volt-ohmmeter. Will trade typewriter, 12 gauge shotgun, pocket watch, violin. B. Lapinski, 2311 N. Latrobe Ave., Chicago, Ill.

FOR SALE OR TRADE—Resistors—10,000 ohm 18 W. wirewound with ferrules 50c; meters 0-10 ma., 3½" bakelite flush panel mtg. $5; interoffice comm. 2 master units $20. Need sensitive meters any make. J. E. Craan, 5201 Eastern Ave., Baltimore 24, Md.

FOR SALE—Sky Champion receiver 1 yr. old; Weston 672, 9½" tube checker meter, needs spring; 1 ma. 280 reflecting scale lab. meter; new Kellogg handset. A. Deming, 203 Glamorgan, Alliance, Ohio.

WANTED TO BUY—Test instruments, tube tester, oscillator, A.F. & R.F. and service equipment with instructions. Bob's Radio Service, 606 Wyandot St., Findlay, Ohio.

WILL TRADE—Weston 697 pocket tester for Supreme, Triplett or other tube tester. Shipment by air express. Julio Bellber, c/o Pan American Airways, San Juan, Puerto Rico.

FOR SALE OR TRADE—Good used tubes at ½ O.P.A. 6-26, 1-85, 4-24A, 3-27, 1-19, 1-1B5/25S, 4-32, 1-71A, 1-84, 1-36, 1-37, 1-39; New tubes O.P.A. list, 5-24A, 2-SQ7; 1-25L6, 1-45, 2-5Z3, 1-2Z2/G84, 1-1B4, 1-1C6, 1-1D7, 2-12SK7; sell in lots of 5, or will trade for 12SQ7, 35Z5, 35Z4, 50L6, 1A7, 1H5, 1N5, 1A5 asst. or one size. Ellison Radio Service, Centertown, Ky.

FOR SALE OR TRADE—National SW-3 receiver with 20, 40, 60, 80 and 160 meter coils and tubes, slightly used. Needs 350v 100ma. power supply. Stanley H. Anonsen, 5307 Gladstone Pl., Normandy 21, Mo.

FOR SALE OR TRADE—Teleplex, copper ribbon type, cuts own tape. Want model locomotive "O" gauge or what have you? H. C. Humphreys, Ward A-1, U. S. Naval Hospital, Corona, Calif.

WILL TRADE—Mendell wardrobe trunk cost $200 for oscillograph and other test equipment or good F-2 camera. Joseph T. Fahey, 236 Elm St., Holyoke, Mass.

WANTED—Good small radios, phonos and radio tubes 117Z6, 50L6, 35L6, 35Z5, 35Z4, 12SA7, 12A8, and 1A7. Noah's Ark, 226 12th St., Augusta, Ga.

FOR SALE—Table radios $15—$20—$25 complete; auto radios $10. Battery radio uses 30 series tubes, $25; 3 console type chassis complete with speakers—all working order $20 ea. or 3 for $50. H. T. Wills, P.O. Box 124, Valetie, N. Y.

WANTED — Multimeter or voltohmmeter, both a-c and d-c, 2-70L7 or 70L7GT or 117L7GT/ 117M7GT or 117N7GT or 117P7GT. Robert J. Daugherty, 628 Main St., Hamilton, Ohio.

FOR SALE—75 to 100 good used tubes in cartons at ½ list price. Sell in one lot. Write for list. Jim's Radio Shop, Mankato, Kans.

FOR SALE—Complete radio repair shop including 800 tubes most all types; late equipment. Reasonable. Freeman Radio Service, Box 392, Freeman, S. Dak.

WILL TRADE—F. M. tuning condenser, 3-15 mmf. sections and 3-410 mmf. sections—want vernier dial; slide rule or other dial mechanism. Edwin Bohr, Route #5, N. Chattanooga, Tenn.

FOR SALE — New Sprague Tel-ohmike. Factory guarantee. Al Werhan, Manlius, N. Y.

WILL TRADE one DX 0-5 voltmeter; two DX 0-8 ditto and two DX 0-800 milliammeters, all Westinghouse d-c panel types. Want tube tester. Frank Way, 406 S. 7th St., Newark 3, N. J.

WANTED—Supreme audolyzer in good condition. Wm. W. Jordan, Lexington, Miss.

FOR SALE — Bendix-DayRad all-wave oscillator, late series 36; Hickok AC-49 dynamic mutual conductance tube tester; Solar CB capacitor analyzer & resistance bridge; Superior late model #1240 tube tester in port. case; Sprague interference analyzer; Hickok #4955 9-X V-O-M. Write for details. Burt's, P.O. Box 308, Elyria Ohio.

FOR SALE—Power amplifier 18 watt output, 3-6-250-500 ohm output, high impedance input for mike or phonograph, $3 Limited number new & used tubes 27, 4 80, 6J5, 6F7, 5T4, 6L6, 5V4, 6N7. Ea H. Swen, Gliby, N. Dak.

FOR SALE—CC solar capacitor analyzer new. Want Triplett #1672 vibrator teste in new condition. Paul Capito, 637 W. 2 St., Erie, Pa.

FOR SALE—Mod. S.Y. signalyzer compl with instr. and 11 tubes. Fine unit fo locating cut-off troubles. A-1 condition $23. No trades. A. Fiess, 3224 Midlan Ave., Syracuse 7, N. Y.

WANTED FOR CASH—12J5; 1R5; 6A7 117Z6; 1C7; 35Z5; 6G6G; 35A5; 35Z3 25Z6; 25Z5; 50L6; 35L6; 12SR7; 12SG and other tubes. Send your list. Williamso Radio Shop, Cooper, Texas.

WANTED—Stancor or similar A & B battery eliminators. Cash or trade fo various meters, interoffice outfits, speakers G. Samkofsky, 527 Bedford Ave., Brooklyn, N. Y.

WANTED—Tube checker any make, goo condition; oscillator and 1A7, 50L6, 50C and 35L6 tubes. J. H. Martin, 213 A Priester Line, Opelika, Ala.

FOR SALE—Weston #663 voltohmmeter #662 oscillator, #665 type 2 analyzer #660 analyzer. M. L. Birkett, 2415 E 7th St., Apt. 4, Tulsa, Okla.

WANTED—25B8 tube, new or used. E. F Riffle, 462 Elm St., Ludlow, Ky.

WILL TRADE—Good sig. gen. and Hicko oscilloscope for Hallicrafters or similis communications receiver. Kurth's Soun Equipment, Hutchinson, Minn.

WANTED — University P.M. units an trumpets for cash. J. W. Elfers, P.O. Bo 5, Muscatine, Iowa.

FOR SALE — 2 battery chargers wit Tungar bulb; Jewell 210 & 209 tub checkers; Pignolet d.c. ammeter, and ac-d voltmeter. A. Fiess, 3224 Midland Ave. Syracuse, N. Y.

WANTED—Set of 5 prong plug coils fo 365 mmfd. cond. or data on how to win coils. Hyman Blatter, 3260 Coney Islan Ave., Brooklyn, N. Y.

WILL TRADE — Emerson combinatio radio for Superior channel analyzer an Superior 1280 tester or will pay cas Walter Jandro, Bldg. 58, Apt. 218, Succes Park, Bridgeport, Conn.

FOR SALE—Astatic T-3 microphone, per fect $12; Brush PL-25 1 oz. Hi-Fi crysti pickup factory reconditioned, hi. im equalizer included, $18. W. D. Swair P. O. Box 97, Gatlinburg, Tenn.

YOUR OWN AD RUN FREE!

This is Sprague's special wartime advertising service to help radio men get needed parts and equipment, or dispose of radio materials they do not need. Send your ad today. Write PLAINLY or PRINT—hold it to 40 words or less. Due to the large number received, ads may be delayed a month or two, but will be published as rapidly as possible.

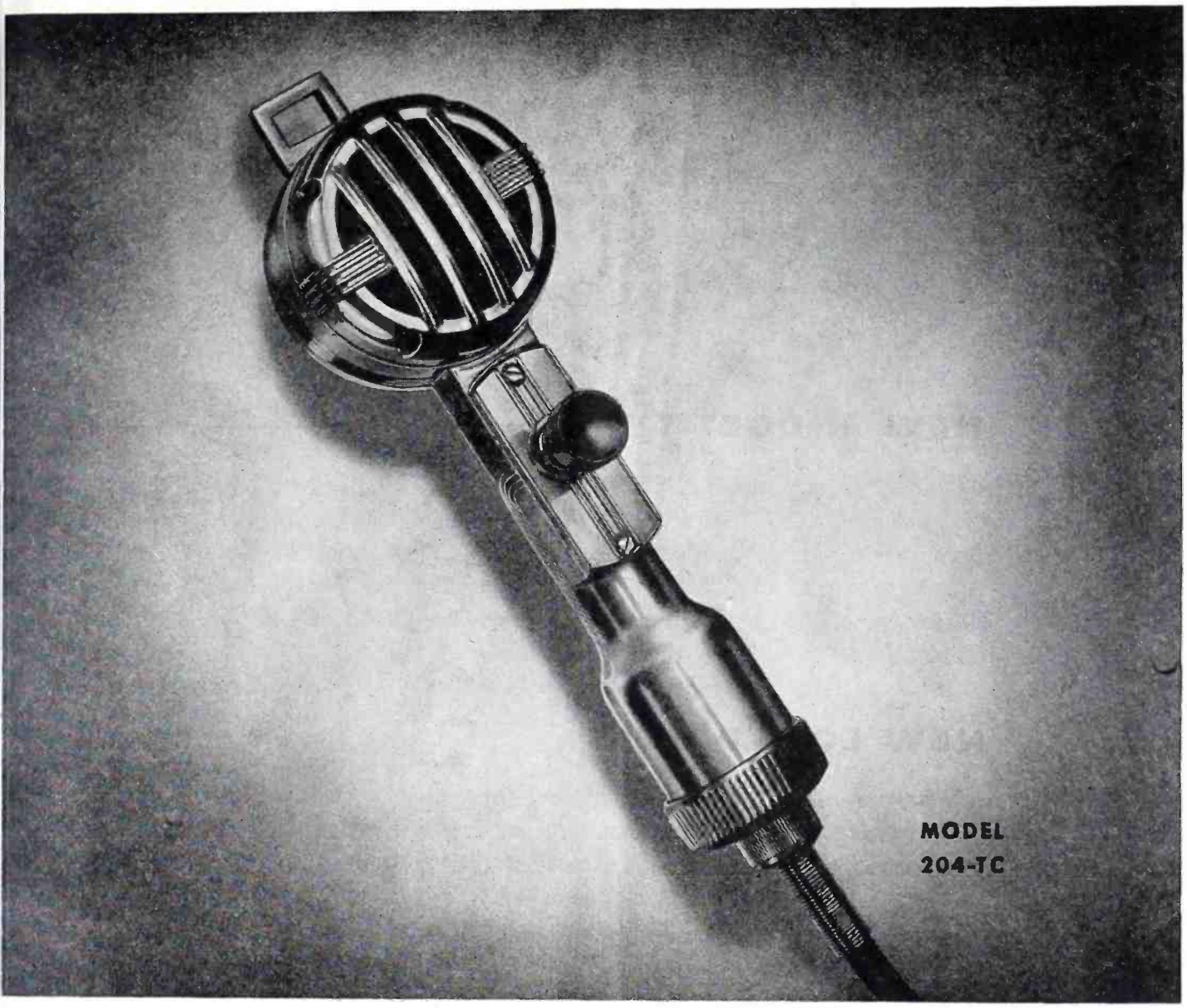
Sprague reserves the right to reject ads which do not fit in with the spirit of this service.

HARRY KALKER, Sales Manager

Dept. S-55, SPRAGUE PRODUCTS CO., North Adams, Mass.

Jobbing Sales Organization for Sprague Electric Company

Obviously, Sprague cannot assume any responsibility, or guarantee goods, services, etc., which might be exchanged through the above advertisements



DYNAMIC HANDI-MIKE

TECHNICAL DATA
MODEL 204-TC

IMPEDANCE: 35-50 Ohms.

FREQUENCY RESPONSE: 200-7500 Cps.

OUTPUT LEVEL: Into 50 ohm input; 44 db below 6 milliwatts for 100 bar signal.

SWITCH: Type "T." Press-to-talk. Vertical toggle with snap action.

CORD: 6 feet long. Rubber jacketed. 2 Conductor and shield.

CIRCUIT: Two wires direct to microphone. Switch "makes" independent circuit. For use in connection with control circuit of transmitter or other relay operated device.

DIMENSIONS: Length overall 8 inches, head diameter 2 1/4 inches.

SHIPPING WEIGHT: 2 pounds.

There are seven other dynamic handi-mike models from which to make a selection.

Universal Handi-Mikes have been, through these years of progress in Radio-Electronics, as common a part to specialized sound equipment as the vacuum tube is to your home radio. The same microphone restyled and redesigned progressively has met the wanted need of a rugged hand held microphone. The Handi-Mikes are now available in both carbon and dynamic microphones with a variety of switches and circuits from which to choose.

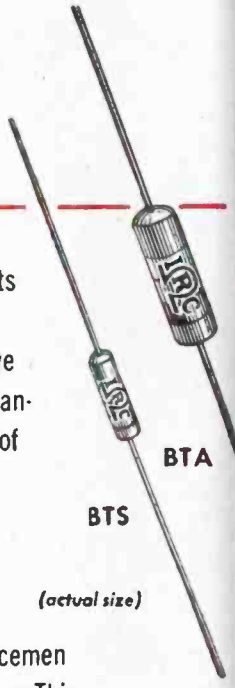
UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA

REPRESENTATIVES: New York, Chicago, Kansas City, Cleveland, Boston, Tampa, Houston, Philadelphia, Detroit, Seattle, St. Paul, Salt Lake, Los Angeles, San Francisco, and Asheville.

"Big Three" news about BT resistors

1 NEW MIDGET TYPES

To meet the growing demand for smaller, space-conserving components, IRC presents two new insulated METALLIZED resistors . . . Type BTS, ½ watt and Type BTA, 1 watt. Thoroughly dependable and engineered to embody the high-quality standards that have made BT's "preferred for performance", these tiny units can be counted on to do a man-size job. Like other BT's they operate at lower temperature than ordinary resistors of comparative size.



(actual size)

2 NEW LOW PRICES

New methods and new techniques in the stocking and packaging of resistors for Servicemen make possible the introduction of new lower prices on IRC Type BT and BW resistors. This means that you can now buy premium quality resistors at prices comparable to non-branded or "unknowns". For example, here are a few of the typical reductions based on list prices: BTS now 13c (BT-½ was 17c), BTA now 17c (BT-1 was 20c), BT-2 now 25c (was 30c), BW-½ now 15c (was 17c), BW-1 now 17c (was 20c), BW-2 now 25c (was 30c). Under IRC's new price set-up you can operate even more profitably than before.

3 RMA PREFERRED RANGES

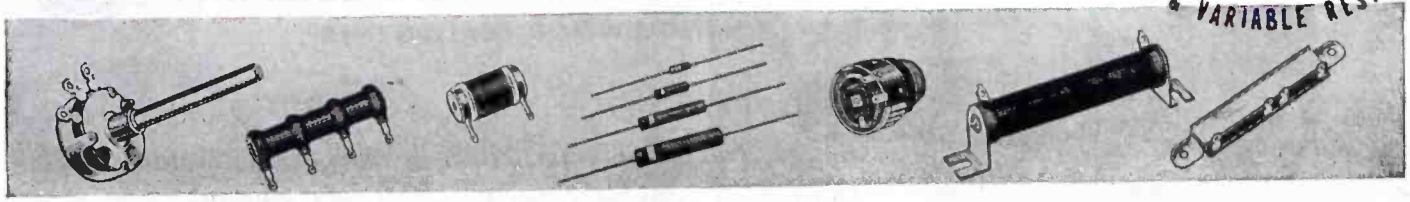
IRC's standardization on RMA Ranges in both BT's and BW's as stock values for Servicemen, enables you to replace the same values you take out when making resistor repairs. Long used by set manufacturers, and now adopted by the Army-Navy in Specification JAN-R-11, the RMA Preferred Number System is a mathematical sequence of ranges which gives complete coverage with the least number of values. RMA Ranges listed for ±10% tolerance resistors are carefully spaced so that preceding or following values are never more than 20% apart, thus assuring complete coverage of every value with regularly stocked BT's and BW's.

INTERNATIONAL RESISTANCE CO.

DEPT. 23-E • 401 N. BROAD ST. • PHILADELPHIA 8, PA.

IRC makes more types of resistance units, in more shapes, for more applications than any other manufacturer in the world.

PREFERRED FOR PERFORMANCE • IRC • FIXED & VARIABLE RESISTORS •



more efficient ...in miniature

Imagine a lady carrying a bunch of keys for old time locks in her evening bag. Their bulk and weight would make this impractical... yet, for modern locks, it is common practise for her to carry several keys. Imagine trying to crowd a kit of old-style large tubes into the midget receiving set of the future. TUNG-SOL Miniature Electronic Tubes have indeed opened up new possibilities in compactness and weight.

When miniature tubes were introduced, they created much interest... but set manufacturers asked "will they work as well?" The answer is "yes." In most circuits. miniatures do a better job than large tubes. Some high frequency circuits could not even be designed with large tubes. Added advantages of miniatures are their small size and reduced weight.

After the war, the experience gained from producing tubes for the Signal Corps and Navy will be at the disposal of TUNG-SOL Jobbers and Dealers. They will find at TUNG-SOL the engineering and production skill to produce all types of tubes that will be necessary to service radio sets and the new and better electronic devices of the future.

TUNG-SOL

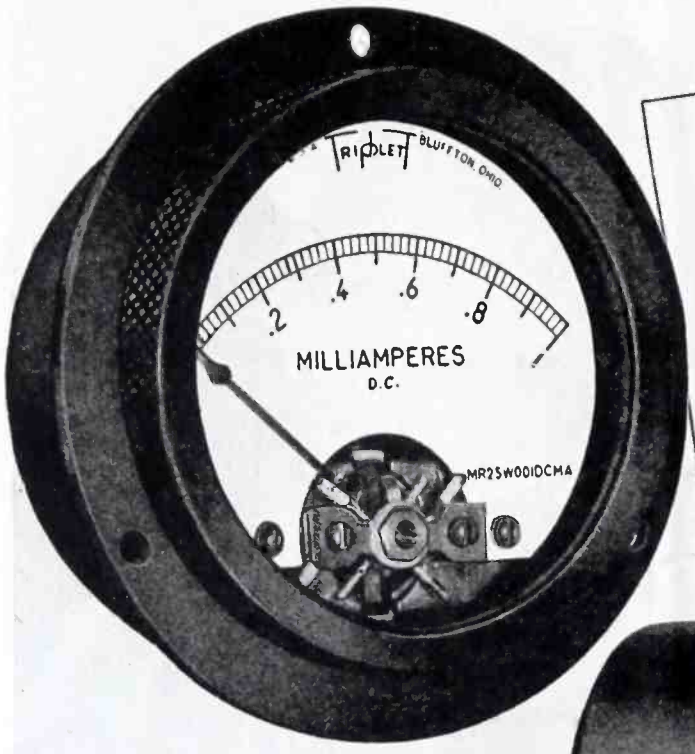
vibration-tested

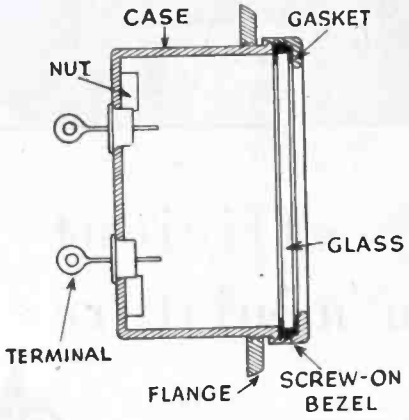
ELECTRONIC TUBES

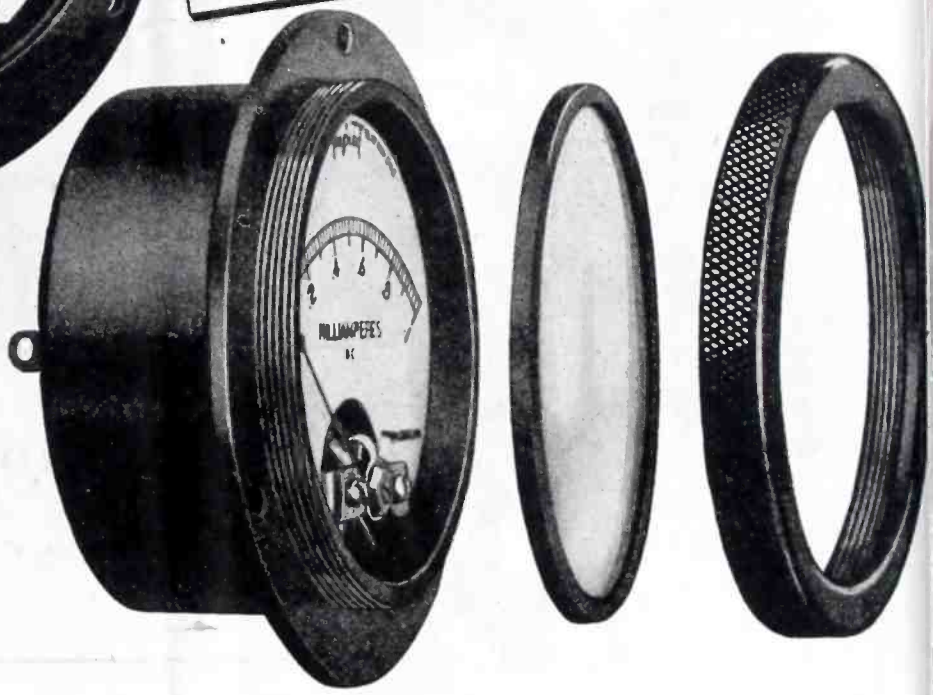
TUNG-SOL LAMP WORKS INC., NEWARK 4, NEW JERSEY

Also Manufacturers of Miniature Incandescent Lamps, All-Glass Sealed Beam Headlight Lamps and Current Intermittors

INTRODUCING THE NEW TRIPLETT LINE OF HERMETICALLY SEALED INSTRUMENTS







ALL THE FEATURES of STANDARD INSTRUMENTS RETAINED

Withstands submersion tests at 30 feet

A screw-on bezel provides uniform pressure for hermetically sealing the glass to the case. The gasket is pressed into every crevice around the edge of the glass and the top of the case, where the permanent seal is made.

Tempered glass window and ceramic sealed terminals are used.

The knurled screw type bezel permits servicing when necessary and resealing without replacing a single part or the use of special tools or equipment.

Complete dehydration of the interior is readily accomplished by recognized temperature difference method (the bezel loosely attached for the escape of all moisture, after which the bezel is tightened to make the permanent seal). Interior is completely dry at slightly above atmospheric pressure.

