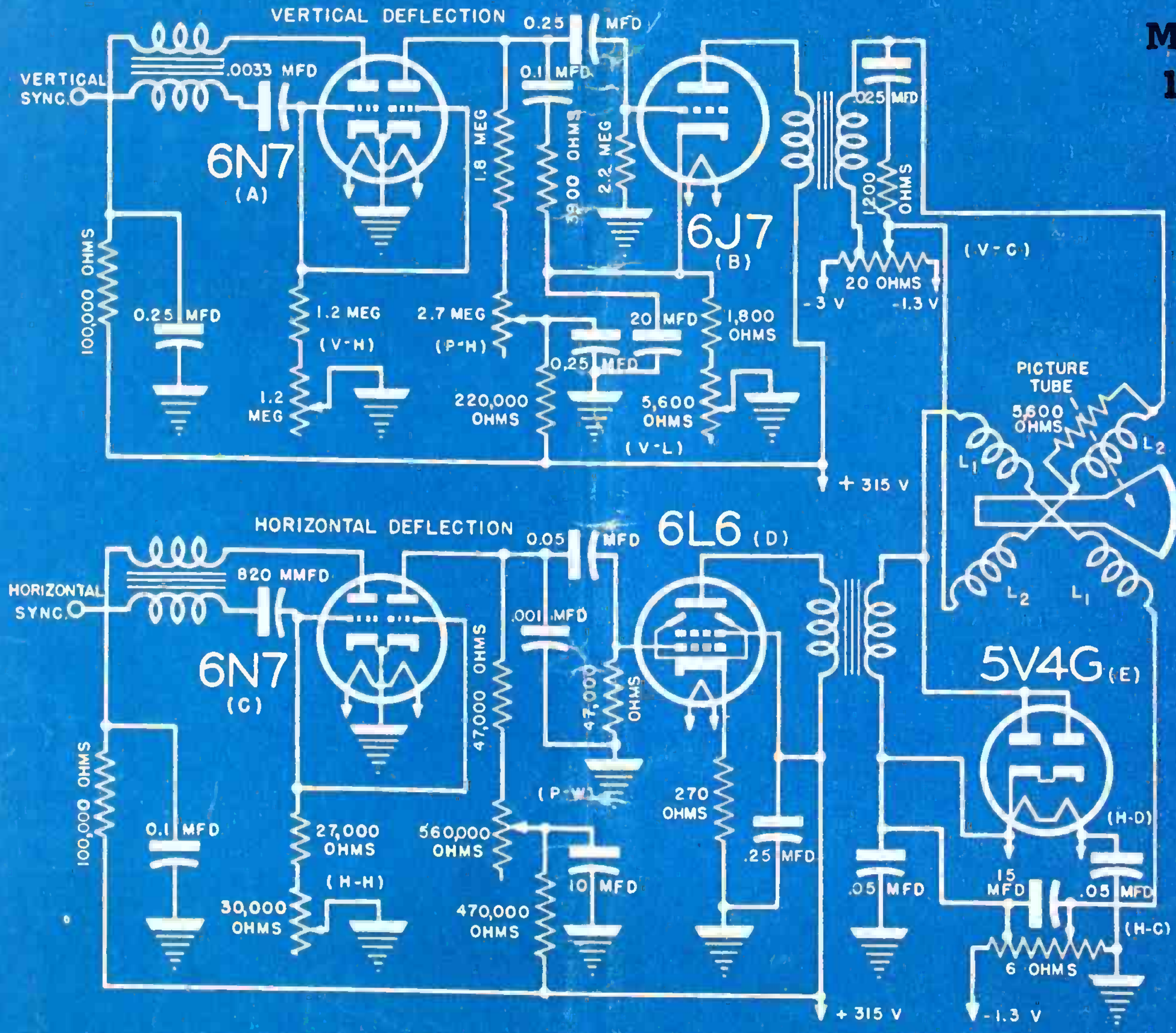
RADIO · TELEVISION · ELECTRONIC

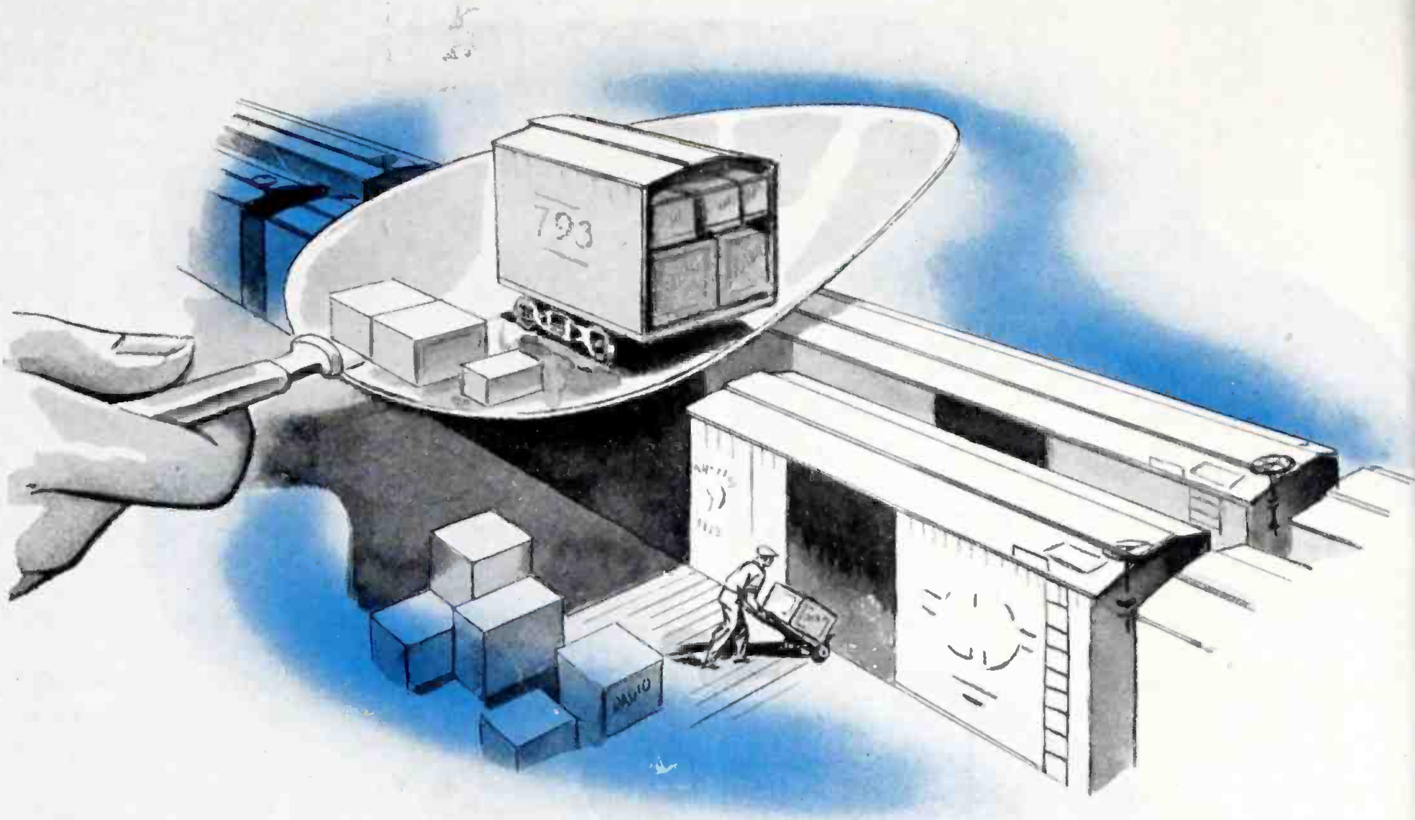
SERVICE

March 1945



Deflection circuits in a television receiver. (See page 36.)

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE



Cut Yourself a Slice of the First Radio Shipments

-- guarantee delivery on your first radio requirements

"Buy your new radio from Your Radio Dealer"—that is the theme of MECK advertising to your customers—appearing in Liberty.

Your biggest postwar problem is—deliveries. Here is a sales plan that answers that problem by guaranteeing deliveries.

An organized sales and distribution plan makes it possible for *you* to depend on *your share* of the *finest* radios available immediately after civilian set production starts.

Meck Radios will be sales leaders, year in and year out—from the start. You can now reserve a section of my production line, get your share of the first radio shipments, and stop worrying.

Ask your Parts Jobber today or write

JOHN MECK INDUSTRIES, Inc., PLYMOUTH, INDIANA

John Meck

EXCELLENCE IN MUSIC AND VOICE RECREATING INSTRUMENTS

MECK RADIOS

TABLE MODELS • PORTABLES • CONSOLE COMBINATIONS • PHONOGRAPHS

Fine instruments produced in volume with quality first . . . . to last.

Triplett

STANDARDS ARE SET BY TRIPLETT

ELECTRICAL INSTRUMENT CO.
BLUFFTON, OHIO

EDITORIAL

SOUND-SYSTEM servicing has become one of the most active projects of the Service Man today. And future plans indicate that sound systems will increase in their value. The dominant merit of sound as a medium of entertainment and utility has been demonstrated so effectively that the systems have become fixtures of importance in offices, plants and stores. Service Men alert to this new and growing medium have acquainted themselves with its problems and provided specialized services that have been most profitable. In the days to come the demand for such services will increase. There will be a surge of interest and use of sound systems for large and small quarters in large and small communities.

Sound has introduced a new phase in business . . . showmanship . . . demanding top-flight performance. The Service Man can be of material assistance in providing that quality of service. For upon his specifications and maintenance capabilities the sound-system performance can rise or fall.

The effectiveness of music at work has been substantiated in countless installations. But one of the most intriguing reports on sound systems' usefulness appeared recently, as a result of a poll at some large banks, where bank officers had believed that the installations would be disastrous. Practically all of the employees and executives declared that the sound system had pepped them up, relieved strain and aided in relieving the monotony of work. The music did not distract as the banking officials thought it would.

Special studios have been installed by many to provide a 24-hour service. There are also the additional important uses of the sound system that have proved themselves during the past years. These include paging, interoffice communications, special announcements, etc.

Sound systems offer the Service Man bright opportunities in installation, maintenance and servicing . . . today and particularly the future.

SERVICING is proving itself so vital in merchandising that many department stores are either establishing full-time departments, or contracting with service shops for exclusive services on a substantial scale. Commenting on the importance of servicing, one of department store heads said that the service shop is next in importance to selling itself. He pointed out that many a customer for a new receiver will be developed in the expert servicing of old equipment.

An analysis with words of wisdom for the Service Man.

SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office

Vol. 14, No. 3 — March, 1945

LEWIS WINNER
Editorial Director

ALFRED A. GHIRARDI
Advisory Editor

F. WALEN
Managing Editor

Copyright, 1945, *Bryan Davis Publishing Co., Inc.*

Published monthly by Bryan Davis Publishing Co., Inc.
19 East 47th Street, New York 17, N. Y. Telephone PLaza 3-0483

Member Audit Bureau of Circulations

Bryan S. Davis, Pres.
F. Walen, Secretary

Paul S. Weil, General Manager
A. Goebel, Circulation Manager

James C. Munn, 10515 Wilbur Avenue, Cleveland 6, Ohio
Pacific Coast Representative: Brand & Brand, 816 W. Fifth St., Los Angeles 13, Calif.; Telephone Michigan 1732

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

CLEVELAND YELLOW CAB COMPANY
Uses RAYTHEON TUBES
in world's first taxicabs with two-way radio!

The eyes of the nation's transportation industry are on Cleveland these days, for it is there that the world's first taxicabs equipped with two-way radio are being demonstrated by the Cleveland Yellow Cab Company.

Officials say that dispatching has proved so much more efficient that future fleets similarly equipped will eliminate millions of miles of wasteful "dead" cruising. And they also report that Raytheon High-Fidelity Tubes, used in both transmitter and receivers, provide clear, dependable reception—even in the tunnels under Cleveland's Terminal Tower.

This application of Raytheon Tubes is just one of many being planned for the postwar period by progressive manufacturers in the electronics field.

If you are a radio service dealer, you, too, should realize that Raytheon's combined prewar and wartime tube experience will result in even *better* tubes for all uses. Keep an eye on Raytheon . . . and watch for a Raytheon merchandising program that will help you be more successful, in the peacetime years ahead, than you've ever been before!

• • •

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, Massachusetts — Los Angeles
New York — Chicago — Atlanta

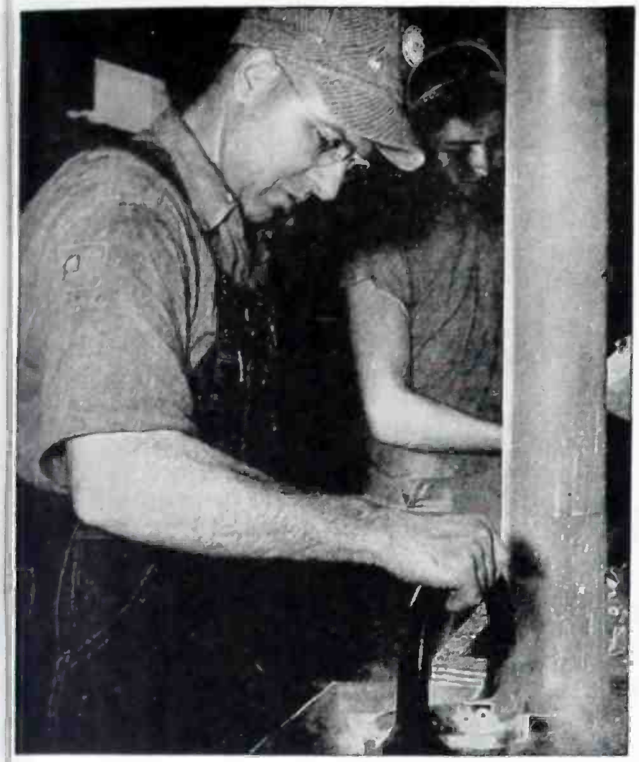
Listen to "MEET YOUR NAVY" Every Saturday Night ENTIRE BLUE NETWORK Coast to Coast 181 Stations

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

RAYTHEON
High Fidelity
ELECTRONIC AND RADIO TUBES

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


CL
★ LAPEL ★
Crystal Microphone
AG
Crystal Microphone
Public Address
C 6
Crystal Microphone
Public Address
C 7
Crystal Microphone
Public Address
RC
Home Recorder
Crystal Microphone
THINK ★ American
when you begin to utilize the conversions of military perfected voice transmission and electronic circuits that will be prevalent in the immediate post war period. Check the advantage of American Microphone quality. It is discernable . . . . it always is.
JOBBERS
Get your name on the list now, to receive important announcements American will make when the war time job is done.
American MICROPHONE CO.
1915 So. Western Avenue, Los Angeles 7, California



/outh and Experience—That's one combination that enables Meissner "precision-el" to produce the quality electronic equipment for which Mt. Carmel is gaining national recognition, for skill in electronics is rapidly becoming a tradition in this little city on the banks of the Wabash.

"PRECISION-EL"

You'll find it in Mt. Carmel, Illinois

Yes, here at Mt. Carmel, the men and women of Meissner bear the name of "precision-el" proudly. It is an honor and responsibility — an honor to be ranked with the most skilled craftsmen in an industry that is precision itself; a responsibility to uphold the Meissner standards of quality, accuracy and dependability.

On this page you will meet a few of the hundreds of men and women in Meissner's employ. Remember that they are your guarantee of performance when you use Meissner products, precision-built by "precision-el."

Light, Airy workrooms like this make any job pleasant. And when it's a precision job in electronics, like those jobs these men and women of Meissner are doing, no wonder they are able to merit the name "precision-el" for their pride in an exacting job well done.

No part is too small to merit the concentration and precision workmanship that characterizes Meissner precision-built products. Here a member of Meissner's "precision-el" shows why the name is so well deserved by the men and women of Meissner.

"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.

MEISSNER

MANUFACTURING COMPANY • MT. CARMEL, ILL.

ADVANCED ELECTRONIC RESEARCH AND MANUFACTURE

Export Division: 25 Warren St., New York; Cable: Simontrice

MARKET in the MILLIONS
FOR G-E ELECTRONIC TUBES AFTER V-DAY

To you as a dealer this big market spells PROFITS!

Few products have as many friends as G-E Mazda lamps.. Countless millions of these familiar bulbs have been sold. When again available, *millions of new General Electric electronic tubes will be sold* by radio dealers and service men—and for the same reasons: quality, dependability and long life.

To 38,000,000 readers, to 28,000,000 radio listeners, G-E tubes are being advertised regularly. The impetus of this wide publicity, added to the favor long enjoyed by G-E Mazda lamps and other G-E home products, assure a market of impressive proportions for G-E electronic tubes. So plan *now* for the larger income that awaits you! Write for the name of your nearest G-E tube distributor to *Electronics Department, General Electric, Schenectady 5, New York.*

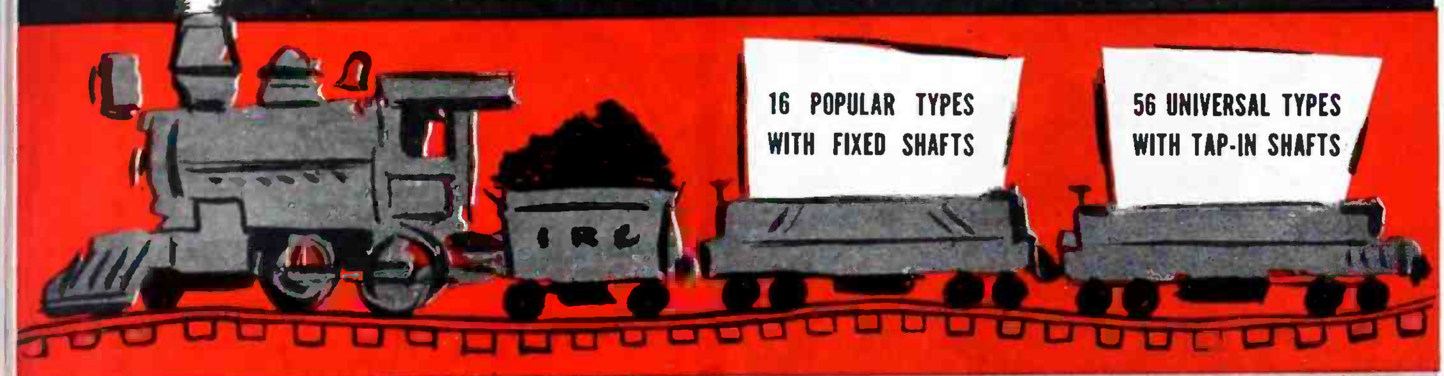
Hear the G-E radio programs: "The World Today" news, Monday through Friday, 6:45 p.m., EWT, CBS. "The G-E All-Girl Orchestra," Sunday 10 p.m., EWT, NBC. "The G-E House Party," Monday through Friday, 4 p.m., EWT, CBS.

GENERAL ELECTRIC

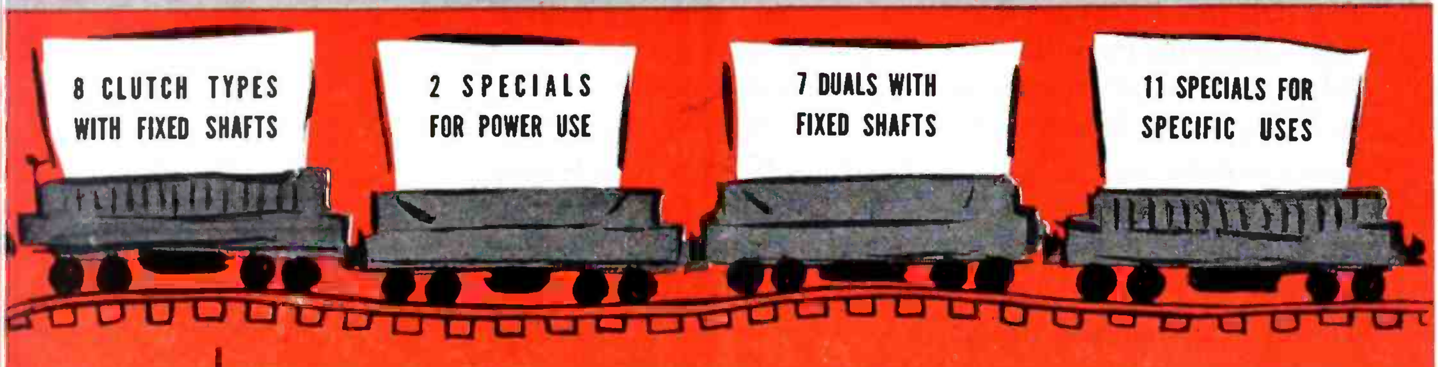
176-D2-6650

GET ABOARD! . . .

IRC's NEW "CENTURY LINE"



100 ALL-PURPOSE CONTROLS THAT WILL CARE FOR BETTER THAN 90% OF ALL YOUR SERVICE NEEDS! THIS MEANS *BETTER DELIVERY, SMALLER INVENTORY, MORE PROFIT* THROUGH FASTER TURNOVER. ASK YOUR PARTS JOBBER ABOUT THE NEW IRC CENTURY LINE TODAY.



PREFERRED FOR PERFORMANCE • IRC • FIXED & VARIABLE RESISTORS •

The IRC "Century Line" was developed because wartime restrictions and critical material shortages made it impossible to produce in sufficient quantity all of the exact duplicates, plus the many special controls which are in demand. The controls included in this streamlined version are all of the same high IRC quality for which the entire industry has always shown preference. Extreme care based on exhaustive study of sales records and set designs makes this "Century Line" the kind a busy service man would choose for himself. All numbers in the Century Line are available for urgent civilian replacement needs under L—265 priorities.

INTERNATIONAL RESISTANCE CO.

DEPT. 23-C • 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.

TO COMPANY PRESIDENTS:

Here's Another
BIG CHANCE FOR YOU
to "Pass the Ammunition!"

Today—thanks largely to you and other industrial executives—22,000,000 civilian workers are speeding victory and achieving postwar security through the Payroll Savings Plan. Over 60% of the 6th War Loan subscriptions came from this source—and, between drives, this forward-looking plan has been responsible for 3 out of 4 War Bond sales!

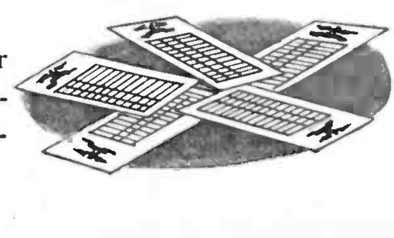
Good as this record is, the Payroll Savings Plan can be still more effective. Believing this can best be accomplished by giving Bond buyers a definite idea of the many benefits accruing to them, the War Finance Division has prepared a variety of active aids for employee education.

This new "ammunition" includes:

a—An entertaining, swift-paced moving picture, graphically showing the importance of buying—and holding—War Bonds.

b—An interesting, easy-to-read booklet, explaining how War Bonds may be accumulated to provide education for children, homes, retirement incomes, etc.

c—Attractive, handy War Bond envelopes, enabling Bond holders to note each separate purchase—and the specific purpose for which each Bond or group of Bonds was bought.



Passing this particular ammunition requires that you reappraise your own company's Payroll Savings Plan. Have your own War Bond Chairman contact the local War Finance Committee—today! They will welcome the chance to discuss this new program with you.

The Treasury Department acknowledges with appreciation the publication of this message by

SERVICE

This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

Three Star Performance!

Note that the Sprague Army-Navy E Flag now contains THREE stars. These stars, coupled with the original flag presentation mean FOUR separate citations for outstanding service in supplying Sprague Capacitors and Koolohm Resistors to match the exacting demands of the nation's armed forces.

Such a fact explains better than words why it has sometimes been impossible to meet all civilian needs for these products. But it also shows beyond question of doubt that you can rely on Sprague Capacitors and Koolohm Resistors for the utmost in service and dependability!

Ask for them by name. We'll appreciate it!

JRGENTLY NEEDED — Rider's Manuals #2 and #12; Late tube checker or tube ind set tester; good capacitor analyzer. F. F. Prewett, 26 San Pablo Ave., Richmon. Calif.

TUBES FOR SALE—34; 57; 85; 1J6; A5; 2A6; 2A7; 6C5; 6E6; 6L6; 6SC7; U5; 12F5; 12SC7; 32L7; 70L7. Want o buy RCA chanalyst for cash. Rose-Bud Elec. Service, Ripon, Wis.

SWAP OR SELL—Have several 4½" 0-50 ind 0-200 micro-amp meters; 2—75 watt nput xmitters with modulators; 2—7" Dumont scopes; 50 new 210 tubes and many mitting tubes such as HY30A, 807; 809, tc. All slightly used but good. Sell or rade for anything of equal value I can ise. Want Hickok traceometer. P. M. McCarthey, Lincoln Radio Co., 1026 N t., Lincoln, Nebr.

FOR SALE — Two 1200A Triplett volt-hm-milliammeters; one Triplett 1210 tube ester; Triplett 1220A free point tester; nodel 122 signal generator. Sell for cash. Vesley A. Covalesky, 854 Fahs St., York, a.

WANTED—Echophone EC-1 or EC-2 receiver or similar superhet short wave set. Cash. Richard Daniels, Webster, Wis.

WANTED—Late model tube tester, any ake, also 25,000 V-O-M for cash. Herbert H. Deppen, 1308 Bellevue Ave., aureldale, Pa.

RGENTLY NEEDED — 12" dual speed ortable phono-recorder, overhead or raight-across feed. Prefer 110 line cut inch. Can use microphone. Must be ood equipment. Irving L. Jacobs, 155-01 9th Ave., Jamaica 2, N. Y.

WANTED—Input transformer for Strom-rg-Carlson #25; also need all-wave sig. enerator. Will pay cash or swap hard-get tubes. George Miller, 94 Holland ve., Elmont, L. I., N. Y.

OR SALE—Good used tubes, meters, ansformers, variable condensers, etc. Write for list. E. R. Loving, 637 Black-awk, Weston, Mo.

RGENTLY NEEDED—Following tubes: A7; 1H5; 1N5; 3Q5; 1A5; 12SA7; 12SK7; SQ7; 117Z6; 35Z5; 35L6; 50L6 for pair of GI sets. Cpl. Howard C. Rix, 174333, 2531 AAF Basic Unit, Sec. C AAF, Pampa, Texas.

WANTED—Rider's manual #11. Evans adio Service, 720 University Ave., Madi-n, Wis.

FOR SALE—Philco #015 battery checker in new condition, $12. E. B. Kling, Blairs Mills, Pa.

WANTED—RME LF-90 frequency inverter; Triplett #1696A modulation monitor; Hallicrafters S-22R marine receiver; Browing frequency meter; Abbott TR4; Sargent model 11 ma.; any broadcast chassis that will tune to 100 kc; SW3 coils #41-42. Walter Kryger, 912 W. 151st St., East Chicago, Ind.

WANTED—Phonograph motor in new or used condition. Dick Walker, 86 Havemeyer Place, Greenwich, Conn.

WANTED — Anything in Radio — books, parts, tubes, etc. Will swap golf clubs and fishing rod. J. Bazewick, 3000 No. Christiana, Chicago 18, Ill.

FOR SALE—160 meter transmitter on 6' rack; 250 tubes in sealed cartons; Sonora AC-DC personal radio; asst. knobs, etc. Will swap any or all for test eqpt. J. Lubinsky, 3349 Fulton Rd., Cleveland, Ohio.

TUBES FOR SALE—In sealed cartons, O.P.A. ceiling price: 4-6V6 GT; 4-6A4; 4-6A6; 4-12A5; 1-1J6G; 1-1C6; 1-1A4; 1-1A6; 1-1F4. French Radio Electric Store, 476 Main St., Stamford, Conn.

FOR SALE—One Crosley Xervac in new condition, complete with accessories. French Radio Electric Store, 476 Main St., Stamford, Conn.

WANTED—RCA-165 Jr. voltohmyst, also Cornell-Dubilier BN Capacitor Analyzer. Describe. Paul Evanosky, 184 Zerby Ave., Edwardsville, Penna.

WANTED—Small, portable V-O-M about 4" x 7½" x 3". Cash. Describe fully. Henry Magarian, 2921 Griffin Ave., Richmond, Va.

WANTED—1" cathode ray tube. Will pay cash or swap equal value in 35Z4; 45Z5; 12SQ7; 6SQ7; 80; 5Y4; 5Y3; 6A8; 12SC7; 6SC7. Robert DeGrasse, 1407 W. Chestnut St., Yakima, Wash.

WILL EXCHANGE Echophone EC-1 and cash for Hallicrafters S-20R or what have you? Clayton Jircik, Box 187, Cleveland, Texas.

WANTED—Philco 027 VTV and circuit tester. Edwin T. Larason, Box 1237, Martinsburg, Ohio.

WANTED for starting new business: Tube tester and sig. generator; 117v ac eqpt. preferred to battery-operated. J. R. Miller, T.M.V. 1/c, Torp. Shop N.A.S., Norfolk 11, Va.

WANTED—Hallicrafter S-27 receiver or similar with provisions for dry cell battery operation. D. R. Gordon, S. P. Railroad, B & B No. 1, Dunsmuir, Calif.

FOR SALE OR TRADE—Model V.P. 553 new Mallory vibrapak. Want Superior or Jackson channel analyzer for cash. John Rierman, Nye Fairway Store, Nye, Wis.

FOR SALE—Practically new 50-watt RCA 110v AC amplifier with tubes; new Thordarson 6v 12-watt amplifier with tubes; 2 new University SAH re-entrant trumpet speakers; new Shure 55-C mike; four Jensen ST-257 (7-lb. magnet) PM speakers with line transformers, used, but excellent. Cash or will trade for photo eqpt. Al. Olson, 2915 Avenue Q½, Galveston, Texas.

URGENTLY NEEDED—12B8GT tube; set of 6-prong plug-in tuning coils; new or used radios, parts, etc. Kenneth Kirk, 236 State St., Jackson, Minn.

WANTED—Six each 3Q7GT; 117Z6GT; 50L6GT; 45Z3; 1LA4; 1LA5; 35L6GT; 35Z5GT and other hard-to-get tubes, also phono pickups, turntables and motors, power transformers, chokes, output transformers, and signal generator. Have three 25-watt output amplifiers for sale. Halmac Sound Service, 111 E. Santa Clara St., San Jose 20, Calif.