These instruments comply with thermal shock, pressure and vibration tests. They also are resistant to corrosion. Instruments conform to S.C. No. 71-3159 and A.W.S. C-39.2-1944 specifications.

Furnished in 1½", 2½" and 3½" metal cases with 1/16" thick walls, in standard ranges. D.C. moving coil, A.C. moving iron and thermocouple types.

Write for circular

STANDARDS ARE SET BY TRIPLETT

Precision first ...to last

Triplett

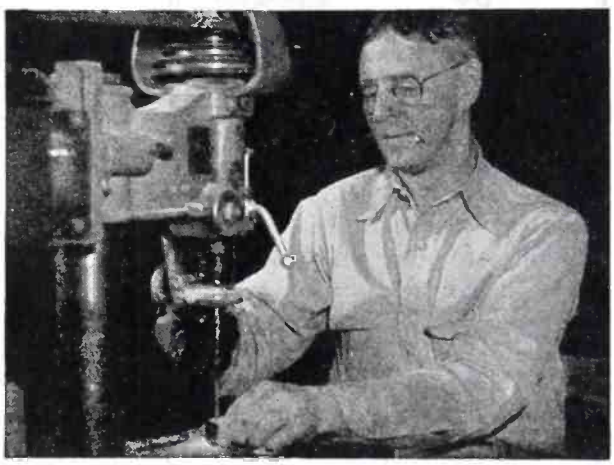
ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

There's no let down in MT. CARMEL

Though the war news is good . . . and getting better every day . . . the men and women of Meissner's famed "precision-el" haven't let down. As you can see, in the photographs on this page, they devote the same concentration to their work now as they did when the going was tough. This stick-to-it-iveness is one more reason for Mt. Carmel's rapid rise to prominence as one of the centers of an exacting industry, electronics.

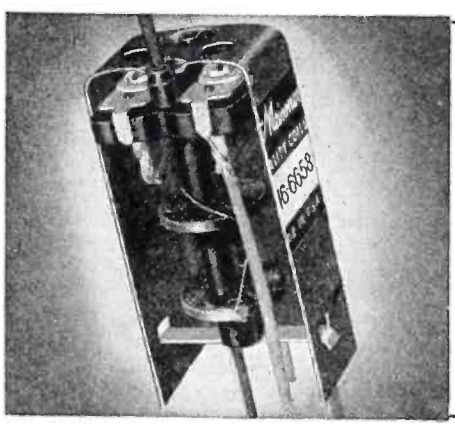
They Listen to a news broadcast during their lunch hour. Then it's back to work with a determination to equal military victories with new production records on the home front . . . without loss of Meissner quality.

Precision-el" at Work. They're building Meissner quality into this vital electronic war material. After victory that same pride in a job well done will give new meaning to Meissner's slogan, "Precision-built by Precision-el."



His Skilled Fingers have mastered many of the secrets of electronics. After victory, he and many of Meissner's "precision-el" like him will pass this knowledge and tradition of precision to a new generation.

His Smile is a Reflection of the hundreds of smiles he sees each day as the men and women of Meissner pass through the gates he guards. If you ask him, he'll tell you it's the smile that helps put precision into "precision-el."



"Step Up" Old Receivers!

These Meissner Ferrocart I. F. input and output transformers are getting top results in stepping up performance of old worn receivers. Special powdered iron core permits higher "Q" with a resultant increase in selectivity and gain, now available for frequency range 127-206. Ask for numbers 16-5728 input, 16-5730 output. List $2.20 each.

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SYLVANIA NEWS
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SYLVANIA SERVICEMAN SERVICE

by FRANK FAX

In various sections of the country, servicemen have been active in a movement to have legislation passed for the licensing of radio servicemen. This, they feel, will tend to preserve their prestige in the eyes of the public, and keep radio repairing standards high by assuring that only those servicemen who are qualified be permitted to set up shop.

Many servicemen maintain that such legislation will be of even greater necessity as we approach the postwar years. (Sylvania's survey shows that within 5 or 6 years after the war, the number of radio sets in America will reach 100 million. All of these millions of units are expected to be more complex in construction and will require more of the expert service radio servicemen have been rendering.)

As reports are received referring to impending or passed legislation, this column will carry the information. Meanwhile Sylvania Electric will welcome additional information regarding this movement from radio servicemen or organizations.

Address Sylvania Electric Products Inc., Emporium, Pa.

SURVEY SHOWS PUBLIC CONFIDENCE IN SERVICEMEN

Future Bright Because of This Widespread Trust and Postwar Increase In Sets

"Does the radio serviceman do a good job?" He most certainly does!

This is one of the outstanding facts revealed by the nation-wide, impartial survey conducted by one of America's leading market research organizations, at the request of Sylvania Electric's Sales Research Department.

PUBLIC IS SATISFIED

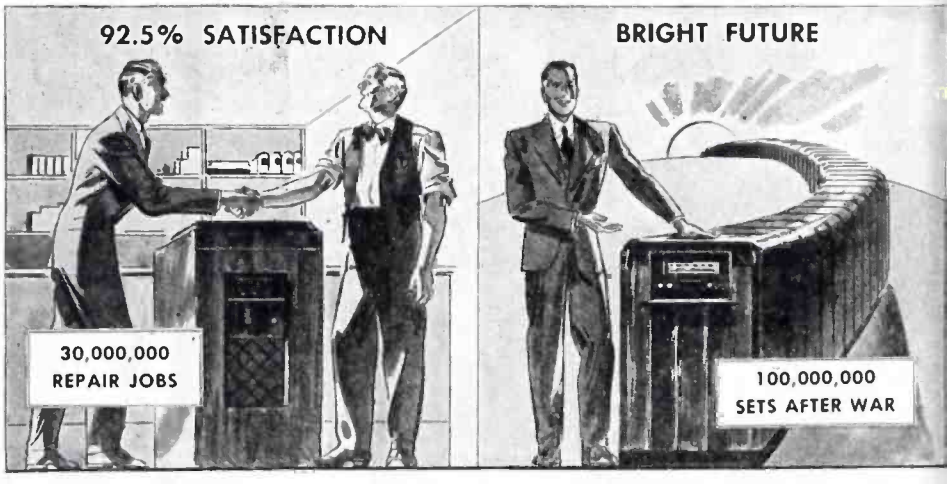
92.5% of the thousands of set owners questioned expressed full satisfaction in the jobs radio servicemen are doing—a highly significant fact when it is considered that repair men are responsible for approximately 30,000,000 repair jobs per year. In addition, of these thousands interviewed, 89.3% said that the serviceman's charge for work is entirely equitable.

These facts show that (1) servicemen have the confidence of the American public; (2) servicemen have obviously exhibited good business sense, have charged "fair" prices—resulting in further establishing a nation-wide feeling of assurance in their work.

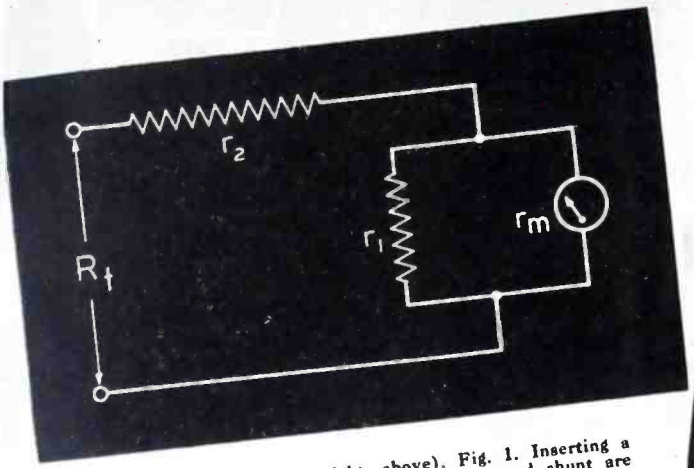
POSTWAR OUTLOOK GOOD

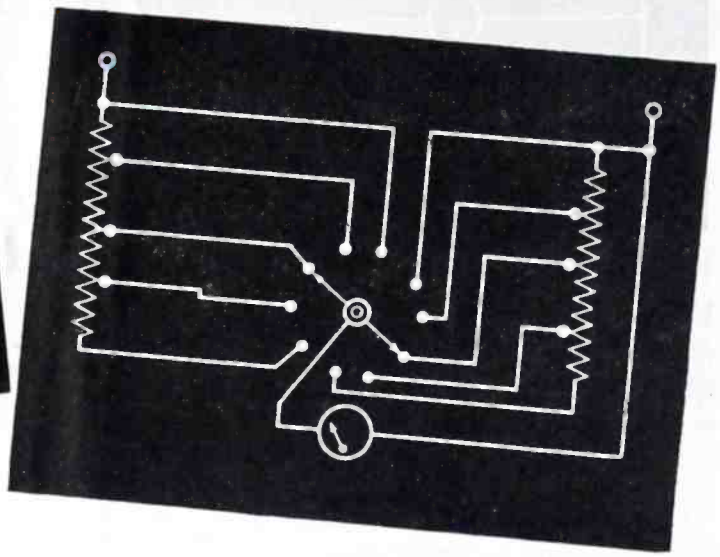
There is every evidence, then, that the future of the radio serviceman is bright. After the war there will be more radios to repair (5 to 6 years after—75 million home radios; 25 million auto sets). More shops and more men will be needed (perhaps 30,000 shops in all, employing 90,000 men)—to handle 50 million repair jobs per year!

(Future issues of SYLVANIA NEWS will report further on this survey.)



SERVICE
A Monthly Digest of Radio and Allied Maintenance





Figs. 1 (above) and 2 (right, above). Fig. 1. Inserting a shunt so that combined resistance of meter and shunt are equal to that of meter when used alone. Fig. 2 shows a method used to change series and shunt resistor ranges with a double-ended rotary switch.

EXTENDING AMMETER RANGES WITH SHUNTS

by LEWIS J. BOSS

Captain, Radio Supervisor, Warwick Police Department
Apponaug, R. I.

EVERY Service Man is familiar with the current restrictions on the sale of meters. Consequently the practice of extending the range of an ammeter by placing shunts of suitable value across the instrument is particularly timely. A single reliable meter can, in this manner, be readily arranged to perform the work of several individual instruments.

Circuit Resistances

Since the presence of such a shunt naturally alters the shunt resistance of the complete instrument, as far as the external circuit is concerned, this alteration of instrument resistance when used in a multi-range circuit must be considered. This discussion offers certain modifications of the ordinary shunted meter which not only extends the usefulness of the meter as a multi-range instrument, but prevents any alteration of the load resistance of the meter, when changing from one range to another.

Simple Shunted Instrument

Before proceeding with an analysis of the proposed modifications of the ordinary shunted meter, let us consider briefly the simple shunted instrument. In that respect, let us assume that a certain deflection is noted when a current i_1 passes through it, and let us further assume that we desire to place a shunt in parallel with the meter so that the same indication is obtained when a current $n \times i_1$ is flowing through the combination.

Total Resistance of Meter

If the resistance of the meter itself is represented by r_m and the resistance of the shunt to be added by r_s then the total resistance R of the meter and shunt is represented by

$$R = \frac{r_m \cdot r_s}{r_m + r_s} \qquad 1$$

Shunts

The shunt must have the proper value of resistance so that the current passing through the meter is still i_1 when the total current I is $I = ni_1$.

For direct current, the current through the shunt is $(n - 1)i_1$.

Since

$$(n-1)\, i_1 r_s = i_1 r_m$$

$$r_s = \frac{r_m}{n-1} \qquad 2$$

where i_1 = current through meter
I = total current
r_s = shunt resistance
r_m = meter resistance

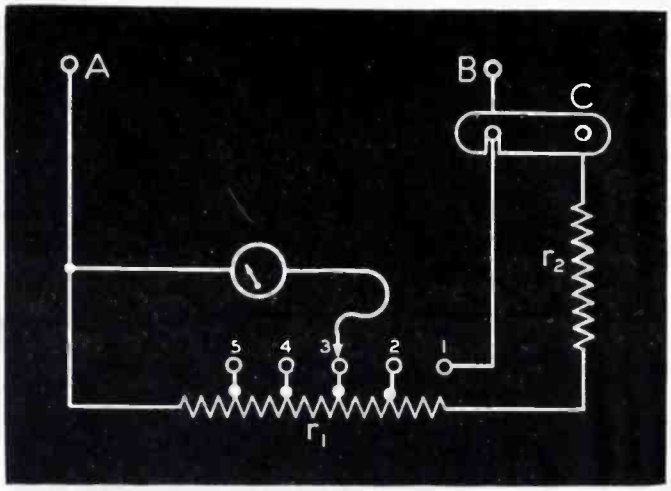
Substituting in equation *1* for r_s we have

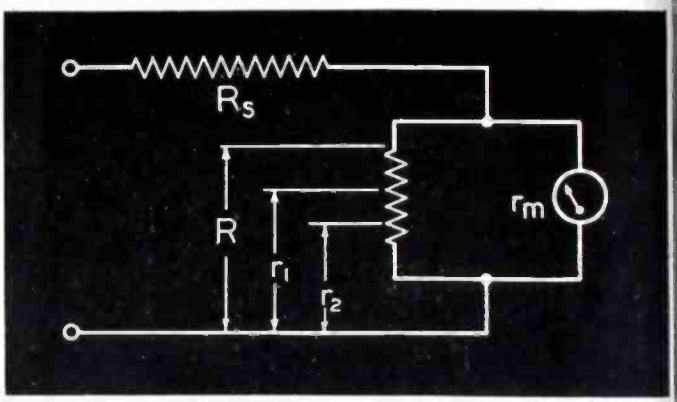
$$R = \frac{r_m \dfrac{r_m}{(n-1)}}{r_m + \dfrac{r_m}{(n-1)}}$$

$$\text{and } R = \frac{1}{n} r_m \qquad 3$$

Meter and Resistance Values

Since it is desired to arrange matters so that the combined resistance of the meter and shunt shall be equal to that of the meter when used alone, additional resistance will have to be





Figs. 3 (left) and 4 (above)
Fig. 3. Arranging circuit so that when portion of resistance in shunt to meter is cut out, it is, at the same time, added to the series resistance. Fig. 4. Circuit used to evaluate error factors. R_s = series resistance; R = shunt resistance; r_m = meter resistance only; r_1, r_2 = successive values of values of R.

placed in series with the combination.

Referring to Fig. 1, let R_t be the total resistance between the line terminals under the new conditions, and we have

$$R_t = r_2 + \frac{r_m \cdot r_1}{r_m + r_1}$$

Since it is required to have the meter read directly on its lowest scale, and as on all scales the total resistance between the line terminals is to be constant, then $R_t = r_m$.

From equation *3* we now have

$$R_t = r_2 + \frac{1}{n} r_m \qquad 4$$

and

$$r_2 = \frac{n-1}{n} r_m \qquad 4a$$

also

$$\frac{r_m \cdot r_1}{r_m + r_1} = \frac{1}{n} r_m$$

or

$$\frac{r_1}{r_m + r_1} = \frac{1}{n}$$

Since these equations express the general case it is convenient to consider the situation when the meter is reading directly. Then $n = 1$, and from *5* we get

$$\frac{r_1}{r_m + r_1} = \frac{1}{n} = 1 \quad \text{for this case.}$$

However, this equation is only satisfied when r_1 is infinitely great compared with r_m, or in other words, when the meter is not shunted. Pursuing this thought further we have

$$r_2 + \frac{1}{n} r_m = r_m, \quad \text{or} \quad r_2 = 0$$

which is also correct for this case.

Equations *2* and *4a* furnish the necessary information regarding the values of the shunt and series resistors required, in terms of the meter's internal resistance and the particular multiplying factor wanted. It will be seen that it is quite possible to make up a set of such resistances and mount them in a case containing the meter and a suitable multi-point switch for changing the shunt and series resistors, according to the proper ratio.

A circuit for changing the series and shunt resistors for the different ranges appears in Fig. *2*, in which a double-ended rotary switch is employed. Such a switch must be very well constructed and have extremely low contact resistance; otherwise the values of the shunt resistor will be upset, especially in the higher ranges, and the indications of the meter rendered false.

Another method of changing the shunt and series resistors that is more efficient than the previously described method will now be considered. In Fig. 1 resistors r_1 and r_2 may be considered as one resistance with the meter connected across one end and a tapped point. In view of this, we find it possible to so arrange the circuit that, when a portion of the resistance in *shunt* with the meter is cut out, it is, at the same time, added to the series resistance. The amount of shunt resistance removed can be made to equal, almost, but not quite, the required addition to the series resistor. The error involved is very small; smaller, in most cases, than the error involved in reading the meter. The simplification of circuit obtained is considerable, Fig. 3.

When using the meter by itself (direct reading) the link between *B* and *C* is opened and the flexible lead from one side of the ammeter is connected to terminal *1*, terminals *A* and *B* becoming the line connections. For other ranges the movable connection is plugged into terminals *2*, *3*, *4*, etc., and the link between *B* and *C* replaced. The resistance between the line terminals *A* and *B* will be practically constant for all ranges and equal to the resistance of the meter itself within very narrow limits.

Design Procedure

The procedure of calculating and designing suitable resistances to convert an ordinary ammeter into a constant resistance, multi-range instrument is quite simple.

For example, consider the case of a fairly high resistance meter, such as would be used in the measurement of small currents.

Resistance of instrument $r_m = 30$ ohms.

To find r_1 and r_2 for the following ranges

$$n = 10;\ 100;\ 1{,}000.$$

For the case where $n = 1$, the meter is, of course, used directly without any shunt.

When $n = 10$

$$r_1 = \frac{r_m}{n-1} = \frac{30}{9} = 3.333 \quad \text{ohms}$$

$$r_2 = \frac{n-1}{n} r_m = 27 \quad \text{ohms}$$

When $n = 100$

$r_1 = 0.303$ ohms
$r_2 = 29.70$ ohms

When $n = 1{,}000$

$r_1 = .030$ ohm
$r_2 = 29.97$ ohms

The values, as determined above, are correct for constant resistance between terminals. For the approximate method previously described, *we shall take the value of the shunt resistance* as correct. This will mean that the amount of series resistance on each range will not be exactly correct, but will have the values as calculated below.

For cases $n = 10$ and $n = 100$ respectively, $r_1 = 3.333$ ohms and 0.303 ohm.

The amount of resistance subtracted, in changing from $n = 10$ to $n = 100$, is consequently 3.030 ohms, which is added to the series resistor. When $n = 10$, $r_2 = 27$ ohms. The actual series resistance, obtained in this way, when $n = 100$, is consequently 30.03 ohms.

The value required, as determined from the calculation above is 29.70 ohms. It is, therefore, evident that

(Continued on page 35)

PUSH-PULL AMPLIFIERS AND PHASE INVERTERS

by EDWARD ARTHUR

A PUSH-PULL amplifier is one in which two small tubes are used instead of one large tube to accomplish the same stage gain, in order to take advantage of certain operating conditions for improved performance. Phase inverters are used in conjunction with push-pull amplifiers as a substitute for the push-pull input transformer. Since an analysis of the uses, advantages, and conditions for optimum performance of push-pull amplifiers aids the study of phase inversion applications, such data will be offered first.

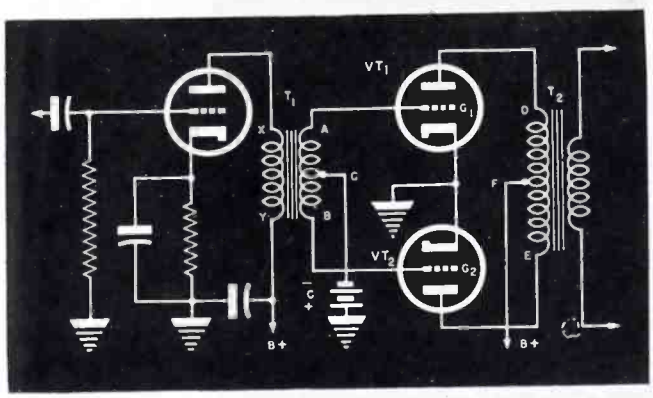


Fig. 1. A typical push-pull output stage is shown here. Any voltage appearing between points *A* and *B* is opposite in sign, with point *C* as a voltage midpoint. This produces the push-pull action.

Triode Circuit

Fig. 1 shows a typical push-pull circuit, driven by a single triode. Any a-c voltage, of audio frequency, developed between points *x* and *y* on the primary of transformer T_1, will appear as an amplified voltage between points *a* and *b* on the secondary of that transformer. We assume, of course, that T_1 has a gain ratio, which is usually the case. However, there is one particular distinction between the voltages developed from G_1 to ground and G_2 to the same point. The a-f voltage developed between points *a* and *b* has a polarity relationship at all times. That is, point *a* is either positive or negative with respect to point *b*. The inclusion of point *c* does not alter this relationship, except to establish a common point for voltage measurement. Thus, if two volts were the total voltage between points *a* and *b*, the voltage from either p-p grid to ground would be one volt, but opposite in sign. It is important that this condition exist to ground, since ground is the common tie point for all voltages in a receiver.

Additive Voltages

A similar condition exists across the primary of the output transformer, T_2. The voltage between *d* and *f* represents the voltage between *a* and *c* amplified by the gain of the tube VT_1; the voltage across *e* and *f* represents the voltage across *b* and *c* amplified by VT_2. Since these voltages are additive, the output voltage is the sum of the individual voltages.

Push-Pull Advantages

A similar voltage gain could be attained by using a single tube with twice the gain of either VT_1 or VT_2. However, there are certain advantages to be gained by the use of push-pull circuits.

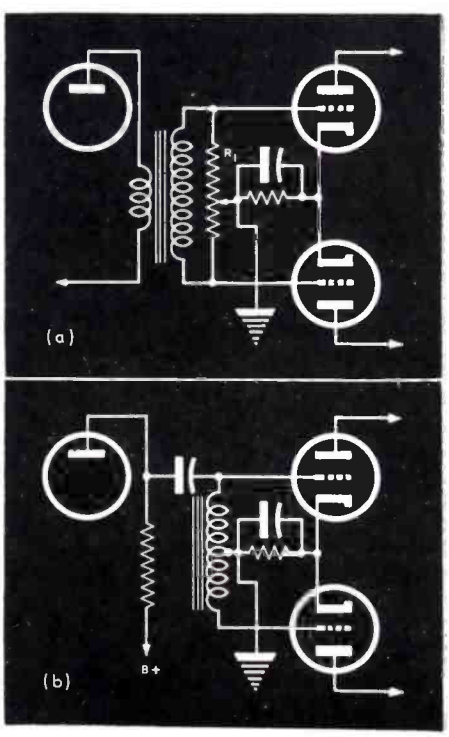
(*1*) Any hum voltage introduced through the *B* supply to the plates of the push-pull tubes, will cancel out, since the hum voltages across *d* and *f*, and *e* and *f*, are in opposition to each other. (*2*) D-c saturation in the core of the output transformer is avoided, because the magnetic fields created by d-c are also in opposition. This is evident from the fact that the outside terminals, *d* and *e*, are both negative (d-c) with respect to point *f*, the center tap. (*3*) Feedback or oscillation is minimized, since feedback voltages cannot be fed back through the *B* supply, (point *f* is a balance point for any voltages developed in the output circuit).

Low Harmonic Output

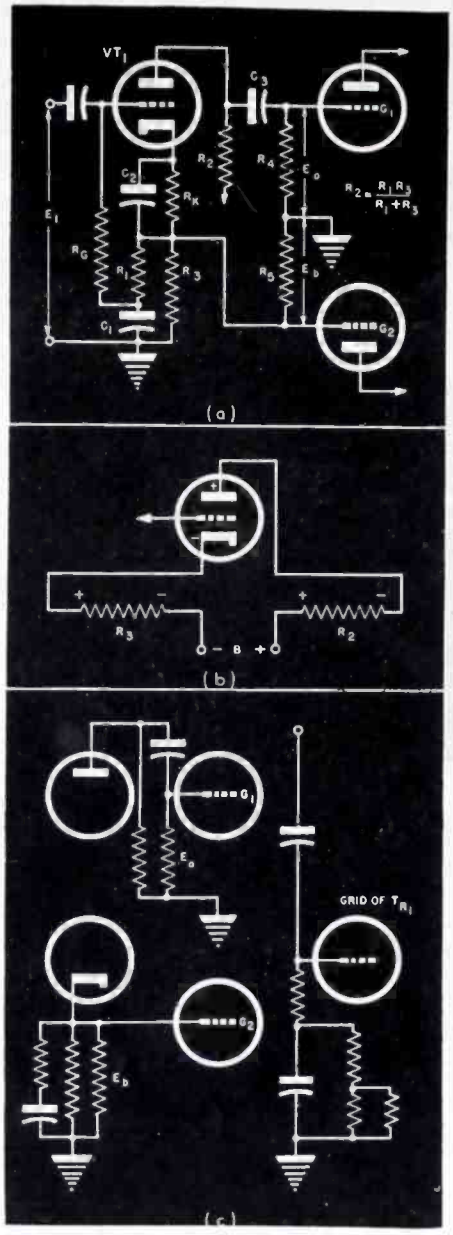
The most important advantage of the push-pull amplifier lies in its low second harmonic output. Reference to any tube data book will show that the maximum rated output of a tube is limited by its harmonic distortion. The greater part of this distortion is of the second order. When the second harmonic approaches 5%, the maximum output has been reached for efficient operation. Push-pull amplification cancels this second harmonic distortion, as well as all even order harmonics, thereby permitting operation at either higher power levels, or at reduced distortion factors.

6L6 Amplifier

Let us take the 6L6 as an amplifier application example. As a class *A* amplifier, with 250 volts on the plate, a single tube will deliver 6.5 watts, at 10% distortion. Two tubes in push pull will deliver 14.5 watts at 2% distortion; more output at lower distortion. Increasing the plate voltage to 270 on



Figs. 2*a* and *b*. Fig. 2*a* shows a method of substituting an interstage for a push-pull transformer. In 2*b*, an open primary in a push-pull transformer is replaced by an RC network.



Figs. 3*a*, *b* and *c*. Fig. 3*a* shows a typical inverter circuit. In *b* we see how the push-pull voltages are developed. In *c*, the load impedances for the push-pull grids are separated, for ease in determining balanced values.

the single tube has no appreciable effect on either the distortion or the power output. However for the 6L6 in push pull, the output increases to 18 watts, at 2% distortion.

Second harmonic distortion, created within the tube, is eliminated because the voltages are built up in each half of the output transformer, in opposition to each other. This is true for all even order harmonics.

Now, to initiate push-pull action in the input of the amplifier, some method of input to the two grids must be used to simultaneously supply both grids with equal potentials of opposite sign, with reference to ground. That is. the input voltages must be 180° out of phase.

Push-Pull Methods

Fig. 2 shows two methods of accomplishing a push-pull action without the use of a standard push-pull input transformer. In Fig. 2*a*, a standard interstage transformer is used. The formula used to determine the proper load resistance, R_1, for the plate of the driver, is:

$$R_1 = R_p N^2, \text{ where}$$

R_1 = resistance in ohms
N^2 = square of the transformer ratio
R_p = load impedance required for plate of previous stage

The potentiometer arm is then used to balance the input voltages to the push-pull grids so that they are equal.

Where the primary of a transformer is open, the circuit shown in Fig. 2*b* may be used. It should be noted that the stage gain will be reduced by the transformer ratio, since in this circuit arrangement the transformer gain can never exceed 1:1. In addition, the plate voltage on the driver tube will be materially reduced, due to the added resistance in the plate circuit, which will further reduce the audio gain.

Phase Inverter Circuits

The purpose of the phase inverter is to duplicate the performance of the push-pull input transformer. This may be done with or without the use of an additional tube. Since most input transformers are also sources of gain, it becomes necessary to use an additional tube where increased stage gain is desirable. With the development of the twin triod, the addition of another tube has been simplified. The only additional components required are some resistors and condensers.

Out-of-Phase Voltages

To develop out-of-phase voltages for supply to the push-pull grids, either one or two tubes may be used. Fig. 3. In Fig. 3*a*, a single tube is used. Here, E_1 represents the a-f voltage applied to the grid of the driver tube, and E_a and E_b represent two voltages, equal in magnitude, but opposite in phase. The bias voltage for the grid of VT_1 is developed across R_k. Since any resistor in the cathode circuit is a continuation of the plate circuit, a tube may be represented, as shown in Fig. 3*b*. If the supply source is considered as the ground point, the cathode end of R_3 has a positive potential with relation to ground, and the plate end of R_2 has a negative potential with relation to the same point. Thus, these two points are out of phase. Increases or decreases in the plate-cathode current will affect both R_2 and R_3 to the same degree, since they are effectively in series. If their numerical value is the same, the voltages across them will be identical. The grid of the driver tube must be returned to ground, yet isolated from the feed end of R_3 which is connected to one of the p-p grids. The isolation circuit consisting of R_1 and C_1, is used for this purpose. However, this introduces a shunt circuit across R_3. Therefore R_2 must be equal to R_3 in parallel with R_1, which is expressed by the formula,

$$R_2 = R_1 \times R_3 / R_1 + R_3.$$

C_1 must be large enough to prevent low-frequency attenuation, in much the same manner as a tone control. Capacitor C_1 here affects the whole system, since it is in series with the input circuit; the load reactance of this circuit will vary with frequency, decreasing as the frequency decreases. In much the same manner, the shunting effect of R_1 in series with C_1 across R_3 will decrease. This will tend to unbalance the voltages applied to the push-pull grids, and result in increased distortion. To minimize its effect, C_1 should be large enough at the lowest audio frequency being used, so that it does not represent any appreciable portion of the total resistance of the circuit. Fig. 3*c* shows the load relations of the various grid circuits.

Increasing Stage Gain

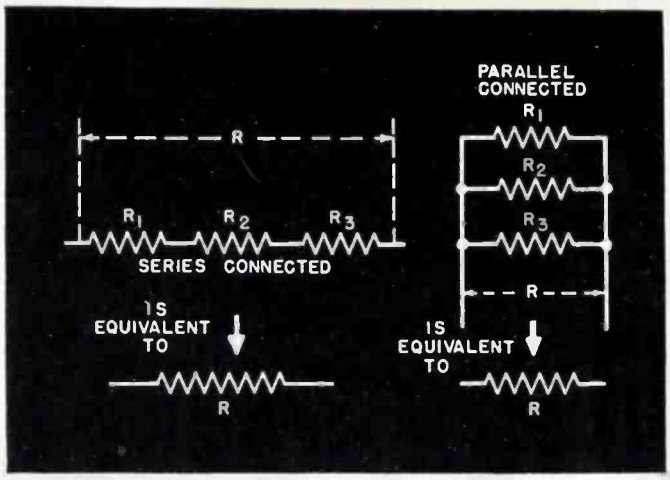
Fig. 4 shows a variation of this principle. Two tubes are used in this circuit to produce greater stage gain.

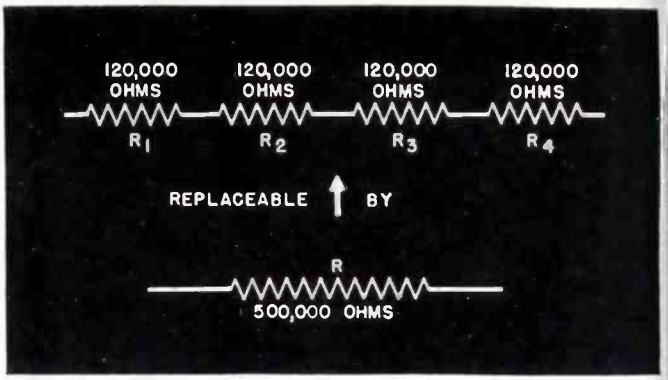
The input voltage is applied to VT_1, amplified, and then applied to the p-p grid, G_1. A portion of this voltage developed across R_1 is then applied to the grid of VT_2. However, the voltage across R_1 is out of phase with the voltage applied to the grid of VT_1. Therefore, the voltage applied to the p-p grid, G_2, will be out of phase with that applied to the p-p grid, G_1. For balance, E_2 must equal E_1.

Inverter Circuits

Figs. 4*b*, *c* and *d* show inverter circuits used with inverse feedback. Feedback, in inverters, is used to prevent unbalance and frequency distortion. If, in Fig. 4*a*, either VT_1 or VT_2 were to require replacement, some unbalance would possibly result if the new tube did not have the same gain as the old one. Therefor, R_1 would have to be adjusted every time the tubes were replaced. In addition, if the tubes did not age equally, the same condition would result. To reduce this effect, inverse

(*Continued on page* 34)





Figs. 1 (left) and 2 (below)
Fig. 1. How either series or parallel groups of resistors can be combined to be equivalent to a single resistance, *R*.
Fig. 2. Replacing a faulty resistor by several resistors of lower value connected in series.

FIXED RESISTOR REPLACEMENT AND SUBSTITUTIONS

[Part Three of a Series]

by ALFRED A. GHIRARDI

Advisory Editor

WHEN either fixed composition or wire-wound resistors require replacement, the choice of the replacement unit should always be governed by the desirability of using a resistor that will give satisfactory performance in the part of the circuit where it is to be used, and at the same time have a long useful life.

Operating Temperatures of Fixed Resistors

It should be remembered that because of the nature of the materials used in their construction, vitreous-enameled type wire-wound resistors are able to operate at much higher full-load temperature than are either composition carbon resistors or phenolic-molded wire-wound resistors. For an ambient temperature of 25° C, composition carbon resistors operate at a full-load temperature ranging from approximately 90° C to 110° C, depending upon manufacture. Phenolic-molded wire-wound resistors are rated on the basis of developing a temperature of 125° C at full-load. Vitreous-enameled wire-wound resistors, however, are rated on the basis of developing a hottest-spot temperature of 275° C (over 550° F) on a 2-terminal resistor suspended in one foot of free air, with the ambient temperature (surrounding air) at 40° C (104° F). Therefore the fact that a particular vitreous-enameled wire-wound resistor in a receiver gets very hot should not necessarily be cause for alarm or reason for replacement, unless there are definite evidences that deterioration is being caused by the high temperature.

Because such high temperatures are developed by vitreous-enameled type wire-wound resistors operated at full rated load, care must be taken when installing them as substitute resistors, either as single units or as a portion of a voltage divider. The full-load developed temperature of 275° C (over 550° F) can quickly injure closely adjacent parts, the radio cabinet, etc.

The full-load temperature of 275° C is based on operation in *free-air* with good ventilation conditions. If the resistor is located in a crowded assembly, or if the cabinet and chassis designs restrict free circulation of air, the temperature may rise considerably above this. Therefore, it is a good rule to limit the operation of such resistors (especially the large power sizes of 10-watt rating or higher) by using oversize units, so they handle only about one-half as much power as they are rated to carry. Where parts are jammed close together in compact receivers, or where the resistor is to be mounted near a hot power resistor, rectifier tube, etc., we must allow 3:1 ratio.

Power-Handling Capacity of Adjustable Resistors

The uses of adjustable type wire-wound resistors call for a word of operating caution. The power-handling capacity of such resistors depends directly upon what proportion of the total resistance is used in the circuit. For example, let us assume that a 1,000-ohm 10-watt adjustable resistor is at hand, and a 600-ohm unit is required. When adjusted to 600 ohms, the 10-watt adjustable resistor will have a power-handling capacity of only $600/1{,}000 \times 10 = 6$ watts. Following the 2:1 rule stated previously, this 600-ohm resistor actually should not be used to handle over $6/2 = 3$ watts! From Ohm's law, the maximum allowable current then will actually be

$$I^2 = \frac{W}{R}, \text{ or } I = \sqrt{\frac{W}{R}} = \sqrt{\frac{3}{600}}$$

= 70 milliamperes (approximately).

If this precaution in the use of such resistors is not observed, burnouts or excessive heating may result.

Resistor-Heating Problems in Compact Receivers

In compact-type midget receivers the resistor problem often is very acute, for in these sets minimum size resistors are crowded in very compact assemblies, and very little facility for ventilation is provided. Accordingly, the temperatures often rise to the point at which at least some of the resistors slowly disintegrate and change in value. If these units are replaced with new resistors of the same wattage rating, the same conditions again prevail. The replacement resistors break down in a short time and the Service Man is condemned for having done a poor repair job. The

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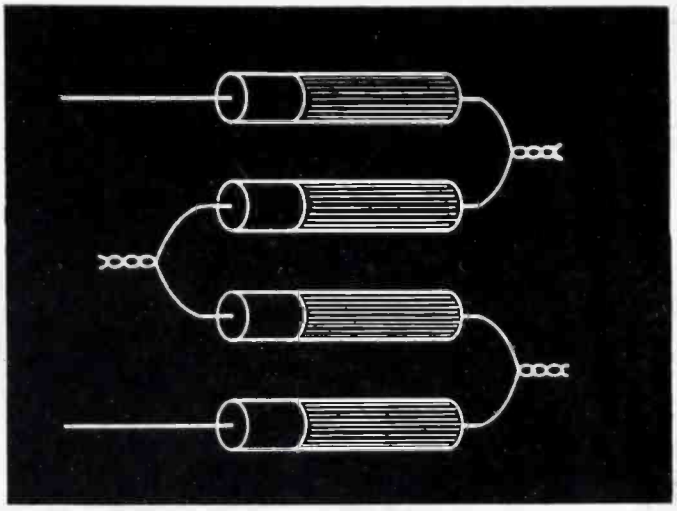
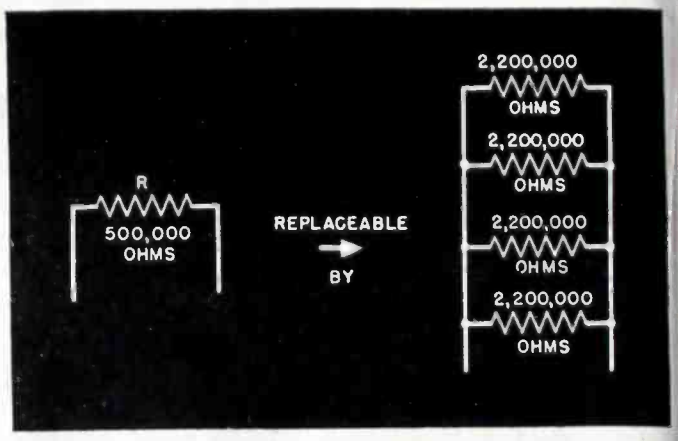
GENERAL ELECTRIC

176-D3-8850





Figs. 3 (left) and 4 (above)

Fig. 3. How to arrange four series-connected replacement resistors to reduce hum pickup. Fig. 4. Replacing a faulty resistor by several equal parallel-connected resistors with values higher than original resistor.

solution in such cases is to use resistors of a higher wattage rating and also to rearrange the parts under the chassis so that more room is provided for air circulation. In some cases this may even necessitate partial rebuilding of the receiver, but it may be more desirable to do this than to have the same trouble reappear in a short time. Often, drilling an adequate number of ventilation holes in the chassis and bottom of the cabinet at strategic places will provide all the additional ventilation that is required. Whenever such measures must be applied it is well to explain the trouble and the proposed remedy to the set owner before proceeding.

How to Figure Resistor Substitutions

Especially in these days of replacement parts shortages, Service Men often are forced to make resistor substitutions when replacements are needed. It has become almost a necessity to know how to quickly make up combinations of available resistors to take the place of faulty units whose exact replacements are not readily available.

Any resistor in a receiver may usually be replaced (if space permits) by a combination of suitable units connected either in series, or in parallel, as illustrated in Fig 1. In rare cases it may be necessary to use a series-parallel combination.

In the case of series-connected resistors:

(*a*)—The equivalent resistance, *R*, is equal to the *sum* of the resistance of each individual unit. Thus, $R = R_1 + R_2 + R_3 + \ldots\ldots R_n$.

(*b*)—The same current flows through each of the series resistors, and this is equal to the current that flowed through the original resistor.

(*c*)—The wattage-handling capacity of the series combination is equal to the sum of the wattage ratings of the individual resistors. Thus, $W = W_1 + W_2 + W_3 + \ldots\ldots W_n$.

In the case of parallel-connected resistors:

(*a*)—The equivalent resistance, R, is equal to the reciprocal of the sum of the reciprocals of the resistance of the individual unit. Thus,

$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \frac{1}{R_n}}$$

(In the special case of only two resistors, R_1 and R_2, connected in parallel the expression for the equivalent resistance, *R*, simplifies down to $R = R_1 \times R_2/R_1 + R_2$).

(*b*)—The total current divides, part flowing through each resistor inversely in proportion to the resistance. The total current is equal to the sum of all the currents flowing through the individual resistors. Thus, $I = I_1 + I_2 + I_3 + \ldots\ldots I_n$.

(*c*)—The wattage-handling capacity of the parallel combination is equal to the sum of the wattage ratings of the individual resistors. Thus, $W = W_1 + W_2 + W_3 + \ldots\ldots W_n$.

The following examples will illustrate how these formulas may be applied to calculate the values of series or parallel resistor combinations that may be used as substitutions to obtain either the desired resistance *or* power requirements, or a combination of both resistance *and* power requirements, for resistor-replacement purposes.

Example 1

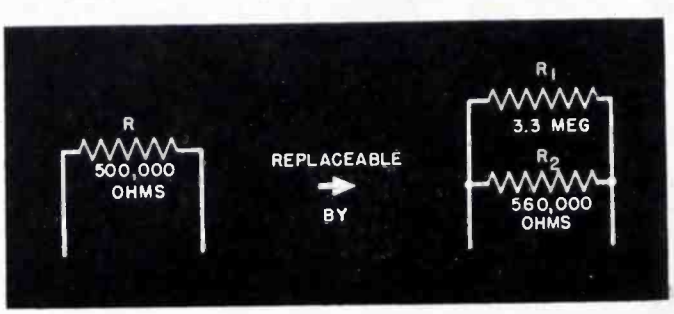
Required: A satisfactory substitution for a faulty grid or plate resistor of 500,000 ohms. Negligible power is to be dissipated by it.

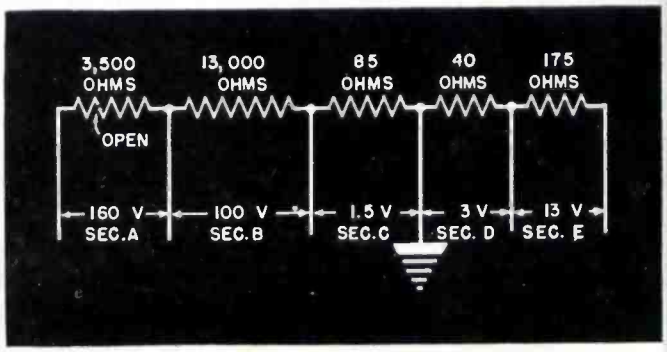
Solution (*a*): Two or more suitable available lower-value resistors can be connected in series to make the required substitution resistance. Using 4 resistors, as illustrated in Fig. 2, each would have to be of 500,000/4 = 125,000 ohms value. From the RMA list of *preferred value* (± 20% tolerance) resistors we note that the nearest *preferred value* resistor to this is 120,000 ohms. Connecting four of these in series would provide a resistance of 120,000 × 4 = 480,000 ohms. This is only 500,000 — 480,000/500,000 × 100 = 4% off from the desired value, which in most cases would be a sufficiently close substitution for the faulty resistor.

Solution (*b*): A workable substitution resistor could also be made up by using suitable available RMA *preferred*

Figs. 5 (left, below) and 6 (below)

Fig. 5. Replacing a faulty resistor by several unequal parallel-connected resistors, each of resistance value higher than that of original resistor. Fig 6, voltage divider with open section.





value (± 20% tolerance) resistors of unequal values (say three), such as 100,000, 220,000 and 220,000 ohms. This would provide a total of 540,000 ohms, which also would be quite satisfactory.

Space limitations and the chance of hum being picked up by a large strung-out assembly limit the number of resistors it is wise to use in such cases. The units should be arranged compactly in the form of a grid, as shown in Fig. 3. Then any hum voltages that may be induced will be induced in opposite direction-sense in each two adjoining resistors, and so will effectively cancel out.

Solution (*c*): If the resistors available are of higher value than the 500,000 ohms required, then parallel connection is necessary. Suppose the only resistors available are of 2.2-megohm (2,200,000 ohms) value. Then the number of these required to be connected in parallel would equal 2,200,000/500,000 = 4 resistors. These would actually make a combined resistance of 2,200,000/4 = 550,000 ohms (Fig. 4), but in most cases this value would be a sufficiently close substitution for the faulty 500,000-ohm resistor.

Solution (*d*): Available unequal resistors of suitable values can also be connected in parallel to make the required resistance (Fig. 5). Suppose we need the 500,000-ohms, and a 3.3-megohm resistor is at hand. The value of the additional resistor that must be connected in parallel with it to make up the 500,000-ohm resistance may be determined by means of the expression $R = R_1 \times R_2/R_1 + R_2$. Substituting the known values we have

$$500{,}000 = \frac{3{,}300{,}000 \times R_2}{3{,}300{,}000 \times R_2}$$

from which, R_2 = 590,000 ohms.

The nearest *preferred value* (± 20% tolerance) resistor to this is 560,000 ohms. If this is used in parallel with the 3.3-megohm resistor, the actual combined resistance will be equal to

$$R = \frac{3{,}300{,}000 \times 560{,}000}{3{,}300{,}000 + 560{,}000} = 478{,}000 \text{ ohms}$$

—a resistance close enough to the desired value for most requirements.