WANTED — Rider's manuals, condenser checker, 6v output power pack and VTVM. Gerald J. Luther, 6328 Tuxedo, Detroit 4, Mich.

WANTED—Test and service eqpt. of all kinds, at once, also several hundred tubes, also 25 or 30 table radios. Rush your list. James Ball, 1614 Dixdale Ave., Louisville 11, Ky.

WANTED—Rider Chanalyst, test oscillator, 3" oscillograph and capacitor analyzer. Must be in good condition. Cash. DeLong's Radio Service, 121 Shamrock St., East Alton, Ill.

FOR SALE—Philco and Superior oscillators; Weston volt-ohm tester; Solar capacity tester; Dayco and Supreme 85 tube testers; I-F output, input and power transformers; speakers; resistance line cords; dials; lamps; carbon and wire wound resistors; 244 tubes mostly new, incl. hard-to-get types, etc. Write for list. Sell all or none, $420. Collins Radio Shop, Church Point, La.

WANTED—by disabled World War II veteran, test eqpt. of all types, also radios, tubes, new and used, also parts. R Demarest, 217 La Grave S.E., Grand Rapids, Mich.

WANTED—12SA7; 12SK7; 12SQ7; 35Z5; 35L6; 50L6; 1A7; 1N5; 1H5; 1A5; 1Q5; 3Q5 tubes. State quantity and price by return mail. Also want sound head for Powers movie projector. Have hundreds of tubes and parts. What do you need. L. M. Wycoff, Marmaduke, Ark.

FOR SALE—32v DC to 115v 150-watt 60-cycle converter; 1/30 h.p. 32v motor for Wurlitzer record player; 11-tube Continental radio comb. chassis, record player OKay for this radio, 18" speaker. Rudolf Helms, Wauzeka, Wis.

FOR SALE—Rider chanalyst with earphones and A-F filter attachment; Hickok sig. generator PSG-15; General Radio variac 0-130v, 5 amps.; Rider's Manuals 1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13. All in god condition. Will sell as one unit, $300 complete. C. G. McKee, R.D. #5, New Castle, Pa.

FOR SALE—Several different models of DC power supplies, from 110v @ 2A to 1200v @ 500 ma. Write for list. I need these tubes, any quantity: 80; 5Z3; 83; 866Jr.; RK866; and 871. Don Linder, 17 N. 1st St., Geneva, Ill.

WANTED—Wireless record player with mike or phono motor, turntable and pickup. Henry P. Sutliff, 617 E. 8th St., South Boston 27, Mass.

WANTED — Hickok #530 tube tester; G-E SG-2 signal generator; voltohmyst. Other makes and models considered. Claude Haston, 2652 Woodbine Ave., Knoxville, Tenn.

WANTED — Test equipment and tubes (especially 12SA7, 12K7 and others of this series). Cash or will trade 50-watt xmitting tubes. R. A. Stratton, 300 Best St., High Point, N. C.

WANTED — 50L6; 35L6; 25Z5; 25Z6; 12SA7; and 35Z5 tubes, also table radio or combination, working or not. Cash. Variety Radio, 556 3rd Ave., New York 16, N. Y.

FOR SALE—Triplett #1230 sig. generator, battery operated, 6 bands, all charts, complete, $5. M. D. Corbett, RFD #1, Concord, N. H.

WANTED—Will pay reasonable price for 25 good table radios, and can use 10 consoles, nothing later than 1936 considered. Will purchase in lots of 25 tubes. What have you? Can furnish several new soldering irons. Cloyd's Radio & Appl. Service, P.O. Box 132, Yakima, Wash.

SEND US YOUR OWN AD TODAY!

For over two years now, the Sprague Trading Post has been helping radio men get the materials they need or dispose of radio materials they do not need. Literally thousands of transactions have been made through this service. Hundreds of servicemen have expressed their sincere appreciation of the help thus rendered.

Send your own ad to us today. Write PLAINLY—hold it to 40 words or less—confine it to radio materials. If acceptable, we'll gladly run it FREE OF CHARGE in the first available issue of one of the five radio magazines wherein the Trading Post appears every month.

HARRY KALKER, Sales Manager.

Dept. S-35, SPRAGUE PRODUCTS CO., North Adams, Mass.

Jobbing distributing organization for products of the Sprague Electric Co.

SPRAGUE CONDENSERS KOOLOHM RESISTORS

TM. REGISTERED U. S. PATENT OFFICE

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

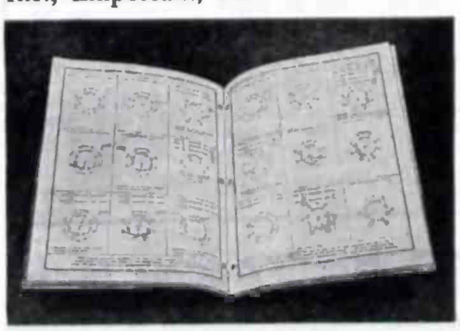
SYLVANIA NEWS
RADIO SERVICE EDITION

MARCH — *Published in the Interests of Better Sight and Sound* — 1945

Newest of Sylvania Electric's technical bulletins on Tube Substitutions is the 20 page "Aids To War-Time Servicing" that servicemen throughout the country are finding most helpful in these days of radio tube shortages.

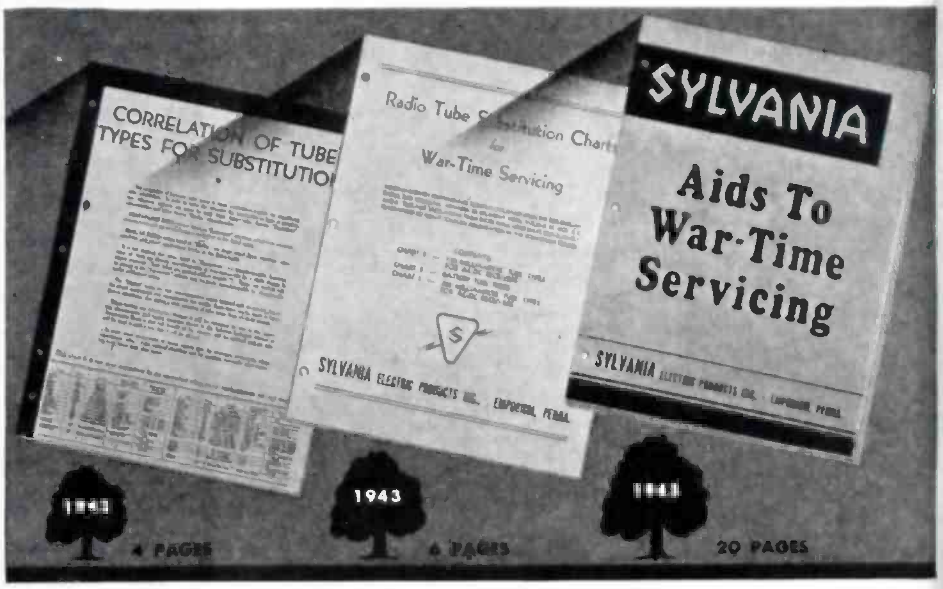
The manual is another Sylvania contribution to assist servicemen in meeting the present acute shortage of many tube types. In addition, it contains several charts of diagrams showing adaptor circuits commonly required.

This bulletin is available free on request from your Sylvania distributor, or from Sylvania Electric Products Inc., Emporium, Pa.



Sylvania Expands Service Aid with New Radio Tube Substitution Manual

Full Data Contained in New 20-page Bulletin Superseding Earlier Guides



Recognizing, early in the war, the difficulties that would result from tube shortages, Sylvania Electric immediately took steps to aid servicemen in tube substitution problems. Early in 1942, Sylvania published—and distributed free to servicemen—a 4-page bulletin, "Correlation of Tube Types for Substitution."

MORE EXTENSIVE DATA

This bulletin proved so helpful to servicemen that Sylvania continued this service in the Technical Section of Sylvania News, and then decided to re-issue the information in more comprehensive form. An enlarged, more fully developed "Radio Tube Substitution Charts for War-Time Servicing" appeared in 1943. This was a 6-page bulletin containing information based in part upon the WPB civilian radio tube program, permitting complete presentation in one convenient folder.

Now, newest and largest of these Serviceman Service charts is a 20-page manual entitled "Aids to War-Time Servicing" presenting the latest in Sylvania Tube Substitution Charts and containing 4 full-page charts of 9 diagrams each describing adaptor circuits.

CONSISTENT POLICY

Publication of this book is the latest step in Sylvania Electric's consistent policy of assisting radio servicemen to carry on their business efficiently and profitably.

SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa.

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS

SERVICE
A Monthly Digest of Radio and Allied Maintenance

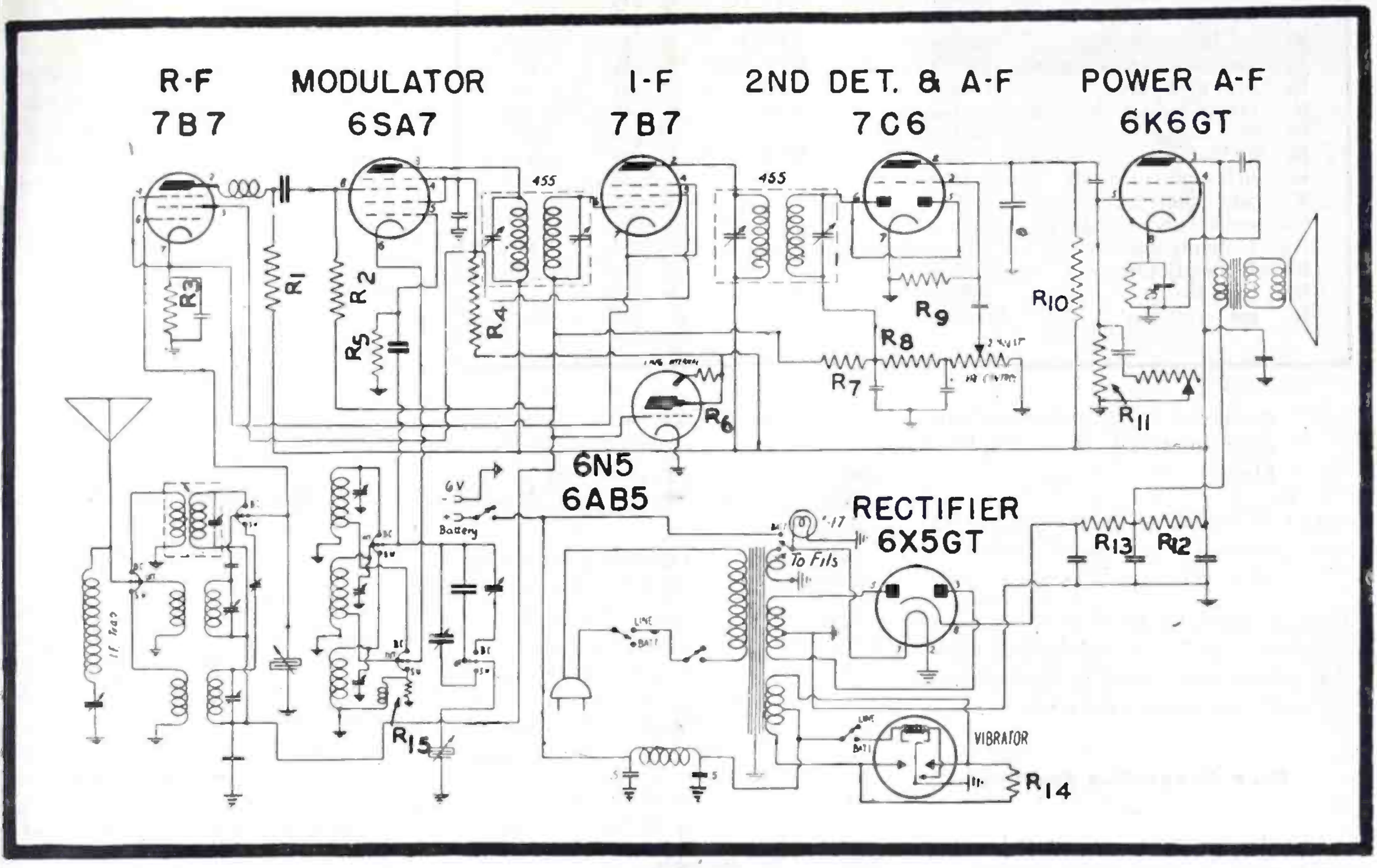


Fig. 1. A battery/a-c 7-tube super that employs fifteen fixed resistors for performing the various important functions described in this article.

FIXED RESISTORS

by ALFRED A. GHIRARDI
Advisory Editor

IF the numerous letters we have been receiving from newcomers to servicing are any indication, there is a steadily growing need for information about the various components that are used in receivers, and about the many simple, though essentially important operatio..: in service work that occupy a large part of the Service Man's time every day.

To assist these newcomers Alfred Ghirardi has especially prepared this, and the next articles of this series. Mr. Ghirardi offers a wealth of background knowledge about each of the important components employed in radio receivers, as well as practical servicing information concerning them that should prove extremely helpful. We invite suggestions for the subjects of future articles in the series.—Ed.

GENERALLY speaking, of the various *fixed* parts employed in receivers, capacitor failures seem to be most frequent. Then in order come resistors and finally coils (including the windings of chokes and transformers). Of those *variable* parts which combine mechanical movement with electrical function, volume and tone controls of the high-resistance type are notoriously liable to give rise to noises or erratic operation. Switches seem to come next. These are followed by variable tuning capacitors and loud speaker voice coils. The construction of these components; the nature of the common faults to which they are liable; and the practical servicing considerations involved in locating the faulty component and then either replacing or repairing it will be discussed in this series of articles. Fixed resistors will be considered first.

Fixed Resistor Applications

Fixed resistors of various types and sizes are employed in receiver circuits to perform a wide variety of important functions. For example, in the typical battery/a-c 7-tube super illustrated in Fig. 1, a total of fifteen fixed resistors of the types specified in the chart on page 12 (Fig. 1(*a*)) are used to perform the various functions enumerated.

The values given are normal or average. Many receivers will be found with values differing from these by as much as 2 to 1, or even greater in some cases.

Examination of the resistor tabulation will reveal that fixed resistors are employed to perform a wide variety of functions, even in simple receivers. To fulfill the various operating requirements imposed upon them, several types of fixed resistors are in general use.

(*1*) *Composition*: resistance element

Fig. 1 (a). Functions of the 15 fixed resistors shown in the circuit diagram (Fig. 1).

Resistor	Function	Type	Usual Value in Ohms	Usual Wattage	Resistance Tolerance
R_1	r-f plate load	carbon	1M-5M	½W	±15%
R_2	modulator grid load	carbon	47M-470M	¼W	±20%
R_3	r-f bias voltage	carbon	250-500	¼W	±20%
R_4	screen-voltage dropping	carbon or wire	10M-25M	2W	±15%
R_5	osc. grid leak	carbon	22,000	¼W	±20%
R_6	target-voltage dropping	carbon	1 meg.	¼W	±20%
R_7	avc voltage	carbon	2-4 meg.	¼W	±20%
R_8	audio filter	carbon	50M-100M	¼W	±30%
R_9	first audio grid leak	carbon	2-15 meg.	¼W	±30%
R_{10}	audio plate load	carbon	¼-½ meg.	¼W	±20%
R_{11}	second audio grid leak	carbon	¼-1 meg.	¼W	±30%
R_{12}	B supply filter	wire or carbon	1M-2M	6-8W	±10%
R_{13}	B supply filter	carbon or wire	100-300	2W	±10%
R_{14}	hash-filter	carbon	100-500	1W	±15%
R_{15}	bias equalizer	carbon	600-1M	¼W	±15%

composed of granular carbonaceous material, or a metallized film.

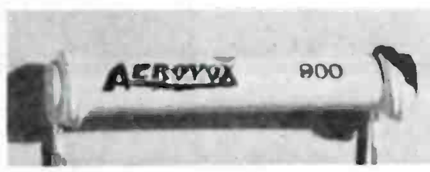
(2) *Wired-wound*: resistance element composed of resistance-alloy wire or ribbon.

Each is manufactured in a range of resistance and power-handling sizes that adequately covers all manufacturing and replacement demands.

Fixed Composition Resistors

Fixed composition resistors, Fig. 2, are used in modern radio receivers in greater numbers than are any other types of fixed resistors. This is so chiefly because they successfully meet the operating requirements imposed upon most of the resistors in the receiver, and at lower cost than do other types.

A good-sized book could be written on the subject of fixed composition resistors! They are, as a matter of fact, a makeshift forced upon us by the failure of nature to provide us with a good choice of inexpensive substances having specific resistance ranging between that of the fairly good conductors and that of the insulators. Those substances that possess such intermediate resistivity are either rare, expensive, or chemically and physically unsuitable. Hence, when high resistivity with reasonable bulk and cost are to be attained, we resort to the use of specially prepared high-resistivity carbon or metallic compositions. Resistors employing these are made in either of two special constructions. They are: (1) molded; (2) sprayed or painted.



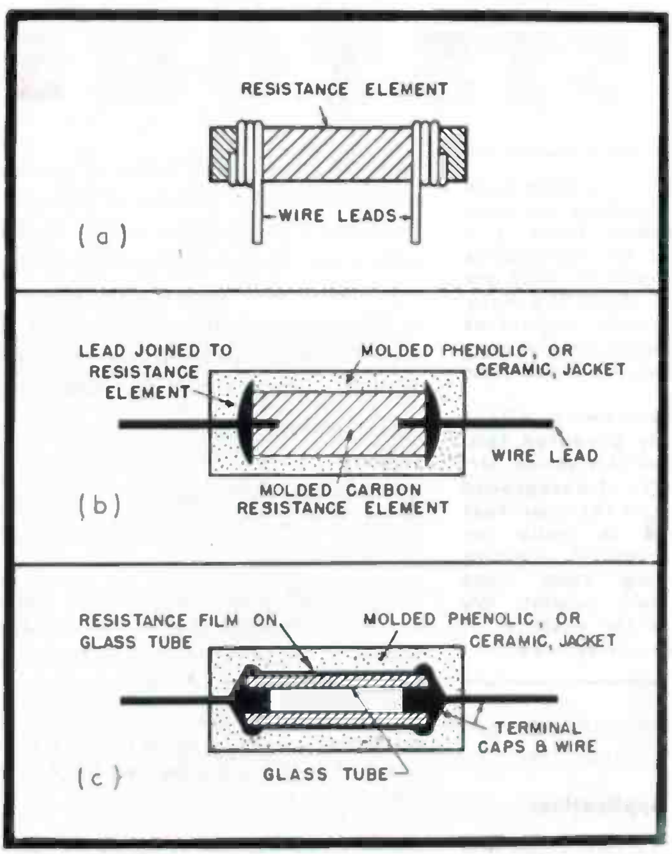


Fig. 2. Molded and sprayed-film type composition resistors. Above is a commercial type of non-insulated molded carbon resistor. (*Courtesy Aerovox*.) At left, (*a*), a cross-sectional view of this resistor.

Above, commercial type of insulated molded carbon resistor. (*Courtesy Aerovox*.) At left, (*b*), a cross-sectional view of this resistor. Below, at left, (*c*), a cross-sectional view of an insulated type sprayed or painted-composition resistor.

Molded Carbon Resistors

Molded carbon resistors, see (*a*) and (*b*) of Fig. 2, consist of a mixture of finely-granulated carbon with various inert materials (metallic oxides or silicon compounds) and a suitable resinous binder, all proportioned according to the resistance value the units are to have. The mixture is compressed in molds and fired at high temperature, or *continuously* extruded and fired. The resulting material is the heart of the resistor. For connecting them into a circuit, short terminal wires are securely wrapped and fastened to the ends of the resistance elements as illustrated at (*a*) of Fig. 2. It is extremely important that these wires make good contact with the body of the resistor, for a poor contact may be the source of disturbing noises in the receiver. The finished resistor is usually given a coating of lacquer or other substance impervious to moisture, then its resistance value measured and painted in accordance with the standard RMA color code. Such uninsulated type mold-carbon resistors are made in all RMA *standard preferred resistance values* (to be discussed later) ranging from 10 ohms to 20 megohms, such resistance values having tolerances of 5%, 10% or 20%, as desired. All resistance values are to be had in six sizes according to the amount of power to be dissipated within the resistor. These are ¼, ½, 1, 2, 4 and 5 watts.

Insulated Molded-Carbon Resistors

In the insulated molded-carbon resistor, molded carbon resistance element is surrounded with a molded phenolic, or ceramic, insulating shell as illustrated at (*b*) of Fig. 2. This protects the resistance element from becoming *shorted* or *grounded* if it comes in contact with the metal receiver chassis wiring or some nearby unit. An additional advantage is that the terminal wires are held absolutely rigid in the insulating shell and hence cannot loosen from the body of the resistor itself and produce a noisy unit. A further important advantage of the insulated-type composition resistor is that the insulating jacket protects the resistor element from the deteriorating effects of the surrounding air, humidity, etc., while the resistor is operating at elevated temperatures.

Temperature Ranges

In general, insulated composition resistors can be operated to 100°C and perhaps to 110° without damage. Hence, resistor sizes of the insulated types are *smaller* in physical dimensions than are non-insulated types of the same wattage rating. This makes them particularly useful in compact, crowded assemblies such as those of small midget receivers. However, they cost slightly more than the uninsulated type. They are made in ¼, ½, 1, and 2-watt sizes and in the RMA *standard preferred values* of resistance.

Insulated Sprayed-Type Composition Resistors

Another type of composition resistor that is used extensively where a compact high-resistance unit is needed, is the so-called *metallized* resistor. In this, the resistance element consists of a thin film of carbon or resistance metal painted or sprayed on a small glass rod or tube, or similar ceramic form. This prepared rod in lengths is then baked at high temperature. The finished tube, cut to size, is press-fitted to metal caps which make firm contact with the resistance layer and which also have the terminal wires attached to them. The unit is then molded into a protective phenolic or ceramic case. The assembly is illustrated at (*c*) of Fig. 2. This type of resistor has the same advantages that the insulated type molded carbon resistor possesses. It is similarly color coded, and is available in the full range of RMA *standard preferred resistor* values.

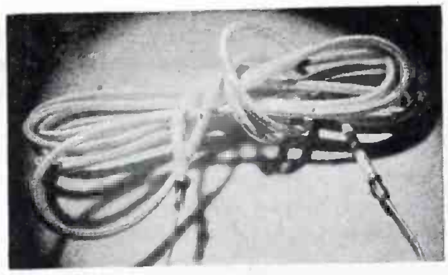


Fig. 3. A glass-insulated flexible resistor. Winding is on a fibre glass core encased in a braided fibre glass covering. (*Courtesy Clarostat*)

Fixed-Value Wire-Wound Resistors

Wire-wound resistors are ordinarily used in radio circuits where more power must be dissipated, or where greater resistance stability or accuracy is needed, than is possible with composition type resistors. They possess properties fundamentally different from the fixed-composition type in that their precision, stability and power-handling ability are more easily controlled in design.

Wire-wound resistors are made up in several different forms depending upon the resistance value and amount of power to be dissipated. Perhaps the cheapest and simplest of these is the form in which bare resistance wire is wound on fibre strips, the ends of the wire being soldered, crimped or welded to suitable mounting terminals. These wire-wound resistors are used as series filament resistors in battery-operated receivers, as grid suppressor resistors; in general in low-voltage circuits where only low resistance values are required and where current leakage across the fibre strip is of little consequence. They are made in power-dissipating capacities up to about 2 watts, although there are some types with higher wattage ratings.

Flexible Resistors

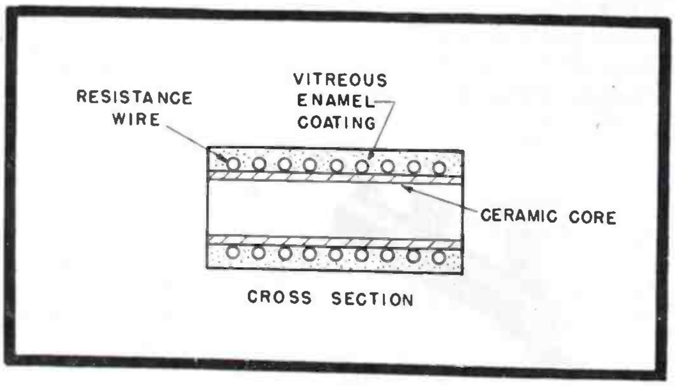
Flexible wire-wound resistors are used occasionally where a compact resistor of comparatively low value is required and the stable, noiseless performance of a wire-wound unit is needed. The resistance wire is wound on a flexible core and impregnated with a suitable insulating and protecting compound. A smooth flexible wiring is then braided over this. Terminal wires are brought out at each end, as illustrated in Fig. 3.

Flexible wire-wound resistors are made in values up to 800 ohms-per-inch in the ½-watt-per-inch rating, and up to 1600 ohms in the 1-watt-per-inch rating. The resistance value required thus determines the length of the resistor. The advantage of this type of wire-wound resistor is that it is self-supporting, flexible, and permits of direct point-to-point wiring in compact assemblies.

Vitreous-Enameled Wire-Wound Resistors

Vitreous-enameled wire-wound resistors are used in high-voltage circuits where larger amounts of power must be dissipated, as in voltage dividers, line-voltage dropping resistors in a-c/d-c receivers, etc. In the common form, illustrated in Fig. 4, the bare resistance wire (which is chosen for high resistivity and low temperature coefficient of resistance) is wound spirally on a porcelain or other form of ceramic tube with the adjacent turns spaced apart approximately ¾

Fig. 4. Common form of vitreous-enameled wire-wound resistor in which the vitreous coating is applied over the entire unit after the bare resistance wire is wound. At left appears a commercial unit (*Courtesy Ohmite*), and at right, a cross-sectional view.



of a wire diameter. The two ends of the wire are silver-soldered, brazed, or welded to metal rings clamped around the ends of the ceramic tube. A special vitreous enamel is then sprayed, dipped or dusted in dry form over the unit. Upon being *fired* at a temperature between 800° and 900° this vitrifies and forms a coating that serves mainly to fix the individual turns of wire in place and to match the thermal expansion of the wire and of the outer protective coating that is next applied. This second coating of refractory cement or vitreous enamel is usually applied wet and is then either baked or fired. It serves as a non-porous coating that protects the resistance element against corrosion and oxidation.

Enameled Resistor Ranges

Such vitreous-enameled wire-wound resistors are available in values from 1 to 100,000 ohms and are generally made in three wattage ratings (10, 20 and 50-watts) for ordinary radio-set use. They are also available in 75, 100 and 200-watt ratings for high-power applications.

Sealed Outer Sheel Units

Another recent form of wire-wound resistor in which the resistance wire itself is coated with a ceramic insulation before it is wound on a glazed ceramic tube, the entire unit then being sealed in an outer glazed ceramic shell for protection against both humidity and mechanical injury, is illustrated in Fig. 5. Because of its obvious advantages, this form of resistor has found wide use in recent military radio and radar equipment, and it is destined for widespread application in postwar radio-electronic equipment.

Fixed Tap Types

Wire-wound vitreous enameled resistors are also made with fixed taps taken off at various points along the winding. These are useful as voltage-dividers and for similar purposes. The top wattage rating for the entire unit is a function of the maximum current flowing in any particular section, since these units are usually wound with one size of wire.

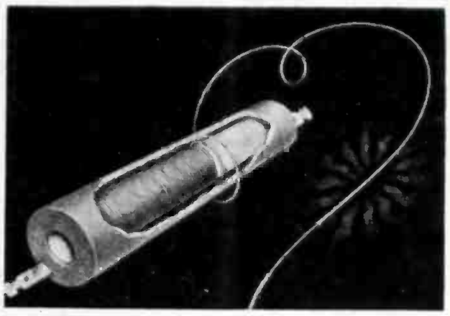


Fig. 5. Another recent form of resistor in which the wire itself is coated with a ceramic insulation before it is wound, the entire unit then being sealed in an outer-glazed ceramic shell.
(Courtesy Sprague Elec.)

Adjustable-Value Wire-Wound Resistors

Wire-wound vitreous-enameled resistors are also available in semi-fixed or semi-adjustable form with a sliding clamp arranged to make contact with a bared track of the resistance wire as illustrated in Fig. 6. The clamp can be locked at any point by means of the clamping screw. Any resistance value is thus obtainable from minimum to the maximum value of the resistor. Such units are extremely useful as adjustable voltage-dropping resistors, voltage dividers, etc. They are made in 25, 50, 75, 100 and 200-watt ratings.

Wire-Wound Phenolic-Insulated Resistors

Small wire-wound resistors in which the resistance element is wound on a ceramic form and molded in a phenolic compound also are used. They resemble the insulated type of carbon resistors in external appearance and are made in a limited range of resistance values seldom exceeding 5,000 ohms, principally in 1 or 2-watt size.

Metal-Clad Wire-Wound Resistors

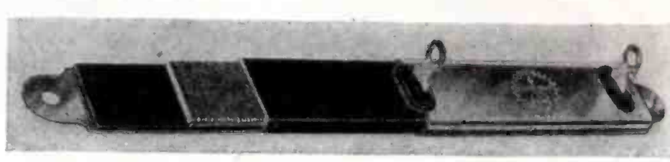
The metal-clad or armored wire-wound resistor is another form that has been widely used in radio receivers in applications where it is desired to dissipate appreciable power-per-unit of resistor area, as in line-voltage dropping resistors, voltage dividers, etc., in small receivers. The resistance wire is wound on a flat strip of high-temperature-resisting bakelite and has molded around it a shell of bakelite or other similar insulating compound. The entire unit is then covered with a metal jacket that provides good mechanical protection and also forms a good heat-dissipating contact when the resistor is mounted on a metal chassis. One such unit is illustrated in Fig. 7. These resistors are made in a variety of resistance sizes, and with a power dissipation of 2½ to 5 watts per inch. Some of the units are provided with one or more fixed taps along their length.

Resistor Types Usually Encountered

As a general rule, the low-wattage fixed resistor units (ranging from ¼ to 5 watts) encountered in radio receivers will be of the composition (compressed carbon or metallized) type. Higher-wattage units will almost always be one of the various forms of the wire-wound type. Wire-wound units of the small bakelite-enclosed type and resembling the insulated type carbon resistors will occasionally be encountered. These will rarely have more than about 5,000 ohms resistance however, and will be of only 1 or 2-watt size.