Example 2

Required: To replace an open section in a voltage divider resistor, or even to replace the complete unit.

Solution: Let the voltage divider resistor be composed of five sections *a-b-c-d-e*, having the resistances indicated in Fig. 6.

Suppose the voltage divider has been checked with an ohmmeter and a section found open. The service notes on the particular receiver in which this resistor is used specify the voltage across this section as 160 volts and the resistance of the section as 3,500 ohms. From this information the power-handling requirements for this section can be calculated as follows:

$$\text{Watts} = \frac{\text{Voltage}^2}{\text{Resistance}} = \frac{160^2}{3{,}500} = 7.3 \text{ watts}$$

In combining resistors, the total wattage rating is cumulative, based on the number and rating of the individual resistors used. Consequently, this will require four 2-watt equal-value resistors connected either in series or in parallel (total 8 watts). If connected in series, each must have a resistance value equal to 3,500/4 = 875 ohms. This is an odd-value resistance, so resistors of the nearest *higher preferred value* (± 20% tolerance), 1,000 ohms, will be used instead. It is better to use resistors of the nearest *higher preferred value* rather than of the nearest *lower preferred value* (which would be 680 ohms) so as to reduce rather than increase the amount of power that will be dissipated in each resistor.

Parallel connection, if employed instead, would require four 2-watt resistors, each having a value of 3,500 × 4 = 14,000 ohms. This, again, is an odd-value resistance. Resistors of the nearest *higher preferred value* (± 20% tolerance), 15,000 ohms, would be used instead.

In either use, the replacement resistors may be connected directly to the terminals of the opened voltage divider section, if it is permanently open.

Other, or all sections could be replaced in a similar manner if necessary.

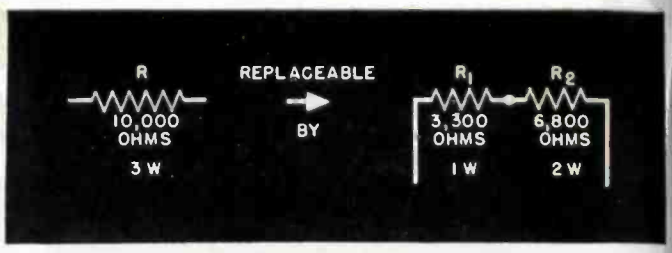


Fig. 7
Replacing a resistor by two series-connected resistors of unequal wattage rating.

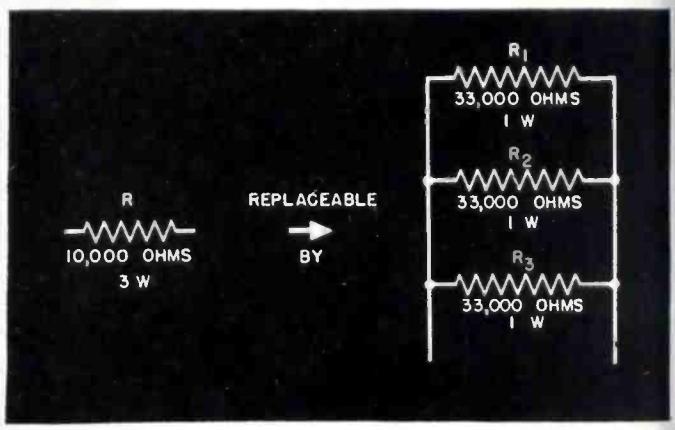


Fig. 8
Replacing a resistor by three parallel-connected equal *preferred* value resistors.

Example 3

Required: A faulty 10,000-ohm 3-watt resistor is to be replaced with resistors of available size and power rating.

Solution: Four practical methods for doing this are possible. Two involve series-connected replacement resistors and two involve parallel-connected units.

(a) *Series-connected arrangements:*

Method 1: Use three 3,300-ohm 1-watt resistors in series (total resistance 3,300 × 3 = 9,900 ohms; total wattage handling capacity 1 × 3 = 3 watts).

Method 2: Fig. 7 shows a

(*Continued on page 22*)

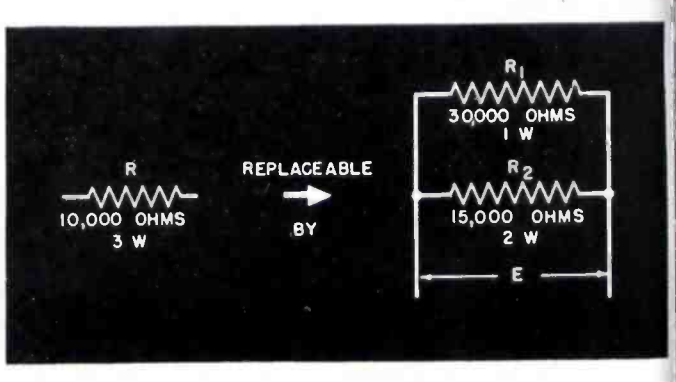
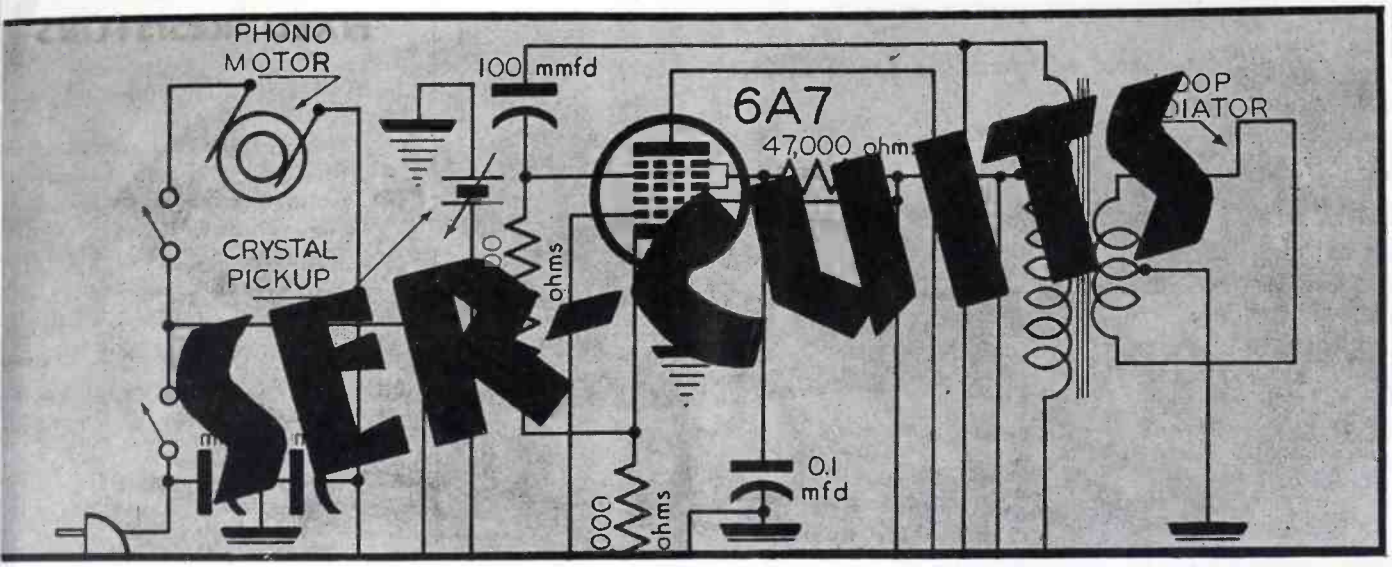


Fig. 9
Replacing a resistor by two parallel-connected resistors of unequal wattage rating.

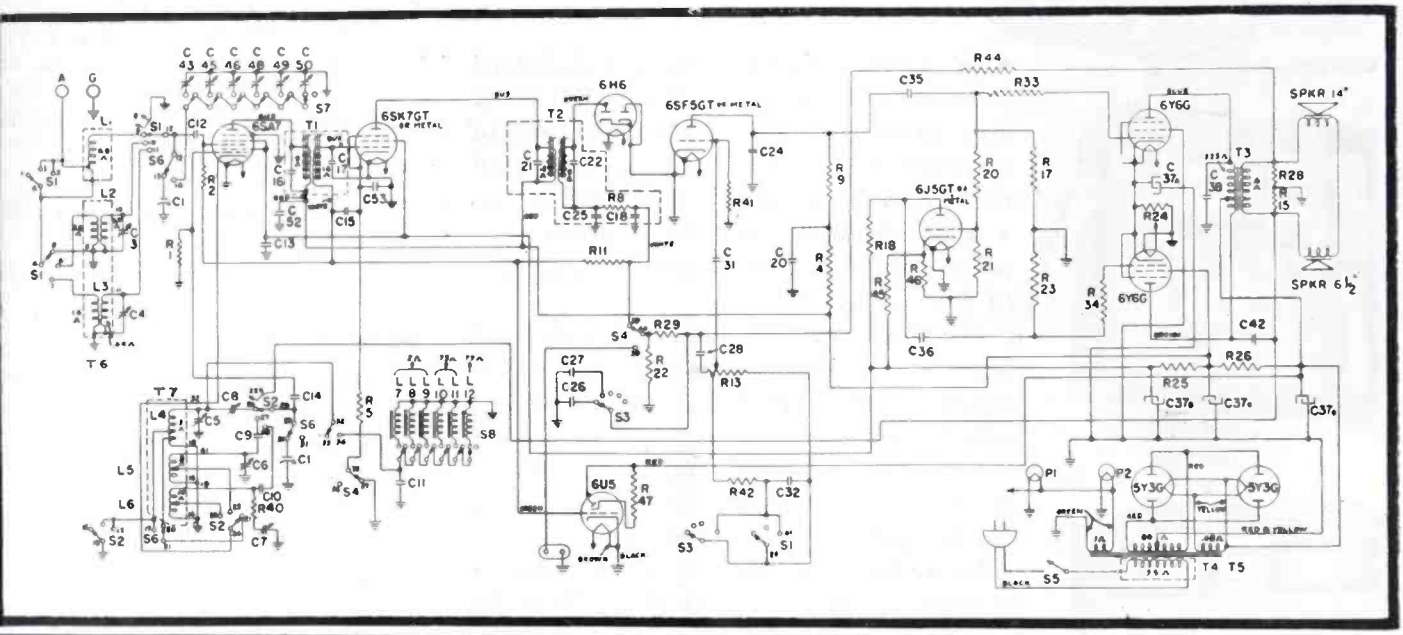


by HENRY HOWARD

THE trend to 2- and 3-band receivers prompted many unusual circuit designs, particularly in he antenna systems. In the G. E. RHJS-1005 three-band model (Fig. 1), for instance, an electrostatic-shielded loop with a direct antenna tap serves on broadcast and as a mass antenna on the two short-wave bands.

(*Continued on page* 31)

Fig. 1. G.E. 3-band receiver using electrostatic shielded loop, which is shorted from antenna tap to low side on s-w to prevent absorption spots due to loop resonance.



Symbol	Description	Symbol	Description	Symbol	Description
C-1	Tuning Condenser	C-37C	20 mfd. 250 V. Dry Electrolytic	R-17	330,000 ohms Carbon Resistor
C-3	3–30 mmf. "C" Antenna Trimmer	C-37D	40 mfd. 250 V. Dry Electrolytic	R-18	68,000 ohms Carbon Resistor
C-4	3–30 mmf. "D" Antenna Trimmer	C-38	.02 mfd. 1000 V. Paper Capacitor	R-20	3.3 megohms Carbon Resistor
C-5	5–40 mmf. "B" Oscillator Trimmer	C-42	.01 mfd. 1000 V. Paper Capacitor	R-21	270,000 ohms Carbon Resistor
C-6	3–30 mmf. "C" Oscillator Trimmer	C-43	100–490 mmf. Station Trimmer	R-22	220,000 ohms Carbon Resistor
C-7	3–30 mmf. "D" Oscillator Trimmer	C-45	100–490 mmf. Station Trimmer	R-23	150,000 ohms Carbon Resistor
C-8	560 mmf. Padding Capacitor	C-46	100–490 mmf. Station Trimmer	R-24	100 ohms 3.4 W. Wire Wound
C-9	1600 mmf. Mica Capacitor	C-48	20–180 mmf. Station Trimmer	R-25	2400 ohms 2 W. Carbon Resistor
C-10	4300 mmf. Mica Capacitor	C-49	20–180 mmf. Station Trimmer	R-26	2200 ohms 2.6 W. Wire Wound
C-11	750 mmf. Mica Capacitor	C-50	7–65 mmf. Station Trimmer	R-28	150 ohms Carbon Resistor
C-12	150 mmf. Mica Capacitor	C-52	.25 mfd. Paper Capacitor	R-29	47,000 ohms Carbon Resistor
C-13	0.1 mfd. Paper Capacitor	C-53	.08 mfd. Paper Capacitor	R-33	1000 ohms Carbon Resistor
C-14	47 mmf. Mica Capacitor	L-1	Beam-a-Scope	R-34	1000 ohms Carbon Resistor
C-15	0.1 mfd. Paper Capacitor	L-2	"C" Band Antenna Coil	R-40	33 ohms Carbon Resistor
C-16	175 mmf. I.F. Capacitor	L-3	"D" Band Antenna Coil	R-41	4.7 megohms Carbon Resistor
C-17	85 mmf. I.F. Capacitor	L-4	"B" Band Oscillator Coil	R-42	100,000 ohms Carbon Resistor
C-18	47 mmf. Mica Capacitor	L-5	"C" Band Oscillator Coil	R-44	4.7 megohms Carbon Resistor
C-20	25 mfd. Paper Capacitor	L-6	"D" Band Oscillator Coil	R-45	15,000 ohms 1 W. Carbon Resistor
C-21	85 mmf. I.F. Capacitor	L-7, 8, 9	Station Oscillator Coils (Code Blue)	R-46	270 ohms Carbon Resistor
C-22	175 mmf. I.F. Capacitor	L-10, 11	Station Oscillator Coils (Code Red)	R-47	1.0 megohm Carbon Resistor
C-24	100 mmf. Mica Capacitor	L-12	Station Oscillator Coil (Code None)	S-1, 2	Band Switch
C-25	47 mmf. Mica Capacitor	P-1, 2	Dial Lamp. MAZDA No. 44	S-3	Tone Switch
C-26	.0015 mfd. Paper Capacitor	R-1	22,000 ohms Carbon Resistor	S-4	Phono Switch
C-27	470 mmf. Mica Capacitor	R-2	1.0 megohm Carbon Resistor	S-5	Power Switch
C-28	.01 mfd. Paper Capacitor	R-4	47,000 ohms Carbon Resistor	S-6	Manual Switch
C-31	.01 mfd. Paper Capacitor	R-5	330 ohms Carbon Resistor	S-7, 8	Feathertouch Tuning Switch
C-32	.003 mfd. Paper Capacitor	R-8	47,000 ohms Carbon Resistor	T-1	1st I.F. Transformer
C-35	.05 mfd. Paper Capacitor	R-9	220,000 ohms Carbon Resistor	T-2	2nd I.F. Transformer
C-36	.05 mfd. Paper Capacitor	R-11	2.2 megohms Carbon Resistor	T-3	Output Transformer
C-37A	20 mfd. 25 V. Dry Electrolytic	R-13	2 megohms Volume Control	T-4	50–60 cycle Power Transformer
C-37B	20 mfd. 250 V. Dry Electrolytic	R-15	15 ohms Carbon Resistor	T-5	25 cycle Power Transformer

FIXED RESISTORS

(*Continued from page 20*)

series-connected arrangement for two resistors of unequal wattage rating, one a 1-watt and one a 2-watt resistor (total 3 watts).

From the expression,

$$\text{Watts} = \text{current}^2 \times \text{resistance},$$
$$3 = \text{current}^2 \times 10{,}000$$

or,

$$\text{current}^2 = \frac{3}{10{,}000} = 0.0003$$

or,

$$\text{current} = 0.0173 \text{ ampere}$$

Since the same current (0.0173 ampere) flows through both resistors, and since watts $= I^2 R$, we have

$$1 = 0.0173^2 \times R_1$$

from which,

$$R_1 = \frac{1}{0.0003} = 3{,}333 \text{ ohms}$$

(A 3,300-ohm 1-watt *preferred value* (± 20% tolerance) resistor will be used.)

Similarly, $2 = 0.0173^2 R_2$, from which

$$R_2 = \frac{2}{0.0003} = 6{,}666 \text{ ohms}$$

(A 6,800-ohm 2-watt *preferred value* resistor will be used.)

(b) *Parallel-connected arrangements:*

Method 1: Use three 30,000-ohm (or 33,000-ohm *preferred value*) 1-watt resistors connected in parallel as shown in Fig. 8. Combined resistance will be 33,000/3 = 11,000 ohms and total power handling capacity will be 1 × 3 = 3 watts.

Method 2: Two replacement resistors of unequal wattage rating may be employed in parallel, one a 1-watt unit and one a 2-watt unit (total power handling capacity 1 + 2 = 3 watts). This arrangement is shown in Fig. 9.

The values of resistance to employ may be calculated as follows: From the expression

$$\text{Watts} = \frac{\text{Volts}^2}{R}$$

we have,

$$3 = \frac{\text{Volts}^2}{10{,}000}$$

from which,

$$\text{volts}^2 = 3 \times 10{,}000 = 30{,}000;$$

then also,

volts $= \sqrt{30{,}000} = 173$

1 = 30,000/R_1 from which
R_1 = 30,000 ohms

and,

2 = 30,000/R_2 from which
R_2 = 15,000 ohms

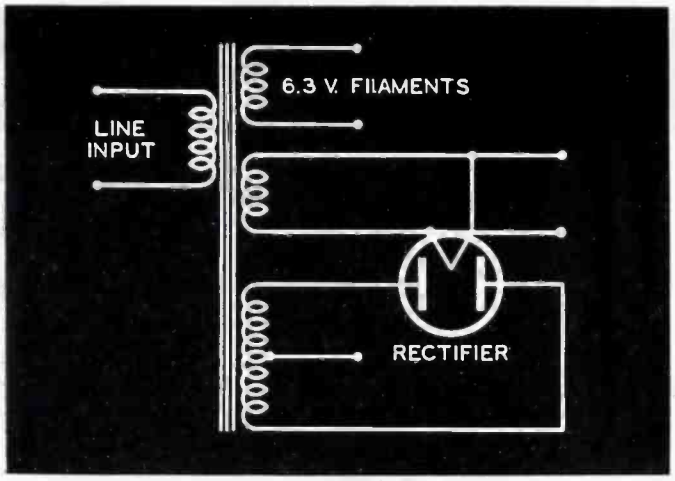
Thus the 10,000-ohm 3-watt faulty resistor may also be replaced by a 30,000-ohm 1-watt resistor and a 15,000-ohm 2-watt resistor connected in parallel (Fig. 9).

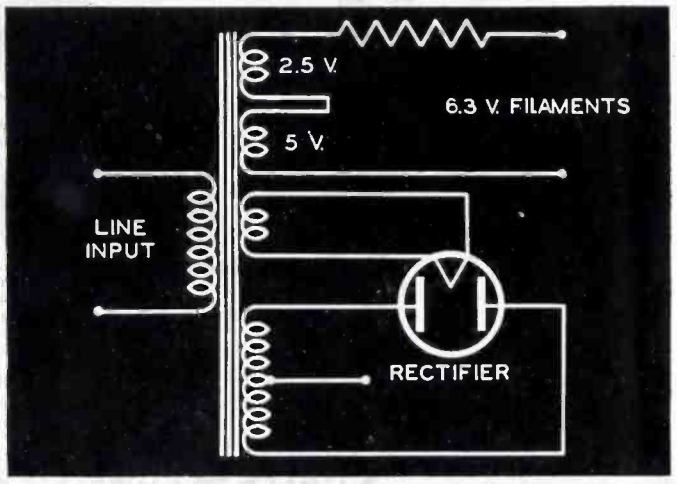
Replacing Close-Tolerance Resistors

In rare cases where close-tolerance esistors are used as original equipment, they are usually identified by a old or bronze band to indicate ±5% olerance, or a silver band for ±10% olerance. If a close-tolerance unit is equired for replacement, two resistors, ne *higher* and one *lower* than the reuired resistance value and so matched hat their combined resistance is equal o the required value ± the allowable olerance, may be used in series or in arallel.

Start your post-war thinking now — that's important — and keep on buying war bonds — that's even more important.

POWER SERVICING





Figs. 1*a* (above) and 1*b* (left). In *a* we have a standard 6.3-volt transformer installation. How to use a 2.5 and 5-volt transformer to secure 6.3 volts is shown in *b*. The two windings are connected in series aiding to provide the required voltage.

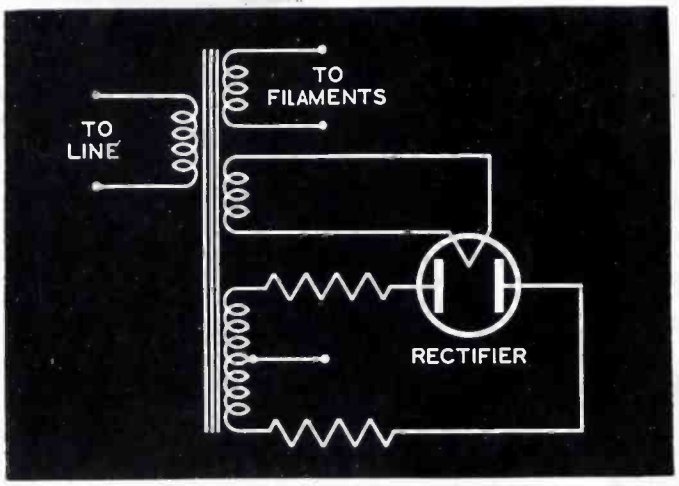


Fig. 2*a*. Method of reducing high voltage when substitute transformer delivers too much voltage.

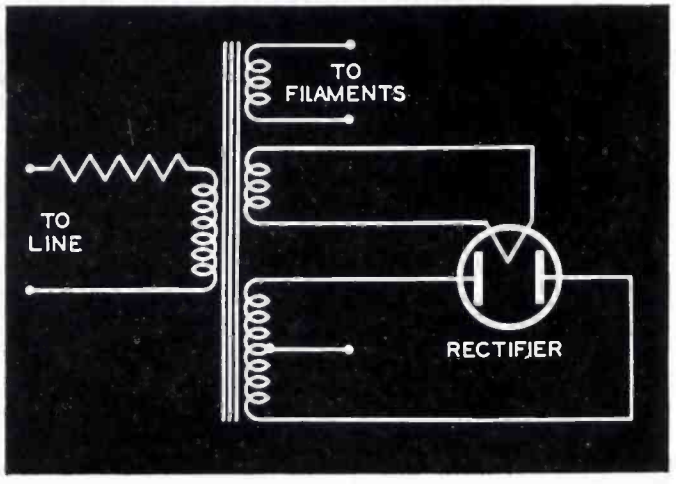


Fig. 2*b*. When all windings provide excess voltage, the primary input should be reduced by inserting a series resistor.