Fig. 7 (below). Metal-clad bakelite resistor, in which the winding is embedded in bakelite, which in turn is encased in the steel casing.
(Courtesy Clarostat)

Fig. 6. Fixed tap and adjustable-tap vitreous enameled wire-wound resistor.
(Courtesy Ohmite)



Get this Display!

Sell Customers on Your Service— Today and Tomorrow

Attractive full-color, 48" x 28" display easel (shown here in black and white)

How about putting this beautiful salesgirl to work for you?

Let her sell your customers the idea . . . quality tubes mean quality service. Identify yourself with the progress and future implicit in the fact that RCA developed and introduced more tubes on the joint Army-Navy Preferred List of vacuum tubes than any other manufacturer . . .

Let people know you are actively in business and are there to stay! Get your Preferred Type Display from your RCA distributor . . . today.

The Fountain-Head of Modern Tube Development is RCA

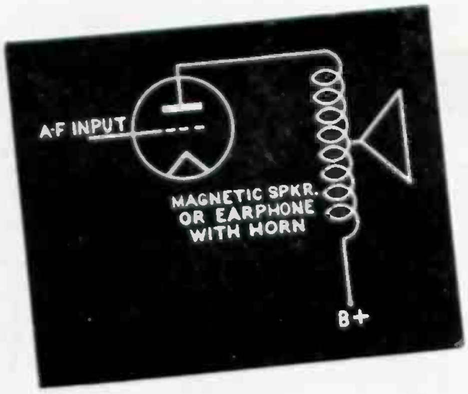
BUY WAR BONDS

RADIO CORPORATION OF AMERICA

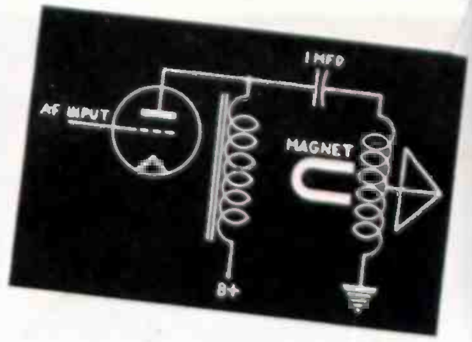
RCA VICTOR DIVISION • CAMDEN, N. J.

LEADS THE WAY . . . In Radio . . . Television . . . Tubes . . . Phonographs . . . Records . . . Electronics

62-6636-39



Figs. 1 (left) and 2 (right). In Fig. 1 we have a directly connected speaker in series with the plate supply. Fig. 2 shows an old type cone magnetic speaker in an impedance coupling circuit. The impedance coupling unit connected to the power tube eliminates d-c in the speaker.



PAST, PRESENT AND FUTURE

by ARNOLD D. PETERS

FEW receiver features have passed through so many turbulent cycles as tone quality. In the early days, when we had audions and loose couplers, and loudspeakers consisting of earphones and horns (megaphones), good tone quality was the equal of a telephone. Actually the demand was for more quantity than quality. There were no power tubes; hence, it was not unreasonable that, a little later, a sensitive horn-type dynamic speaker became the standard of comparison. This was the Magnavox with a 6-volt field made for storage battery excitation. The quantity was good, for those days, but the quality was, well, let us say understandable. The frequency range was very limited and there were no lows at all. Mechanically-inclined experimenters concocted speakers by attaching a pin to an ordinary earphone and connecting it to an external large diaphragm. The first real quality advance came when the magnetic type reproducers appeared. Western Electric provided this development, with a high quality cone speaker.

Cone Speakers

The cone speakers were actuated by a long pin connected to a motor-type armature suspended in the field of a large horseshoe magnet. These were wound for an impedance of several thousand ohms and connected directly in the plate circuit of a 10,000-ohm tube, as in Fig. 1. Upon the introduction of the 171, the first real low-impedance power tube, impedance coupling, (Fig. 2), became necessary. High plate currents were damaging the armatures, causing heating and maladjustment due to the large magnetic forces. Also the tone quality suffered because of iron saturation. In the improved arrangement a high-inductance a-f choke coil carried the d-c, and a 1-mfd blocking condenser passed the signal while isolating the speaker. The frequency range was extended in both directions, and the improvement in bass response was particularly noticeable.

Electro-Dynamic Speakers

Various manufacturers provided cone speakers and units, some with large units having increased flux densities with improved low-frequency response. However, the speakers were extremely frail and could not be mounted satisfactorily in a cabinet or console. This problem prompted the introduction of the electro-dynamic speaker, with its heavy, robust construction, large field coils, heavy yoke and provision for cabinet mounting and an output that lacked neither quantity nor quality. Low impedance tubes made it necessary to use transformer coupling for linking to the voice coils, Fig. 3. Used in conjunction with a 210 or 171, the performance proved superior to all previous systems.

Push-Pull Amplifiers

The next development of importance to better quality was the push-pull amplifier with the same dynamic speaker. Two distinct advantages were offered by push-pull. In the first instance a center-tapped primary winding on the output transformer provided division of the d-c plate in both directions so that the core saturation was eliminated. This resulted in a higher inductance; hence, higher reactance and better matching at the bass frequencies with a consequent improvement in bass response. To have complete cancellation of d-c effects the two output tubes were matched. Accordingly widely different tubes, such as a new one and very old one were not recommended. The second obvious improvement due to push-pull was the cancellation of all even harmonics. This is due to the in-phase currents flowing in opposite directions from the plates to the centertap, thus cancelling, Fig. 4. While theoretically a push-pull stage doubles the power output of a single tube, in practice, for a given amount of distortion, the power is more than doubled.

Bass Response Era

During 1928, a bass response trend was initiated. Bass response emphasis became a requisite of receivers. Manufacturers shunted large capacitors across the audio amplifier to provide the effect of bass boost. Actually the quality was destroyed, for a boomy bass usually resulted.

The next few years saw general improvements in quality due to the introduction of consoles, improvements in components, and new and better power tubes, such as the 45 and 2A3. Speakers also had new cone designs floated by means of a chamois or leather support which in-

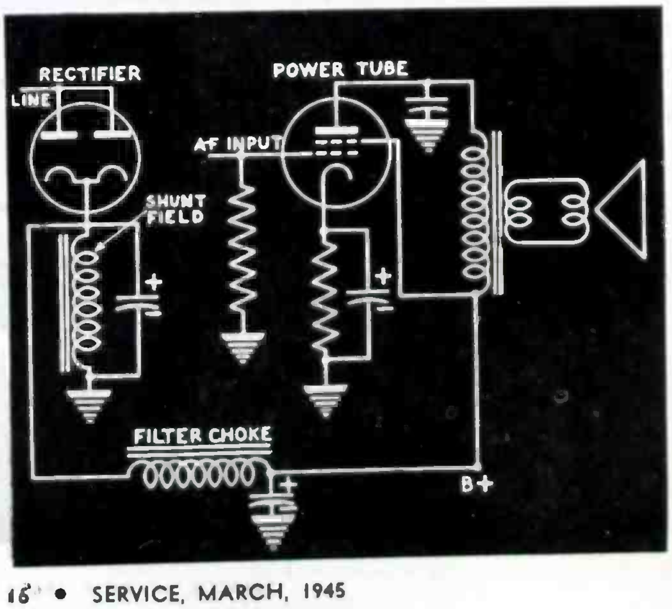
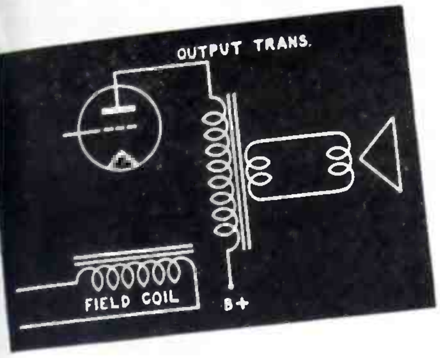
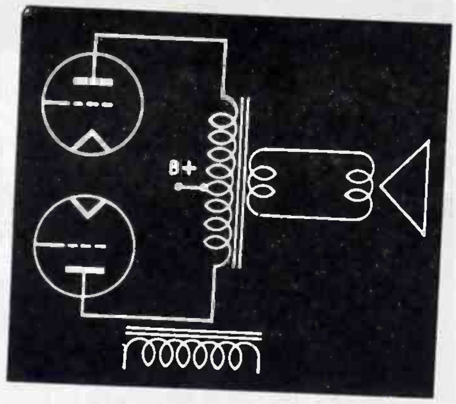


Fig. 5. A shunt-field filter circuit in an a-c/d-c receiver.



Figs. 3 (left) and 4 (right). Fig. 3, an output transformer used to provide matching between low-impedance voice coil and high impedance tube. Fig. 4 illustrates a simple push-pull circuit that helped to provide a decided improvement in quality.



STATUS OF TONE QUALITY

reased the bass output. Peerless and Colonial brought out speakers with only or 2 turns of heavy copper bars, acting as a secondary of the output transformer, to feed a 1-turn voice coil. These speakers had remarkable tone quality and perseverance. Many are still in use today.

Pentode Tubes

Tone quality faced a real test in the 932 period, with the introduction of the pentode type of output. While this tube offered many excellent features, its unusual properties required specialized treatment. Where such attention was omitted, tone quality suffered and quite substantially. For instance, before the pentode era a standard home console receiver had a second harmonic distortion of approximately 5% and decreasing amounts of distortion for higher order harmonics. Power-pentode receivers, on the other hand, often had a total harmonic distortion of 10 to 15%, and this was principally made up of third and higher order harmonics which are far more unpleasant to the ear than second harmonic distortion. Since odd harmonics were present, push-pull was of no assistance except that a different operating point (a compromise point) could be selected. This would reduce the third harmonic somewhat, while increasing the second. Beam power tetrodes later introduced created less third, but more second harmonic distortion.

Harmonic Distortion

While power pentodes had high output and considerably more voltage gain than triodes, their defects appeared to outweigh their advantages in a high quality receiver. The bass and high-frequency resonance points usually found in a dynamic speaker in conjunction with its output transformer caused a mismatch in loading which lead to increased harmonic distortion. In triodes, increased load impedance actually decreases distortion. Negative feedback, or degeneration offered a means of overcoming some of the pentode problems.

The increased gain due to pentodes led to the elimination of interstage audio transformers in favor of resistance coupling. This provided space and many economies, economies that were not however always judiciously effected. In some instances safety factors were disregarded to produce low-cost components. Smaller diameter speakers with weak fields were introduced. These were not capable of quality reproduction, regardless of the type amplifier used.

Class B Tetrodes

The introduction of class *B* tetrodes and pentodes for more power output provided more audio problems. For some of the receivers using these tubes had fairly good quality when run wide open, but when throttled down to apartment house levels, the reproduction was quite bad.

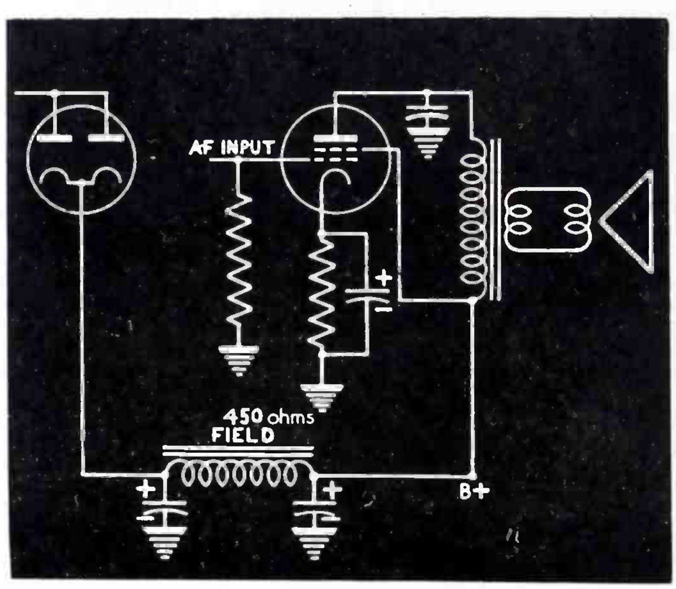
The tone quality feature faced problems in the early midget sets, particularly a-c/d-c models. Small electro-dynamic speakers with ample excitation of a 2000 to 3000-ohm shunt field were used, Fig. 5. Quality was fair, certainly commensurate with the size and price of the receiver. Then series field speakers became popular. Originally these were wound with No. 33 wire and had a resistance of about 450 ohms, Fig. 6. The 450 ohms of No. 33 later became 450 ohms of No. 34 with still less ampere turns; then 34½ and even 35. Having less ampere turns, they had weaker fields, and poorer quality.

A parallel case appeared in p-m speakers. There being no field coil to serve as a filter choke, resistance filters with very large capacitors were used, Fig. 7. Original p-m speakers in compact sets had good grade alnico magnets weighing 3 to 5 ounces. However, economies again applied and lighter magnets were used, ranging from 2 to as low as 0.8 ounce. Tone quality suffered materially, as a result.

Miscellaneous Quality Factors

Damping: The ability of a speaker to reproduce high frequencies and transients such as the clap of percussion instruments depends to a great extent upon the damping characteristics of the speaker. The plate resistance of the power tube is reflected across the speaker and assists the damping in the same manner as the shunt on a sensitive d-c meter increases its damping. The voice coil, in a magnetic field, acts like a generator when in motion, the power developed being dissipated in the effective resistance. A low impedance tube such as the 2A3 triode gives excellent damping, while a pentode, because of its high plate resistance, gives very poor damping. However, by applying a sufficient amount of

Fig. 6, a 450-ohm series-field filter in an a-c/d-c receiver.



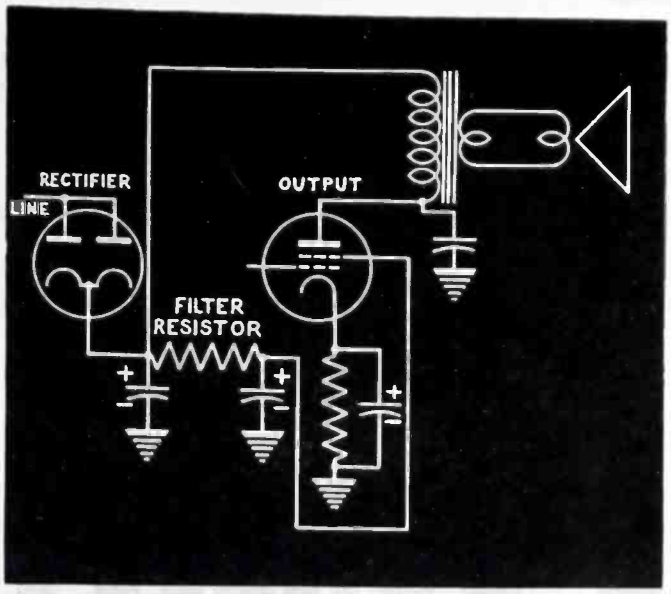


Fig. 7. A p-m speaker in a resistance-filter.

negative feedback, the effective plate resistance can be lowered to provide reasonable damping.

Noise: High quality demands the absence of noise. The coming of f-m should contribute greatly toward noise reduction, particularly summer static which often ruins reception completely. Deadening crashes in a-m sets can be made less objectionable by employing a limiter in the form of a grid resistance in series with the power tube grid. The heavy crash, representing a momentary voltage overload, will cause a voltage drop in this resistor due to the passage of grid current.

Deterioration: In considering quality we must consider long term performance, and thus component deterioration is an important factor. The poor quality of many components, particularly paper condensers, small resistors and output transformers caused a decadence of quality in the manufactured receiver but that isn't the whole story. Temperature, humidity and mechanical stresses play an important role in receiver efficiency.

Among the receiver defects caused by deterioration, we have hum. This may be caused by drying out of electrolytic condensers. Regeneration, tendency to squeaky quality or, in extreme cases, actual parasitic oscillation is another deterioration problem. Bad electrolytics may cause this, too. In this instance we may have a common impedance feedback in the power supply because of reduced bypass action of the filter condensers. Warping of speaker cones provide chatter and other mechanical defects. Leaky paper condensers also cause trouble. For instance, a leaky blocking condenser in a resistance-coupled amplifier can easily force a positive bias on the following grid which causes distortion.

Defective tubes can introduce noise, distortion and intermittents. Composition resistors or loose connections in tubular capacitors are another source of trouble. In auto and storage battery receivers the wearing of the vibrator contacts may cause hash, low volume or distortion.

Postwar Tone Quality

Many factors will determine the quality of reproduction in the peacetime receivers. Some are quite easily obtained; others only in part. The Service Man should be conversant with all.

An ideal system would provide: (1) adequate tone control; (2) balanced bass and treble range; (3) elimination of prominent peaks or valleys in sound output within the required range, no added frequencies not present in the original signal, and no extraneous signals or noise; (4) sufficient dynamic range in sound level; (5) good transient response.

Discussion of Quality Factors

Analyzing the foregoing we find that *high fidelity* to many has meant an extended range in high-frequency reproduction. This is not so, for an extended range in one direction is undesirable.

Speech Reproduction

In the reproduction of speech, it is desirable to reduce bass and increase treble response for greatest intelligibility, since the intelligence is carried mainly by the sibilants which are made up primarily of the higher frequencies. For music, a wide range extending in both directions is necessary. The exact frequency band is open to argument. It is quite an accomplishment to get appreciable 60-cycle output without any hum or to get a wide band with a single speaker, etc. When a signal is weak or suffers from a high noise level it is usually beneficial to cut both lows and highs for the greatest signal-noise ratio. Tone controls can also take care of individual likes and dislikes, particularly in records where the tone balance varies a great deal.

I-F Bandwidths

Effective acoustic response requires a properly treated room. The i-f bandwidth must be wide enough to handle the highest audio-frequency, and the audio amplifier and speakers must be properly designed and maintained for flat response.

Linear Problems

It is impossible to avoid added frequencies in output since we must have perfect linear amplification which doesn't exist. Single tube characteristics are never absolutely linear there must always be some harmonic distortion, but this can be kept within small, practical limits by proper design.

Selectivity

To eliminate extraneous signals or noise, we must have strong signals and adequate selectivity in the r-f end. Since noise is proportional to bandwidth (for a-m), reducing the bandwidth may improve reception in special cases.

Room Levels

Room level introduces quite a problem too. Since the room level cannot possibly be equal to the original program level, the optimum level and range is what you think it should be. Low background noise and a quiet room are certainly necessary. So is sufficient sound level which depends upon the physical conditions of the room and also upon neighbor etiquette (such as apartments in the summertime!). There is the possibility of using volume expansion, particularly on records. Bass compensation for different sound levels, such as obtained by tapped volume controls is a very important factor, and one, by the way, which needs standardization.

Transient Response

Good transient response requires a wide-band system and good damping of the speaker.

Listener Abilities

In establishing tone quality standards, we must not overlook the hearing abilities of the listener. As we know this characteristic varies considerably.

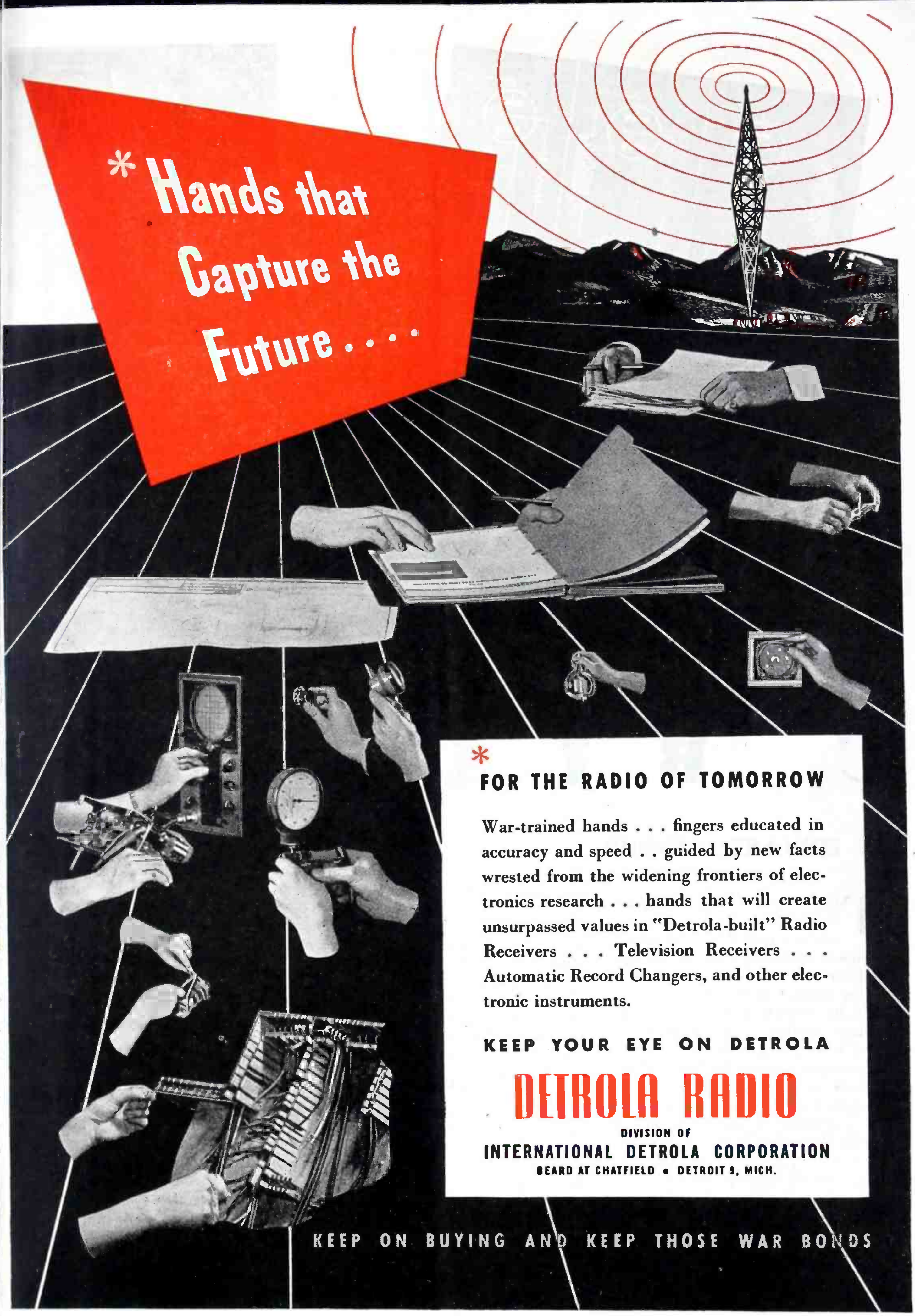
An effective analysis of this important problem was provided by Edward Arthur in the December issue of SERVICE. He said:

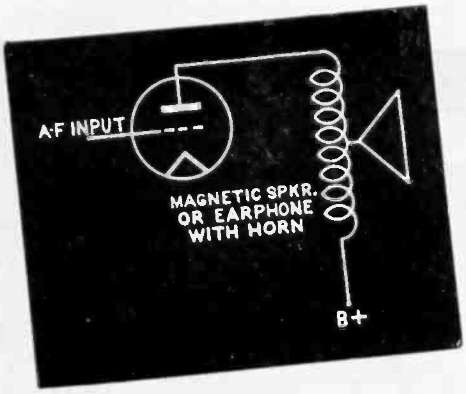
"There is a progressive deterioration of hearing ability with age. This is particularly true of the ear response in the upper registers. A surprisingly large percentage of people are tone deaf in varying degrees.

"Given a person of normal hearing, the response of the ear to frequencies between 30-15,000 cps varies, so that maximum response seems to lie between 3,000 and 4,000 cps. The second and more important factor in relation to receiver design, is that this variation in ear response is a function of volume level. Hearing response is poor at low frequencies at low levels, and improves as the amplitude is increased. High-frequency response likewise improves with amplitude, but not as rapidly.

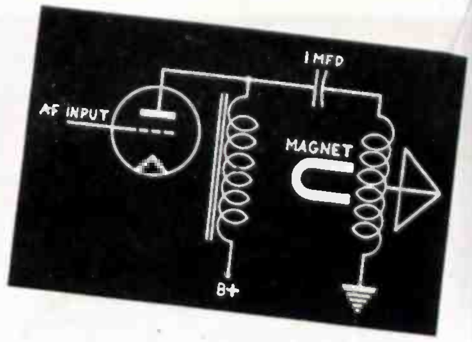
"Another factor is the influence of the duration of listening. Hearing acuteness decreases with time, due to fatigue.

"Perfect reproduction involves a frequency range of from 30 to 15,000 cps. However, the extreme frequencies may be eliminated, and satisfactory reproduction will still be obtainable. To gain some idea of this, let us take the response from an orchestra. We find that 95% quality is available with a frquency range of from 70 to 10,000 cps; 90% with a range of from 90 to 8,000 cps. Authorities differ, but the limits for good reproduction would seem to lie between 90 and 100 cps for the lower end, and 9,000 and 10,000 cps for the upper end. A note should be made here regarding speech reproduction limits, which are between 200 and 3,000 cps."


* Hands that Capture the Future....
*
FOR THE RADIO OF TOMORROW
War-trained hands . . . fingers educated in accuracy and speed . . guided by new facts wrested from the widening frontiers of electronics research . . . hands that will create unsurpassed values in "Detrola-built" Radio Receivers . . . Television Receivers . . . Automatic Record Changers, and other electronic instruments.
KEEP YOUR EYE ON DETROLA
DETROLA RADIO
DIVISION OF
INTERNATIONAL DETROLA CORPORATION
BEARD AT CHATFIELD • DETROIT 9, MICH.
KEEP ON BUYING AND KEEP THOSE WAR BONDS



Figs. 1 (left) and 2 (right). In Fig. 1 we have a directly connected speaker in series with the plate supply. Fig. 2 shows an old type cone magnetic speaker in an impedance coupling circuit. The impedance coupling unit connected to the power tube eliminates d-c in the speaker.



PAST, PRESENT AND FUTURE

by ARNOLD D. PETERS

FEW receiver features have passed through so many turbulent cycles as tone quality. In the early days, when we had audions and loose couplers, and loudspeakers consisting of earphones and horns (megaphones), good tone quality was the equal of a telephone. Actually the demand was for more quantity than quality. There were no power tubes; hence, it was not unreasonable that, a little later, a sensitive horn-type dynamic speaker became the standard of comparison. This was the Magnavox with a 6-volt field made for storage battery excitation. The quantity was good, for those days, but the quality was, well, let us say understandable. The frequency range was very limited and there were no lows at all. Mechanically-inclined experimenters concocted speakers by attaching a pin to an ordinary earphone and connecting it to an external large diaphragm. The first real quality advance came when the magnetic type reproducers appeared. Western Electric provided this development, with a high quality cone speaker.

Cone Speakers

The cone speakers were actuated by a long pin connected to a motor-type armature suspended in the field of a large horseshoe magnet. These were wound for an impedance of several thousand ohms and connected directly in the plate circuit of a 10,000-ohm tube, as in Fig. 1. Upon the introduction of the 171, the first real low-impedance power tube, impedance coupling, (Fig. 2), became necessary. High plate currents were damaging the armatures, causing heating and maladjustment due to the large magnetic forces. Also the tone quality suffered because of iron saturation. In the improved arrangement a high-inductance a-f choke coil carried the d-c, and a 1-mfd blocking condenser passed the signal while isolating the speaker. The frequency range was extended in both directions, and the improvement in bass response was particularly noticeable.

Electro-Dynamic Speakers

Various manufacturers provided cone speakers and units, some with large units having increased flux densities with improved low-frequency response. However, the speakers were extremely frail and could not be mounted satisfactorily in a cabinet or console. This problem prompted the introduction of the electro-dynamic speaker, with its heavy, robust construction, large field coils, heavy yoke and provision for cabinet mounting and an output that lacked neither quantity nor quality. Low impedance tubes made it necessary to use transformer coupling for linking to the voice coils, Fig. 3. Used in conjunction with a 210 or 171, the performance proved superior to all previous systems.

Push-Pull Amplifiers

The next development of importance to better quality was the push-pull amplifier with the same dynamic speaker. Two distinct advantages were offered by push-pull. In the first instance a center-tapped primary winding on the output transformer provided division of the d-c plate in both directions so that the core saturation was eliminated. This resulted in a higher inductance; hence, higher reactance and better matching at the bass frequencies with a consequent improvement in bass response. To have complete cancellation of d-c effects the two output tubes were matched. Accordingly widely different tubes, such as a new one and very old one were not recommended. The second obvious improvement due to push-pull was the cancellation of all even harmonics. This is due to the in-phase currents flowing in opposite directions from the plates to the centertap, thus cancelling, Fig. 4. While theoretically a push-pull stage doubles the power output of a single tube, in practice, for a given amount of distortion, the power is more than doubled.

Bass Response Era

During 1928, a bass response trend was initiated. Bass response emphasis became a requisite of receivers. Manufacturers shunted large capacitors across the audio amplifier to provide the effect of bass boost. Actually the quality was destroyed, for a boomy bass usually resulted.

The next few years saw general improvements in quality due to the introduction of consoles, improvements in components, and new and better power tubes, such as the 45 and 2A3. Speakers also had new cone designs floated by means of a chamois or leather support which in-

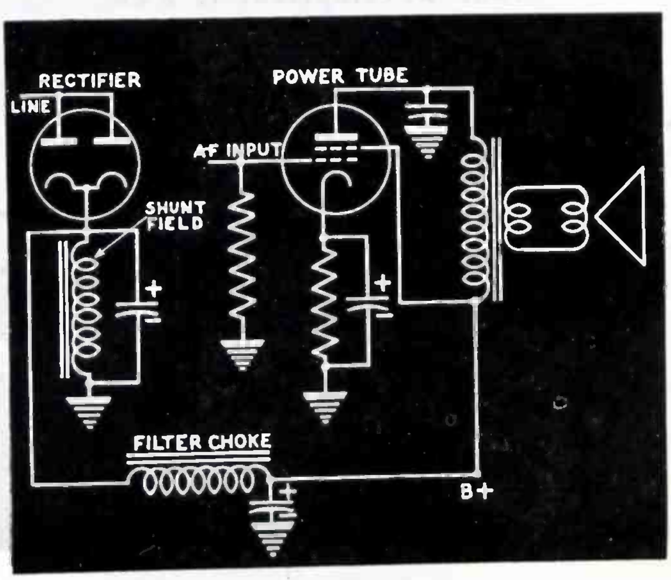
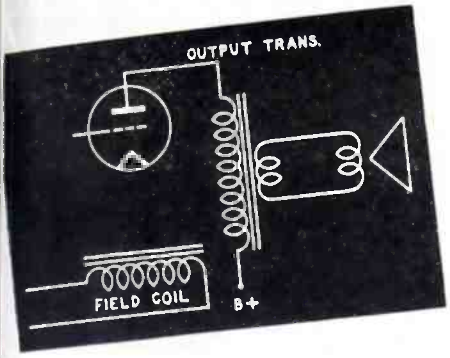
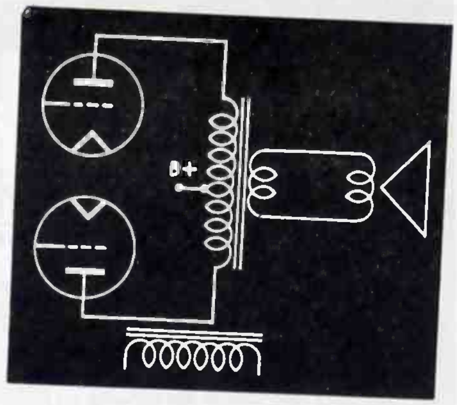


Fig. 5. A shunt-field filter circuit in an a-c/d-c receiver.



Figs. 3 (left) and 4 (right). Fig. 3, an output transformer used to provide matching between low-impedance voice coil and high impedance tube. Fig. 4 illustrates a simple push-pull circuit that helped to provide a decided improvement in quality.



STATUS OF TONE QUALITY

reased the bass output. Peerless and Colonial brought out speakers with only or 2 turns of heavy copper bars, acting as a secondary of the output transformer, to feed a 1-turn voice coil. These speakers had remarkable tone quality and perseverance. Many are still in use today.

Pentode Tubes

Tone quality faced a real test in the 1932 period, with the introduction of the pentode type of output. While this tube offered many excellent features, its unusual properties required specialized treatment. Where such attention was omitted, tone quality suffered and quite substantially. For instance, before the pentode era a standard home console receiver had a second harmonic distortion of approximately 5% and decreasing amounts of distortion for higher order harmonics. Power-pentode receivers, on the other hand, often had a total harmonic distortion of 10 to 15%, and this was principally made up of third and higher order harmonics which are far more unpleasant to the ear than second harmonic distortion. Since odd harmonics were present, push-pull was of no assistance except that a different operating point (a compromise point) could be selected. This would reduce the third harmonic somewhat, while increasing the second. Beam power tetrodes later introduced created less third, but more second harmonic distortion.

Harmonic Distortion

While power pentodes had high output and considerably more voltage gain than triodes, their defects appeared to outweigh their advantages in a high quality receiver. The bass and high-frequency resonance points usually found in a dynamic speaker in conjunction with its output transformer caused a mismatch in loading which lead to increased harmonic distortion. In triodes, increased load impedance actually decreases distortion. Negative feedback, or degeneration offered a means of overcoming some of the pentode problems.

The increased gain due to pentodes led to the elimination of interstage audio transformers in favor of resistance coupling. This provided space and many economies, economies that were not however always judiciously effected. In some instances safety factors were disregarded to produce low-cost components. Smaller diameter speakers with weak fields were introduced. These were not capable of quality reproduction, regardless of the type amplifier used.

Class B Tetrodes

The introduction of class *B* tetrodes and pentodes for more power output provided more audio problems. For some of the receivers using these tubes had fairly good quality when run wide open, but when throttled down to apartment house levels, the reproduction was quite bad.

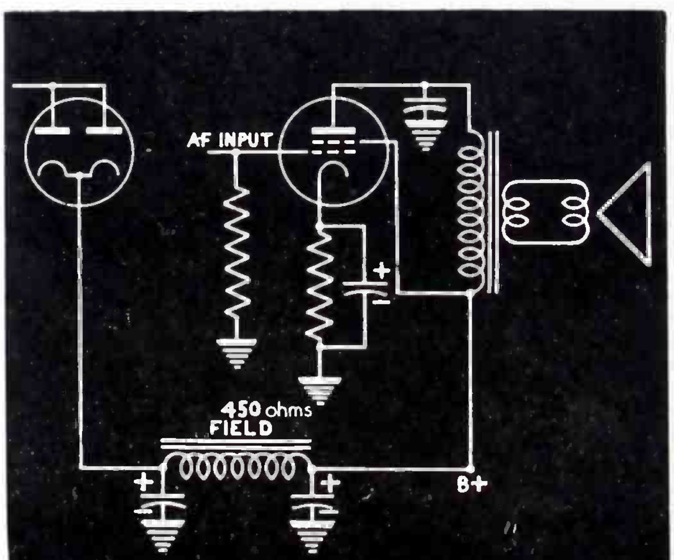
The tone quality feature faced problems in the early midget sets, particularly a-c/d-c models. Small electro-dynamic speakers with ample excitation of a 2000 to 3000-ohm shunt field were used, Fig. 5. Quality was fair, certainly commensurate with the size and price of the receiver. Then series field speakers became popular. Originally these were wound with No. 33 wire and had a resistance of about 450 ohms, Fig. 6. The 450 ohms of No. 33 later became 450 ohms of No. 34 with still less ampere turns; then 34½ and even 35. Having less ampere turns, they had weaker fields, and poorer quality.

A parallel case appeared in p-m speakers. There being no field coil to serve as a filter choke, resistance filters with very large capacitors were used, Fig. 7. Original p-m speakers in compact sets had good grade alnico magnets weighing 3 to 5 ounces. However, economies again applied and lighter magnets were used, ranging from 2 to as low as 0.8 ounce. Tone quality suffered materially, as a result.

Miscellaneous Quality Factors

Damping: The ability of a speaker to reproduce high frequencies and transients such as the clap of percussion instruments depends to a great extent upon the damping characteristics of the speaker. The plate resistance of the power tube is reflected across the speaker and assists the damping in the same manner as the shunt on a sensitive d-c meter increases its damping. The voice coil, in a magnetic field, acts like a generator when in motion, the power developed being dissipated in the effective resistance. A low impedance tube such as the 2A3 triode gives excellent damping, while a pentode, because of its high plate resistance, gives very poor damping. However, by applying a sufficient amount of

Fig. 6, a 450-ohm series-field filter in an a-c/d-c receiver.



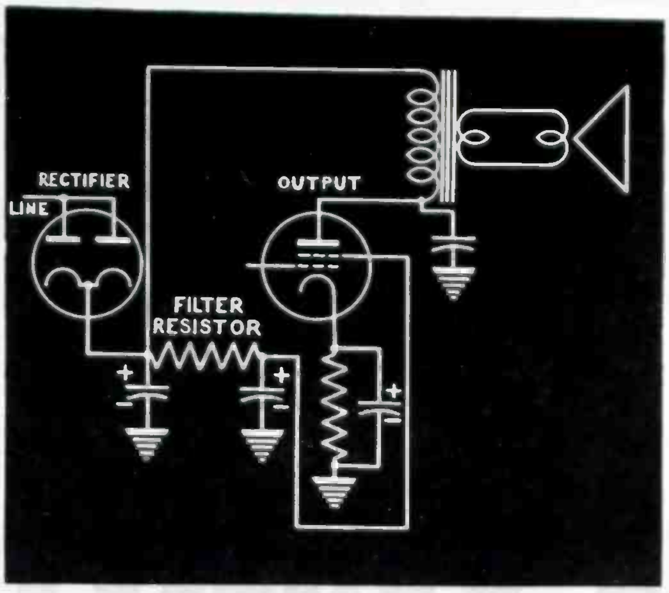


Fig. 7. A p-m speaker in a resistance-filter.

negative feedback, the effective plate resistance can be lowered to provide reasonable damping.

Noise: High quality demands the absence of noise. The coming of f-m should contribute greatly toward noise reduction, particularly summer static which often ruins reception completely. Deadening crashes in a-m sets can be made less objectionable by employing a limiter in the form of a grid resistance in series with the power tube grid. The heavy crash, representing a momentary voltage overload, will cause a voltage drop in this resistor due to the passage of grid current.

Deterioration: In considering quality we must consider long term performance, and thus component deterioration is an important factor. The poor quality of many components, particularly paper condensers, small resistors and output transformers caused a decadence of quality in the manufactured receiver but that isn't the whole story. Temperature, humidity and mechanical stresses play an important role in receiver efficiency.

Among the receiver defects caused by deterioration, we have hum. This may be caused by drying out of electrolytic condensers. Regeneration, tendency to squeaky quality or, in extreme cases, actual parasitic oscillation is another deterioration problem. Bad electrolytics may cause this, too. In this instance we may have a common impedance feedback in the power supply because of reduced bypass action of the filter condensers. Warping of speaker cones provide chatter and other mechanical defects. Leaky paper condensers also cause trouble. For instance, a leaky blocking condenser in a resistance-coupled amplifier can easily force a positive bias on the following grid which causes distortion.

Defective tubes can introduce noise, distortion and intermittents. Composition resistors or loose connections in tubular capacitors are another source of trouble. In auto and storage battery receivers the wearing of the vibrator contacts may cause hash, low volume or distortion.

Postwar Tone Quality

Many factors will determine the quality of reproduction in the peacetime receivers. Some are quite easily obtained; others only in part. The Service Man should be conversant with all.

An ideal system would provide: (1) adequate tone control; (2) balanced bass and treble range; (3) elimination of prominent peaks or valleys in sound output within the required range, no added frequencies not present in the original signal, and no extraneous signals or noise; (4) sufficient dynamic range in sound level; (5) good transient response.

Discussion of Quality Factors

Analyzing the foregoing we find that *high fidelity* to many has meant an extended range in high-frequency reproduction. This is not so, for an extended range in one direction is undesirable.

Speech Reproduction

In the reproduction of speech, it is desirable to reduce bass and increase treble response for greatest intelligibility, since the intelligence is carried mainly by the sibilants which are made up primarily of the higher frequencies. For music, a wide range extending in both directions is necessary. The exact frequency band is open to argument. It is quite an accomplishment to get appreciable 60-cycle output without any hum or to get a wide band with a single speaker, etc. When a signal is weak or suffers from a high noise level it is usually beneficial to cut both lows and highs for the greatest signal-noise ratio. Tone controls can also take care of individual likes and dislikes, particularly in records where the tone balance varies a great deal.

I-F Bandwidths

Effective acoustic response requires a properly treated room. The i-f bandwidth must be wide enough to handle the highest audio-frequency, and the audio amplifier and speakers must be properly designed and maintained for flat response.

Linear Problems

It is impossible to avoid added frequencies in output since we must have perfect linear amplification which doesn't exist. Single tube characteristics are never absolutely linear there must always be some harmonic distortion, but this can be kept within small, practical limits by proper design.

Selectivity

To eliminate extraneous signals or noise, we must have strong signals and adequate selectivity in the r-f end. Since noise is proportional to bandwidth (for a-m), reducing the bandwidth may improve reception in special cases.

Room Levels

Room level introduces quite a problem, too. Since the room level cannot possibly be equal to the original program level, the optimum level and range is what you think it should be. Low background noise and a quiet room are certainly necessary. So is sufficient sound level which depends upon the physical conditions of the room and also upon neighbor etiquette (such as apartments in the summertime!). There is the possibility of using volume expansion, particularly on records. Bass compensation for different sound levels, such as obtained by tapped volume controls is a very important factor, and one, by the way, which needs standardization.

Transient Response

Good transient response requires a wide-band system and good damping of the speaker.

Listener Abilities

In establishing tone quality standards, we must not overlook the hearing abilities of the listener. As we know this characteristic varies considerably.

An effective analysis of this important problem was provided by Edward Arthur in the December issue of SERVICE. He said:

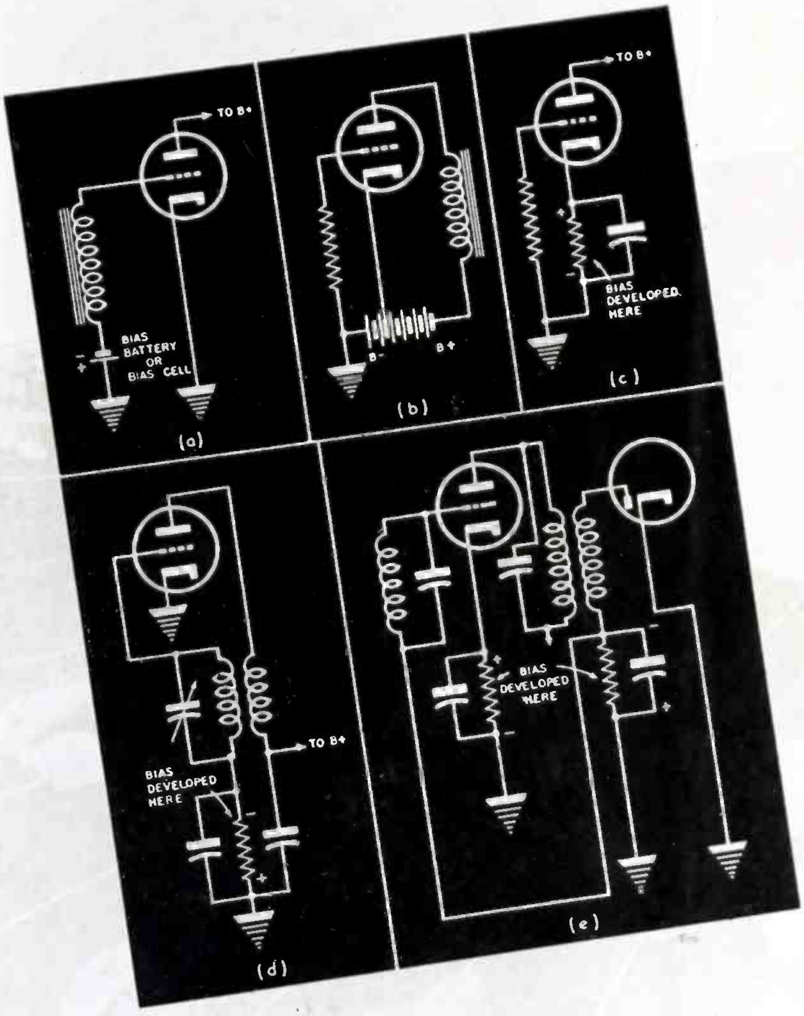
"There is a progressive deterioration of hearing ability with age. This is particularly true of the ear response in the upper registers. A surprisingly large percentage of people are tone deaf in varying degrees.

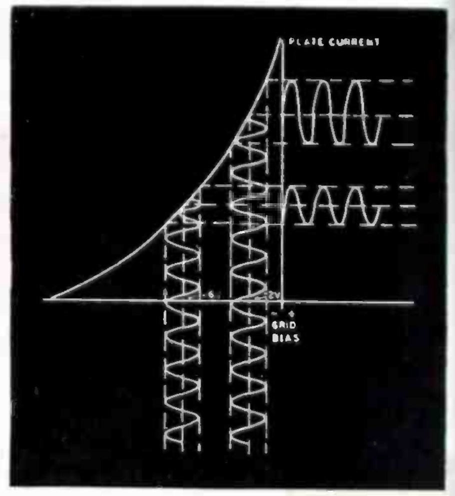
"Given a person of normal hearing, the response of the ear to frequencies between 30-15,000 cps varies, so that maximum response seems to lie between 3,000 and 4,000 cps. The second and more important factor in relation to receiver design, is that this variation in ear response is a function of volume level. Hearing response is poor at low frequencies at low levels, and improves as the amplitude is increased. High-frequency response likewise improves with amplitude, but not as rapidly.

"Another factor is the influence of the duration of listening. Hearing acuteness decreases with time, due to fatigue.

"Perfect reproduction involves a frequency range of from 30 to 15,000 cps. However, the extreme frequencies may be eliminated, and satisfactory reproduction will still be obtainable. To gain some idea of this, let us take the response from an orchestra. We find that 95% quality is available with a frquency range of from 70 to 10,000 cps; 90% with a range of from 90 to 8,000 cps. Authorities differ, but the limits for good reproduction would seem to lie between 90 and 100 cps for the lower end, and 9,000 and 10,000 cps for the upper end. A note should be made here regarding speech reproduction limits, which are between 200 and 3,000 cps."

* Hands that Capture the Future . . . .
* FOR THE RADIO OF TOMORROW
War-trained hands . . . fingers educated in accuracy and speed . . guided by new facts wrested from the widening frontiers of electronics research . . . hands that will create unsurpassed values in "Detrola-built" Radio Receivers . . . Television Receivers . . . Automatic Record Changers, and other electronic instruments.
KEEP YOUR EYE ON DETROLA
DETROLA RADIO
DIVISION OF
INTERNATIONAL DETROLA CORPORATION
BEARD AT CHATFIELD • DETROIT 9, MICH.
KEEP ON BUYING AND KEEP THOSE WAR BONDS





Figs. 1 (left) and 2 (above). Fig. 1 shows five methods of obtaining *C* bias. In (*a*) we have a fixed bias method. Bias cells or *C* batteries may be used. In (*b*) we have another fixed bias method accomplished by returning the cathode to some potential above *B*—. In (*c*) we have a self-bias method obtained by means of a cathode resistor. In (*d*) we see how grid current provides its own bias in an oscillator. In (*e*) the total bias on the grid is the sum of the cathode bias plus the voltage developed by the diode rectifier. Fig. 2 shows how bias voltages influence the amplification of a tube. Note that amplification is higher at minus two volts than at minus six volts.

C BIASING

by EDWARD ARTHUR

THE *C* bias, or control-grid bias is quite an important factor in receiver operation. Accordingly complete familiarity with biasing types and applications is quite helpful in locating sources of trouble.

In its simplest form, *C* bias is the voltage applied to the control grid. This voltage may be developed in the control-grid circuit itself, or in the cathode or bleeder circuits, or it may be applied directly to the control grid. Its amplitude is dependent on the circuit with which it is associated, and the particular mode of operation of the tube: that is, whether the tube is an r-f amplifier, oscillator, detector, audio voltage or power amplifier, or a control circuit.

Bias Types

Bias methods are classified as either self-bias or fixed bias. Self-bias, or cathode bias, is used in audio amplifiers, where the tube is operating near peak values. Higher values of grid resistors may be used in self-bias circuits, permitting greater stage gain in resistance-coupled amplifiers. This is due to the decreased loading effect of the grid resistor on the previous stage. Self-bias also permits the tube to adjust its bias to its plate current, so that voltage variations are automatically compensated.

Bias Methods

Five basic methods may be used for supplying grid bias:

(*1*) By the use of a dry battery, giving the required voltage directly. Bias cells also come under this category. This is a fixed method of bias.

(*2*) By bleeder resistance in the *B* supply.

(*3*) By developing the voltage across a resistor in the cathode circuit of the tube. This is a self-bias method.

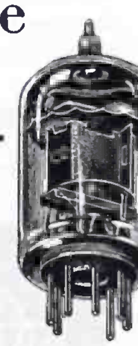
(*4*) By developing the voltage across a resistor in the grid circuit of a tube as in self-excited oscillators; a self-bias method.

(*5*) By rectification of an applied signal, as in avc systems associated with diode detectors. Here, the bias voltage will vary with the strength of the incoming signal, Fig. 1.

Bias Voltage

In effect, the bias voltage determines the operating point of any tube in any circuit. Fig. 2 shows an I_p-E_g curve of a triode, and the effect of bias voltage on the amplification factor of the tube. Bias alone does not determine the amplification, since other factors such as the impedance of the grid and plate circuits associated with the tube, filament and plate potentials, and the effectiveness of the filter circuits, also influence circuit gain. However, the influence of the bias voltage is high, and its ability to control gain characteristics is often used, as in avc sys-

more efficient ...in miniature



The modern hearing aid is a fine example of greater efficiency . . . in miniature. No longer does the awkward ear trumpet or an apologetic "a little louder please" embarrass the hard of hearing. The compact hearing aid of today, with its inconspicuous ear button, admits these people to a world from which partial deafness had formerly isolated them. This has been made possible by smaller tubes.

In countless applications, TUNG-SOL Miniature Tubes do everything the large old style tubes did and in most cases are doing it better.

To manufacturers of radio sets and electronic devices, size and weight reduction is so important that TUNG-SOL is now producing many of the new miniature types. The development of other miniature types to function where larger tubes are now used is also foreseen.

Jobbers, dealers and service men will not only find the TUNG-SOL line complete, but each tube as dependable a tube as can be made.

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

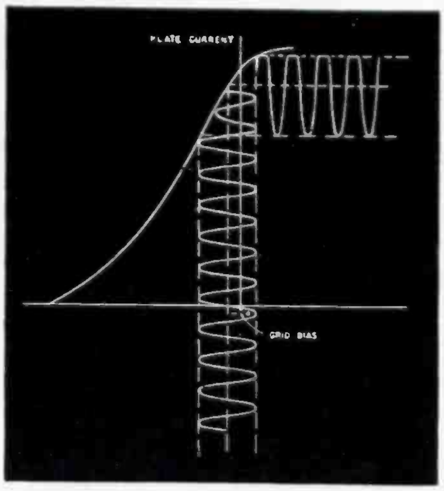


Fig. 3 shows what happens when the signal input exceeds the bias voltage. On the positive peaks of input the grid draws current and creates distortion. Note the distorted flat top on the output signal. This, in effect, is a form of signal rectification.

tems, to control the amplitude of the received signal.

Other Grid Voltage Uses

A second use of the grid voltage is to prevent the control grid of a tube from going positive, draining current, and thereby distorting the wave form, Fig. 3. This is particularly true of audio voltage and power amplifiers. From Fig. 3, it can be seen that if, on the positive half-cycle of the grid input voltage, the peak of the input or driving voltage, were to exceed in value the grid bias voltage, since these two voltages are opposite in sign, the sum would equal a positive value. This positive voltage, applied to the grid, causes the grid to draw current and creates the distortion shown in Fig. 3. It should be noted at this point, that most a-c voltmeters, vacuum tube or otherwise, measure rms or .707 of peak voltage, and that in calculating maximum permissable input voltage, it should not exceed .707 of the grid bias voltage.

Rectification

Grid bias also serves other purposes. In grid or plate detectors, it serves to produce rectification of the received signal, Fig. 4 *a, b*.

Plate Detectors

In Fig. 4*a* is shown a typical plate detector. The grid is biased to cut off, the point where the plate draws a negligible amount of current. The received signal contains both negative and positive potentials. Since the plate is already drawing no current, the negative portions of the a-c input wave have no effect on the plate current. However, the positive portions of the input signal cancel an appropriate amount of the grid bias voltage, and a proportionate plate current flows. The filter circuit consisting of L_1C_1, and C_2, removes the r-f component, and only the modulation, or audio voltage is created across the primary of the audio transformer *T*.

Grid-Leak Detectors

Fig. 4*b* shows a typical grid-leak detector. Here the bias is zero. Its operation may be considered as identical to that of a diode detector in combination with an amplifier. On th positive half of the input voltage, th grid draws current. This current de velops a voltage across *R*, which af fects the plate current, in much th same way as varying the grid bia does. The filter, L_1, C_1 and C_2, filter out the a-c component, and the plat current variations in the audio trans former, *T*, create the audio componen

Triode Oscillators

Fig. 5*a* shows a typical triode os cillator, where a similar action may b observed. Here, the input drive is sup plied by the plate of the tube. Agair positive values of input voltage caus the grid to draw current, creating bias voltage across *R*. Its counterpar in converters is shown in Fig. 5*b* Note that *R* is returned directly t the cathode, and not to ground. Thi is done so that the bias voltage use for the mixer or amplifier portion o the converter, does not affect the os cillator portion. If a bias voltage o fixed proportions were applied to th oscillator grid, it would not start os cillation.

DAVC and QAVC Systems

A further use of *C* bias appears i *davc* and *qavc* systems. In the delaye avc system shown in Fig 6*a*, the audi diode D_1 is returned to cathode whereas, the avc diode D_2 returns to ground through R_1. This puts the de veloped bias in the cathode circuit usually one or two volts on D_2, but not D_1. D_2, therefore will not rectify, unti the signal voltage applied to it exceeds the cathode voltage. No additional bias will be applied to the r-f portion of the receiver until the signal strength is in excess of the cathode bias voltage This permits reception of weak signals without avc action.

Muting Systems

Fig. 6*b* shows a typical qavc, or muting system. Its purpose is to keep a receiver silent, until an input signal of desired intensity is received. This is another form of inter-channel noise suppression, used in some receivers to kill noise between stations while tun ing.

Muter Circuit Details

T_1 is a diode detector, T_2 is the muter, and T_3 is the first audio tube. T_2 biases T_3 to cut off when no signal is present. This is accomplished by applying a positive voltage to the cathode of T_3 through the resistive net-

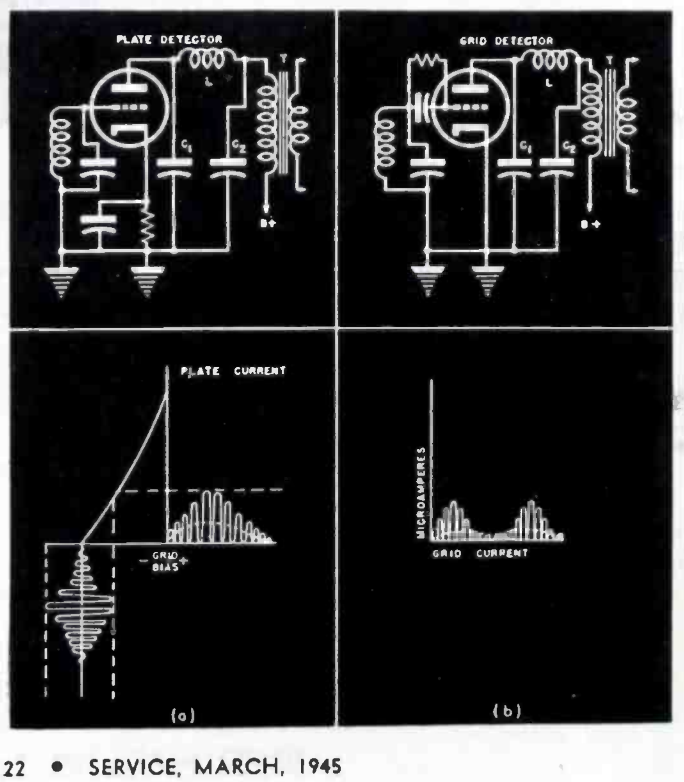
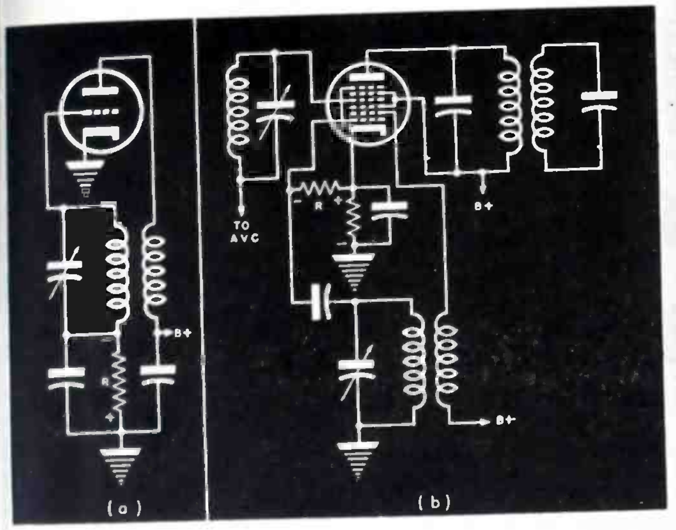
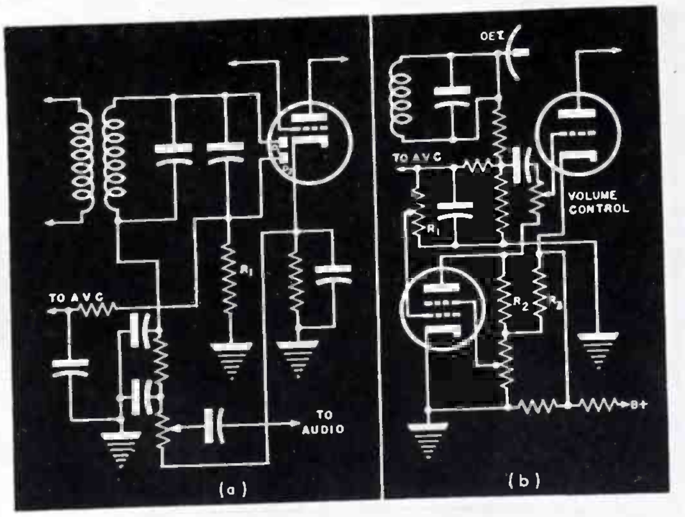


Fig. 4. How grid bias influences detection is illustrated here. In (*a*), since the tube is biased to cutoff, plate current will flow only on positive peaks of input signal. In (*b*) we have a grid detector. Here grid current serves to bias the tube. This occurs on positive peaks of the input signal and the plate current is reduced proportionately.





Figs. 5 (left, above) and 6 (right, above). Fig. 5 shows the bias network for oscillators and converters. Fig. 6 (*a*), a method of delaying avc action for weak signals. In (*b*) we have a typical muter for suppressing inter-station noise. Diode detector T_1 is at top center; T_2 or muter, lower left; T_3 or first a-f, upper right.

work associated with T_2. Since the voltage drop through this network is determined by the current drawn by the plate of T_2, reducing this current to zero, or cut-off, will remove the cut-off bias applied to T_3. This is accomplished by applying the avc voltage developed across *R*, to the grid of the muter tube. So long as this voltage is in excess of the cut-off bias on T_2, the cut-off bias applied to T_3 will be removed, and the audio tube will operate. Note that the volume control in this circuit is in reality the control grid resistor of T_3, and that the bias voltage on this grid is developed across R_2 and R_3.

Cathode Biases

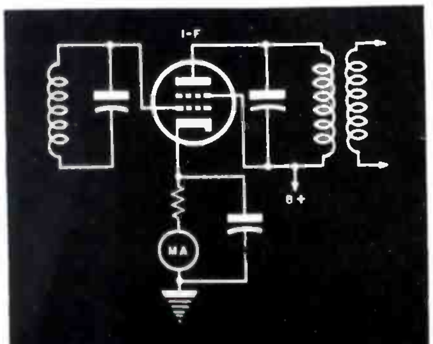
Where bias voltage is developed in the cathode of a tube, it is important to remember that the cathode resistor is common to both input and output circuits. Unless degeneration is desired, this resistor must be bypassed. The value of bypass condenser necessary is determined by its reactance at the lowest frequency involved. Bypass condensers in r-f circuits usually range from .1 to .05 mfd, whereas audio bypass condensers range from 1 mfd up to 100 mfd, depending on the frequencies involved. Currents drawn by plates and screen grids pass through the cathode resistance, and must be included in any cathode bias computations.