MANY factors may contribute to power transformer breakdowns. Some of these are . . . defective construction, high temperatures or humidity, excessive line voltages or surges, allied component defects, or any combination of these effects. Higher than normal temperatures may be caused by overloading, insufficient ventilation, high ambient temperature or power-line troubles such as low frequency or bad waveform. When transformers are not properly treated with insulating materials they are subject to various forms of deterioration due to moisture, which prompts insulation breakdown. Excessive heating can be caused by the gradual breakdown of some unsuspected component such as a filter condenser which gradually draws more and more leakage current. Since exact replacements are still unavailable, servicing of many receivers has presented many problems. In some instances transformer repair is possible. In other instances an *approximate-exact* replacement must be used. Such installations involve several circuit changes.

Replacing 6.3-Volt Transformers

In Fig. 1*a*, we have a conventional 6.3-volt transformer setup that may be altered. The alteration is shown in Fig. 1*b*. Here we have a method of adapting an old-type transformer with three-filament windings for replacement. In this modified circuit, the old-type transformer originally had a heavy 2.5-volt winding, standard rectifier 5-volt winding and a light 5-volt winding for power tubes. The modified unit can supply 6.3 volts by combining the 2.5-volt and the 5-volt power-tube windings in the proper direction and adjusting the voltage by a series resistor of approximately 1 ohm. If a further substitution of a heater-type rectifier tube is warranted, the substituted unit need have only a 2.5- and a single 5-volt winding. Types 6X5 or 6ZY5G can be used on the same 6.3-volt winding as the other

TRANSFORMER

by ARNOLD D. PETERS

ubes, provided that their output is ufficient for the required load.

Excessive Voltage Control

In Fig 2a, we have a case where an *approximate-exact* replacement transformer was used. The replacement was satisfactory except that the *B*-voltage delivered was excessive. To reduce this voltage it is necessary to insert a pair of resistors, preferably 10-watt wire-wound (5 watters may do) directly in the plate leads to the rectifier. A larger single resistor in the common high voltage lead would also be satisfactory. Where the rectifier is found to heat up faster than the load, the voltage should be reduced further to protect the first filter section. This precaution becomes a necessity when a filament-type rectifier is used with heater-type power tubes and very little safety factor has been allowed for dry electrolytic filters.

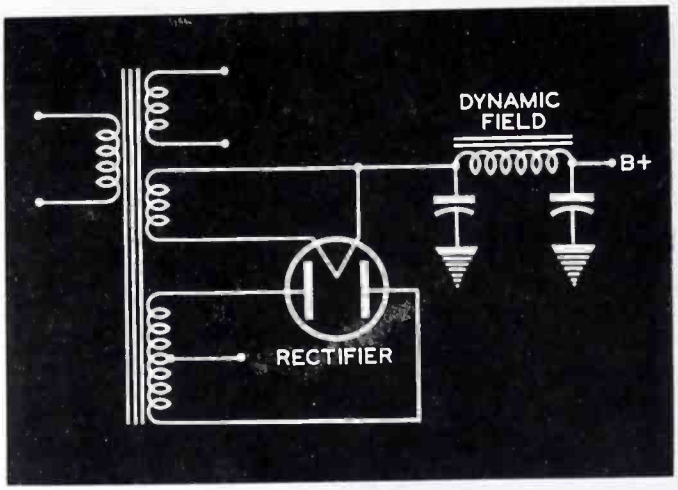
When an oversize replacement transformer must be used, and the available transformer gives excessive voltages on all windings, a primary resistor or choke should be used as in Fig. 2*b*. For most applications, a 25-watt adjustable resistor of 20 to 50 ohms will be most convenient. In an emergency a small coil of wire, with or without iron may be used as a choke.

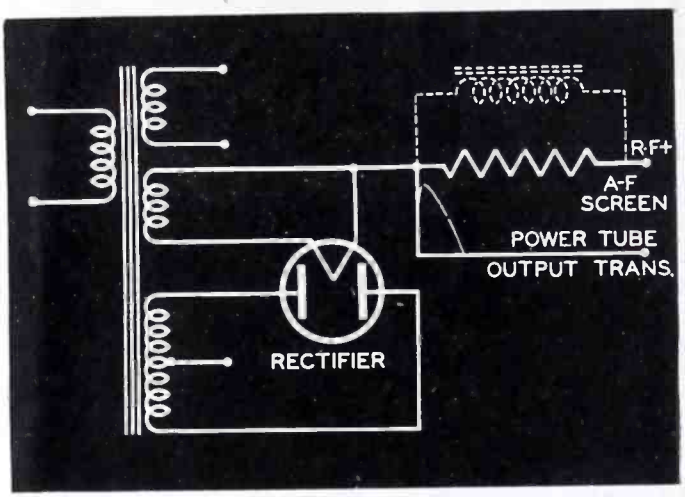
Increasing B Voltage

B-voltage adjustments can also be made by changes in the filter circuit. For instance, the voltage drop in a dynamic speaker field or additional filter choke may be used to adjust the *B* voltage. Fig. 3*a* shows the field used as a choke. When it is desired to increase the *B* voltage, the *IR* drop in the field may be eliminated by the use of a p-m speaker, as in Fig. 3*b*. The power-output tubes then receive their supply directly from the rectifier. Additional filter capacitance will probably be required.

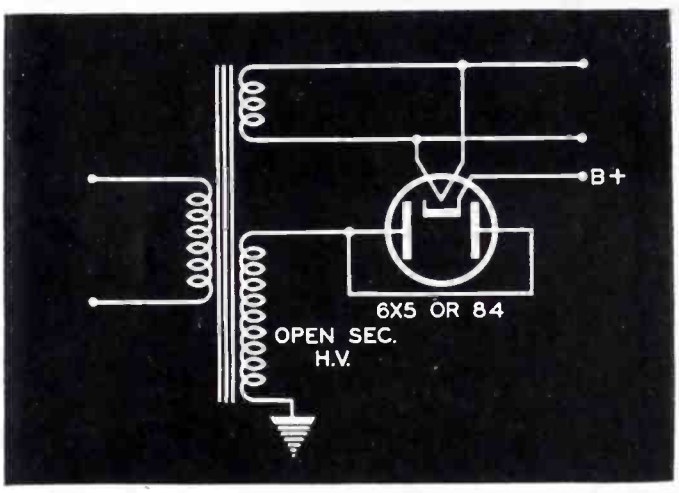
Replacing Open High-Voltage Transformer

When a high-voltage winding opens in a transformer and there are no

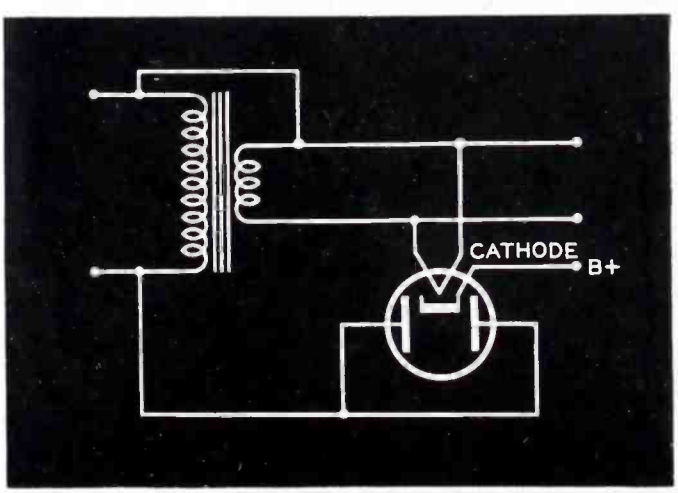


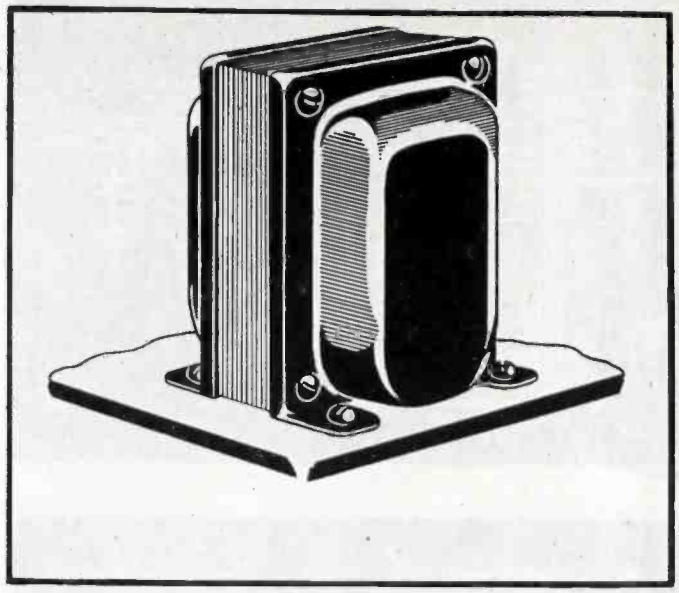


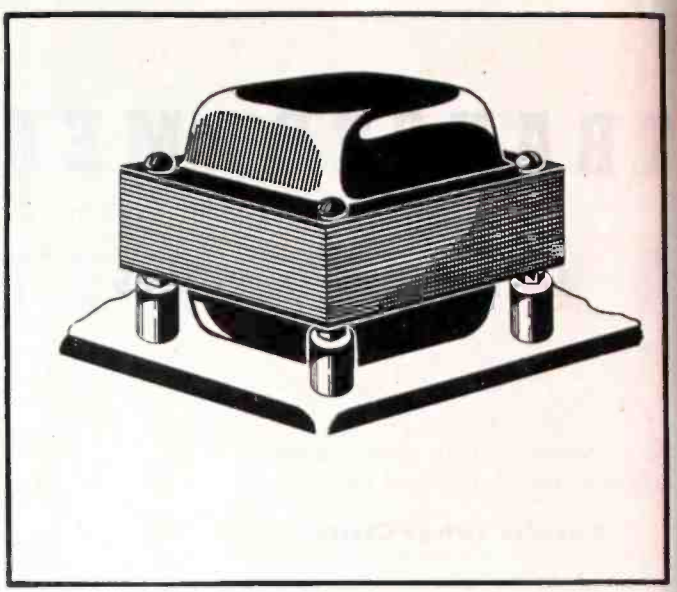
Figs. 3*a* (top) and 3*b* (right). How to increase *B* voltage by changing an electromagnetic speaker to a p-m speaker. In *a*, we have the e-m installation, while in *b*, we have the p-m substitution.



Figs. 4*a* (right) and 4*b* (below). Here we have a method of using a transformer with an open transformer or a filament transformer as a power transformer with the *B* voltage coming directly from the line.







Figs. 5*a* (left) and 5*b* (right). In replacing an upright transformer with a flat-mount type, the method shown in *b* should be used. The chassis should not be cut. Instead mount as indicated, using spacers.

shorts, the line voltage may be used for *B* supply. Fig. 4*a* shows a typical half-wave supply for small sets which may be replaced by the arrangement in Fig. 4*b*, which uses the same transformer or simply a filament transformer. There will be a reduction in power output but the sensitivity will usually not be lowered materially. Since the chassis will become alive with line voltage, certain precautions are imperative. An insulated panel for chassis grip should be inserted so that contact with the chassis is impossible. It is also necessary to avoid set screws on knobs or live dials, etc. The line plug should also be marked for polarity, when possible, so that the chassis is at ground potential.

Mounting Transformers

When horizontal-core replacement transformers are used in place of upright types they should be mounted as shown in Fig. 5. This eliminates the tedious job of cutting a large hole in the chassis. Transformers that emit an annoying buzz may usually be cured by wedging a wooden shim between the coil and lamination. If this doesn't work, restacking the laminations may be necessary. The preferred method of stacking is to alternate the laminations, one in one direction, the next in the opposite direction, not in groups of four or five as they are sometimes assembled.

Using Low-Voltage Transformers

Filament transformers, or any transformer with low-voltage windings, are very handy for line-voltage modification either up or down, as shown in Fig. 7. The transformer really becomes an autotransformer with this connection, with an output rating equal to the current rating of the filament winding. Transformer rewinding is necessary in some instances. Most power transformers have from 4 turns-per-volt for large units to 10 turns-per-volt for the smallest units. The primary is usually wound nearest to the core, although this is not always the case. If, however, the primary is next to the core, the filament and high-

(*Continued on page* 36)

Fig. 6
Copper wire coil data chart. These data are useful when rewinding primaries of transformers.

B. & S. Gauge	Diam. in Mils	Circular Mil Area	Turns per linear inch: Enamel	S.C.C.	D.S.C. or S.C.C.	D.C.C.	Turns per square inch: S.C.C.	Enamel S.C.C.	D.C.C.	Feet per pound: Bare	D.C.C.
10	101.9	10380	9.6	—	9.3	8.9	87.5	84.8	80.0	31.82	30.9
11	90.74	8234	10.7	—	10.3	9.8	110	105	97.5	40.12	38.8
12	80.81	6530	12.0	—	11.5	10.9	136	131	121	50.59	48.9
13	71.96	5178	13.5	—	12.8	12.0	170	162	150	63.86	61.5
14	64.08	4107	15.0	—	14.2	13.8	211	198	183	80.44	77.3
15	57.07	3257	16.8	—	15.8	14.7	262	250	223	101.4	97.3
16	50.83	2583	18.9	18.9	17.9	16.4	321	306	271	127.9	119
17	45.26	2048	21.2	21.2	19.9	18.1	397	372	329	161.3	150
18	40.30	1624	23.6	23.6	22.0	19.8	493	454	399	203.4	188
19	35.89	1288	26.4	26.4	24.4	21.8	592	553	479	256.5	237
20	31.96	1022	29.4	29.4	27.0	23.8	775	725	625	323.4	298
21	28.46	810.1	33.1	32.7	29.8	26.0	940	895	754	407.8	370
22	25.35	642.4	37.0	36.5	34.1	30.0	1150	1070	910	514.3	461
23	22.57	509.5	41.3	40.6	37.6	31.6	1400	1300	1080	648.4	584
24	20.10	404.0	46.3	35.3	41.5	35.6	1700	1570	1260	817.7	745
25	17.90	320.4	51.7	50.4	45.6	38.6	2060	1910	1510	1031	903
26	15.94	254.1	58.0	55.6	50.2	41.8	2500	2300	1750	1300	1118
27	14.20	201.5	64.9	61.5	55.0	45.0	3030	2780	2020	1639	1422
28	12.64	159.8	72.7	68.6	60.2	48.5	3670	3350	2310	2067	1759
29	11.26	126.7	81.6	74.8	65.4	51.8	4300	3900	2700	2607	2207
30	10.03	100.5	90.5	83.3	71.5	55.5	5040	4660	3020	3287	2534
31	8.928	79.70	101	92.0	77.5	59.2	5920	5280	—	4145	2768
32	7.950	63.21	113	101	83.6	62.6	7060	6250	—	5227	3137
33	7.080	50.13	127	110	90.3	66.3	8120	7360	—	6591	4697
34	6.305	39.75	143	120	97.0	70.0	9600	8310	—	8310	6168
35	5.615	31.52	158	132	104	73.5	10900	8700	—	10480	6737
36	5.000	25.00	175	143	111	77.0	12200	10700	—	13210	7877
37	4.453	19.83	198	154	118	80.3	—	—	—	16660	9309
38	3.965	15.72	224	166	126	83.6	—	—	—	21010	10666
39	3.531	12.47	248	181	133	86.6	—	—	—	26500	11907
40	3.145	9.88	282	194	140	89.7	—	—	—	33410	14222

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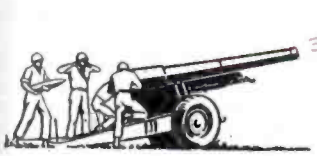

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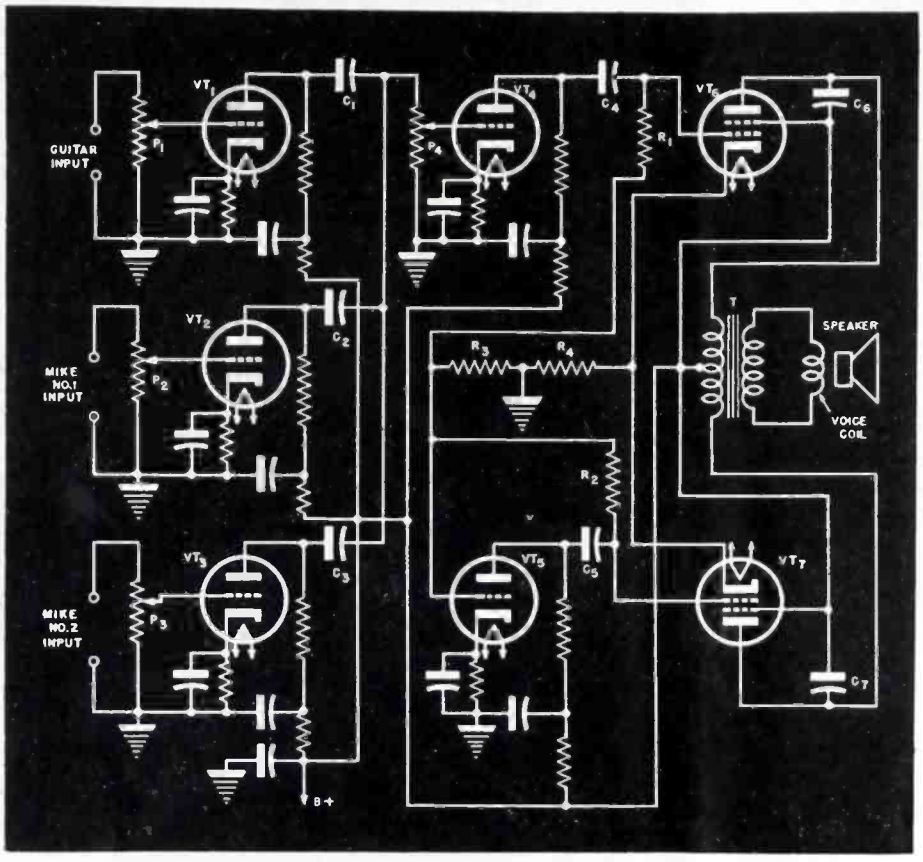


Fig. 1. High-gain amplifier with push-pull output stage. Electronic mixing and phase inversion are featured.

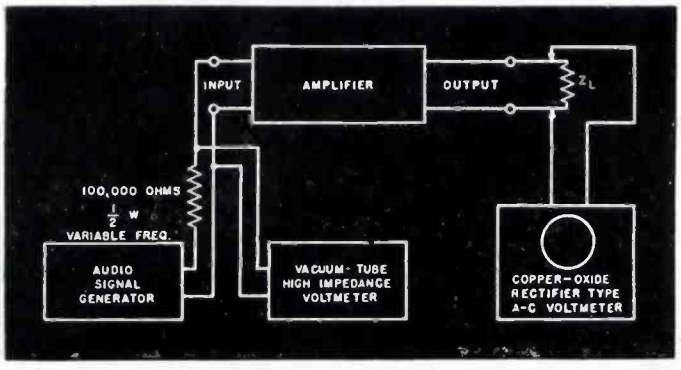
EVERY p-a installation usually requires specialized attention. Thus it is impossible to provide any standard rules to follow. However, many of the tube circuits are standardized and thus rapid choice of tubes and systems are possible. For instance, assuming the electrical output is known, we can decide on the types of output tubes to use. Today the pentode and beam power types are widely used because they offer high audio output with low excitation requirements. Suppose, for example, we wish to use a pair of 6L6 tubes in a push-pull output stage, Fig. 1. Since resistance coupling is employed we cannot use class *B* amplification. Therefore, the tubes are going to operate in class *A*. This means that the plate currents will not vary too much and the need for extra power supply regulation is reduced. From the RCA tube manual we note that for cathode-resistor bias, and plate and screen voltages of 270, the maximum signal power output will be 18.5 watts. The peak audio voltage, grid-to-grid, is 40 volts. If we assume that ½ of this voltage appears between either 6L6 grid and ground, we have 20 volts between the grid and ground, or 20 peak audio volts across R_3 and R_4. The peak voltage is roughly 1.5 times the effective or root-mean-square value read on an ordinary a-c voltmeter. Therefore, the peak divided by 1.5 will give us the rms value. In this case this would be 20/1.5 or about 13 volts. Assuming a value of 100,000 ohms for R_3 and 400,000 ohms for R_4, in Fig. 1, the power in the grid circuit is: $P = E^2/R = 13 \times 13/400{,}000 + 100{,}000 = .0003$ watt, approximately.

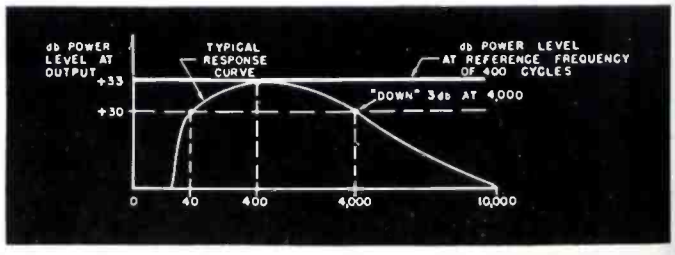
In view of the small amount of power, the grid resistors may be rated at ¼ watt each. We have indicated that the maximum output is 18.5 watts. Assuming an output of 18 watts maximum and an output transformer efficiency of 80%, the power delivered to the voice coil circuit would be:

Power out = power in × % efficiency = 18 × 80/100 = 14.4 watts.

Suppose that the power is somewhat less than 14.4 or 12 watts. Then, the power ratio would be 12/.0003 watt, or 40,000. The logarithm of 40,000 is 4.602. Multiplying by 10, we find that the power gain is 46 db approximately.

The db gain of the amplifier varies with frequency. To test the response, we can use the setup of Fig. 2. A vacuum-tube voltmeter is connected to the input to check the input signal level which should be kept constant as the frequency is varied. The output meter may be a special type, such as the Weston power level indicator, which will show the output in decibels with reference to standard level of .006 watt. Then, the departures can be read in db directly without calculations. The reference frequency usually





Figs. 2 (left) and 3 (above). Fig. 2, a setup used to test audio response. The vacuum-tube voltmeter connected to the input checks the input signal level, which should be kept constant as we vary the frequency. Output meter may be of the power level indicator type, which shows the output in db in reference to the standard level of .006 watts. Z_L = dummy load resistance = 1.5 x voice coil resistance. Fig. 3, variation in audio power output as a function of frequency.