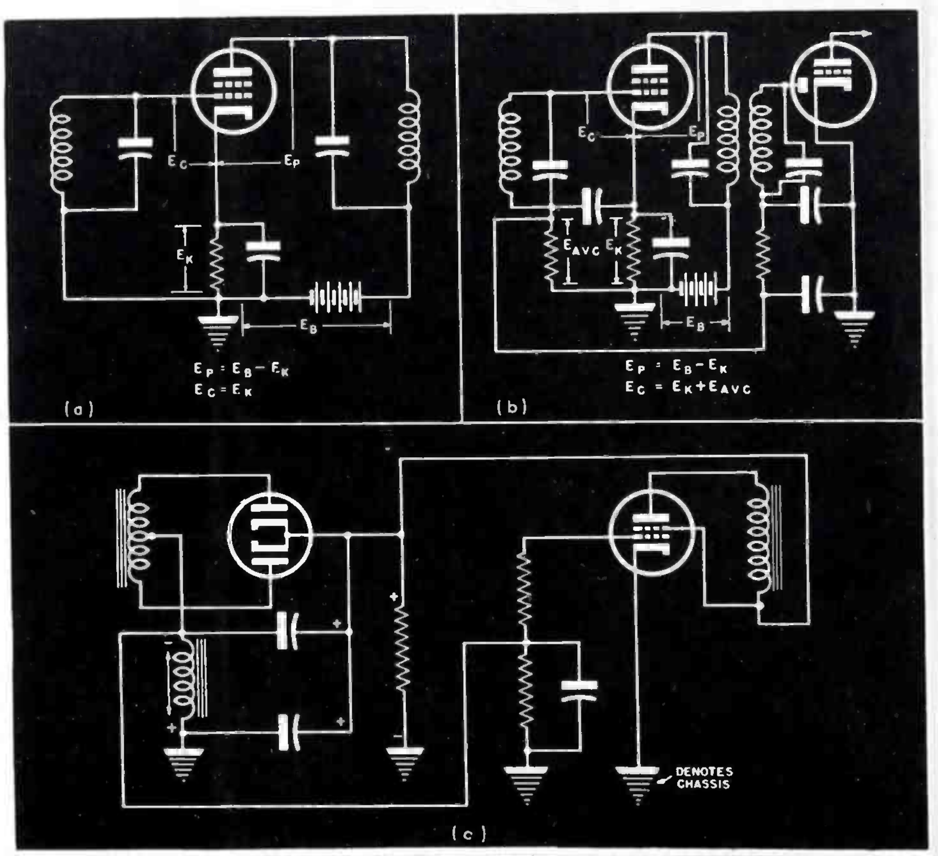
The avc action, and bias reaction of a receiver may be used in aligning a receiver, Fig. 7. The method used is to unsolder the cathode resistor of the i-f stage, and insert a milliammeter. Since any increase in signal voltage applied to the diode detector, increases the bias on the r-f portion of the receiver, a reduction in the plate current of the r-f tubes follows. By making the necessary alignment adjustments of the various r-f and i-f elements for a minimum current reading in the milliammeter, a fair degree of alignment may be obtained.

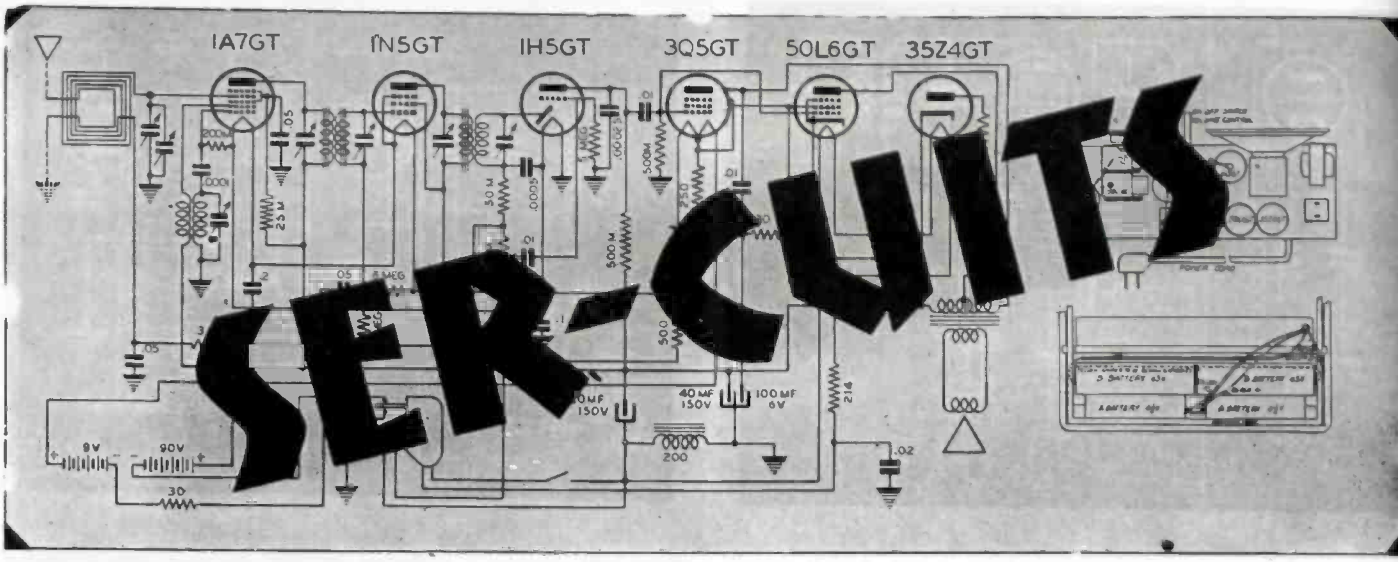
Grid bias may also be indicative of the emission of a tube. Poor emission

(*Continued on page* 28)

Figs. 7 (below) and 8 (right). Fig. 7. Here we see how set alignment may be accomplished with a milliammeter in the cathode return of an avc-controlled i-f tube. Fig. 8 shows how effective voltages are measured. In (*a*) the grid bias is equal to the cathode bias. In (*b*) the grid bias is the sum of the cathode bias plus the avc voltage. In (*c*) cathode bias is a function of the voltage drop across the filter choke.







SER-CUITS

by HENRY HOWARD

THE trend toward high fidelity has prompted the production of a-m receivers with emphasis on the tone quality as well as f-m sets with their fidelity features. In Fig. 1, we have an 11-tube a-m high-fidelity receiver that uses wide-band i-f's. It is a Truetone model D1042, 3-band job. Both foil and loop antennas are included, the former being used for the two short-wave bands. The loop primary is furnished with a jumper which shorts the primary in loop operation. Three-gang tuning is used. The tuned r-f stage is coupled to the first detector in a rather unique way; the plate is tapped down on the detector grid coil in an autotransformer fashion with an impedance step-up to the grid, G_3 of the 6SA7. The oscillator utilizes a cathode-tapped Hartley on the high-frequency band and cathode ticklers on the other bands. There is a 13-mmfd ceramic trimmer across the tuning condenser.

The first i-f transformer has a tertiary winding for variable selectivity, a wide band being obtained by connecting this winding in series with the secondary tuning capacitor. This is switched in by the *voice* pushbutton. A 6SK7 first i-f operates without bias, other than avc, and is resistance coupled to the 6SK7 second i-f via a 10-mmfd condenser, and a 25,000-ohm plate load. The second i-f is biased from a tap on the voltage divider. Bass is accentuated by cutting in a bass compensation circuit consisting of a .01-mfd condenser and a 60,000-ohm

(*Continued on page* 30)

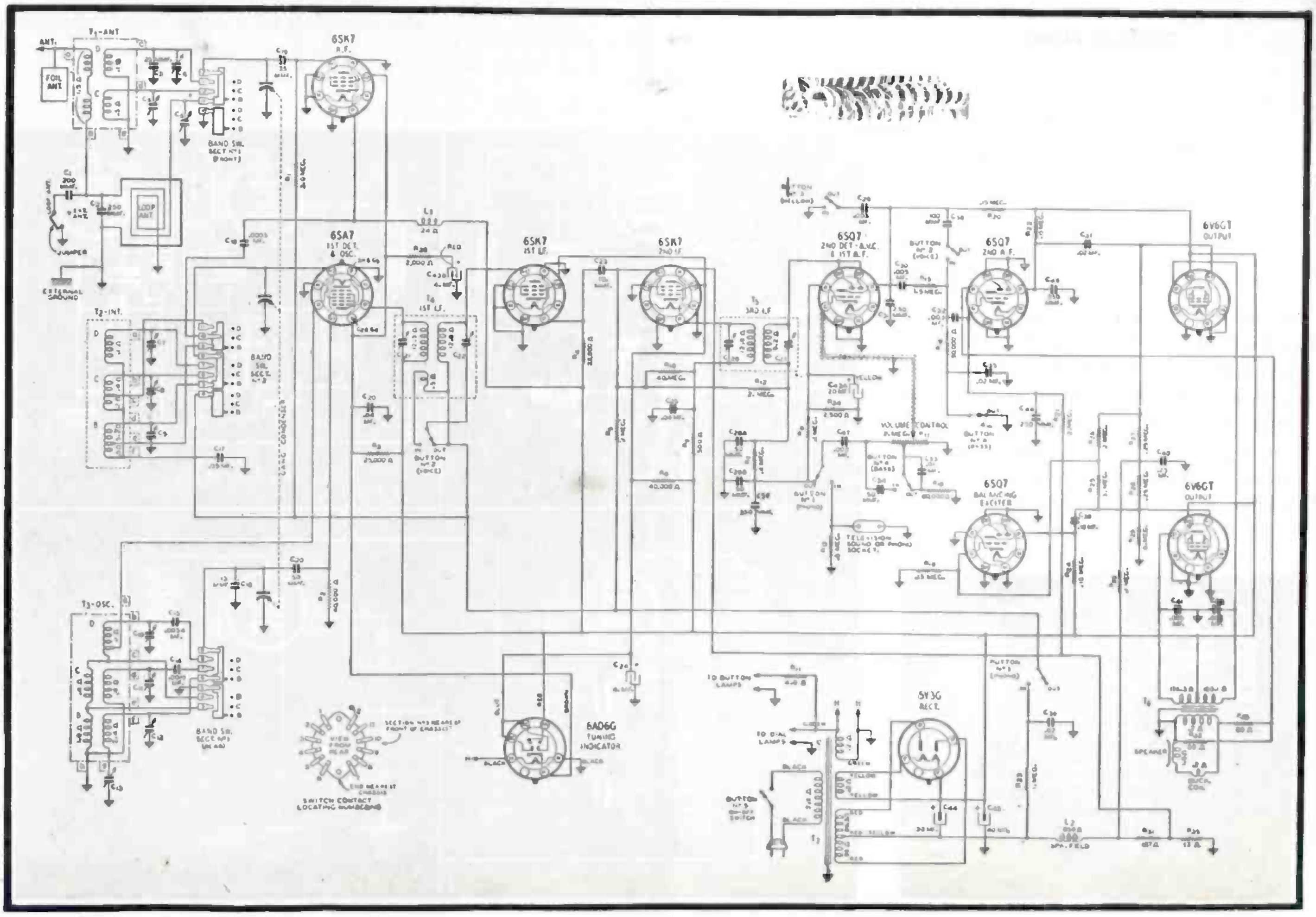
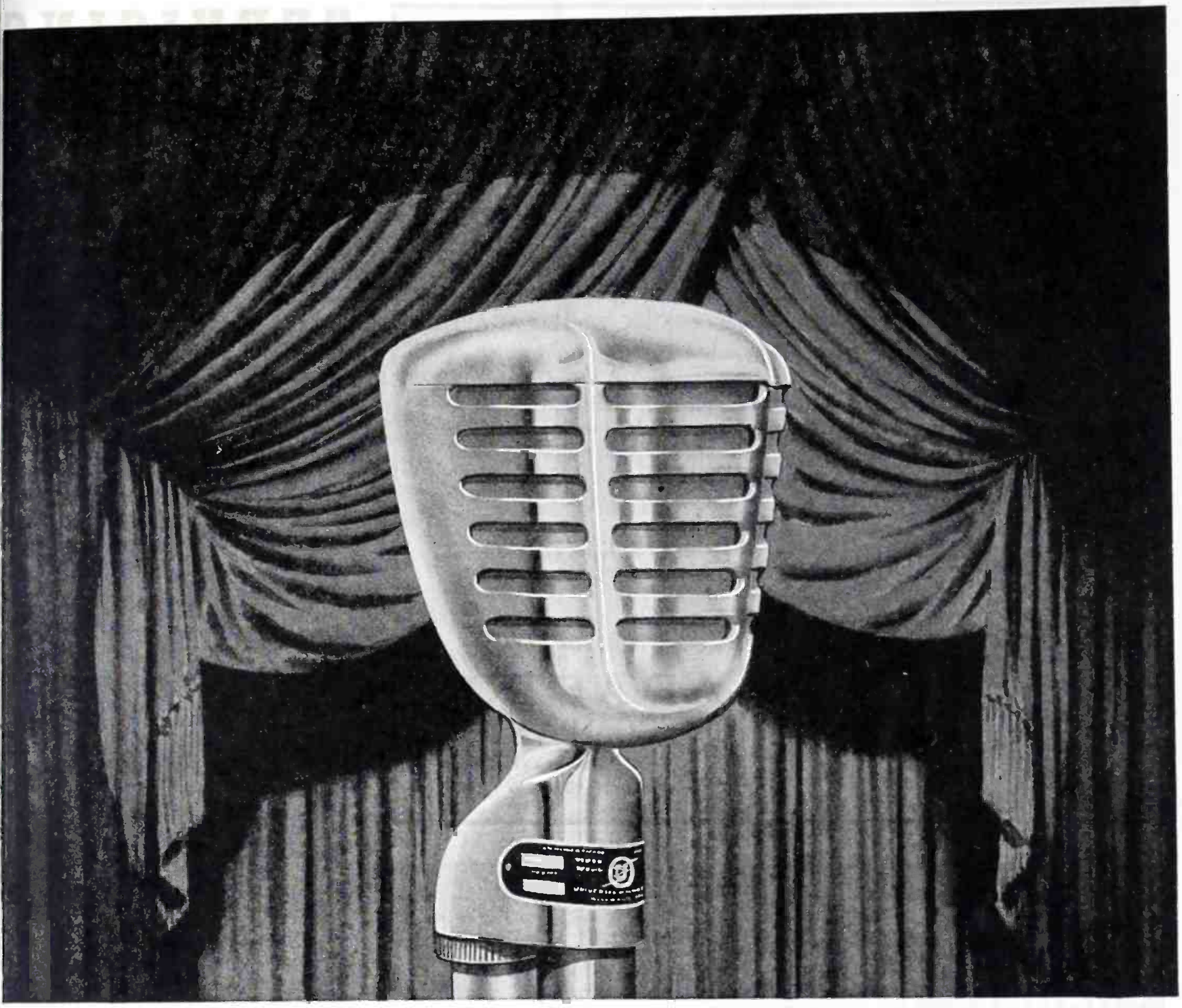
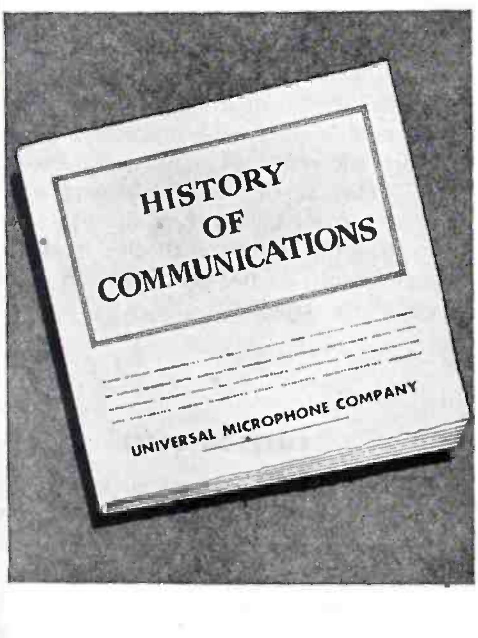


Fig. 1. Truetone D1042 11-tube a-m high-fidelity receiver.



UNIVERSAL'S NEW D-20 MICROPHONE



The stage was set for something new and here it is. Universal's new D-20 Microphone . . . soon on your radio parts jobbers' shelves to fill your essential requirements . . . uses Universal's "Dynoid" construction . . . A dynamic microphone of conventional characteristics built to fill the utility requirements of war time plus advance styling of the many modern things to come. Orders placed now with your Radio Parts Jobbers will assure early delivery when priority regulations are relaxed.

< FREE — History of Communications Picture Portfolio. Contains over a dozen 11" x 14" pictures suitable for office, den or hobby room. Write factory for your Portfolio today.

UNIVERSAL MICROPHONE COMPANY

INGLEWOOD, CALIFORNIA

FOREIGN DIVISION: 301 CLAY STREET, SAN FRANCISCO 11, CALIFORNIA ·· CANADIAN DIVISION: 560 KING STREET WEST, TORONTO 1, ONTARIO, CANADA

An Aid in SELLING
. . . and in STORING

THIS powerful silent-salesman is the newest idea in the Adapter field. It makes it easier for you to SELL adapters, and easier to stock them for your own use. Who but ADAPTOL would have even thought of it!

ADAPTOL Adaptors are noted for quality, craftsmanship and precision. They convert for use of available tubes . . . they transform to scarce type tubes. We are the originators of 1R5 to 1A7 adapters, and of five substitutes for the 12A8 tube. Little wonders of convenience!

177 types of adapters, including a large selection with built-in resistors.

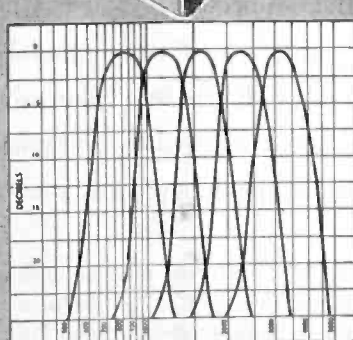
WRITE FOR DETAILS

ADAPTOL COMPANY
260C UTICA AVENUE
BROOKLYN 13, NEW YORK

FREED MULTI-CHANNEL FILTER

for frequency selection in remote control systems

Here is a great forward step in filters for frequency selective remote control systems. Consisting of five band pass filters having their inputs in parallel and five separate outputs, it features unusually broad pass band and high attenuation at the adjacent channels, constant electrical stability and power handling capability which makes possible the use of a rectifier and relay directly in the output of the filter. Hermetically sealed and ruggedly constructed for long life and durability.



While no transformers are being made for civilian use, we will reserve a copy of the Freed Post-War Catalogue for you. Send in your name today.

FREED TRANSFORMERS
FREED TRANSFORMER COMPANY
74A SPRING STREET, NEW YORK CITY

SERVICING HELPS

PHILCO 38-39

Distortion and oscillation: A voltage check revealed all voltages normal. However in a point-to-point resistance check, the 8-mfd electrolytic condenser, 15, was found to be open. While replacement of this condenser cleared up oscillation, some distortion still remained. We noticed that distortion only appeared at the peak of resonance. Since the check we made previously revealed all voltages to be normal, we suspected receiver alignment as a cause of the trouble. Realignment of the set eliminated the distortion. (The second i-f transformer had been slightly detuned, causing this condition.)

•

MAJESTIC 91

Intermittent and noisy: Trouble traced to the equalizer control mounted on the back end of the variable condenser shaft. To reach this control, the cover must first be removed from the gang. By disconnecting the lead to the control and grounding the lead, thereby eliminating the equalizer from the circuit, results will improve; intermittents will also disappear. Noise was traced to loose nuts on the terminal strip on the power supply.

•

GENERAL ELECTRIC H639

Intermittent operation; volume drops off suddenly and returns: We suspected an open condenser or a balky tube. A voltage check did not indicate anything. We then tapped all the components with a rubber hammer head. This showed up a faulty condenser, C_7. This is the audio coupling condenser from the plate of the 6J5 tube to the grid of the 25L6 tube. Replacement with a .005-mfd 600-volt unit cured the trouble.

•

EMERSON CB243

Inoperative: In a visual inspection we found that the filaments of all but the 80 were active. Insertion of a new 80 did not clear up the trouble. Instead, after about a minute the plates of the 80 became red hot. A resistance check from the filament of the rectifier to ound indicated a resistance of 180 ıms, or a B+ short. We discon- ected the electrolytic condenser C_{38} ıd checked with an ohmmeter. A full ale reading on the ohmmeter showed at the condenser was shorted. Re- acement with a 16-mfd dry electro- tic solved that problem. Turning on e set with the speaker plug out of socket could have caused the fore- oing problem. The surge in the recti- er voltage would cause a condenser eak down.

•

STEWART WARNER 07-511

Hiss, but no reception: A voltage heck showed all voltages to be nor ıal. A disturbance check on the an- enna section of the gang resulted in click from the loudspeaker while the ame check on the oscillator section of he variable offered no results. This ndicated that the oscillator section was ot working. A resistance check of the scillator coil disclosed that the pri- nary was open. Fortunately the open vas found right at the ground lug and he wire was long enough to be re- oldered.

George Ryan

•

MOTOROLA 51 X 12

Oscillation: Install a 20-mfd 150-volt electrolytic from the plus side of the output filter to chassis.

•

MOPAR 600 (CHRYSLER)

Intermittent operation: Many of these sets have defective oscillator coils re- sulting in erratic oscillator perform- ance. Set may operate perfectly for weeks, then refuse to operate due to a non-operating oscillator. Occasionally when testing coil winding with ohm- meter the defect will show by a vary- ing resistance reading.

•

CROSLEY 1336

Substitution: Two 6N6 tubes are used as output tubes. When in need of re- placement use 6F6 tubes to directly replace the costly and hard-to-get 6N6's.

•

EMERSON 1941-1942 PORTABLES

Sharp whistle accompanies reception

(*Continued on page 29*)

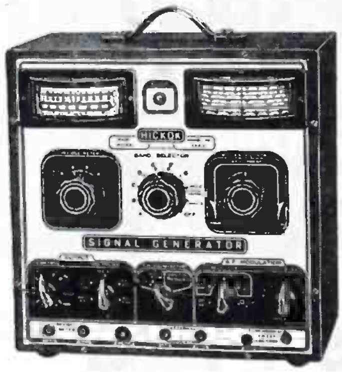
THE STANDARD OF QUALITY FOR A THIRD OF A CENTURY

HICKOK INSTRUMENTS

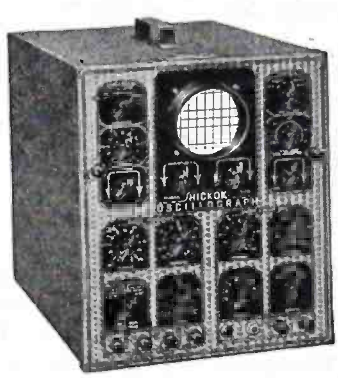
Electronic and Radio Service Equipment

Volt-Ohm-Milliammeter

All-Purpose Tube and Set Tester



Signal Generators



Oscillograph

● HICKOK Instruments have long been known as the ultimate in scientific development. Illustrated here are but 4 of our 36 leaders in the Radio Service field. Thousands of Radio Service men have preferred HICKOK Instruments because of their unusual accuracy and dependability.

HICKOK pioneered in Dynamic Mutual Conductance Tube Testing Equipment. In the field of Signal Generators, Traceometers, Vacuum tube Voltmeters, Oscillographs, Zero Current Testers, Volt-ohm-milliammeters and Industrial Analyzers the name HICKOK is assurance of excellence.

PRECISION CALIBRATED • LASTING ACCURACY

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10521 Dupont Avenue Cleveland 8, Ohio

SPEED UP REPAIRS WITH THESE G-C AIDS!

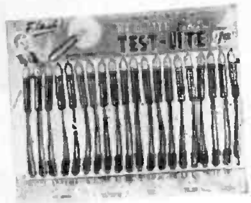
FREE STEEL CABINET

G-C Dial Belt Kits

Exact replacement woven fabric belts. Easy to install — no stretching — no adjustments — a perfect fit every time. Kits come with 25, 50, 100, 200 or 300 belts.

Automatic Wire Stripper

Strips insulation from all types of wire. Does the job instantly, easily, perfectly. An ideal tool for radio men, electricians and sound men.



G-C Ne-O-Lite

New improved design. Useful hundreds of ways. Tests AC and DC lines, DC polarity, fuses, etc. You can't afford to be without this handy all-purpose trouble shooter.

Order From Your Radio Parts Jobber
ALWAYS ASK FOR G-C PRODUCTS

GENERAL CEMENT MFG. CO.
ROCKFORD, ILLINOIS

STANCOR *Transformers*

THE STANDBY OF SERVICEMEN

Call your nearest Stancor Jobber—or write us for his address

STANDARD TRANSFORMER CORPORATION
1500 NORTH HALSTED STREET • CHICAGO

C BIASING

(*Continued from page 23*)

will result in low-bias values. When checking converters to see if the oscillator is working, the voltage across the oscillator-grid resistor should be measured. No grid voltage indicates no oscillation. A vtvm must be used since the current in this resistor is quite small and the shunting effect of a meter may itself stop the oscillations.

Ohm's Law

A quick determination of plate and screen grid current being drawn by a tube may be made by measuring the bias developed in the cathode current, by use of the Ohm's law.

Reference to receiver diagrams will give the Service Man some idea of what values to expect for *C* bias in various parts of a receiver. A quick check of these values may often localize troubles that otherwise would require extensive search. In r-f circuits where avc is used, bias measurements should be made under no signal conditions, since the cathode bias will be reduced due to the higher grid bias and lower plate currents. Cathode bias is here distinguished from grid bias, as being that part of the grid bias developed in the cathode circuit, whereas grid bias is the sum of the cathode bias and avc bias.

Voltage References

Occasionally Service Men misinterpret voltage values because of the confusion of terms such as ground, B—, chassis, etc. All voltage references should be made to cathode, Fig. 8. No matter how voltages are distributed, the cathode is the true minus reference point. Thus, control grid voltage is the voltage between control grid and cathode. The plate and screen grid voltage is the voltage measured between plate or screen grid and cathode. These are effective values. Sometimes manufacturer's notes mention that all voltages are measured to ground or chassis. In this case, the chassis is used as a common d-c terminal for voltage distribution, and is kept at r-f ground by the inclusion of appropriate r-f and a-f bypasses across d-c elements.

Simple Pentode Circuits

Fig. 8*a* shows a simple pentode circuit. The effective plate voltage, or E_p is less than the *B* voltage E_b, by E_k, the developed cathode bias. E_c, or the grid bias in this case is equal to E_k. Where avc is used, as in Fig. 8*b*, E_c is equal to the sum of E_k and E_{avc}.

Fixed Biases

Fig. 8*c* shows another method of developing fixed bias. Here a bleeder circuit establishes chassis as positive, with relation to *B*—. By returning the cathode to chassis, and the control grid to *B*—, a negative voltage is impressed on the grid with relation to the chassis or cathode. E_p in this case is equal to E_b-E_c, where E_b is the total d-c voltage output of the rectifier, and E_c is the drop across the filter choke.

A-F Bias Voltages

In cathode-bias systems the effective plate voltage is dependent on the bias voltage. Where the supply voltage is fixed, any increase in bias voltage will decrease the plate voltage in like amount. For example, if the supply voltage were 250, with a developed bias voltage of 16, the effective plate voltage would be 234. If the bias voltage were decreased to 8, the effective plate voltage would be 242. This is only true when using a-f transformers since the voltage drop across it is small.

When computing cathode resistors it is necessary to take into account the increase or decrease in plate voltage. It is sometimes desirable to reduce the effective plate voltage, particularly in tube substitutions. This may be done directly in the cathode circuit by the addition of the necessary size resistor. By returning the grid to the point in the cathode circuit giving the desired bias the additional cathode drop does not influence the bias, yet reduces the effective plate voltage.

;ERVICING HELPS

(*Continued from page 27*)

; *low and medium volume; disap-ars when volume control is turned ; full*: Replace filament string elec-olytic condenser. Symptoms occur ıly when operating on a-c.

•

ARWIN 302

istortion: Remove metal bottom ›ver from chassis to diminish heat ıused by line voltage reducer mount-l underneath the chassis.

•

ZENITH MODELS

ial belts: Quite often when replac-g dial belts on these receivers the elt is either too tight or too loose ven when the proper belt replacement ; used. To remedy this we loosened ıe bolts on the dial bracket attached) the condenser gang, allowing con-enser gang to drop slightly if belt is oo tight or to raise if belt is too loose.

•

TUBE SUBSTITUTIONS

\ 58 instead of a 35 is an excellent eplacement. Use adapter or change ocket. The suppressor grid should be ied to the cathode.

A 47 can in most cases be replaced irectly by a 33. The filament of the 3 is rated at 2 volts while that of the 7 is 2.5 volts. This slight voltage verload on the 33 does not seem to mpair its quality. It is necessary to educe plate and screen volts to 180 olts.

Edward Goldschmidt

•

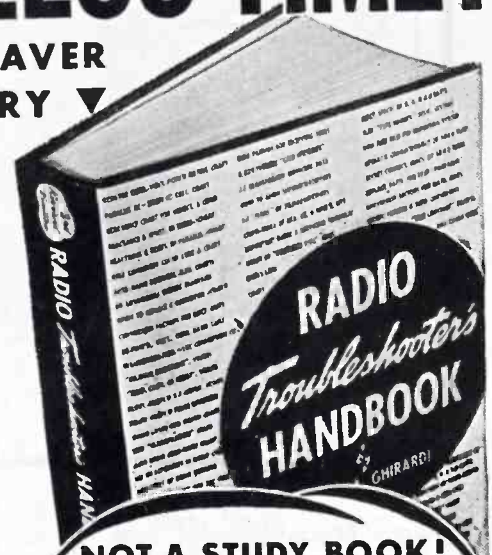
ZENITH 7S432, 433, 434, 449, 450, 458, 160, 461, 462, 487, 488 (CHASSIS 5724)

Oscillation on l-f automatic buttons. This is due to coupling between the r-f circuits and the primary circuit of the oscillator coupling roll. The coupling is so great that the automatic oscillator circuit may be tuned by varying the r-f trimmer capacities. To remedy, shield the blue lead between the oscillator coil primary and the automatic oscillator coupling coil. Ground the shield.