P-A AMPLIFIERS

ected is 400 cycles, but 1,000 cycles occasionally used. If we assume at the output is 12 watts at 400 cles, the ratio with respect to the erence level of .006 watt is 12/.006 2,000. The logarithm of 2,000 is 0 approximately and multiplying by we get the db equivalent of 33 db. us, the power level is 33 db above 06 watt standard level.

Suppose the power level indicator ows that the output for a test fre- ency of 4,000 cycles is 30 db. We e *down* 3 db and theoretically we unt a flat response from 40 to 10,000 cles within 1 or 2 db for *high fidel-*. Actually, the response of the am- ifier may be varied later to make up r deficiencies in the installation of ikes and loudspeakers. However, hen beginning the design we do strive r flat response. Indiscriminate peaks id valleys in the response curve of e amplifier make it virtually impos- ble to accurately control (later) the sponse of the system overall to se- re the desired overall curve.

The response curve can be plotted s shown in Fig. 3. We note a de- ded slope in the curve between 4,000 nd 10,000 cycles, showing that the igh frequency gain is lower than it ould be. To bring up the high end f the curve, we may use smaller val- es of coupling capacity between the rid and plate circuits in Fig. 1. hese capacitors are identified as C_1, C_2 and C_3. To equalize the outputs of VT_1, VT_2 and VT_3, all three capacitors vould need to be changed. To avoid ritical circuit problems, C_1, C_2 and C_3 nay remain constant in value and C_4 an be varied. Decreasing the value f C_4 tends to provide a high-frequency mprovement, since the reactance of C_4 lecreases as the frequency is raised. The reduction in gain is not desirable n some cases. Up to a certain point the high-frequency response of the amplifier can be raised by *decreasing* the values of C_6 and C_7. The impedance reflected by the voice coil load is largely resistive. We then have the equivalent circuit shown in Fig. 4. One-half of the push-pull stage is shown for simplicity. As f rises we will have an increased shunting effect for C_6 and more of the available current will flow in C_6 than in Z_L. Therefore, if C_6 is lowered in capacity the high-frequency output will rise. Since the voice coil has some inductive reactance and at high audio frequencies it may be appreciable, the equivalent circuit shown in Fig. 5 results. As X_L becomes larger, it may cause feedback, due to resonance or decreased to the fact that the plate load is higher in value than the grid-plate impedance of the tube. Therefore, there is a limit to how little capacitance may be used before regeneration or uncontrolled oscillation and parasitics start to cause distortion.

The distortion in the output can be measured in a variety of ways. One method is to check the relative intensities of the harmonic and fundamental voltages. Many Service Men, however, merely listen carefully to the output and then decide whether the distortion is appreciable or tolerable. The amount of distortion which can be tolerated is tied in with hearing phenomena and psychology. As we know

(*Continued on page* 36)

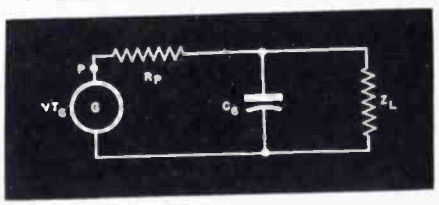


Fig. 4 (above). This circuit illustrates the reflection of the voice coil load, which is largely resistive. As the frequency rises, we have an increased shunt effect for C_6 and more of the available current flows in C_6 than in Z_L. Thus if C_6 is decreased the h-f output will rise.

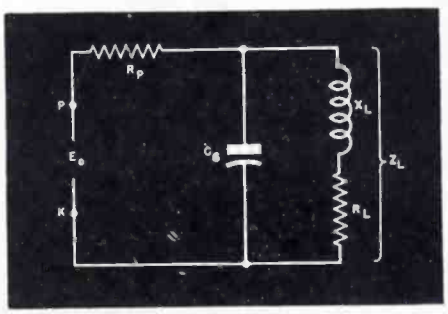


Fig. 5 (above). Here we have a circuit illustrating the effect of X_L. As this becomes larger, feedback may result due to resonance or to the fact that the plate load is higher in value than the grid-plate impedance of the tube. Fig. 6 (below). An oscilloscope setup to check output.

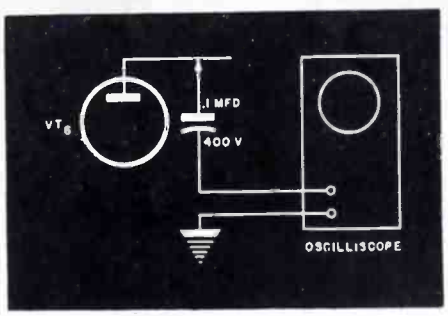


Fig. 7. Simple frequency dividing network applied in some p-a system installations.

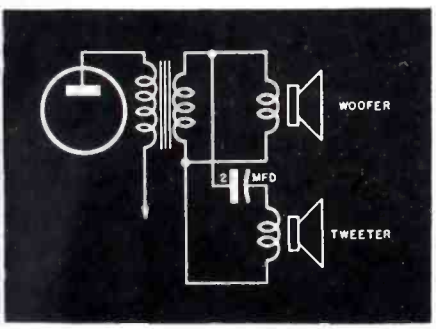
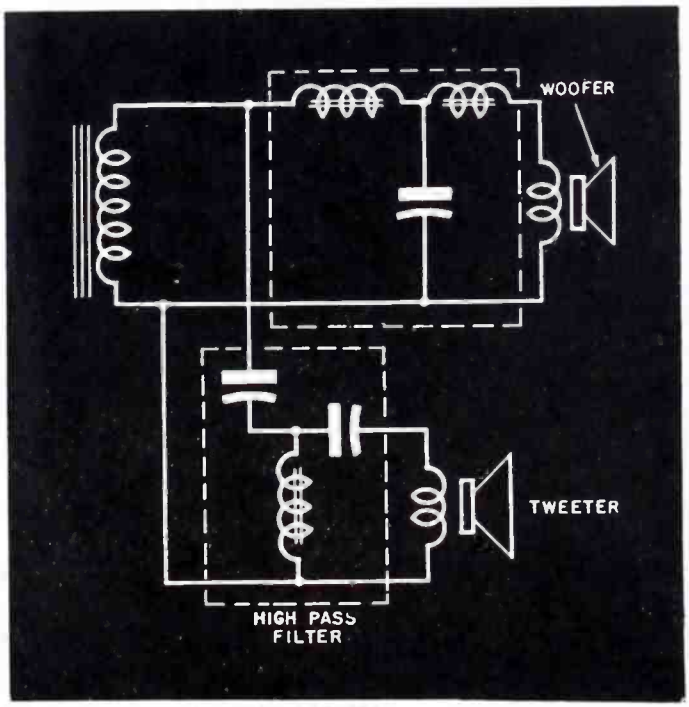


Fig. 8. An improved type of frequency dividing network, using high-pass filters. This system is used in the more expensive types of p-a amplifier systems.



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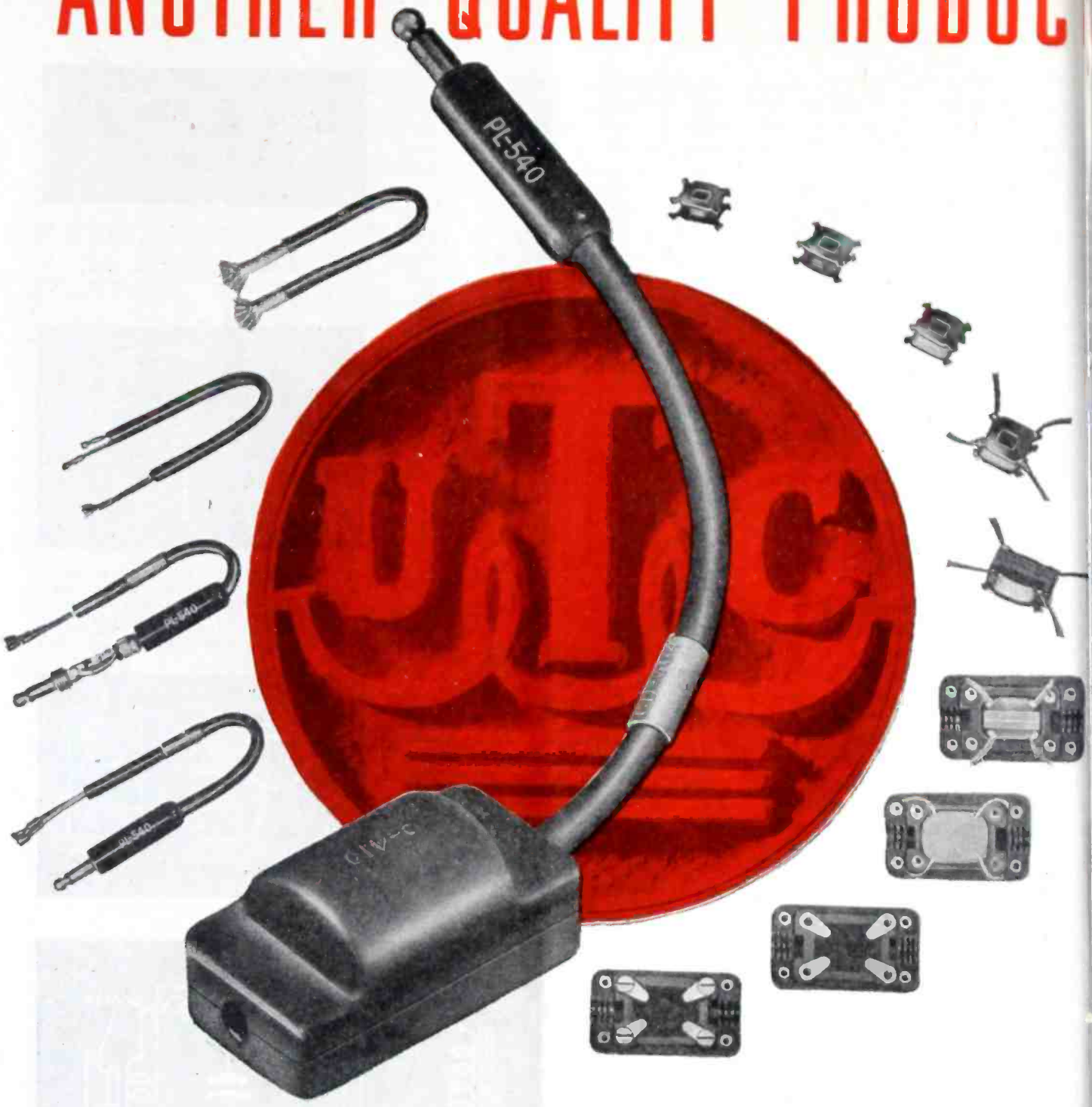

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SER-CUITS

(*Continued from page 21*)

ıe loop is shorted from antenna tap low side on these bands to prevent sorption spots due to loop resonance. c push buttons operate trimmer ıdensers across the loop and shunt rmeability tuned coils across the cillator b-c coil. Iron core i-f transrmers in a 6SK7 stage feed a 6H6 tector and 2-megohm tapped volume ntrol through a series resistor of ,000-ohms and shunt resistor of 220ms.

Audio Amplifier

The audio amplifier consists of a F5 first a-f, the same type inverter d a pair of 6Y6Gs for output. Two n speakers, 6½" and 14", are conected in series. Two resistors, 150 ms and 15 ohms, form a potentiıeter across the output transformer condary with the junction grounded. ı inversed feedback voltage is taken ɔm the high side of the secondary d fed back to the volume control rough a 4.7-megohm resistor. Asymetrical audio shunt capacitors are ed, from power-tube plate to round; .02-mfd on the top tube and 1 mfd on the bottom, the latter being returned to the low side of the output transformer, 15 ohms from actual ground.

There are 1000-ohm series grid resistors in the power stage to reduce the effects of overloading signals, such as static crashes. A four-position tone control shunts a .0015-mfd capacitor across the detector output for bass, .00047-mfd for less bass, circuits as is for normal, and a short across a .003-mfd tone compensator for treble. A 100,000-ohm resistor is in series with a .003-mfd capacitor across the volume control. On phono, the i-f cathode is opened from ground, eliminating radio interference regardless of signal strength. A pair of 5Y3Gs are in parallel in a two-section resistance filter in the power system.

Emerson 363

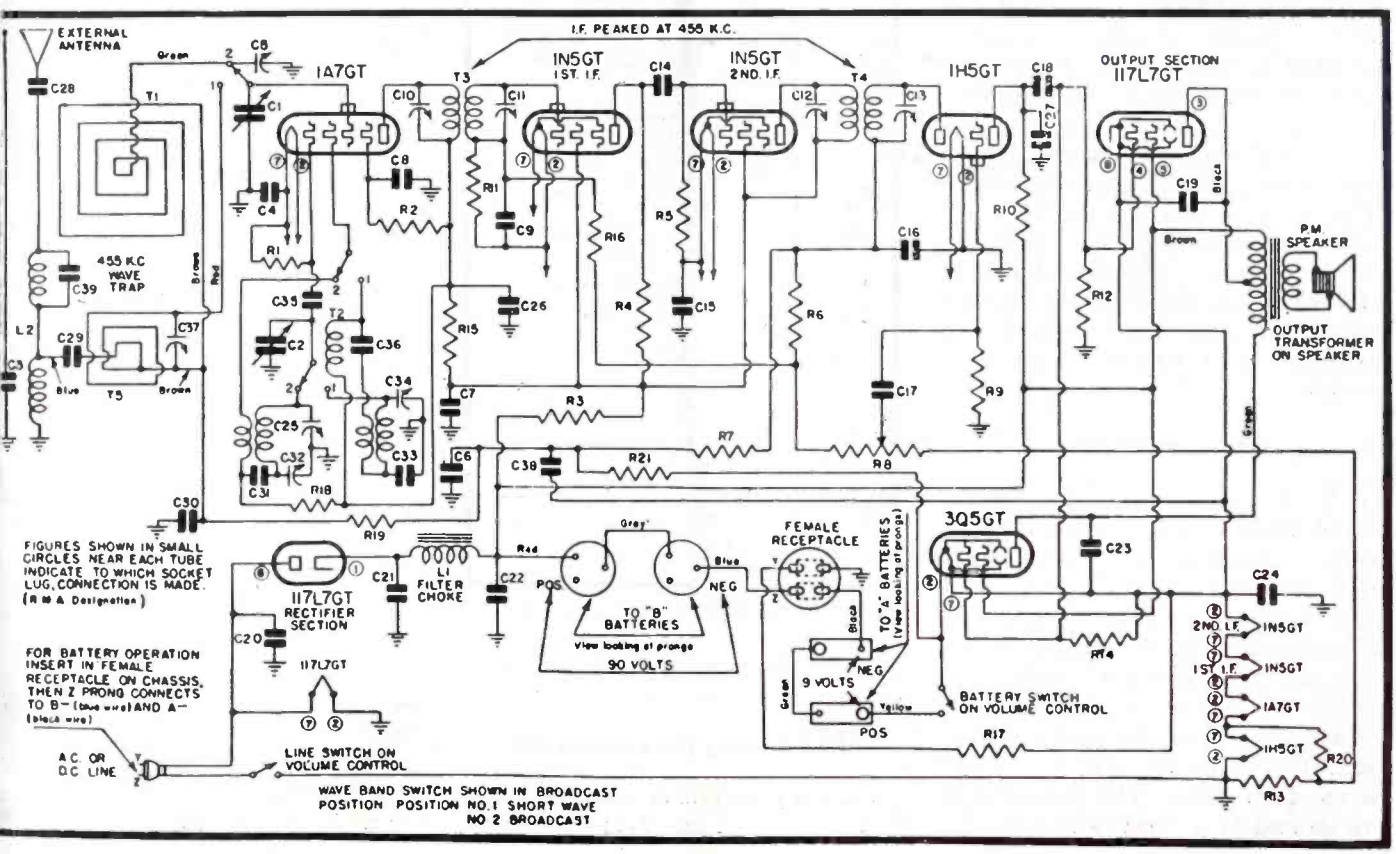
In Fig. 2 we have a two-band battery a-c/d-c portable, Emerson 363, using a loop for each band. The external antenna connection runs through a .006-mfd capacitor, 455-kc wave trap, ground choke and a .1-mfd blocking condenser to a tap near the low side of the short-wave loop for autotransformer type coupling. Some capacity coupling is also obtained through a .0025-mfd capacitor from the low side of the loop to ground, particularly on the broadcast band where this capacitor has a reactance of about 520 ohms at 750 kc and 260 ohms at 1500 kc. This capacity path is isolated by a

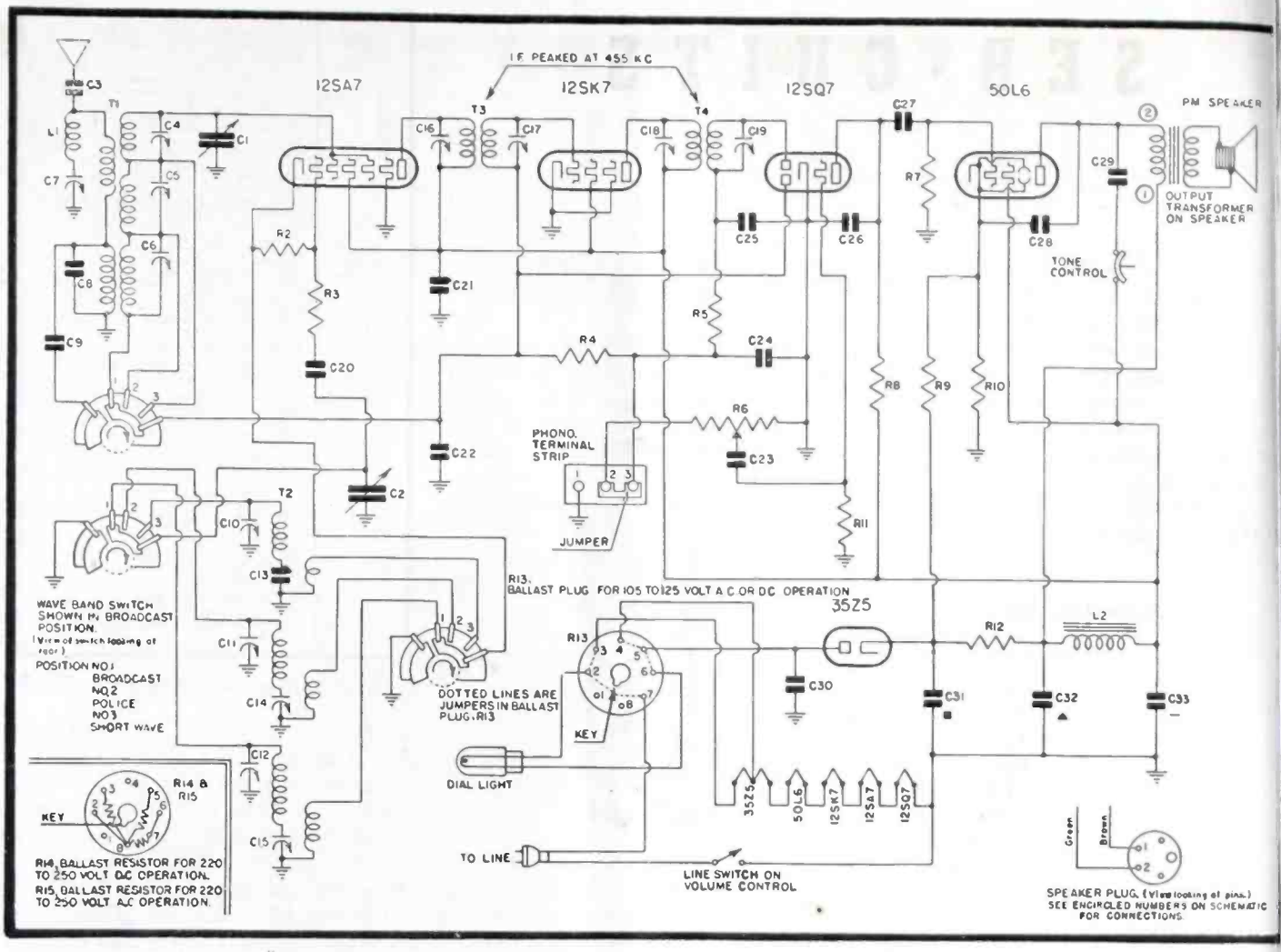
(*Continued on page 32*)

Fig. 2. Emerson 363 a-c/d-c portable, with loops for broadcast and s-w bands. Battery-tube filaments serve as a cathode resistor for 117L7.

L1	Iron core filter choke
L2	Antenna choke and 455 kc wave trap
T1	Broadcast loop antenna
T2	Two-band oscillator coil
T3	Double-tuned 455 kc first i-f transformer
T4	Double-tuned 455 kc diode i-f transformer
T5	Short-wave loop antenna
R1	200,000 ohm ½ watt carbon resistor
R2	30,000 ohm ½ watt carbon resistor
R3	500 ohm ½ watt carbon resistor
R4	25,000 ohm ½ watt carbon resistor
R5, R19	100,000 ohm ½ watt carbon resistor
R6	50,000 ohm ½ watt carbon resistor
R7, R14	3 megohm ½ watt carbon resistor
R8	Volume control, 500,000 ohm with double pole line switch
R9, R11	5 megohm ½ watt carbon resistor
R10, R12	500,000 ohm ½ watt carbon resistor
R13, R20	160 ohm ½ watt carbon resistor
R15	1000 ohm ½ watt carbon resistor
R16, R21	15 megohm ½ watt carbon resistor
R17	1200 ohm ½ watt carbon resistor
R18	15,000 ohm ½ watt carbon resistor
C1, C2	Two-gang variable condenser
C3	0.002 mf, 600 volt tubular condenser
C4, C15	0.25 mf, 100 volt tubular condenser
C5, C37	Dual antenna trimmer strip
C6, C7, C9, C26	0.05 mf, 200 volt tubular condenser
C8, C31	0.02 mf, 200 volt tubular condenser
C10, C11, C12, C13	Trimmers, part of i-f transformers.
C14, C16	0.00022 mf mica condenser
C17, C28	0.006 mf, 600 volt tubular condenser
C18	0.02 mf, 400 volt tubular condenser.
C19	0.005 mf, 600 volt tubular condenser
C20	0.05 mf, 400 volt tubular condenser
C21, C22	Multiple dry electrolytic condenser: C21—20 mf, 150 volts C22—40 mf, 150 volt
C23	0.01 mf, 400 volt tubular condenser
C24	40 mf, 25 volt dry electrolytic condenser
C25, C34	Dual oscillator trimmer strip
C27	0.0002 mf, 600 volt tubular condenser
C29	0.1 mf, 200 volt tubular condenser
C30	0.0025 mf mica condenser
C32	Single adjustable padding condenser, 300-600 mmf
C33	0.00185 mf mica condenser (coded 0.0019)
C35	0.00011 mf mica condenser
C36	0.0001 mf mica condenser
C38	0.015 mf, 400 volt tubular condenser
	6½" permanent magnet dynamic speaker
	Wave band switch
	Battery cable

Parts list for Emerson 363 shown in Fig. 2.