Zenith Shop Notes

HANDLE MORE JOBS IN A LOT LESS TIME!

THE GREATEST TIME SAVER IN SERVICING HISTORY ▼



Radio servicemen everywhere say that A. A. Ghirardi's RADIO TROUBLESHOOTER'S HANDBOOK (3rd Edition) helps them TURN OUT TWICE AS MUCH WORK IN A GIVEN TIME! Four times out of five, it tells exactly how to repair a set—*without any elaborate testing whatever!*

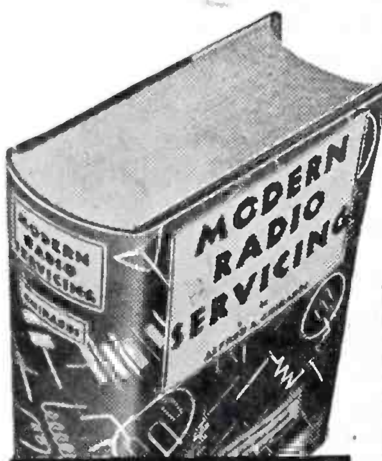
Actually, this big 4-pound, 744-page manual-size Handbook is a complete guide to quick, easy repairs on PRACTICALLY EVERY RADIO RECEIVER NOW IN USE.

4,800 DIFFERENT RADIO MODELS

Its 404-page Case History Section gives full details on common trouble symptoms, their causes and remedies for OVER 4,800 DIFFERENT RADIO MODELS. It describes the trouble exactly, tells exactly what to do to repair it. It eliminates much testing—helps you to do TWO OR MORE jobs in the time normally required for one—repair cheap sets profitably—train new helpers, etc.

Equally important are hundreds of other pages specifically geared to today's needs—dozens of hints on the proper substitution of tubes and parts; i-f alignment peaks for over 20,000 superhets; transformer troubles, etc., and hundreds of graphs, tube charts, data, etc.—all carefully indexed so you can find what you need in a hurry. Price only $5 complete ($5.50 foreign) on our UNRESERVED 5-DAY MONEY-BACK GUARANTEE!

NOT A STUDY BOOK!
You don't study this Handbook! Simply look up the radio's Make, Model, and the Trouble Symptom—and go to work! Eliminates useless testing on 4 JOBS OUT OF 5!
ONLY $5 COMPLETE



The Only Complete Guide to MODERN PROFESSIONAL RADIO SERVICE WORK

COMPLETE DATA ON TEST INSTRUMENTS, TROUBLESHOOTING, REPAIR

Once in a blue moon a technical book is written that is so important, so complete, and so easy to understand that it is used and recommended universally by members of a profession! A. A. Ghirardi's MODERN RADIO SERVICING is that kind of a book—AND MORE!

Actually, it is the only single, inexpensive book giving a complete course in modern Radio Repair Work in all its branches. Explains all necessary test instruments . . . even how to build your own; how to troubleshoot ALL makes of receivers, analyze their circuits, test components; make adjustments; repairs, etc.—all step-by-step. Used for reference, it serves as a beautifully cross-indexed volume for "brushing up" on any type of work that may puzzle you. 1300 pages, 720 self-testing review questions, 706 illustrations and diagrams. $5 complete ($5.50 foreign) 5-DAY MONEY-BACK GUARANTEE.

See Money-Saving Offer in Coupon!

EVERY CONCEIVABLE SERVICE SUBJECT!

Milliammeters, ammeters & voltmeters; Methods and instruments for measuring resistance; ohmmeters; How to build your own instruments; Tube checkers; Set analyzers; Point-to-point testing; Test oscillators; Preliminary trouble checks; AVC and QAVC circuits; Troubleshooting; Testing components; Obscure radio troubles; Aligning and neutralizing; Auto radios; All-wave radio servicing; Marine radio; Interference reduction; How to start and operate a Radio-Electronic service business, etc., etc.

5-DAY MONEY BACK GUARANTEE

Dept. S-35, Technical Division.
MURRAY HILL BOOKS, INC.,
232 Madison Ave., New York 16, N. Y.

Enclosed find $ ______ for books checked (send postpaid) or ☐ send C.O.D. (in U.S.A. only) for this amount plus postage. If not fully satisfied, I may return the books in 5 days for full refund.

☐ RADIO TROUBLESHOOTER'S HANDBOOK $5 ($5.50 foreign)
☐ MODERN RADIO SERVICING $5 ($5.50 foreign)
☐ **MONEY-SAVING COMBINATION** — Both books (over 2040 pages of invaluable service data) for only $9.50 ($10.50 foreign).

Name ....
Address ....
City & Dist. No. .... State ....
Please print or write plainly

An Aid in **SELLING** . . . and in **STORING**

THIS powerful silent-salesman is the newest idea in the Adapter field. It makes it easier for you to SELL adapters, and easier to stock them for your own use. Who but ADAPTOL would have even thought of it!

ADAPTOL Adaptors are noted for quality, craftsmanship and precision. They convert for use of available tubes . . . they transform to scarce type tubes. We are the originators of 1R5 to 1A7 adapters, and of five substitutes for the 12A8 tube. Little wonders of convenience!

Adaptol

177 ***types of adapters, including a large selection with built-in resistors.***

WRITE FOR DETAILS

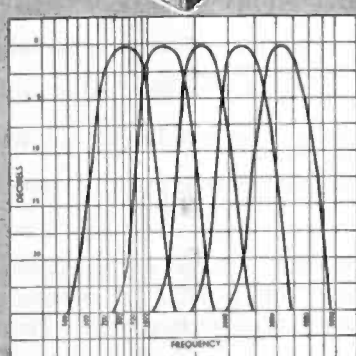
ADAPTOL COMPANY
260C UTICA AVENUE
BROOKLYN 13, NEW YORK

FREED MULTI-CHANNEL FILTER

for frequency selection in remote control systems

Here is a great forward step in filters for frequency selective remote control systems. Consisting of five band pass filters having their inputs in parallel and five separate outputs, it features unusually broad pass band and high attenuation at the adjacent channels, constant electrical stability and power handling capability which makes possible the use of a rectifier and relay directly in the output of the filter. Hermetically sealed and ruggedly constructed for long life and durability.

While no transformers are being made for civilian use, we will reserve a copy of the Freed Post-War Catalogue for you. Send in your name today.



FREED TRANSFORMERS
FREED TRANSFORMER COMPANY
74A SPRING STREET, NEW YORK CITY

SERVICING HELPS

PHILCO 38-39

Distortion and oscillation: A voltage check revealed all voltages normal. However in a point-to-point resistance check, the 8-mfd electrolytic condenser, 15, was found to be open. While replacement of this condenser cleared up oscillation, some distortion still remained. We noticed that distortion only appeared at the peak of resonance. Since the check we made previously revealed all voltages to be normal, we suspected receiver alignment as a cause of the trouble. Realignment of the set eliminated the distortion. (The second i-f transformer had been slightly detuned, causing this condition.)

•

MAJESTIC 91

Intermittent and noisy: Trouble traced to the equalizer control mounted on the back end of the variable condenser shaft. To reach this control, the cover must first be removed from the gang. By disconnecting the lead to the control and grounding the lead, thereby eliminating the equalizer from the circuit, results will improve; intermittents will also disappear. Noise was traced to loose nuts on the terminal strip on the power supply.

•

GENERAL ELECTRIC H639

Intermittent operation; volume drops off suddenly and returns: We suspected an open condenser or a balky tube. A voltage check did not indicate anything. We then tapped all the components with a rubber hammer head. This showed up a faulty condenser, C_7. This is the audio coupling condenser from the plate of the 6J5 tube to the grid of the 25L6 tube. Replacement with a .005-mfd 600-volt unit cured the trouble.

•

EMERSON CB243

Inoperative: In a visual inspection we found that the filaments of all but the 80 were active. Insertion of a new 80 did not clear up the trouble. Instead, after about a minute the plates of the 80 became red hot. A resistance check from the filament of the rectifier to round indicated a resistance of 180 ıms, or a B+ short. We disconected the electrolytic condenser C_{38} ıd checked with an ohmmeter. A full ale reading on the ohmmeter showed at the condenser was shorted. Replacement with a 16-mfd dry electrotic solved that problem. Turning on e set with the speaker plug out of s socket could have caused the foreoing problem. The surge in the rectier voltage would cause a condenser reak down.

•

STEWART WARNER 07-511

Hiss, but no reception: A voltage heck showed all voltages to be noral. A disturbance check on the anenna section of the gang resulted in click from the loudspeaker while the ame check on the oscillator section of he variable offered no results. This ndicated that the oscillator section was ıot working. A resistance check of the ›scillator coil disclosed that the prinary was open. Fortunately the open was found right at the ground lug and the wire was long enough to be resoldered.

George Ryan

•

MOTOROLA 51 X 12

Oscillation: Install a 20-mfd 150-volt electrolytic from the plus side of the output filter to chassis.

•

MOPAR 600 (CHRYSLER)

Intermittent operation: Many of these sets have defective oscillator coils resulting in erratic oscillator performance. Set may operate perfectly for weeks, then refuse to operate due to a non-operating oscillator. Occasionally when testing coil winding with ohmmeter the defect will show by a varying resistance reading.

•

CROSLEY 1336

Substitution: Two 6N6 tubes are used as output tubes. When in need of replacement use 6F6 tubes to directly replace the costly and hard-to-get 6N6's.

•

EMERSON 1941-1942 PORTABLES

Sharp whistle accompanies reception

(*Continued on page 29*)

THE STANDARD OF QUALITY FOR A THIRD OF A CENTURY

HICKOK INSTRUMENTS

Electronic and Radio Service Equipment

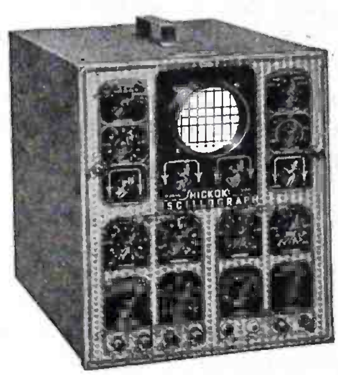

Volt-Ohm-Milliammeter


All-Purpose Tube and Set Tester

● HICKOK Instruments have long been known as the ultimate in scientific development. Illustrated here are but 4 of our 36 leaders in the Radio Service field. Thousands of Radio Service men have preferred HICKOK Instruments because of their unusual accuracy and dependability.

HICKOK pioneered in Dynamic Mutual Conductance Tube Testing Equipment. In the field of Signal Generators, Traceometers, Vacuum tube Voltmeters, Oscillographs, Zero Current Testers, Volt-ohm-milliammeters and Industrial Analyzers the name HICKOK is assurance of excellence.


Signal Generators


Oscillograph

PRECISION CALIBRATED • LASTING ACCURACY

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10521 Dupont Avenue Cleveland 8, Ohio

C BIASING

(*Continued from page 23*)

will result in low-bias values. When checking converters to see if the oscillator is working, the voltage across the oscillator-grid resistor should be measured. No grid voltage indicates no oscillation. A vtvm must be used since the current in this resistor is quite small and the shunting effect of a meter may itself stop the oscillations.

Ohm's Law

A quick determination of plate and screen grid current being drawn by a tube may be made by measuring the bias developed in the cathode current, by use of the Ohm's law.

Reference to receiver diagrams will give the Service Man some idea of what values to expect for *C* bias in various parts of a receiver. A quick check of these values may often localize troubles that otherwise would require extensive search. In r-f circuits where avc is used, bias measurements should be made under no signal conditions, since the cathode bias will be reduced due to the higher grid bias and lower plate currents. Cathode bias is here distinguished from grid bias, as being that part of the grid bias developed in the cathode circuit, whereas grid bias is the sum of the cathode bias and avc bias.

Voltage References

Occasionally Service Men misinterpret voltage values because of the confusion of terms such as ground, B—, chassis, etc. All voltage references should be made to cathode, Fig. 8. No matter how voltages are distributed, the cathode is the true minus reference point. Thus, control grid voltage is the voltage between control grid and cathode. The plate and screen grid voltage is the voltage measured between plate or screen grid and cathode. These are effective values. Sometimes manufacturer's notes mention that all voltages are measured to ground or chassis. In this case, the chassis is used as a common d-c terminal for voltage distribution, and is kept at r-f ground by the inclusion of appropriate r-f and a-f bypasses across d-c elements.

Simple Pentode Circuits

Fig. 8*a* shows a simple pentode circuit. The effective plate voltage, or E_p is less than the *B* voltage E_b, by E_k, the developed cathode bias. E_c, or the grid bias in this case is equal to E_k. Where avc is used, as in Fig. 8*b*, E_c is equal to the sum of E_k and E_{avc}.

Fixed Biases

Fig. 8*c* shows another method of developing fixed bias. Here a bleeder circuit establishes chassis as positive, with relation to *B*—. By returning the cathode to chassis, and the control grid to *B*—, a negative voltage is impressed on the grid with relation to the chassis or cathode. E_p in this case is equal to E_b-E_c, where E_b is the total d-c voltage output of the rectifier, and E_c is the drop across the filter choke.

A-F Bias Voltages

In cathode-bias systems the effective plate voltage is dependent on the bias voltage. Where the supply voltage is fixed, any increase in bias voltage will decrease the plate voltage in like amount. For example, if the supply voltage were 250, with a developed bias voltage of 16, the effective plate voltage would be 234. If the bias voltage were decreased to 8, the effective plate voltage would be 242. This is only true when using a-f transformers since the voltage drop across it is small.

When computing cathode resistors it is necessary to take into account the increase or decrease in plate voltage. It is sometimes desirable to reduce the effective plate voltage, particularly in tube substitutions. This may be done directly in the cathode circuit by the addition of the necessary size resistor. By returning the grid to the point in the cathode circuit giving the desired bias the additional cathode drop does not influence the bias, yet reduces the effective plate voltage.

SERVICING HELPS

(Continued from page 27)

in low and medium volume, disappears when volume control is turned on full: Replace filament string electrolytic condenser. Symptoms occur only when operating on a-c.

•

ARWIN 302

Distortion: Remove metal bottom cover from chassis to diminish heat caused by line voltage reducer mounted underneath the chassis.

•

ZENITH MODELS

Dial belts: Quite often when replacing dial belts on these receivers the belt is either too tight or too loose even when the proper belt replacement is used. To remedy this we loosened the bolts on the dial bracket attached to the condenser gang, allowing condenser gang to drop slightly if belt is too tight or to raise if belt is too loose.

•

TUBE SUBSTITUTIONS

A 58 instead of a 35 is an excellent replacement. Use adapter or change socket. The suppressor grid should be tied to the cathode.

A 47 can in most cases be replaced directly by a 33. The filament of the 33 is rated at 2 volts while that of the 47 is 2.5 volts. This slight voltage overload on the 33 does not seem to impair its quality. It is necessary to reduce plate and screen volts to 180 volts.

Edward Goldschmidt

•

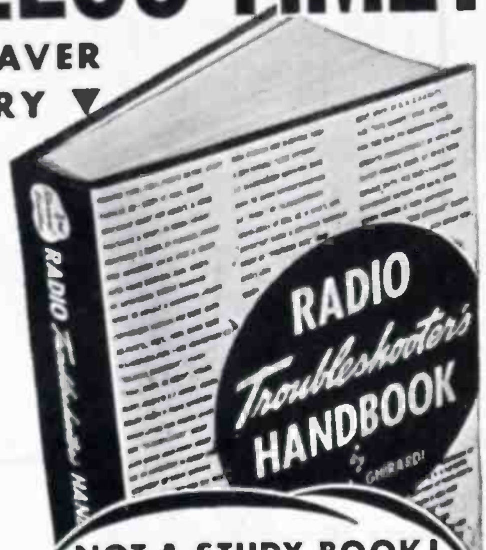
ZENITH 7S432, 433, 434, 449, 450, 458, 460, 461, 462, 487, 488 (CHASSIS 5724)

Oscillation on l-f automatic buttons: This is due to coupling between the r-f circuits and the primary circuit of the oscillator coupling roll. The coupling is so great that the automatic oscillator circuit may be tuned by varying the r-f trimmer capacities. To remedy, shield the blue lead between the oscillator coil primary and the automatic oscillator coupling coil. Ground the shield.

Zenith Shop Notes

HANDLE MORE JOBS IN A LOT LESS TIME!

THE GREATEST TIME SAVER IN SERVICING HISTORY ▼



Radio servicemen everywhere say that A. A. Ghirardi's RADIO TROUBLESHOOTER'S HANDBOOK (3rd Edition) helps them TURN OUT TWICE AS MUCH WORK IN A GIVEN TIME! Four times out of five, it tells exactly how to repair a set—*without any elaborate testing whatever!*

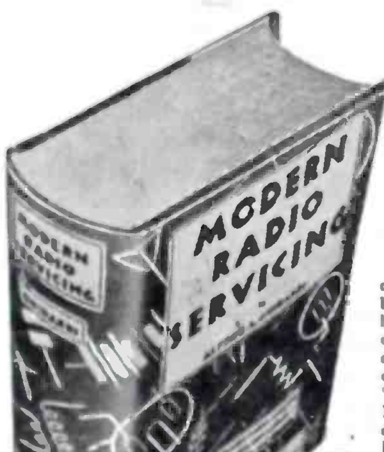
Actually, this big 4-pound, 744-page manual-size Handbook is a complete guide to quick, easy repairs on PRACTICALLY EVERY RADIO RECEIVER NOW IN USE.

4,800 DIFFERENT RADIO MODELS

Its 404-page Case History Section gives full details on common trouble symptoms, their causes and remedies for OVER 4,800 DIFFERENT RADIO MODELS. It describes the trouble exactly, tells exactly what to do to repair it. It eliminates much testing—helps you to do TWO OR MORE jobs in the time normally required for one—repair cheap sets profitably—train new helpers, etc.

Equally important are hundreds of other pages specifically geared to today's needs—dozens of hints on the proper substitution of tubes and parts; i-f alignment peaks for over 20,000 superhets; transformer troubles, etc., and hundreds of graphs, tube charts, data, etc.—all carefully indexed so you can find what you need in a hurry. Price only $5 complete ($5.50 foreign) on our UNRESERVED 5-DAY MONEY-BACK GUARANTEE!

NOT A STUDY BOOK!
You don't study this Handbook! Simply look up the radio's Make, Model, and the Trouble Symptom—and go to work! Eliminates useless testing on 4 JOBS OUT OF 5!
ONLY $5 COMPLETE



EVERY CONCEIVABLE SERVICE SUBJECT!

Milliammeters, ammeters & voltmeters; Methods and instruments for measuring resistance; ohmmeters: How to build your own instruments; Tube checkers; Set analysers; Point-to-point testing; Test oscillators; Preliminary trouble checks; AVC and QAVC circuits; Troubleshooting; Testing components; Obscure radio troubles; Aligning and neutralizing; Auto radios; All-wave radio servicing; Marine radio; Interference reduction; How to start and operate a Radio-Electronic service business, etc., etc.

The Only Complete Guide to MODERN PROFESSIONAL RADIO SERVICE WORK

COMPLETE DATA ON TEST INSTRUMENTS, TROUBLESHOOTING, REPAIR

Once in a blue moon a technical book is written that is so important, so complete, and so easy to understand that it is used and recommended universally by members of a profession! A. A. Ghirardi's MODERN RADIO SERVICING is that kind of a book—AND MORE!

Actually, it is the only single, inexpensive book giving a complete course in modern Radio Repair Work in all its branches. Explains all necessary test instruments . . . even how to build your own; how to troubleshoot ALL makes of receivers, analyze their circuits, test components; make adjustments: repairs, etc.—all step-by-step. Used for reference, it serves as a beautifully cross-indexed volume for "brushing up" on any type of work that may puzzle you. 1300 pages, 720 self-testing review questions, 706 illustrations and diagrams. $5 complete ($5.50 foreign) 5-DAY MONEY-BACK GUARANTEE.

See Money-Saving Offer in Coupon!

5-DAY MONEY BACK GUARANTEE

Dept. S-35, Technical Division,
MURRAY HILL BOOKS, INC.,
232 Madison Ave., New York 16, N. Y.

Enclosed find $ .... for books checked (send postpaid) or ☐ send C.O.D. (in U.S.A. only) for this amount plus postage. If not fully satisfied, I may return the books in 5 days for full refund.

☐ RADIO TROUBLESHOOTER'S HANDBOOK $5 ($5.50 foreign)
☐ MODERN RADIO SERVICING $5 ($5.50 foreign)
☐ MONEY-SAVING COMBINATION — Both books (over 2040 pages of invaluable service data) for only $9.50 ($10.50 foreign).

Name ....
Address ....
City & Dist. No. .... State ....
Please print or write plainly

SER-CUITS

(*Continued from page 24*)

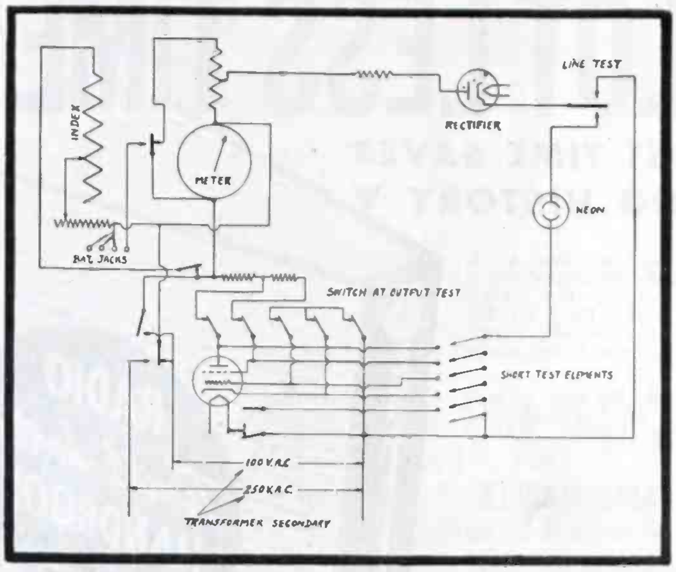


Fig. 2. The G.E. TC3 and 3P tube checker with individually operated lever switches to control voltage ranges from 1 to 117.

resistor in series. A *mellow* button shunts a .003-mfd condenser across the first a-f output. A second switch on the *voice* button places a 100-mmfd capacitor in parallel with a .005-mfd condenser plus a 1.5-megohm audio coupling network from first to second audio, aiding the highs. A second switch on the *bass* button cuts in a .02-mfd condenser in series with a 50,000-ohm resistor in a high-attenuating circuit across the second audio input.

Biasing

The 6SQ7 second audio is biased from the voltage divider, and the cathode obtains degenerative voltage from a potentiometer on the output transformer secondary. This provides for better quality. About 20% of the output voltage is fed back. The *phono* button switches the volume control to the phono socket and also blocks the 6SA7 converter, and first and second i-f stages by connecting the avc bus to a high negative potential. The center tap of the transformer secondary drops through the 856-ohm speaker field and two voltage divider resistors of 187 and 13-ohm values. The high bias is filtered by a 1-megohm resistor and a .02-mfd condenser to prevent any hum getting into the audio. A 6SQ7 phase inverter and push-pull 6V6's complete the lineup.

G.E. TC-3, 3P

A dynamic mutual conductance tube checker with sockets for all tubes is shown in Fig. 2. This checker has a unique circuit switch known as a *PMT* circuit switch. *PMT* is a contraction for the word . . . permutation . . . used in mathematics to describe the system of obtaining the number of combinations available from a series of consecutive numbers, considering all or a certain number at a time. An example would be . . . 1 to 8, taken 8 at a time. The result would be 40,320 combinations of the eight numbers. In this unit, a series of 18 individually-operated lever switches provides this flexibility. And it permits placing the proper voltages on the right pin of the tube.

An opposing voltage method is used in testing outputs. That is, opposed grid and plate voltages produce a meter reading affected simultaneously by ability of the grid to control the plate current and the ability of the cathode to furnish the necessary current. Rejection results either from a defective grid control, spotty or worn-out cathodes, or from an open element.

Shorts are indicated by the meter as well as a glow on the neon indicator. Checks are made while the tube is hot, with the sensitivity on 2 megohms. Provision is made for checks between every element including the cathode heater.

Battery tests are also provided. Three d-c voltmeter ranges are available: 0-10, 0-100, and 0-1000. The top range is convenient for d-c power-supply measurements.

Meissner 9-1047

An f-m adaptor providing fidelity results, is shown in Fig. 3 (see page 40), the Meissner 9-1047. It is designed to plug into a phono jack of a standard radio receiver. The better the receiver, particularly the audio, the better the fidelity results. This model covers the 41.2 to 50.4 mc range with an oscillator operating on the low side of the r-f signal for improved stability. The receiver uses a dipole antenna primary feeding a tuned r-f stage (12SK7).

The inductor of the first detector is in the plate lead of the r-f amplifier and the tuning condenser is isolated by a pair of .004-mfd blocking capacitors. A 250,000-ohm shunt across the tuned circuit guarantees ample band width. The 12SA7 with a cathode tapped Hartley functions as in standard sets. Plate decoupling filters are used in the r-f amplifier screen and plate, and the converter output and the second i-f plate. Two transformer-coupled 12SK7 i-f stages work at 4.3 mc and feed a 12SJ7 limiter. Only the first i-f has self bias.

The set is wired for a-c/d-c operation with series filaments. The converter operates at ground potential with the r-f amplifier tube next in line. Both are bypassed by a .001-mfd condenser and isolated from the remainder of the string by an r-f choke. The pilot lamp tap on the 35Z5 is unused; instead, a 117-volt pilot light is connected right across the line.

Alignment

The receiver may be aligned by any competent Service Man with all-wave equipment. While an f-m oscillator or an oscillograph will help, they aren't imperative in this instance. The discriminator (7A6) is aligned as follows:

(*1*) The gain of the 12SJ7 limiter is increased by shunting the 100,000-ohm plate dropping resistor with about 2000 ohms.

(*2*) A 4.3-mc signal is then fed to the limiter grid through a .05-mfd coupling condenser.

(*3*) Then the secondary trimmer is tuned for a balanced minimum. Three minima are possible, off-tune on one side, the correct balanced minimum and off-tune on the other side. At the proper point, the signal rises as the trimmer is tuned in either direction.

(*4*) The primary trimmer is aligned for maximum response; a bit of mistuning of the secondary trimmer should be allowed so that some signal leaks through for tuning.

(*5*) The i-f amplifier is aligned by working back, stage by stage, and keeping the input voltage as low as possible to prevent limiter action which gives an apparent broadening of the signal.

(*6*) Finally the secondary of the

(*Continued on page* 40)

EQUALIZERS by UTC

3AX . . . THE UNIVERSAL EQUALIZER FOR BROADCAST AND RECORDING SERVICE. PROVIDES ADJUSTABLE EQUALIZATION AT 25, 50, OR 100 CYCLES FOR LOW END, AND AT 4000, 6000, 8000, OR 10,000 CYCLES AT HIGH END. CALIBRATED CONTROLS READ DIRECTLY IN DB EQUALIZATION AND FREQUENCY SETTING. THE INSERTION LOSS EFFECTED BY THE EQUALIZER IS COMPENSATED THROUGH SPECIAL COMPENSATING PADS, SO THAT IT IS CONSTANT REGARDLESS OF SETTING. RAPID CHANGE IN TONE COLOR CAN BE OBTAINED WITH NEGLIGIBLE CHANGE IN VOLUME.

4C . . . AN IDEAL SOUND EFFECTS FILTER FOR BROADCAST AND RECORDING SERVICE. LOW PASS FILTER FREQUENCIES OF 100, 250, 500, 1000, 2000, 3000, 4000, AND 5000 CYCLES ARE PROVIDED. IDENTICAL HIGH PASS FILTER FREQUENCIES ARE PROVIDED. THIS UNIT EMPLOYS NOISELESS SWITCHING, AND A SUFFICIENTLY WIDE RANGE OF FREQUENCIES TO TAKE CARE OF ANY TYPE OF TONE COLOR REQUIRED.

MAY WE COOPERATE WITH YOU ON DESIGN SAVINGS FOR YOUR APPLICATION . . . WAR OR POSTWAR?

ARMY E NAVY
ALL PLANTS

United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

STANCOR *Transformers*

THE STANDBY OF SERVICEMEN

Call your nearest Stancor Jobber—or write us for his address

STANDARD TRANSFORMER CORPORATION

1500 NORTH HALSTED STREET • CHICAGO

C BIASING

(*Continued from page* 23)

will result in low-bias values. When checking converters to see if the oscillator is working, the voltage across the oscillator-grid resistor should be measured. No grid voltage indicates no oscillation. A vtvm must be used since the current in this resistor is quite small and the shunting effect of a meter may itself stop the oscillations.

Ohm's Law

A quick determination of plate and screen grid current being drawn by a tube may be made by measuring the bias developed in the cathode current, by use of the Ohm's law.

Reference to receiver diagrams will give the Service Man some idea of what values to expect for *C* bias in various parts of a receiver. A quick check of these values may often localize troubles that otherwise would require extensive search. In r-f circuits where avc is used, bias measurements should be made under no signal conditions, since the cathode bias will be reduced due to the higher grid bias and lower plate currents. Cathode bias is here distinguished from grid bias, as being that part of the grid bias developed in the cathode circuit, whereas grid bias is the sum of the cathode bias and avc bias.

Voltage References

Occasionally Service Men misinterpret voltage values because of the confusion of terms such as ground, B—, chassis, etc. All voltage references should be made to cathode, Fig. 8. No matter how voltages are distributed, the cathode is the true minus reference point. Thus, control grid voltage is the voltage between control grid and cathode. The plate and screen grid voltage is the voltage measured between plate or screen grid and cathode. These are effective values. Sometimes manufacturer's notes mention that all voltages are measured to ground or chassis. In this case, the chassis is used as a common d-c terminal for voltage distribution, and is kept at r-f ground by the inclusion of appropriate r-f and a-f bypasses across d-c elements.