0.1-megohm resistor and .05-mfd filter.

117L7 Cathode Resistor Circuit

Two 1N5 i-f stages are used with inter-resistance coupling, using a 25,000-ohm plate load, 100,000-ohm grid leak and a .00022-mfd mica coupling capacitor. Two output tubes are used, a 3Q5 for battery and 117L7 for line power. The output transformer primary is tapped for the 117L7 to secure optimum impedance matching to a p-m speaker. On line, the string of battery tube filaments are operated as the cathode resistor of the 117L7, bypassed by a 40-mfd 25-volt electrolytic.

Emerson EX 386

Fig. 3 shows a three-band a-c/d-c model, Emerson EX 386, with quite a unique voltage adjustment system to insure long component life. This consists of a ballast resistor with a key adjustment. The waveband switch links all the secondaries of the antenna coils in series, switching the ground to the low side of the various coils. Ordinarily the grid is switched to the high sides. The unused coils are shorted to prevent dead spots due to absorption. Inactive oscillator coils are also grounded.

L1	Adjustable 455 kc wave-trap
L2	Filter choke
T1	Three-band antenna coil
T2	Three-band oscillator coil
T3	Double-tuned 455 kc first i-f transformer
T4	Double-tuned 455 kc second i-f transformer
R2	20,000 ohm ½ watt carbon resistor
R3	50 ohm ½ watt carbon resistor
R4	3 megohm ½ watt carbon resistor
R5	5000 ohm ½ watt carbon resistor
R6	Volume control .3 megohm with line switch
R7	500,000 ohm ½ watt carbon resistor
R8	250,000 ohm ½ watt carbon resistor
R9	20,000 ohm 1 watt carbon resistor
R10	140 ohm 1 watt wire-wound resistor
R11	15 megohm ½ watt carbon resistor
R12	75 ohm 1 watt wire-wound resistor
R13	Shorting plug for 105-125 volt a.c. or d.c. operation
R14	Ballast resistor for 220-250 volt d.c. operation
R15	Ballast resistor for 220-250 volt a.c. operation
C1, C2	Two-gang variable condenser
C3	0.01 mf, 400 volt tubular condenser
C4, C5, C6	Trimmers, part of antenna coil assembly
C7	Trimmer, part of 455 kc wave-trap
C13	0.0034 mf, mica condenser
C14	Single adjustable padding condenser (Range: 750-1300 mmf.)
C15	Single adjustable padding condenser (Range: 300-600 mmf.)
C16, C17	Trimmers, part of first i-f transformer
C18, C19	Trimmers, part of second i-f transformer
C20, C25	0.00011 mf, mica condenser
C21	0.1 mf, 200 volt tubular condenser
C22, C29	0.05 mf, 200 volt tubular condenser
C23	0.002 mf, 600 volt tubular condenser
C24	0.00006 mf, mica condenser
C25	0.00011 mf, mica condenser
C26	0.00022 mf, mica condenser
C27	0.02 mf, 400 volt tubular condenser
C28	0.024 mf, 400 volt tubular condenser
C30	0.05 mf, 400 volt tubular condenser
C31, C32, C33	Three section dry electrolytic condenser C31, C32—40 mf, 150 volt C33—20 mf, 150 volt

Fig. 3. Emerson EX 386, 3-band a-c/d-c receiver.

Hum-Bucking Cathode Circuit

Since a p-m speaker is used, no hum-bucking coil on the field is possible, so a hum-bucking cathode circuit is utilized in the power amplifier. A 20,000-ohm resistor is run from the rectifier output at the beginning of the filter to the cathode which is not bypassed. The bias resistor is 140 ohms. The first filter section consists of a 40-mfd capacitor and a 75-ohm resistor, second 40-mfd unit, filter choke, and then 20 mfd. The plate of the 50L6 is supplied from the first section and the screen from the second; thus very little hum can be expected in the output. Usually, the power tube plate and the screen is supplied directly from the rectifier.

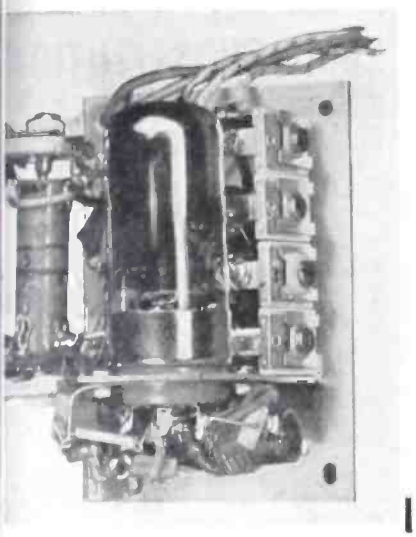
Garod 3 P 1812

In reply to many requests, we are listing the functions of the tubes used in the Garod 3 P 1812 a-m/f-m/s-w receiver, discussed in Ser-Cuits, April SERVICE. The 7V7 is an r-f tube for f-m; 7Q7 tubes are used as a-m and f-m converters; 7A7 and 7H7 tubes serve as i-f's; 7C7 tubes are used as first and second limiters; 7A6 is a discriminator; 6SQ7 serves as an avc, detector and phono amplifier; another 7A7 is used in the a-m r-f section; 6SQ7 tubes are used as a phase changer and a-f amplifier; while in the output we have 6K6 tubes.

.M CONVERTERS

T the recent FCC allocation hearings, Hallicrafters' engineers demonstrated types of converters for permitting eption in the proposed f-m band of 102 mc with receivers designed for 50 mc reception.

)ne was a single tube converter, for in primary service areas where signal ength is high. Three views of this de- are shown. The upper view shows unit uncased. The tube used is a 7S7

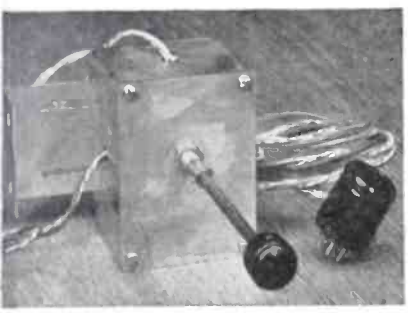


de view of one-tube converter showing the tube, bandpass inductances, and adjustable condensers.

●

a band-pass circuit together with the propriate padder condensers.

The center illustration shows the unit embled, while in the bottom view ap- r the unit mounted in a receiver cab- t. Operation is by means of a switch unted on the front panel. During a nsition period, when f-m stations may



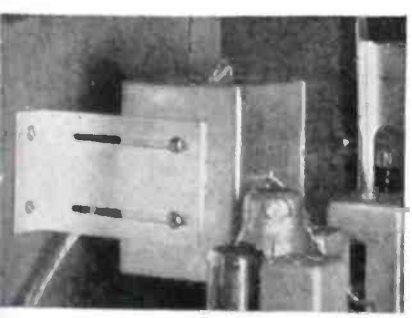
e tube converter, complete with mounting bracket, power take-off plug, etc.

●

erate on both bands, the receiver may switched from one band to the other. ming, with this unit, is done with the eiver dial. The converter is powered om the receiver voltage supply.

●

Converter installed in a typical prewar f-m console.



PUSH-PULL AMPLIFIERS

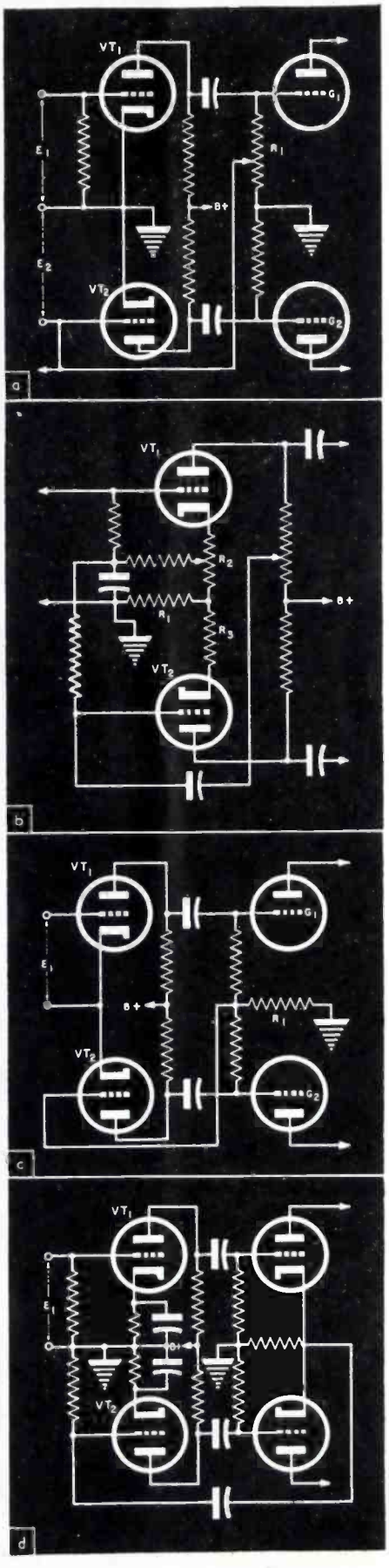
(*Continued from page* 14)

feedback is used. In addition, any non-uniformity in frequency response is also equalized.

Fig. 4*b* shows a phase inverter using negative feedback. Here, a portion o the voltage developed in the output o VT_1 is applied to the grid of VT_2 i very much the same manner as in Fig 4*a*. However, any unbalance in the tw circuits produces an a-c voltage o audio frequency across R_1, which i common to both tubes. This feedbac voltage is thereby applied to the grid of both tubes, through the cathode re sistor network. R_2 and R_3 apply addi tional feedback to the circuit, but ma be bypassed if feedback is only desire for balancing purposes.

Fig. 4*c* shows another method o using circuit unbalance for self com pensation. Here, any unbalance in th developed voltages driving G_1 and G is reflected as a voltage drop across R This voltage is then used to feed th grid of the inverter tube, VT_2, which tends to reduce this unbalance. If th inverter tube is a high-gain amplifier the unbalance may be reduced to very low levels.

Fig. 4*d* is similar to Fig. 4*c*, except that the cathode circuit of the output stage is used to provide the unbalanced



Figs. 4*a*, *b*, *c* and *d*. Four methods of inversion are shown here. Fig 4*a* will give inversion with stage gain. In *b*, *c*, *d*, appear inverter circuits utilizing negative feedback for equalization of frequency response.

dback voltage. Note its similarity to circuit in Fig. 4*b* insofar as feedk is concerned.

The use of feedback in association h inverter circuits is recommended, ce it results in improved audio dity. Quite a few set manufacturers orporated this feature in their pre- r models, and will probably include n their postwar receivers.

•

XTENDING AMMETER RANGES

(*Continued from page* 12)

htly more resistance has been ed, in series, than is actually re- red.

similarly, the value of the shunt re- ance cut out in changing from n = to n = 1,000, is equal to .030 ohm. e added series resistance becomes 303 ohms, while the calculated fig- is 29.97 ohms.

Using the equation

$$r_2 + \frac{r_m \cdot r_1}{r_m + r_1} = R_t$$

inserting the values found for r_1 r_2 for the various ranges, the ual resistance of the combination is nd for any range.

f the meter were not in the circuit, value of R_1 and R_2 would equal 27 ns, 3.333 ohms, or 30.333 ohms. is represents the maximum possible ersion from the value desired, 30 ns, or an error of 1.111%. When = 1,000, the shunt resistance across meter is .030 ohm. The 30 ohms the meter itself, considered as a nt across this low value of resis- ce, is, therefore, negligible. The ue of $R_1 + R_2$, as compared to the ired resistance (which is the meter istance), may be considered as the ximum error introduced.

t should be noted that the first mul- ier determines the maximum error. example, if *n* were to equal 5,25 instead of 10,100 etc., the error oduced would be greater. Taking same meter as an example, when = 5,25 etc., R_1 = 7.5 ohms and = 24 ohms. The maximum possible or is then 5%. Therefore, to keep error low, when using this system, first multiplier stage should be as h as practical.

s, for n = 10, R_t = 30 ohms
for n = 100, R_t = 30.330 ohms
for n = 1,000, R_t = 30.333 ohms

The errors in percentage for the ve ranges are 0.0%, 1.11% and 11%, respectively.

TRANSFORMER SERVICING

(*Continued from page 26*)

voltage winding may be easily removed, cutting the latter with a razor blade and removing one layer at a time, allowing the primary winding to remain. It is then a simple matter to add filament or other low-voltage windings when desired.

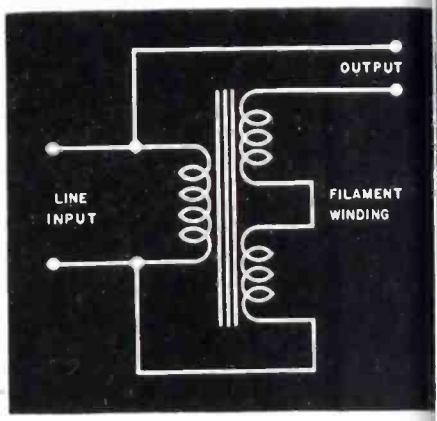


Fig. 7. Using a filament transformer as an auto transformer for raising or lowering line voltage

P-A AMPLIFIERS

(*Continued from page 29*)

the hearing of an individual will depend upon the conditions under which hearing is practiced, whether the room is noisy, distance from source, etc., and upon the physical condition and age of the person making the auditory test. Further, some people cannot hear equally well with both ears. In view of all this, it is desirable to check on our own ears and hearing by using electrical measuring instruments.

An oscillograph can be connected across the output of VT_6, as shown in Fig. 6. When the waveform becomes kinky or changes from a sine wave, distortion is present. With the amplifier gain control first at maximum, audio generator at minimum, the output of the a-f generator can gradually be raised. At first the scope will show a sine wave. Then, as the output of the generator is raised to the point where distortion sets in, the waveform will change. At that particular point the level at the input of the audio amplifier can be tested with the vacuum tube voltmeter to learn the maximum permissible input signal level before distortion becomes noticeable. The plate connection to the output tube is desirable in single-ended amplifiers since the usual oscillograph has a lim

(*Continued on page 38*)

OLD TIMER'S CORNER

by SERVICER

'RED wandered into the place the other evening looking quite glum. When conversation finally began, he d me that his last signal generator had ne sour, and that he had just heard m the factory that he would have to it for at least two months for either epair or for a new one. He didn't know iat he was going to do, for his shop had ys of receivers to be repaired.

'Why not take some old chassis and e the oscillator off that as a generator?" asked.

He told me that he had tried it and it he had blown over seven fuses on the s he was trying to service.

'Guess that you must have been using a-c/d-c set," I opined.

He nodded his head.

'Well, there's no excuse for that, Fred," said. "You know as well as I do that ose models have their ground connected one side of the house lines, and prob- ly when you hooked the two together u crossed yourself up."

That's just what had happened.

The Repair

I went over to his shop and fixed him . Took a bit of insulated wire and isted another wire to it, making a very iall coupling condenser. Naturally I saw it that the wires never touched each ier at any point. Then I soldered one re to the grid clip of the oscillator oe and used the other as a probe. The gnal was weak but steady. Of course, ere was no modulation on it. So I isted more wire together and then the gnal got louder and louder and finally went dead. I guessed that I had coupled e oscillator too tightly to the radio set der test, so I reduced the twisted part the wires and taking a .0005-mfd mica ndenser I hooked the two sets' grounds gether through it. There was no fuse owout and the signal was as steady and st right for signal tracing.

"There's your signal generator," I told ed.

"Incidentally you could have used an dinary high-pitched buzzer for a signal nerator, in a pinch. Of course, to con- ol it you should put the output through ordinary amplifier stage, but that isn't ry hard to get together in a repair shop. ou can use any triode with about 2500 ms in the cathode circuit bypassed by 8-mfd condenser. Couple the buzzer to e grid, bypassed by a 5-megohm re- tor. Then you insert a 2.5-mh choke in e plate circuit to help keep the r-f here you want it, and couple the plate rough a .25-mfd blocking condenser to a avy (10 watt) 3000-ohm potentiometer. nother condenser of about .005-mfd is connected to the arm and a wire from there is used as a probe.

Signal Generator Frequency

"This signal generator transmits a signal of about 500 cycles, not 500 kc. That means that you will find little or no difference between 1200 kc and 1200.5 kc. For rough alignment this is ideal since you will not have to rock the signal generator back and forth to make sure you have a lined-up job. Sure, you cannot line it up on the nose; but you can speed up alignment just about 30% since you do not have to make signal generator adjustments while you are getting ready for the final step of alignment."

Many service shops use this system. The buzzer has one disadvantage, it must be run by batteries. And batteries cost money. However since most of your servicing involves time, with parts and sets being so hard to get, the faster you can finish your work the better. So on that score alone, the *buzzer generator* will more than pay for its keep.

Meeting the Problem

What I am driving at is this. So many men are licked before they start because they will not analyze their problems with a bit of care. When they see the only thing with which they have been working for the past few years blow up, confusion appears to set in. The man who is cool in the emergency and the man who can act when the going gets a bit harder, is the man who will succeed every time.

P-A AMPLIFIERS

(*Continued from page 36*)

ited deflection sensitivity and better results will be obtained. The signal voltage in the plate circuit of the output tube may be fairly large, 10 or 20 volts not being uncommon, while the voltage across the voice coil or dummy load may only be 2 or 3 volts in many cases.

In laboratories a wave analyzer may be available for checking the fundamental and harmonic voltages individually. Usually, when the distortion becomes readily noticeable the second harmonic voltage may be 5% or 10% of the fundamental. In a push-pull stage the second harmonic voltage in the plate circuit of either of the push-pull tubes may be appreciable, whereas the second harmonic measured across the voice coil or dummy load, due to the push-pull cancellation action, may be small. Therefore, as a general thing it is better to check for distortion in a push-pull system by connecting the indicating instrument across the voice coil. If the oscillograph lacks adequate gain, a small a-f amplifier stage may be built up to boost the signal. Care must be taken to see that the extra stage has flat characteristics and that the bias on the pre-amplifier tube is higher than the peak value of the signal voltage, to prevent overloading of the pre-amplifier stage and the generation of harmonic distortion in that stage. A plate-to-plate connection could be used, but it has the disadvantage of putting one side of the oscillograph above ground potential which may lead to the reduction of spurious voltages and incorrect conditions in testing.

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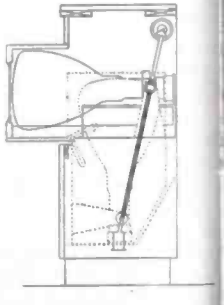
PROJECTION TELEVISION

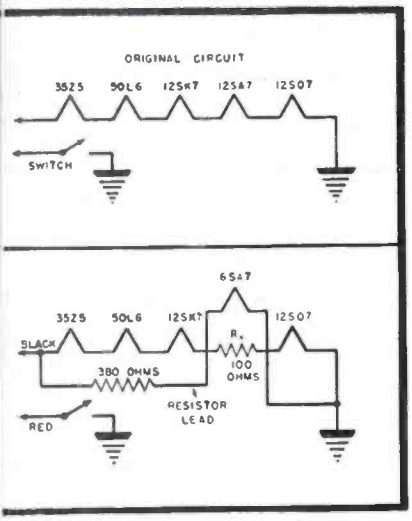


Above, projection type television receiver recently demonstrated by Du Mont. Image is 3' x 4'. Right, 20" c-r tube direct - viewing console model with tube retraction mechanism to permit use of compact consoles.

ERVICING HELPS

TUBE SUBSTITUTIONS

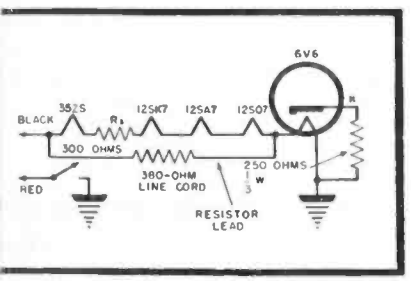
METHOD used to replace a 12SA7 with a 6SA7 is shown in Fig. 1. 25L6 may be substituted for the .6 in the same manner, except that the cord value is then 320 ohms, and R_x becomes 320 ohms. However since is an odd resistance value, 300 or 350 ms may be used, the latter in the high- voltage areas, the former in low-line tage areas.



s. 1 and 2. Original and rewired circuits.

Using 6V6 to Replace 50L6

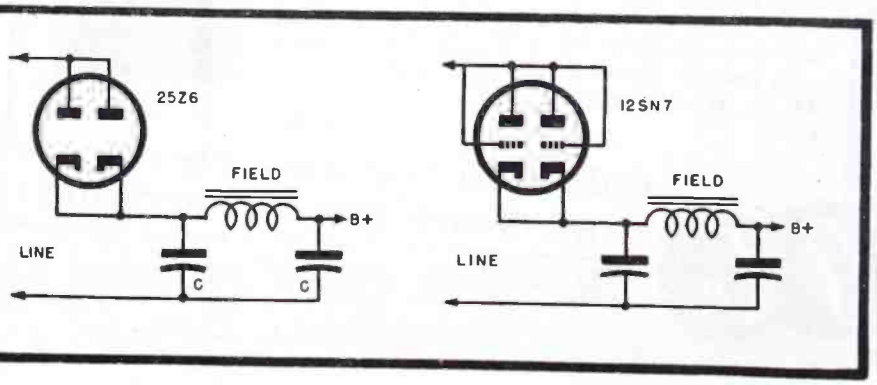
n our locality we were able to secure A7, 6SK7, and 6V6 tubes. Accord- ly we set up a circuit using 6V6 tubes replace 50L6 and 351.6 tubes, Fig. 3. R_x was calculated at E = 45 volts; I = ampere. Thus R_x = 300 ohms. Total rent drain equals .45 ampere. Shunt .300 + (tubes) .150 = .450.



Better results were obtained when the)-ohm bias resistor was replaced with 250-ohm unit. 10-watt resistors were d for R_x. The load impedance was natched, but not enough to war- t changing of the output trans- mer. As a result of these changes, eral unusual effects will be noticed; a ger warming period, and some distor- n at high volume levels. None of our

(*Continued on page* 40)

Figs. 3 (above) and 4 (right)
3. Using a 6V6 to replace a 35L6 or 50L6.
4. How to replace a 25Z6 with a 12SN7.



(*Continued from page 39*)

customers objected to either. Incidentally one side of the line switch must be grounded to the chassis, when these changes are made. If the negative is above ground (as in the Crosley 52 series) a line switch return must be used instead of the chassis (as shown in Fig. 1).