Simple Pentode Circuits

Fig. 8*a* shows a simple pentode circuit. The effective plate voltage, or E_p is less than the *B* voltage E_b, by E_k, the developed cathode bias. E_c, or the grid bias in this case is equal to E_k. Where avc is used, as in Fig. 8*b*, E_c is equal to the sum of E_k and E_{avc}.

Fixed Biases

Fig. 8*c* shows another method of developing fixed bias. Here a bleeder circuit establishes chassis as positive, with relation to *B*—. By returning the cathode to chassis, and the control grid to *B*—, a negative voltage is impressed on the grid with relation to the chassis or cathode. E_p in this case is equal to E_b-E_c, where E_b is the total d-c voltage output of the rectifier, and E_c is the drop across the filter choke.

A-F Bias Voltages

In cathode-bias systems the effective plate voltage is dependent on the bias voltage. Where the supply voltage is fixed, any increase in bias voltage will decrease the plate voltage in like amount. For example, if the supply voltage were 250, with a developed bias voltage of 16, the effective plate voltage would be 234. If the bias voltage were decreased to 8, the effective plate voltage would be 242. This is only true when using a-f transformers since the voltage drop across it is small.

When computing cathode resistors it is necessary to take into account the increase or decrease in plate voltage. It is sometimes desirable to reduce the effective plate voltage, particularly in tube substitutions. This may be done directly in the cathode circuit by the addition of the necessary size resistor. By returning the grid to the point in the cathode circuit giving the desired bias the additional cathode drop does not influence the bias, yet reduces the effective plate voltage.

SERVICING HELPS

(Continued from page 27)

n low and medium volume; disappears when volume control is turned n full: Replace filament string electrolytic condenser. Symptoms occur nly when operating on a-c.

•

ARWIN 302

Distortion: Remove metal bottom cover from chassis to diminish heat caused by line voltage reducer mounted underneath the chassis.

•

ZENITH MODELS

Dial belts: Quite often when replacing dial belts on these receivers the belt is either too tight or too loose even when the proper belt replacement is used. To remedy this we loosened the bolts on the dial bracket attached to the condenser gang, allowing condenser gang to drop slightly if belt is too tight or to raise if belt is too loose.

•

TUBE SUBSTITUTIONS

A 58 instead of a 35 is an excellent replacement. Use adapter or change socket. The suppressor grid should be tied to the cathode.

A 47 can in most cases be replaced directly by a 33. The filament of the 33 is rated at 2 volts while that of the 47 is 2.5 volts. This slight voltage overload on the 33 does not seem to impair its quality. It is necessary to reduce plate and screen volts to 180 volts.

Edward Goldschmidt

•

ZENITH 7S432, 433, 434, 449, 450, 458, 460, 461, 462, 487, 488 (CHASSIS 5724)

Oscillation on l-f automatic buttons. This is due to coupling between the r-f circuits and the primary circuit of the oscillator coupling roll. The coupling is so great that the automatic oscillator circuit may be tuned by varying the r-f trimmer capacities. To remedy, shield the blue lead between the oscillator coil primary and the automatic oscillator coupling coil. Ground the shield.

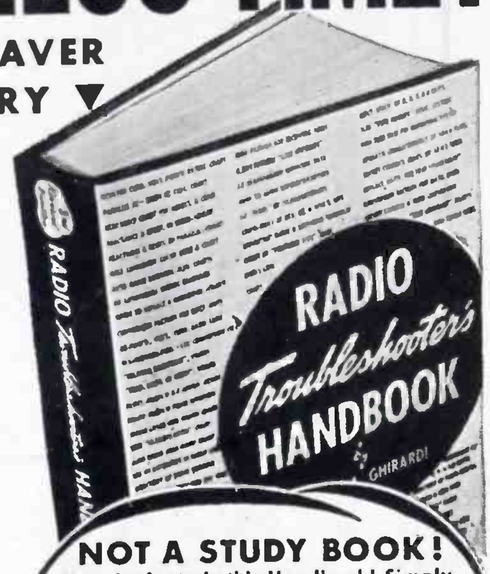
Zenith Shop Notes

HANDLE MORE JOBS IN A LOT LESS TIME!

THE GREATEST TIME SAVER IN SERVICING HISTORY

Radio servicemen everywhere say that A. A. Ghirardi's RADIO TROUBLESHOOTER'S HANDBOOK (3rd Edition) helps them TURN OUT TWICE AS MUCH WORK IN A GIVEN TIME! Four times out of five, it tells exactly how to repair a set—*without any elaborate testing whatever!*

Actually, this big 4-pound, 744-page manual-size Handbook is a complete guide to quick, easy repairs on PRACTICALLY EVERY RADIO RECEIVER NOW IN USE.

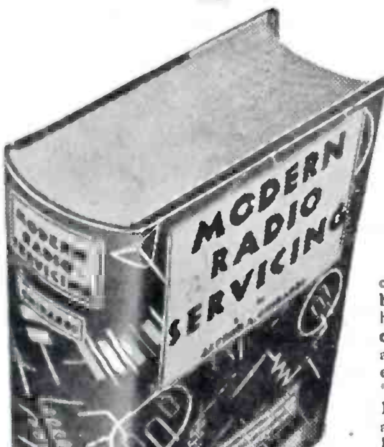


4,800 DIFFERENT RADIO MODELS

Its 404-page Case History Section gives full details on common trouble symptoms, their causes and remedies for OVER 4,800 DIFFERENT RADIO MODELS. It describes the trouble exactly, tells exactly what to do to repair it. It eliminates much testing—helps you to do TWO OR MORE jobs in the time normally required for one—repair cheap sets profitably—train new helpers, etc.

Equally important are hundreds of other pages specifically geared to today's needs—dozens of hints on the proper substitution of tubes and parts; i-f alignment peaks for over 20,000 superhets; transformer troubles, etc., and hundreds of graphs, tube charts, data, etc.—all carefully indexed so you can find what you need in a hurry. Price only $5 complete ($5.50 foreign) on our UNRESERVED 5-DAY MONEY-BACK GUARANTEE!

NOT A STUDY BOOK!
You don't study this Handbook! Simply look up the radio's Make, Model, and the Trouble Symptom—and go to work! Eliminates useless testing on 4 JOBS OUT OF 5!
ONLY $5 COMPLETE



The Only Complete Guide to MODERN PROFESSIONAL RADIO SERVICE WORK

COMPLETE DATA ON TEST INSTRUMENTS, TROUBLESHOOTING, REPAIR

Once in a blue moon a technical book is written that is so important, so complete, and so easy to understand that it is used and recommended universally by members of a profession! A. A. Ghirardi's MODERN RADIO SERVICING is that kind of a book—AND MORE!

Actually, it is the only single, inexpensive book giving a complete course in modern Radio Repair Work in all its branches. Explains all necessary test instruments . . . even how to build your own; how to troubleshoot ALL makes of receivers, analyze their circuits, test components; make adjustments; repairs, etc.—all step-by-step. Used for reference, it serves as a beautifully cross-indexed volume for "brushing up" on any type of work that may puzzle you. 1300 pages, 720 self-testing review questions, 706 illustrations and diagrams. $5 complete ($5.50 foreign) 5-DAY MONEY-BACK GUARANTEE.

EVERY CONCEIVABLE SERVICE SUBJECT!

Milliammeters, ammeters & voltmeters; Methods and instruments for measuring resistance; ohmmeters; How to build your own instruments; Tube checkers; Set analyzers; Point-to-point testing; Test oscillators; Preliminary trouble checks; AVC and QAVC circuits; Troubleshooting; Testing components; Obscure radio troubles; Aligning and neutralizing; Auto radios; All-wave radio servicing; Marine radio; Interference reduction; How to start and operate a Radio-Electronic service business, etc., etc.

See Money-Saving Offer in Coupon!

5-DAY MONEY BACK GUARANTEE

Dept. S-35, Technical Division.
MURRAY HILL BOOKS, INC.,
232 Madison Ave., New York 16, N. Y.

Enclosed find $ .... for books checked (send postpaid) or ☐ send C.O.D. (in U.S.A. only) for this amount plus postage. If not fully satisfied, I may return the books in 5 days for full refund.

☐ RADIO TROUBLESHOOTER'S HANDBOOK $5 ($5.50 foreign)
☐ MODERN RADIO SERVICING $5 ($5.50 foreign)
☐ **MONEY-SAVING COMBINATION** — Both books (over 2040 pages of invaluable service data) for only $9.50 ($10.50 foreign).

Name ....
Address ....
City & Dist. No. .... State ....
Please print or write plainly

SER-CUITS

(*Continued from page 24*)

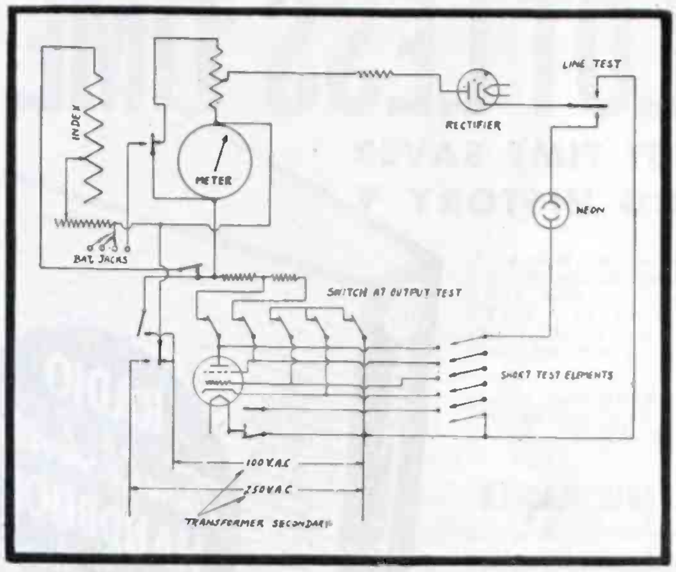


Fig. 2. The G.E. TC3 and 3P tube checker with individually operated lever switches to control voltage ranges from 1 to 117.

resistor in series. A *mellow* button shunts a .003-mfd condenser across the first a-f output. A second switch on the *voice* button places a 100-mmfd capacitor in parallel with a .005-mfd condenser plus a 1.5-megohm audio coupling network from first to second audio, aiding the highs. A second switch on the *bass* button cuts in a .02-mfd condenser in series with a 50,000-ohm resistor in a high-attenuating circuit across the second audio input.

Biasing

The 6SQ7 second audio is biased from the voltage divider, and the cathode obtains degenerative voltage from a potentiometer on the output transformer secondary. This provides for better quality. About 20% of the output voltage is fed back. The *phono* button switches the volume control to the phono socket and also blocks the 6SA7 converter, and first and second i-f stages by connecting the avc bus to a high negative potential. The center tap of the transformer secondary drops through the 856-ohm speaker field and two voltage divider resistors of 187 and 13-ohm values. The high bias is filtered by a 1-megohm resistor and a .02-mfd condenser to prevent any hum getting into the audio. A 6SQ7 phase inverter and push-pull 6V6's complete the lineup.

G.E. TC-3, 3P

A dynamic mutual conductance tube checker with sockets for all tubes is shown in Fig. 2. This checker has a unique circuit switch known as a *PMT* circuit switch. *PMT* is a contraction for the word . . . permutation . . . used in mathematics to describe the system of obtaining the number of combinations available from a series of consecutive numbers, considering all or a certain number at a time. An example would be . . . 1 to 8, taken 8 at a time. The result would be 40,320 combinations of the eight numbers. In this unit, a series of 18 individually-operated lever switches provides this flexibility. And it permits placing the proper voltages on the right pin of the tube.

An opposing voltage method is used in testing outputs. That is, opposed grid and plate voltages produce a meter reading affected simultaneously by ability of the grid to control the plate current and the ability of the cathode to furnish the necessary current. Rejection results either from a defective grid control, spotty or worn-out cathodes, or from an open element.

Shorts are indicated by the meter as well as a glow on the neon indicator. Checks are made while the tube is hot, with the sensitivity on 2 megohms. Provision is made for checks between every element including the cathode heater.

Battery tests are also provided. Three d-c voltmeter ranges are available: 0-10, 0-100, and 0-1000. The top range is convenient for d-c power-supply measurements.

Meissner 9-1047

An f-m adaptor providing fidelity results, is shown in Fig. 3 (see page 40), the Meissner 9-1047. It is designed to plug into a phono jack of a standard radio receiver. The better the receiver, particularly the audio, the better the fidelity results. This model covers the 41.2 to 50.4 mc range with an oscillator operating on the low side of the r-f signal for improved stability. The receiver uses a dipole antenna primary feeding a tuned r-f stage (12SK7).

The inductor of the first detector is in the plate lead of the r-f amplifier and the tuning condenser is isolated by a pair of .004-mfd blocking capacitors. A 250,000-ohm shunt across the tuned circuit guarantees ample band width. The 12SA7 with a cathode tapped Hartley functions as in standard sets. Plate decoupling filters are used in the r-f amplifier screen and plate, and the converter output and the second i-f plate. Two transformer-coupled 12SK7 i-f stages work at 4.3 mc and feed a 12SJ7 limiter. Only the first i-f has self bias.

The set is wired for a-c/d-c operation with series filaments. The converter operates at ground potential with the r-f amplifier tube next in line. Both are bypassed by a .001-mfd condenser and isolated from the remainder of the string by an r-f choke. The pilot lamp tap on the 35Z5 is unused; instead, a 117-volt pilot light is connected right across the line.

Alignment

The receiver may be aligned by any competent Service Man with all-wave equipment. While an f-m oscillator or an oscillograph will help, they aren't imperative in this instance. The discriminator (7A6) is aligned as follows:

(*1*) The gain of the 12SJ7 limiter is increased by shunting the 100,000-ohm plate dropping resistor with about 2000 ohms.

(*2*) A 4.3-mc signal is then fed to the limiter grid through a .05-mfd coupling condenser.

(*3*) Then the secondary trimmer is tuned for a balanced minimum. Three minima are possible, off-tune on one side, the correct balanced minimum and off-tune on the other side. At the proper point, the signal rises as the trimmer is tuned in either direction.

(*4*) The primary trimmer is aligned for maximum response; a bit of mistuning of the secondary trimmer should be allowed so that some signal leaks through for tuning.

(*5*) The i-f amplifier is aligned by working back, stage by stage, and keeping the input voltage as low as possible to prevent limiter action which gives an apparent broadening of the signal.

(*6*) Finally the secondary of the

(*Continued on page* 40)

EQUALIZERS by UTC

3AX . . . THE UNIVERSAL EQUALIZER FOR BROADCAST AND RECORDING SERVICE. PROVIDES ADJUSTABLE EQUALIZATION AT 25, 50, OR 100 CYCLES FOR LOW END, AND AT 4000, 6000, 8000, OR 10,000 CYCLES AT HIGH END. CALIBRATED CONTROLS READ DIRECTLY IN DB EQUALIZATION AND FREQUENCY SETTING. THE INSERTION LOSS EFFECTED BY THE EQUALIZER IS COMPENSATED THROUGH SPECIAL COMPENSATING PADS, SO THAT IT IS CONSTANT REGARDLESS OF SETTING. RAPID CHANGE IN TONE COLOR CAN BE OBTAINED WITH NEGLIGIBLE CHANGE IN VOLUME.

4C . . . AN IDEAL SOUND EFFECTS FILTER FOR BROADCAST AND RECORDING SERVICE. LOW PASS FILTER FREQUENCIES OF 100, 250, 500, 1000, 2000, 3000, 4000, AND 5000 CYCLES ARE PROVIDED. IDENTICAL HIGH PASS FILTER FREQUENCIES ARE PROVIDED. THIS UNIT EMPLOYS NOISELESS SWITCHING, AND A SUFFICIENTLY WIDE RANGE OF FREQUENCIES TO TAKE CARE OF ANY TYPE OF TONE COLOR REQUIRED.

MAY WE COOPERATE WITH YOU ON DESIGN SAVINGS FOR YOUR APPLICATION . . . WAR OR POSTWAR?

ARMY E NAVY
ALL PLANTS

United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

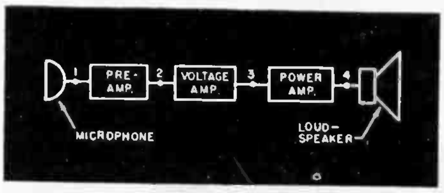


Fig. 1. Block diagram of a simple public-address amplifier.

A-F AMPLIFIER TESTING

by WILLARD MOODY

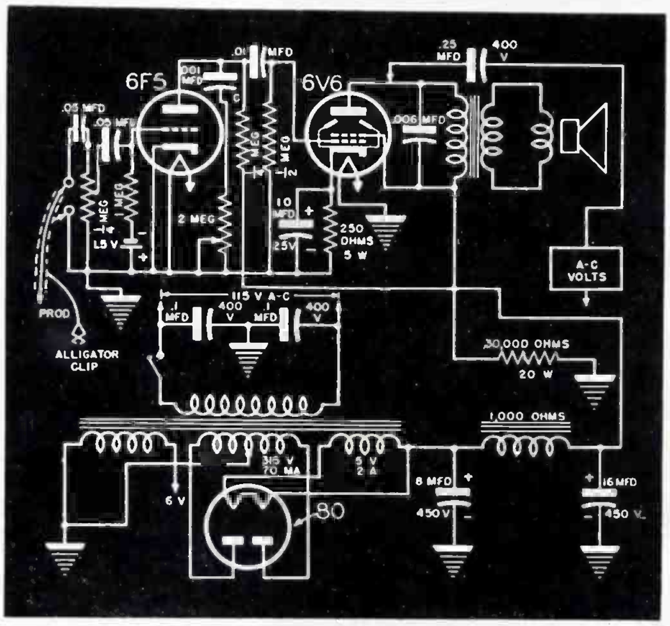


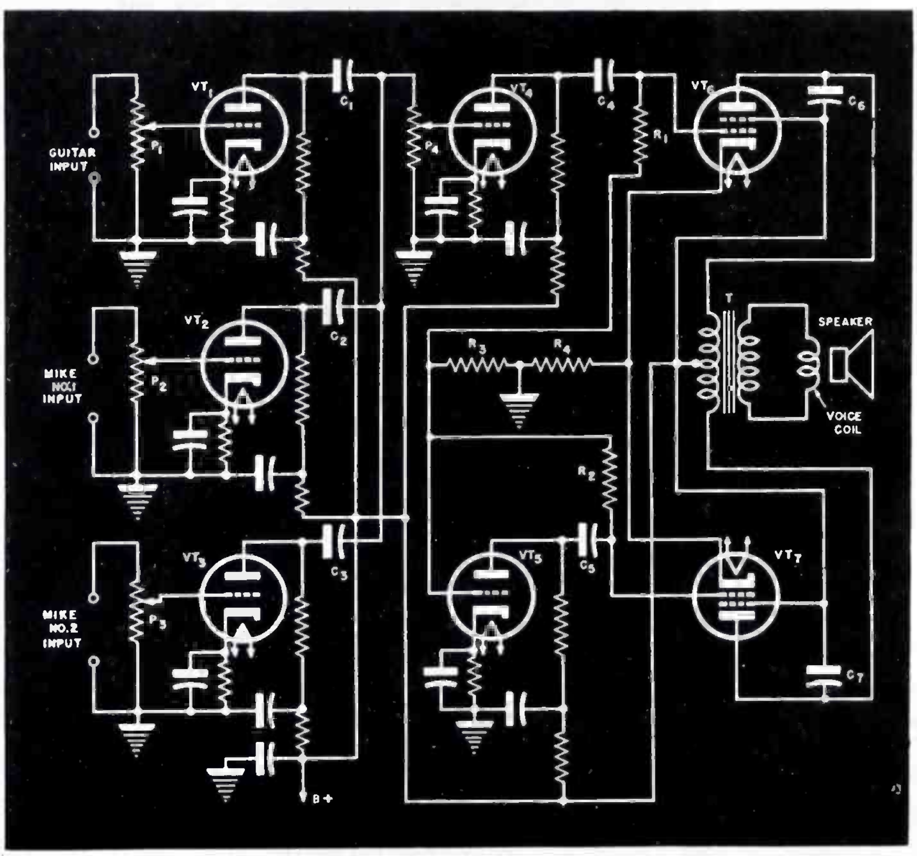
Fig. 2. An audio-frequency test amplifier. This unit can be used as an audio signal tracer. A shielded lead may be connected to the input. Audio voltages can be checked for intensity and distortion, and hum content or relative hum level.

A N audio amplifier may be tested to determine whether it meets design specifications or satisfies maintenance requirements. While laboratory equipment, such as variable-frequency audio generators and vacuum-tube voltmeters would be very helpful for these tests, many Service Men do not have such apparatus. There are however some practical test means that may be substituted. For instance a high quality crystal-type phonograph pickup and microphone of the crystal type can be used for checking a-f amplifiers.

Loudspeaker as Check

A good quality loudspeaker should be used for checking audio output. If the speaker is mounted on a suitable baffle, the tone will be improved. Tests made with a test speaker instead of the regular bank of speakers handled by a p-a amplifier will not tell the whole story, but will assist in doing preliminary trouble-shooting work. For stage-by-stage testing, we may use an audio signal tracer consisting of a high-gain amplifier so arranged that it can be used to check the level at any point in the system. Using the tracer, hum and distortion tests also can be made.

Fig. 3. Electronic mixing and phase inversion in a typical high-gain amplifier having a push-pull-output stage. To check the individual sources of signal potentials, the signal tracer can be connected across P_1, P_2, or P_3. For checking the mixed output, the tracer would be connected across P_4.



Audio Power Measurements

A vacuum-tube voltmeter or copper-oxide rectifier type a-c voltmeter may be used for checking the signal voltage across a dummy load in the output of the amplifier when audio power measurements are to be made, $P = E^2/R_L$ An oscillograph may be used for testing, but many Service Men prefer meters instead, or the signal tracer.

Five Basic Check Factors

In testing an amplifier system five factors should ordinarily be checked. These are gain, linearity and distortion, hum level and power output. As indicated previously, there are two types of tests that can be made. We ive, for instance, the design test, here it may be desired to check on m or oscillation, secure a given form response curve, or a certain value power output. In the service test, r major problem is to make the nplifier operate as originally planned, llowing the original circuits of the sign. Design tests are conducted by rvice Men who build custom amplirs.

Service Tests of A-F Amplifiers

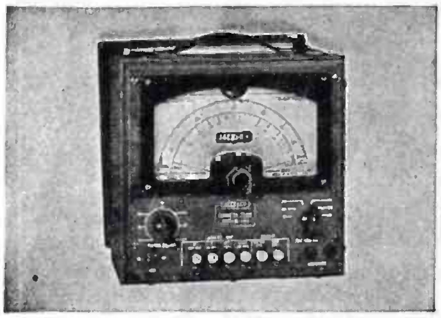
One of the simplest high-gain audio nplifier tests covers the amplifier acrity check. It is only necessary to vance the gain control to maximum d place your finger or a test prod the high side of the control or to e grid of the first audio tube. For ample, in many receivers a 75 works ito a 42 output stage which drives a udspeaker, or a 6SQ7 may feed a 6 or 6V6. Touching the 75 top cap the 6SQ7 grid will produce a loud ise, hum or squeal if the amplifier is orking and has its usual high gain. the response is weak, an audio dect exists. In the circuit of Fig. 2, r example, an open in the .01-mfd ndenser between the 6F5 plate and 76 grid would cut the gain, not alwing normal passage of the signal om the 6F5 to the 6V6. In the case a p-a amplifier, whistling into the ike or merely tapping it will show hether the system is alive or not. cidentally, the audio amplifier shown the figure can be used as an audio gnal tracer. A shielded lead may be tached to the input. Audio voltages n be checked for intensity and disrtion and hum content or relative m level. The alligator clip may be tached to *B minus* or the on-off vitch in a-c/d-c amplifiers or midget ceivers, while the test prod is used contact the grid and plate connecons of the amplifier being checked. he level at the 6F5 grid can be conolled by means of the 250,000-ohm otentiometer. A small dry cell may connected in series with the grid turn to put a bias on the 6F5, or a as cell specially made for this service n be used. With a short mike cable d the gain control well up, crystal ikes can be tested. If mikes are to be ecked it would be desirable to add nother stage of pre-amplification. A ystal record player will provide sufcient output to drive the amplifier rmally.

Checking Microphones

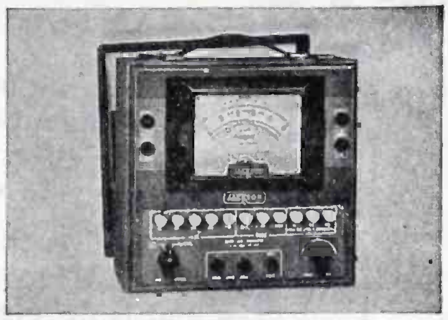
The test amplifier may be used to ck up signals at the output of the e-amplifier, when checking micro-

(*Continued on page* 37)

You can put Teamwork into Testing!

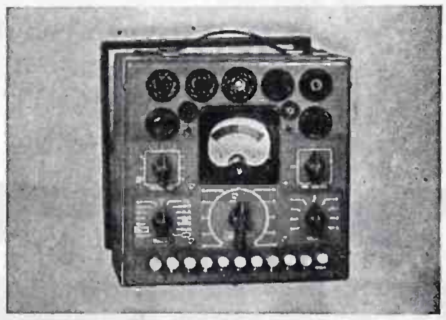


Condenser Tester—Model 650A.
Measures Capacity, Power Factor and Leakage

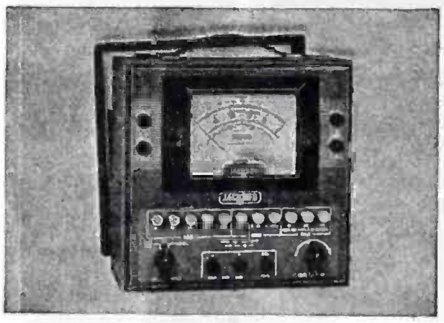


Sensitive Multimeter—Model 642.
20,000 ohms per volt—complete ranges

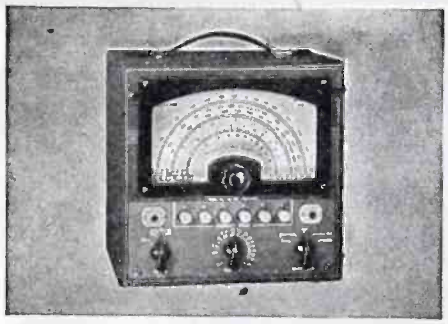
Electronic Multimeter—Model 645.
A *new* Jackson instrument of advanced design



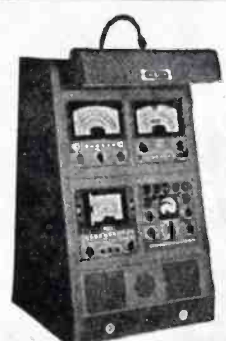
Tube Tester—Model 634.
Uses exclusive Jackson "Dynamic" Test Method



Multimeter—Model 643.
1000 Ohms per volt. Push key range selection



Test Oscillator—Model 640.
Accurate to ½% covers full frequency range



"Service Lab"
Assembly of *Standard-Size* Jackson Instruments

YES, TEAMWORK is needed to test and service a radio set. No one instrument, of course, can do the full job. Each Jackson instrument is a specialist, yet a member of the team—each outstanding in accuracy and performance, and each backing up the other.

Every Jackson unit is separate and complete. And besides being matched in quality and performance, the instruments shown here are uniform in dimensions, appearance and finish. They can be assembled in any combination you choose—as in the Jackson-built Service Lab illustrated (left). Whether you need one, several, or a complete set of instruments, *buy for the future—with Jackson.*

BUY WAR BONDS AND STAMPS TODAY

JACKSON

Fine Electrical Testing Instruments

JACKSON ELECTRICAL INSTRUMENT COMPANY, DAYTON, OHIO

WAR vs PEACE

RADIART

RADIART is devoting most of its energies to war work . . . shipments of RADIART Electronic Devices for government orders are being made according to schedule.

But that part of each month's production that is available after government schedules have been met is devoted to the manufacture of RADIART VIBRATORS for civilian use.

With W P B permission, RADIART plans to continue to furnish their jobbers with RADIART VIBRATORS on this contingent basis.

Radiart Corporation

3571 W. 62nd. St. CLEVELAND 2, OHIO

OLD TIMER'S CORNER

by SERVICER

WAS walking home the other evening around 11 and saw a light in Ed's shop. Couldn't help wondering what he was doing up at that hour so I rapped on the window and Ed came out all covered with paint. Seems like he was redecorating his place.

Now with about some fifty-odd radios in the corner waiting repair, I couldn't for the life of me figure why Ed was taking the valuable time to fix up his place. And I said so.

"You know, Bill," he said, "We're up to our ears in a war right now, but we won't always be. And I got it all figured out that this shop is going to be one of the first to be ready for that postwar period. Sure we haven't much to sell but we can be long on *good-will*. This place hasn't had a good going over for quite a spell, and I think that it is high time that it got to look like we were going to be in business even after everything eases up. So I am doing it over late at night, a bit at a time, and if you'll come on over here, I'll show you what I have been planning.

"You know how noisy the place is when you are doing some audio work? Well, I went over to that war plant in town and spoke to the purchasing agent. He told me that they had just finished installing new ceilings throughout the offices, and that there were scraps of the deadening material left over which I could have for a few cents. While patching normally doesn't look too well, if a lot of personal trouble is taken, a pretty nice job can be done. And with a bit of joiner over the cracks, you can't see where I put the pieces together. Makes a pretty fine ceiling don't you think? And is it quiet! Later I will do the top of the walls down to about 5 feet from the floors. But I have to wait until I uncover a new source for that.

"Then I have moved all the odds and ends out of the drawers, sorted it all and threw away what we definitely couldn't use in a month of Sundays. The rest was put into small boxes ready for their places in the drawers I am going to build into a working bench-cabinet.

The Test Panel

"We went over to the lumber yard and bought some fine 5-ply plywood. Then I made a test panel for all the instruments I usually use, and made up some patch cords for them. Finally I've opened all the test sets and cleaned them out and put them in order. That's as far as I have gone.

"I am planning a test bench made up of fibre-board on top of a bench of 1½" finished white pine. The bench board will

, stained brown, while the fibre-board ill be left natural. The sets will be re- ,ired here.