Remounting Resistors

Since tie lugs with more than 2 insulated lugs have not been generally available, we now use the method shown in Fig. 5 for mountings. The resistor can be mounted more firmly in this way, and in addition the distance between the lugs happens to be equal to the length of a standard 10-watt resistor.

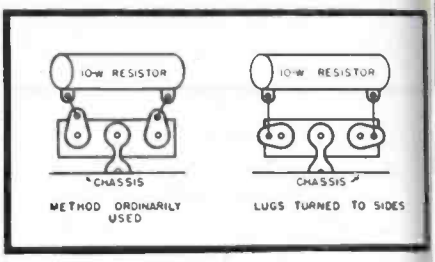


Fig. 5. Old and new methods of mounting resistors.

Replacing 25Z6

To replace a 25Z6, a 12SN7 can be used as shown in Fig. 4. The heater-dropping resistor is 40 ohms at 5 watts or more.

John J. Wajgel

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ZENITH 6S301

Severe oscillation in mixer and i-f stages; a negative grid voltage of 250 measured with a 20,000 ohms-per-volt meter, on mixer grid, and about 100 on i-f grid: The trouble was traced to shorted field wires of the speaker and a bad 6K7G; *1* pin was not grounded. Grounding of *1* pin is essential; tube shield of no value in stopping oscillation. Detuning i-f would stop oscillation but cut gain way down. New socket with provision for grounding *1* pin should be installed. If socket is not available simply solder a wire to 6K7 *1* pin and ground. Shorted field caused extremely high voltages.

If set is dead, trouble may be due to an open in rectifier filament circuit.

Willard Moody

•

ZENITH 6S439, 469 (CHASSIS 5678)

Hiss: Caused by excessive converter stage gain which is almost at the point of oscillation. Connect a 1,000-ohm resistor between the red and black wavemagnet leads at the wavemagnet socket.

ZENITH 7S633, 634, and 657 (CHASSIS 7B01)

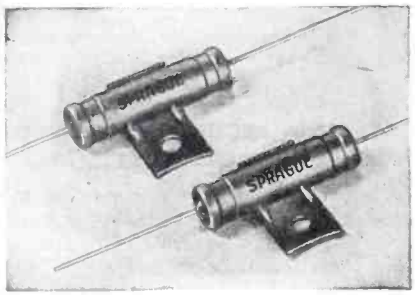
Dead on broadcast and short-wave tuning, but all right on pushbuttons. Caused by inactive oscillator circuit that checks okeh. Clean the oscillator section contacts of the band switch and apply a light coating of lubriplate.

Zenith Shop Notes

NEW PRODUCTS

SPRAGUE HYPASS CAPACITORS

Hypass capacitors said to be non-resonant at frequencies as high as 50 megacycles and in some instances, up to 300 megacycles, have been announced by Sprague Electric Company, North Adams, Massachusetts. The units can be used for filtering or bypassing over wide frequency bands.



* * *

GENERAL CEMENT ALIGNING KIT

An all-purpose aligning kit, 5022, with alligator and hexagonal screw drivers, enclosed in leatherette case has been produced by General Cement Manufacturing Co., 919 Taylor Avenue, Rockford, Ill.

* * *

G. E. GLASS TERMINAL SEAL PAPER CAPACITORS

Hermetically sealed, fixed paper-dielectric capacitors with glass terminal insulators, CP-60, -62, and -64, characteristics E and F, have been announced by G. E.

Glass terminal seals are said to provide an unusually high degree of resistance to humidity, fungus growths, and termites.

Capacitance values range from 0.05 to 0.50 mfd. for voltages of 600, 1000, or 1500.

* * *

OHMITE RITEOHM RESISTORS

Two types of Riteohm precision resistors, series 82 and 83, have been announced by the Ohmite Manufacturing Company, 4835 Flournoy Street, Chicago 44, Ill.

Both units use enameled alloy resistance wire, non-inductively pie-wound on a non-hygroscopic ceramic bobbin which has a hole through the center for a No. 6 screw. After being wound, the units are vacuum impregnated with a varnish.

Riteohm 82 is available in 2, 4 and 6-pie types; maximum resistance of 2 pie, 400,000 ohms; 4 pie, 750,000 ohms; 6 pie, 1 megohm. Sizes are 11/16" diameter by 1⅛" long, 1 7/16" long or 1¾" long for the 2, 4 and 6-pie units respectively. The minimum resistance available for all units is .1 ohm.

Riteohm 83 is available in small and large 2-pie and 4-pie types. Maximum resistance of small 2 pie, 200,000 ohms; large 2 pie, 400,000 ohms; 4 pie, 800,000 ohms. Sizes are: ½" diameter by 7/16" long,

(Continued on page 45)

NEWS

THOMAS JOYCE JOINS RAYMOND ROSEN

Thomas F. Joyce, former general manager of the radio, phonograph and television department of RCA Victor has acquired an interest in Raymond Rosen and Company, Philadelphia. He will act as general manager.

* * *

RAYTHEON N. Y. OFFICE CHANGE

The radio receiving tube division of the Raytheon Manufacturing Company has moved its N. Y. City offices to the Lincoln Building, 60 East 42nd Street.

General sales headquarters of the receiving tube division will remain indefinitely at 55 Chapel Street, Newton, Massachusetts.

* * *

NEWS OF THE REPRESENTATIVES

A. V. Rodman, 1827 So. Hope St., Los Angeles, 15, Cal., has become a member of the Los Angeles chapter of the Representatives.

Dave M. Marshank of the Los Angeles chapter has removed to 672 Lafayette Park Place, Los Angeles 5, Cal. V. T. Rupp, of the same chapter is now located at 1150 W. Olympic Blvd., Los Angeles 15, Cal.

Arnold M. Sinai of the California chapter has been discharged from the armed forces and is back in business at 1280 Mission St., San Francisco 3, Cal. W. I. Otis, of the same chapter has moved to 600 Camelia St., Oakland 2, Cal.

* * *

SYLVANIA RECOMMENDED TUBE REFERENCE LIST

A pin-up chart of recommended tube types has been published by Sylvania Electric Products Inc., 500 Fifth Avenue, New York 18, N. Y.

Listings include many tube types selected for better performance in equipment now being designed and those that are contemplated for postwar production.

* * *

SPRAGUE TROPICAL RESISTOR CATALOG

A catalog describing Sprague Koolohm resistors having *tropicalized* glazed outer protective shells and moistureproof end seals has been issued by the Sprague Products Company, North Adams, Mass. Values covered include 5-, 10-, 25-, 50- and 120-watt fixed, as well as 10-watt adjustable types.

* * *

AERO NEEDLE MOVES

The Aero Needle Company has moved its plant to the Edison Park area in Chicago.

The sales offices have also been moved. New quarters are at 619 North Michigan nue, Chicago, Ill.

* * *

ROLA WINS WHITE "E" STAR

The Rola Company, Cleveland, has received its third "E" flag star.

* * *

WESTINGHOUSE NAME CHANGE

The Westinghouse Electric and Manufacturing Company will hereafter be known as the Westinghouse Electric Corporation.

* * *

JULIUS HABER NAMED RCA VICTOR ASS'T. AD DIRECTOR

Julius Haber has been appointed assistant director of the advertising and sales promotion department of the RCA Victor Division of the Radio Corporation of America. Mr. Haber was formerly director of publicity.

Harold D. Desfor was named director of publicity. He was formerly assistant to Mr. Haber.

* * *

WILLETT JOINS DEMAMBRO SUPPLY

Mell Willett, has joined the Demambro

Radio Supply Company, 1111 Commonwealth Avenue, Boston, Mass. He will be in charge of sales in the electronic parts department.

Mr. Willett was formerly with The Eastern Company, Cambridge, Mass., where he managed the Cambridge and Worcester branches handling radio parts.

* * *

PASCHKES BECOMES SOLAR BOARD CHAIRMAN

Otto Paschkes has relinquished the presidency of the Solar Manufacturing Corp., to assume the newly created post of board chairman. Elected to succeed him as president was Paul Hetenyi, formerly executive vice president.

Mr. Paschkes will continue actively as chief administrative officer.

Other personnel changes included the election of Wickham C. Harter, secretary, to the dual post of vice president and secretary, and the promotion of James I. Cornell, chief engineer, to the second vice presidency.

* * *

N. U. SALES STAFF HONORS J. H. (ROBBY) ROBINSON

In appreciation of the sincere cooperation given them during the past 15 years when J. Homer (Robby) Robinson was affiliated with National Union as sales manager, N. U. salesmen gave a party in his honor at the Advertising Club in New York recently.

A set of golf clubs and a Masonic ring were presented to "Robby" on behalf of the salesmen by Henry Hutchins and Bill Hendrickson.

"Robby" was recently appointed vice president and general sales manager of the American Radio Hardware Company, Mount Vernon, N. Y.

* * *

WARTIME RECORDING DISCUSSED BEFORE R. C. OF A.

F. W. Whitehouse, field and application engineer of the Recordgraph division of Frederick Hart & Company, delivered a paper recently describing the Recordgraph machine and its use on the war fronts before members of the Radio Club of America. The unit was also demonstrated. Records taken under adverse battle conditions were run.

* * *

1944 N. U. INCOME REPORT

The net income of the National Union Radio Corporation in 1944 amounted to $269,735, after provision for income and excess profits taxes and adjustments applicable to prior years, as compared with $539,663 for the year 1943.

* * *

RADOLEK CATALOG

A 24-page catalog describing a variety of available components has been issued by the Radolek Company, Randolph at Jefferson Street, Chicago, Ill.

* * *

HOME WIRE RECORDER

William Lear and the Lear wire recording magazine designed for home receiver use. Unit provides one-hour of recording.

INTERNATIONAL MERIT TO SELL LAUBSCHER NEEDLES

International Merit Products Corporation, 254 West 54th Street, New York 19, New York, has been appointed Western Hemisphere sales representatives for phonograph needles manufactured by Laubscher Brothers, Taeuffelen, Switzerland.

The North American division, comprising U. S. A. and Canada, is under the management of Edward M. Bieber. The Latin American division is under the management of T. William Maas.

The officers of the corporation are: Ernest T. Laubscher, chairman of the board; Julius Mueller, president; Anna Mueller, vice president; Ernest T. Laubscher, treasurer; and Harvey McCoy, secretary. The needles will sell under the trade mark Meritone.

* * *

DETROLA WINS "E"

The Detrola radio division, International Detrola Corporation, have received the Army-Navy E.

* * *

C-D REPLACEMENT CAPACITOR CATALOG

Catalog 195 with data on capacities, sizes and prices of Cornell-Dubilier can-

(*Continued on page 44*)

(*Continued from page 43*)

types and cardboard tube type, electrolytic capacitors, paper capacitors, wax impregnated and Dykanol tubular capacitors, drawn metal shell units, replacement paper units, photo-flash units, auto radio units, transmitting paper types, and also various types of mica capacitors has been issued by Cornell-Dubilier Electric Corporation, South Plainfield, N. J.

Capacitor test instruments and interference filters also are described.

* * *

DALE DISTRIBUTING MOVES

Offices and showrooms of the Dale Distributing Company, Inc., have been moved to 40 East 32nd Street, New York 16, N. Y.

* * *

WAR VETERAN RADIO OPPORTUNITIES DISCUSSED BY GEN. SARNOFF

Opportunities for returning servicemen in radio and electronics are outlined by Brigadier General David Sarnoff, president of Radio Corporation of America, in a booklet recently released.

Listed among radio and electronic fields needing servicemen are those of broadcasting, television, radar, radio-facsimile, radio relays, radiothermics, electron microscopy, supersonics, aircraft and marine radio. General Sarnoff suggested that the *electronizing* of industry also may prove to be an attractive occupation for returning veterans. He called attention to a recent survey which reveals a total of 16,800 electronic devices in use in 796 American industrial plants.

* * *

GOLENPAUL CELEBRATES 15TH YEAR WITH AEROVOX

Charley Golenpaul celebrated his fifteenth anniversary with Aerovox Corporation in May.

Golenpaul came to Aerovox in 1930, from Clarostat where he had been general sales manager.

He helped organize the Sales Managers Club and has served several terms as chairman of the Eastern group, which post he again occupies. He is active in various trade movements.

* * *

MECK DIE-CUT DEALER FOLDERS

A series of 3" x 4" die-cut folders illustrating postwar receivers have been issued by John Meck Industries, Inc., Plymouth, Indiana.

* * *

HOWARD RADIO APPOINTS SMITH BENNY AS EASTERN REP.

Howard Radio Company has appointed Smith Benny Sales Co., 11 West 42nd Street, as Eastern representatives. They will be in charge of distributor appointments in Maine, New Hampshire, Vermont, New York, Massachusetts, Rhode Island, Connecticut, New Jersey, Pennsylvania, Maryland, Delaware and Washington, D. C.

NEW PRODUCTS

(*Continued from page 41*)

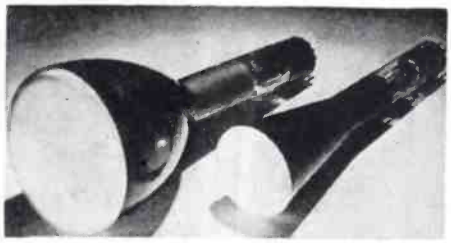
⅝" long or 1" long. The minimum resistance is 10 ohms for all units.

Common applications for these resistors are voltmeter multipliers, attentuation pads, etc.

* * *

SYLVANIA C-R TUBES

Standard 3AP1, 3BP1, 5AP1, 5BP1, 5CP1 and 5HP1 RMA c-r tubes and similar tubes supplied with P4 or other special phosphors, are now available from Sylvania Electric Products Inc., Emporium, Pa.



* * *

G-E PORTABLE OSCILLOSCOPES

A portable oscilloscope, type CRO-3A, has been announced by G. E.

The oscilloscope can be used for the study of wave shapes and transients, measurement of modulation adjustment of receivers, determinations of peak voltages, and tracing of tube characteristics.

Unit is equipped with a 906-P1 cathode-ray tube which has a greenish screen that can be viewed in daylight. G. E. says that moderately high-speed traces can also be photographed on the screen.

The unit has a wide-range sweep circuit featuring a linear amplifier. Sweep rates from 10 to 30,000 per second; adjustable by a 7-point vernier switch.

* * *

CENTRALAB MEDIUM DUTY POWER SWITCHES

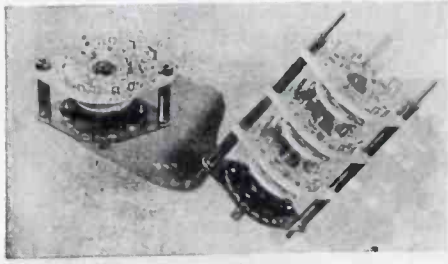
A J-switch series for power applications has been announced by Centralab, Division of Globe-Union, Inc., 900 East Keefe Ave., Milwaukee 1, Wis

Switches will be available in one to five sections, with srorting or nonshorting type contacts. In addition to the complete units, sections and indexes will be available separately for individual assembly in any desired combination. The switching combinations for the present will be one pole, 17 positions (18 positions, continuous rotation, with eighteenth position "off") and 3 poles, 5 positions (6 positions, with sixth position "off"). All units will be furnished with adjustable stops for limiting the desired number of positions.

Switches will have single hole, bushing mounting. In addition, there will be tie-rod extensions at both the front and rear of the switch to serve as locating keys and offer additional support in mounting. Locknuts, lockwashers, and a 2¼" bar knob wil be furnished with each unit. The bar knob has double set screws for secure mounting to the shaft.

Units wil have a double-roller index with minimum life operation of 25,000 cycles. Contact buttons wil be solid sil-

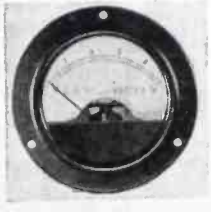
ver, and the terminals lug type. The rotor operating shaft will be square, fitting a staked sleeve in steatite rotors; sections will be grade 1.5 steatite, wax impregnated.



HICKOK SEALED METERS

Hermetically sealed 2½", 3½" and 4" round style meters with internal pivot construction, have been announced by The Hickok Electrical Instrument Company, 10529 Dupont Ave., Cleveland 8, Ohio.

Dimensions are in accordance with American War Standards C39.2-1 and C39.2-2. Instruments offered include voltmeters, ammeters, milliameters and microammeters, both a-c and d-c.



WALSCO SYNTHETIC INSULATION

Synthetic wire installation, "flexitube," has been announced by the Walter L. Schott Company, 9306 Santa Monica Boulevard, Beverly Hills, California.

Flexitube is said to be resistant to abrasion and effective over temperatures ranging from minus 35° C to plus 75° C.

Stock colors are red, black, green, and clear; other colors can be supplied. Sizes (B-S gage) range from 2 to 18.

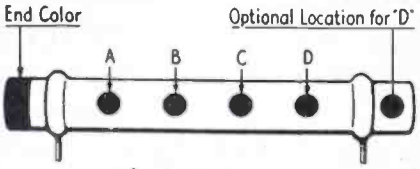
A sample kit containing various sizes and colors wil be furnished free upon request.

• • •

MARION MULTI-RANGE METERTESTER

A 0-10 ma/0-25-microampere 0-100-volt multi-range metertester featuring a stepless vacuum tube voltage control; 8½" mirror scale standard instrument and .1% wire-wound resistors has been announced by the Marion Electrical Instrument Co., Manchester, New Hampshire.

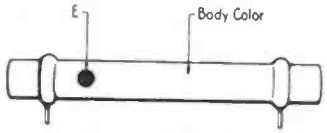
METHOD III



Color	Capacity mmfd: First Digit Dot A	Capacity mmfd: Second Digit Dot B	Multiplier Dot C	Tolerance Values: For Capacities Greater than 10 mmfd Dot D	Tolerance Values: For Capacities of 10 mmfd or less Dot D	Temper. Coefficient of Capac. mmfd/mmfd/°C End Color
Black	0	0	1	....	....	0
Brown	1	1	10	±1%	±0.1 mmfd.	$-0.3(10)^{-4}$
Red	2	2	100	....	....	$-0.8(10)^{-4}$
Orange	3	3	1,000	....	....	$-1.5(10)^{-4}$
Yellow	4	4	10,000	....	....	$-2.2(10)^{-4}$
Green	5	5	....	±5%	±0.5 mmfd.	$-3.3(10)^{-4}$
Blue	6	6	....	....	....	$-4.7(10)^{-4}$
Violet	7	7	.001	....	....	$-7.5(10)^{-4}$
Gray	8	8	.01	±2½%	±0.25 mmfd.	....
White	9	9	.1	±10%	±1.0 mmfd.	....

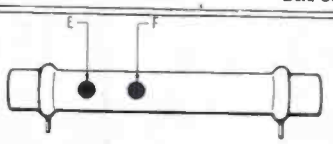
RCA CERAMIC CAPACITOR COLOR CODE CHARTS

METHOD I



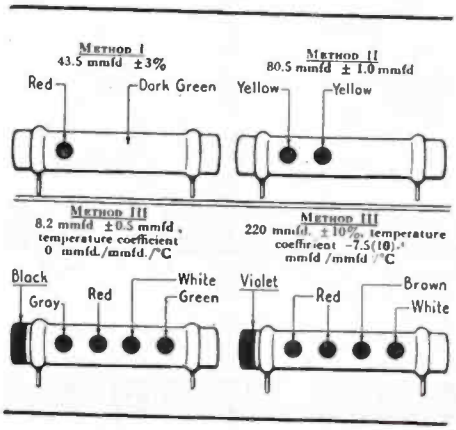
Capacity mmfd	Tolerance	Dot E	Body Color
34	±2½%	Red	White
37	±3%	Brown	Dark Green
43.5	±3%	Red	Dark Green
50	±2½%	Orange	Cream
120	±2%	Blue	Dark Green
150	±5%	White	Dark Green
400	±5%	Yellow	Dark Green

METHOD II



Capacity mmfd	Tolerance	Dot E	Dot F
4.7	±0.5 mmfd	Brown	Brown
4.7	±10%	Brown	Red
5.6	±0.5 mmfd	Blue	Blue
8.2	±0.5 mmfd	Orange	Orange
8.2	±0.5 mmfd	Yellow	Blue
10	±0.5 mmfd	Blue	Orange
10	±5%	Brown	Orange
12	±5%	Brown	Yellow
15	±5%	Brown	Blue
15	±10%	White	Orange
18	±5%	Brown	White
22	±5%	Red	Orange
27	±5%	Yellow	White
33	±10%	Red	Yellow
39	±2½%	Blue	White
39	±2½%	Red	Brown
39	±10%	Blue	Red
47	±2½%	Red	Blue
47	±2½%	Blue	Yellow
47	±10%	Red	White
56	±2½%	White	White
56	±2½%	White	Brown
68	±10%	Orange	Yellow
80.5	±1.0 mmfd	Yellow	Yellow
82	±2½%	Orange	Blue
82	±2½%	Red	Red
82	±10%	White	Gray
85	±1.0 mmfd	White	Red
215	±2½%	Orange	White

Examples



High-Voltage CONTROLS

★ The ingenious Clarostat Series 60 Hi-Voltage Coupler provides either 3,000 or 10,000 volts breakdown insulation between the control proper and its shaft and mounting.

This coupler is available with Clarostat Midget Controls Series 37 (composition-element) and Series 43 (wire-wound). Also with the large Series 58 wire-wound controls. Likewise with Clarostat multiple controls.

Especially desirable for controls used in high-voltage circuits such as television equipment, cathode-ray oscillographs, and many electronic applications.

Neat. Unit mounts as readily as usual control. And SAFE where high voltages are involved.

★ See Our Jobber...

He can help you solve your wartime servicing and maintenance requirements. Ask for copy of our "Interim Line" catalog. Or write us direct.

JOTS AND FLASHES

WILL WHITMORE named advertising manager of Western Electric Co. . . . R-L Electronic Corp., Chicago, appointed to distribute National Union radio tubes. . . . Astatic jobber s-m, Ray Schottenberg, recently visited jobbers in Virginia and Washington, D. C. . . . John Meck Industries, Inc., underwrites full cost of hospitalization and life insurance plan for employees with company over three months. . . . Albany (N. Y.) Hardware & Iron Co. to distribute Bendix home radios. . . . Radio Parts Co. of Phoenix, Arizona, will distribute Hoffman radios. . . . 5th "E" Award to Stromberg-Carlson. . . . With the European phase of the war concluded, there is a big possibility that you will be offered various assortments of surplus merchandise through dubious channels . . . don't be tempted. . . . Play ball with your industry and your customers. . . . Stock and sell only nationally known parts and equipment . . . guaranteed merchandise that assures customer satisfaction and a fair profit to yourself. . . . Work as closely as possible with your distributor . . . he can help you, plenty. . . . Have you bought your quota and a bit more of the 7th War Loan Bond issue?

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