"Around the edge of the bench I plan ,me 115-volt a-c outlets. This time I n going to have enough outlets. No ,ore patch cords for me! By the way, ,ll have my batteries hidden away under ,e bench with a permanently installed ,arger. Merely by throwing a couple of ,vitches I will be able to keep them ,arged. At the same time I'll also have ,-volt power for car radios I get for ,pair.

"I have a few instruments of which you ,now, and I have circuits for the rest. ,ly old oscillograph will be placed dead ,enter on the test panel with the signal ,enerator to the right and the volt-ohm- ,illiameter to the left. Those three are ,sed the most. A home-made ohm-sifter ,ill be placed outside. This will be used ,or continuity checking. I'm also in the ,rocess of assembling parts for a simple ,acuum-tube voltmeter. This should be ,leal for signal tracing.

There's a speaker above with a univer- ,al transformer. This unit can be con- ,ected to almost any type of circuit to ,heck the speaker output. I also built a ,eon-light output meter for testing audio ,utputs.

"With the taps of the transformer ,rought out on the panel, I can match ,ny output or line to that speaker. I'll ,void plenty of headaches this way.

Audio Oscillators

"Joe, who has a shop a few blocks ,way, has given me a relaxation audio ,scillator circuit. While it will not have ,oo good a wave-form, it will do until I ,an get one from a factory after the war. ,That will be mounted to the right of, and ,bove the oscillograph. I can use that for ,udio checking together with the vtvm.

"In this corner I am going to build a ,arge cabinet to hold the sets that have ,een repaired and are awaiting delivery. ,t's a shame that they get banged around ,o much. There's always the chance that ,ome one will put a hot soldering iron on ,hem and mar the surface. So I am ,oing to put the sets into a safe place. On the other side I am putting another ,abinet to hold the radios awaiting repair. That will keep them out of the way.

"Here in the middle of the shop I am ,utting my desk so that I can watch the ,ront of the place which is ahead of this ,ounter.

"In front of the shop I plan to put some chairs around and leave plenty of room for the merchandise. To the far left I am installing some sound-proof booths, which will be open at the front, for the kids to listen to their jive records. Two record players have already been built from odds and ends found around here. In the last row there will be a closed-in room for those who want to hear the classics. A very fine high-fidelity job is being built for that purpose.

"So that's what is keeping me busy these days. Then, too, I went downstairs and got up that sign we've had there since Pearl Harbor. It says, '*The customer is always right!*'

"We feel that we want to have that in front of us from now on, because it won't be too long before we can use it again.

"And believe me, we will want the customers to know that we feel that way, too."

Today we look upon a moving, active, thinking world. Things are happening—fast. Science has rushed ahead fifty years. Dreams are becoming realities. Truly we are coming closer to the stars. The Astatic Corporation is a factor in this moving, living plan, and from Astatic research laboratories come new and improved products for a new era. Not the least important of these is a zephyr-light pickup for phonograph equipment, which will reproduce the living voices and the instrumental artistry of the entertainment world with a clarity, beauty and true-to-life realism heretofore unknown. As FM will contribute to the improvement of radio reception, so will Astatic sound detection and pickup products advance the fidelity of phonographic recordings to bring the great American audience closer to the stars.

"You'll HEAR MORE *from Astatic"*

WAR vs PEACE

STANDARD OF COMPARISON RADIART

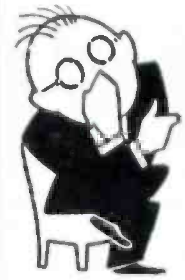
RADIART is devoting most of its energies to war work . . . shipments of RADIART Electronic Devices for government orders are being made according to schedule.

But that part of each month's production that is available after government schedules have been met is devoted to the manufacture of RADIART VIBRATORS for civilian use.

With W P B permission, RADIART plans to continue to furnish their jobbers with RADIART VIBRATORS on this contingent basis.

Radiart Corporation

3571 W. 62nd. St. CLEVELAND 2, OHIO



OLD TIMER'S CORNER

by SERVICER

WAS walking home the other eve-ning around 11 and saw a ligh in Ed's shop. Couldn't help won dering what he was doing up at that hou so I rapped on the window and Ed cam out all covered with paint. Seems lik he was redecorating his place.

Now with about some fifty-odd radio in the corner waiting repair, I couldn' for the life of me figure why Ed was tak ing the valuable time to fix up his place And I said so.

"You know, Bill," he said, "We're u to our ears in a war right now, but w won't always be. And I got it all figured out that this shop is going to be one o the first to be ready for that postwa period. Sure we haven't much to sell but we can be long on *good-will*. Thi place hasn't had a good going over fo quite a spell, and I think that it is hig time that it got to look like we were go ing to be in business even after everythin eases up. So I am doing it over late a night, a bit at a time, and if you'll come on over here, I'll show you what I have been planning.

"You know how noisy the place is when you are doing some audio work? Well, I went over to that war plant in town and spoke to the purchasing agent. He told me that they had just finished installing new ceilings throughout the offices, and that there were scraps of the deadening material left over which I could have for a few cents. While patching normally doesn't look too well, if a lot of personal trouble is taken, a pretty nice job can be done. And with a bit of joiner over the cracks, you can't see where I put the pieces together. Makes a pretty fine ceil-ing don't you think? And is it quiet! Later I will do the top of the walls down to about 5 feet from the floors. But I have to wait until I uncover a new source for that.

"Then I have moved all the odds and ends out of the drawers, sorted it all and threw away what we definitely couldn't use in a month of Sundays. The rest was put into small boxes ready for their places in the drawers I am going to build into a working bench-cabinet.

The Test Panel

"We went over to the lumber yard and bought some fine 5-ply plywood. Then I made a test panel for all the instruments I usually use, and made up some patch cords for them. Finally I've opened all the test sets and cleaned them out and put them in order. That's as far as I have gone.

"I am planning a test bench made up of fibre-board on top of a bench of 1½" fin-ished white pine. The bench board will stained brown, while the fibre-board ll be left natural. The sets will be re-ired here.

"Around the edge of the bench I plan me 115-volt a-c outlets. This time I ı going to have enough outlets. No ore patch cords for me! By the way, l have my batteries hidden away under e bench with a permanently installed arger. Merely by throwing a couple of vitches I will be able to keep them arged. At the same time I'll also have volt power for car radios I get for pair.

"I have a few instruments of which you ıow, and I have circuits for the rest. y old oscillograph will be placed dead nter on the test panel with the signal enerator to the right and the volt-ohm-illiameter to the left. Those three are ed the most. A home-made ohm-sifter ill be placed outside. This will be used r continuity checking. I'm also in the ocess of assembling parts for a simple acuum-tube voltmeter. This should be eal for signal tracing.

There's a speaker above with a univer-l transformer. This unit can be con-ected to almost any type of circuit to ıeck the speaker output. I also built a eon-light output meter for testing audio ıtputs.

"With the taps of the transformer ought out on the panel, I can match ny output or line to that speaker. I'll void plenty of headaches this way.

Audio Oscillators

"Joe, who has a shop a few blocks way, has given me a relaxation audio scillator circuit. While it will not have o good a wave-form, it will do until I an get one from a factory after the war. That will be mounted to the right of, and bove the oscillograph. I can use that for udio checking together with the vtvm.

"In this corner I am going to build a arge cabinet to hold the sets that have een repaired and are awaiting delivery. ts a shame that they get banged around o much. There's always the chance that ome one will put a hot soldering iron on hem and mar the surface. So I am oing to put the sets into a safe place. On the other side I am putting another abinet to hold the radios awaiting repair. That will keep them out of the way.

"Here in the middle of the shop I am utting my desk so that I can watch the ront of the place which is ahead of this ounter.

"In front of the shop I plan to put ome chairs around and leave plenty of oom for the merchandise. To the far eft I am installing some sound-proof ooths, which will be open at the front, or the kids to listen to their jive records. Two record players have already been built from odds and ends found around here. In the last row there will be a closed-in room for those who want to hear the classics. A very fine high-idelity job is being built for that purpose.

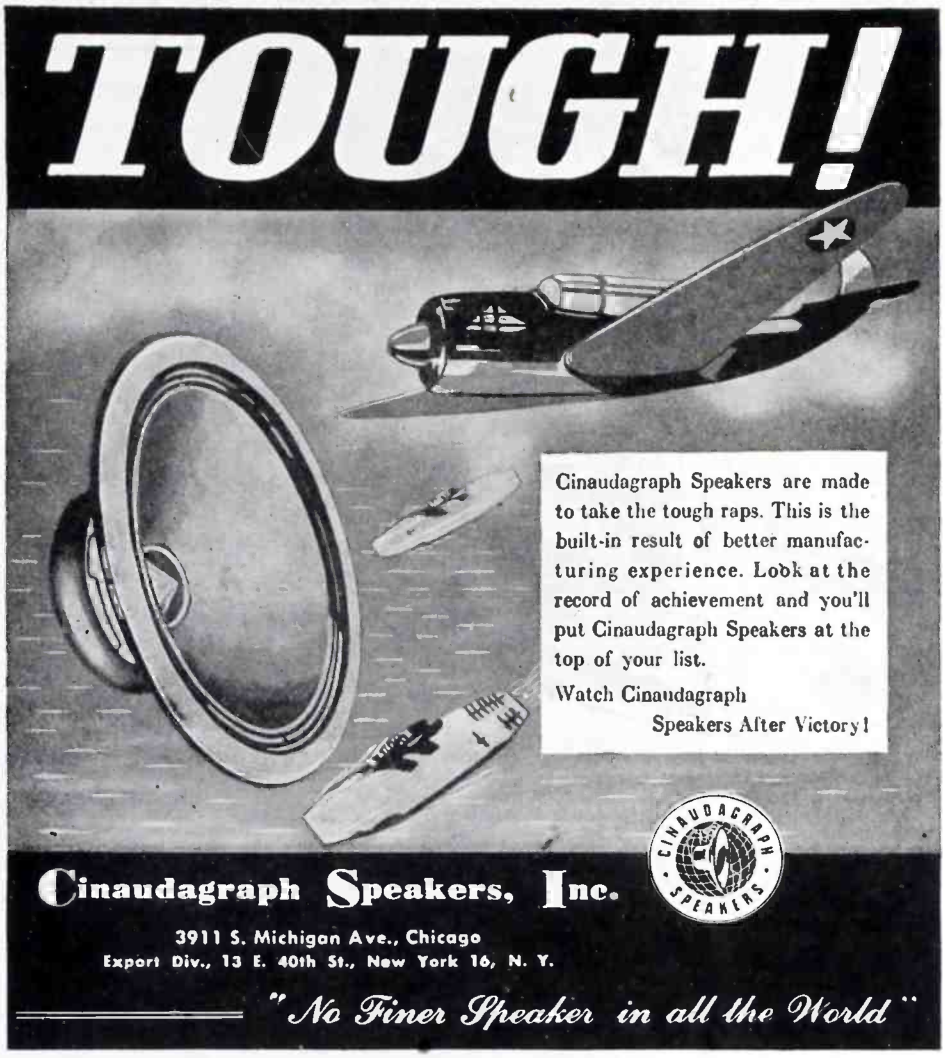
"So that's what is keeping me busy these days. Then, too, I went down-stairs and got up that sign we've had there since Pearl Harbor. It says, *'The customer is always right!'*

"We feel that we want to have that in front of us from now on, because it won't be too long before we can use it again.

"And believe me, we will want the cus-tomers to know that we feel that way, too."

Today we look upon a moving, active, thinking world. Things are happening—fast. Science has rushed ahead fifty years. Dreams are becoming realities. Truly we are coming closer to the stars. The Astatic Corporation is a factor in this moving, living plan, and from Astatic research laboratories come new and improved products for a new era. Not the least important of these is a zephyr-light pickup for phonograph equipment, which will reproduce the living voices and the instrumental artistry of the entertainment world with a clarity, beauty and true-to-life realism heretofore unknown. As FM will contribute to the improvement of radio reception, so will Astatic sound detection and pickup products advance the fidelity of phonographic recordings to bring the great American audience closer to the stars.

"You'll HEAR MORE *from Astatic"*



TELEVISION DEFLECTION CIRCUITS

(See Front Cover)

DEFLECTION circuits used in the RCA TRK-12 receiver are shown in the front-cover diagram this month.

In cathode-ray tube circuits, the electron beam can be deflected by sawtooth waves applied electrostatically by direct connection to the deflecting plates or electromagnetically by energizing a pair of deflecting coils. This receiver uses the latter system. The vertical and horizontal circuits are fundamentally similar, the difference being due to the widely different frequencies at which they operate; 13,230 cycles for *H* and 60 cycles for *V*.

Sync Separator

Preceding the input terminals is a sync separator whose function it is to accept the composite synchronizing pulses and bring about their separation by means of low- and high-pass filters. The vertical pulses are then applied to the upper blocking oscillator and the horizontal pulses to the lower to keep them in synchronism with the transmitter. The apparently open circuits at the binding posts are completed to ground through the filter circuits of the sync separator.

Blocking Oscillator

Blocking oscillators are used to provide high level, steep pulses for accurate control of the charge and discharge cycles of the 6N7 discharge tube. Plate tickler circuits are used with very close coupling. This causes the grid to be completely cut off during a period of each cycle by a high negative charge on the grid condenser. The rate at which this charge leaks off through the grid leak determines the timing of the pulses to the discharge tube. This frequency is made adjustable by varying the grid leak resistance; 1.2 megohms for the vertical and 30,000 ohms for the horizontal. The corresponding grid condensers are of 3300 and 820 mmfd capacities. The grid leak adjustments are termed *hold* controls, *V-H* and *H-H*. Decreasing resistance tends to increase oscillator frequency because the condenser discharges more rapidly.

Next in the circuit are the height and width controls. These function by varying the plate load resistance of the discharge tubes. The picture height control (*P-H*) is a 2.7-megohm variable in the vertical discharge circuit which discharges a 0.1-mfd condenser in series with 3900 ohms, driving a 6J5 amplifier. Similarly, the picture width control (*P-W*) is a variable 560,000-ohm unit which controls the discharge of a .001-mfd condenser in the horizontal discharge tube, driving a 6L6 amplifier. The 6J5 has a 5600-ohm variable cathode bias resistor for controlling vertical linearity. Actually the bias varies the waveform through the deflecting coils, the object being to obtain a straight sawtooth wave. Transformer coupling is used between the 6J5 and the coils. A small amount of d-c is inserted in series with the output a-c sawtooth for vertical centering (*V-C*) of the picture. This is accomplished by a 20-ohm potentiometer with terminals connected to —3 volts and —1.3 volts, the adjustment being made within these values. An output capacitance is shunted across the vertical deflecting coils to tune out some of the reactance. This consists of a .025-mfd condenser in series with 1200 ohms. There is also a 5600-ohm equalizing shunt on the top deflecting coil.

Returning to the horizontal amplifier, the unbypassed 270-ohm cathode bias resistor allows some current degeneration which improves the damping qualities of the 6L6 load circuit. A 5V4G with elements in parallel is connected in parallel with the secondary of the output transformer in such a direction that it loads the 6L6 while the trace is being drawn, the load being removed during the retrace period. Thus, selective horizontal damping (*H-D*) is effected. This prevents the formation of transient oscillations. These oscillations, if allowed to take place, have the effect of reducing the average power supplied to the horizontal deflecting coils. The clearness of the picture may also be affected. Remember the speed at which these deflecting coils are working, 13230 cycles-per-second.

Horizontal centering (*H-C*) is accomplished as in the vertical, but with a 6-ohm control working between ground (zero) and —1.3 volts. No filter or equalizer is used. However the added d-c is bypassed by a 15-mfd condenser. Also, .05-mfd r-f bypass condensers are used between the 5V4G heater and ground.

A-F TESTING

(*Continued from page* 33)

hones for output. If a copper-oxide ectifier type a-c voltmeter is connected the output, visual indications afording higher accuracy will be posble in checking gain. As an example, eferring to Fig. 1, the test amplifier ay be connected to point *3*. The output indication on the output meter is oted. Then the test amplifier is shifted point *2*. The level of the signal at will be lower than at *3*. If it is not onsiderably lower, the gain between and *3* is low, and if the gain of the mplifier being tested normally is high etween *2* and *3*, we have definite proof f trouble here. A little experience in sing the test amplifier or audio signal acer will soon show what to expect checking.

To check the amplifier, a test signal necessary. When using speech at he mike, the signal level jumps around uite a bit, giving fluctuations on the utput meter of the test amplifier. One ay of getting around the difficulty ould be to have an assistant hum to the mike, but variations in output result. In a more elaborate setup n audio amplifier fed by an audio enerator can be made to work into a peaker, which in turn would provide ound pressure at the mike. Thus a est signal would be available. Another ethod involves the use of a small uzzer of the type used for code pracce. This can be connected to a No. 6 ry cell and allowed to run. The buzzer ay be placed at different positions om the microphone to check the irectivity pattern of the mike and the esponse of the amplifier. The buzzer, witch and battery are simply conected in series. The a-f signal tracer ay be used for checking the stage ain in each stage of the amplifier, r for finding the dead stage, working ight on down the line from input to utput, or in the reverse direction om output to input. For example, asuming the circuit of Fig. 2 is that of simple amplifier, an audio signal

(*Continued on page* 38)

One of a series of Electro-Voice advertisements explaining in detail the applications and specifications of Electro-Voice microphones

... a general-purpose dynamic microphone with an exceptionally wide and flat frequency response—for both indoor and outdoor speech and music pick-up —is required...

Electro-Voice MODEL 630

This versatile, moderately priced microphone is excellent for public address, all types of dispatching and call systems, paging systems, churches, auditoriums, hotels, recording studios and broadcast remote pick-ups. Though somewhat lighter in weight, it is a sturdy microphone, built with typical Electro-Voice care to serve satisfactorily over a long period of time. Attractively styled, it is finished in lustrous chromium. The Model 630 is unusually flat through lower and middle register, rising 5 db on upper frequencies for added crispness of speech. Operates efficiently in salt air and humidity.

OUTPUT LEVEL: Power ratings: 54 db below 6 milliwatts for 10 bar pressure. Voltage rating (high impedance) 7 db above .001 volt/bar, open circuit. Voltage developed by normal speech (10 bars): .0224 volt.

FREQUENCY RESPONSE: 40-8000 c.p.s., with slightly rising characteristics.

WEIGHT: 1½ pounds.

TILTABLE HEAD: 90° tiltable head for directional or non-directional operation.

CABLE CONNECTOR: Built-in cable connector permits movement of head without moving the cable.

CASE: Built of highest quality, high impact pressure cast metal.

TRANSFORMER CORE: Nickel alloy; hydrogen annealed; low capacity windings.

DIAPHRAGM: Fine quality, heat-treated duralumin; corrosion-inhibited for use in salt air and humidity.

CONDUCTOR CABLE: 20-ft. well shielded cable and connector; low impedance balanced to ground.

HI-Z (DIRECT TO GRID) or 50, 200, 250 and 500 ohms.

SCIENTIFICALLY DESIGNED GRILLE: Reduces wind noise.

ON-OFF SWITCH: Standard ⅝" — 27 stand coupler.

MAGNETIC CIRCUIT: Employs Alnico V and Armco magnetic iron.

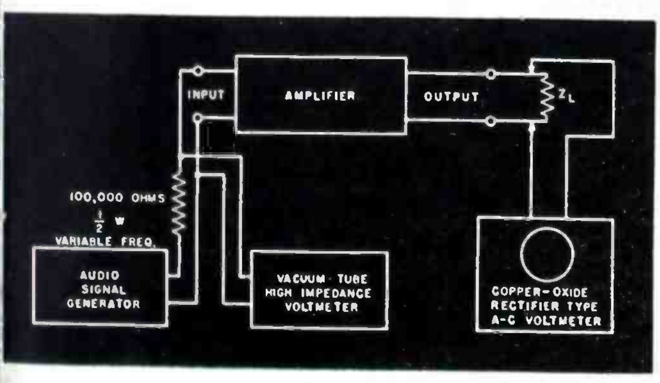
List Price, $30.00

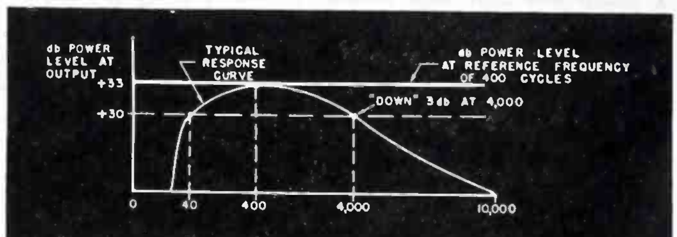
Contact your nearest radio parts distributor today. His knowledge of Electro-Voice microphones may aid you in selecting the appropriate type for your individual need. He may also be an important factor in speeding your order.

THE RED CROSS ASKS YOUR HELP ... GIVE GENEROUSLY

Electro-Voice MICROPHONES

ELECTRO-VOICE CORPORATION • 1239 SOUTH BEND AVENUE • SOUTH BEND 24, INDIANA





Figs. 4 (left) and 5 (above). Fig. 4, 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. 5, variation in audio power output as a function of frequency.

UNIMETER

This unit fulfills an extremely important need for general utility portable service equipment. It has wide range coverage for both a-c and d-c measurements of voltage, current measurements on d-c and the popular ranges on resistance.

The UM-3 is designed to clearly indicate all the functions which aid in the prevention of application of high voltages when preparing for current or resistance measurements.

Other G-E units for better servicing include: Tube Checker TC-3, Unimeter UM-4, and Oscilloscope CRO-3A.

For details write: *Electronics Department, General Electric, Schenectady 5, New York.*

Electronic Measuring Instruments

UM-3 GENERAL ELECTRIC

177-D2

RADIO MEN *Save Money* at NATIONAL

ON HARD TO GET RADIO PARTS

National Electronic can supply you immediately with hundreds of hard-to-get radio parts at exceptional prices . . . a few listed below. Every NATIONAL radio part is *unconditionally guaranteed* for superior quality. Take advantage of these savings by placing your order today.

LIMITED OFFER
Dry battery eliminator for farm sets. Will deliver up to 112 v. of B and up to 2 v. of A from any 6 v. storage battery. In handsome black metal container . . . complete with cables, etc. Extra special while they last. $15.95 each.

3000 m.f.d. at 3 v. F.P. Condenser in aluminum can 1⅜ D x 2 1/16 H. Fresh stock. Special, while they last....................Each, $1.39; 10 for $11.99

A superior Mike Cable, single conductor, shielded and pre-war natural rubber cover. 13c per ft.; 100 ft. $9.90

Dual conductor and shield as above 18c per ft.; 100 ft. for $15.95

CONTINENTAL CARBON RESISTOR KIT No. C6 Assortment. 100 RMA coated ½ and 1 Watt resistors (⅔'s are one watt). Unusual bargain at $3.35

20 MFD 150 WV Tubular Pigtail Electrolytic. One year guarantee..............35c; 10 for $3.30

10 MFD 450 WV Tubular Pigtail Electrolytic. One year guarantee.............43c; 10 for $3.95

50 MFD 150 WV Tubular Pigtail Electrolytic. One year guarantee..............49c; 10 for $4.45

Heavy Duty GE Pyranol 10 MFD 600 WV (900 Pk) Oil filled paper filter condenser in Hermetically Sealed metal container 3" x 4½" x 1" with connections brought through ceramic bushings. List $9:80 Our price $3.30; 10 for $29.50

Assortment of 200 pcs. Special Radio Hardware including Tube Sockets, Terminal Strips, Grid Caps and Plugs..............................Kit $1.49

20 x 20/150 WV Tubular Electrolytic. First Line Condenser. One year guarantee. Each 61c; 10 for $5.60

HI-TEMP RUBBER PUSH BACK WIRE—Solid and Stranded (#20). 100 ft., 71c; 10 for $6.50

OUTSTANDING OFFER
An assortment of 20 high grade Vitreous Enameled Wire Wound Resistors in 5, 10 and 25 Watt sizes, ranging from 30 to 30,000 Ohms. Selected as to popular usage. Ohmite, Electrohm, Sprague, Utah, etc. Kit #E77. List price, $9.60. Your cost is only $2.99.

10 MFD 50 WV Tubular Pigtail Electrolytic Condensers. One year guarantee. Each 28c; 10 for $2.45

LOCTAL SOCKETS—(Metal Supporting Ring). 10 for $1.10; 100 for $9.99

COD orders require 20% deposit. We accept no orders for less than $2.50, and pay all shipping charges only on prepaid orders of $25.00 or more. L-265 or AA-3 certificates are required.

FREE. Our latest money saving bulletin is ready NOW. Get your copy and inspect the NATIONAL money saving line. You'll save.

NATIONAL ELECTRONIC SUPPLY—Dept. S-3

NATIONAL ELECTRONIC SUPPLY · 622 KINZIE · CHICAGO 10, ILLINOIS

A-F TESTING

(*Continued from page 37*)

tracer may be used to check the signal at the 6V6 plate. If the signal is not heard there, but is heard with the tracer connected to the 6V6 grid, the trouble may be an open in the primary of the output transformer, defective 6V6, or possibly a lack of filament voltage on the 6V6.

Electronic Mixing

Some amplifier systems have provision for electronic mixing, Fig. 3. The signal tracer may be connected across P_1, P_2 or P_3 to check the individual sources of signal potentials, while for checking the mixed output the tracer would be connected across P_4. If it appears that normal output is delivered by VT_1 and VT_2, and with P_1 and P_2 turned down to check VT_3 no output is obtained with P_3 at maximum, the trouble is in the VT_3 stage. This might be an open circuit due to a poor connection. In other cases P_3 or VT_3 might be defective. Using a voltohmmeter the circuit can be checked.

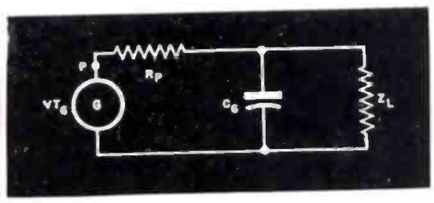


Fig. 6 (above). This circuit illustrates the reflection of the voice coil load, which is largely resistive. As the frequency rises, we have an increased shunt effect for C_6 and more of the available current flows in C_6 than in X_L. Thus if C_6 is made lower, the h-f output will rise.

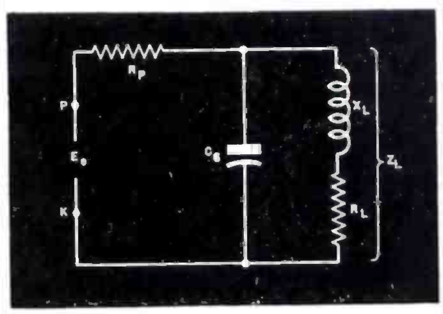
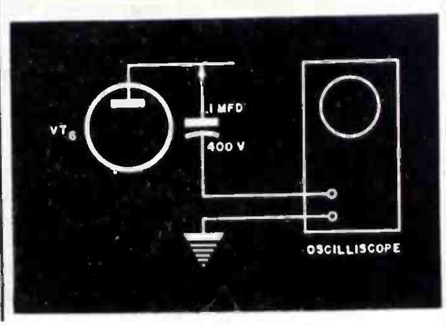


Fig. 7 (above). Here we have a circuit illustrating the effect of X_L. As this becomes larger, feedback may result due to resonance or to the fact that the plate load is higher in value than the grid-plate impedance of the tube. Fig. 8 (below). An oscilloscope setup to check output.



NEWS

COLE AND SIEGEL HONORED BY AEROVOX STAFF

S. I. Cole, retiring president, and amuel Siegel, retiring vice president, ere feted by their Aerovox associates a recent banquet held in New Bedford, ass. Colonel Emanuel Cohen, U. S. Signal Corps Reserve, third member of the iginal owners and management, was presented by Mrs. Cohen at the banquet.

One of the features of the evening was e playing of recordings of vocal tributes thirty-two of Mr. Cole's associates. milar records were also made for Mr. iegel.

Mr. Cole announced his retirement as eneral manager of the company.

* * *

JAMES KNIGHTS RECEIVES W. E. LICENSE

The James Knights Company, Sandwich, Illinois, has been licensed by the Vestern Electric Company to manufacture electronic equipment under W. E. atents.

Louis Cunz has been appointed chief roduction supervisor of the quartz cutng department. John Ernst has become hief production supervisor of crystal finshing.

* * *

BABKES IS NOW LEAR RADIO PURCHASING HEAD

E. Joseph Babkes, formerly in charge of scheduling distribution of radio test quipment for the WPB, has been appointed radio purchasing agent for Lear, nc., Grand Rapids, Michigan.

* * *

JONES PLUG CATALOG

A 32-page catalog, No. 14, has just been released by Howard B. Jones Company, 2460 W. George Street, Chicago 18. Described are multi-contact plugs and sockets, terminal strips, fuse mounts, etc. A complete listing of the entire line of barrier strips is also included.

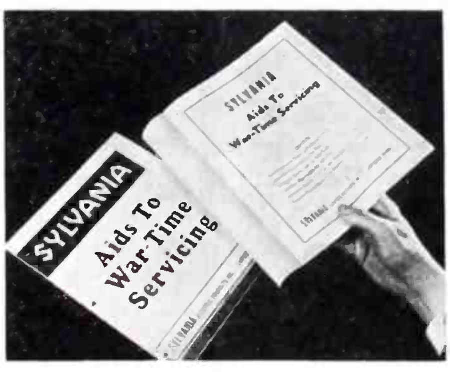
* * *

SYLVANIA WARTIME SERVICING MANUAL

A 20-page manual with replacement tube data has been compiled by the commercial engineering department of Sylvania Electric Products, Inc., Emporium, Pa.

In addition to a section describing the recommended use of substitute types when original types are not obtainable, the manual contains information for battery, 150 and 300 ma, transformer and auto-tube types.

Thirty-six adaptor circuit diagrams are included for use with the tabulations



when changes in tube socket wiring are required. Tabulations are used to indicate the type of changes needed including: filament voltage, filament current, socket wiring, socket type, alignment, top cap connection and changes in bias or plate voltage.

Circuit modifications for battery and a-c/d-c sets are also described in detail. Manuals are free through Sylvania distributors or direct.

* * *

NEWS OF THE REPRESENTATIVES

At the January meeting of the Mid-Lantic chapter of the Representatives, Wilmer S. Trinkle was elected president; Norman M. Sewell was named vice president, and Samuel M. Jeffries, secretary-treasurer. The chapter has created a new board of governors to act as a

(*Continued on page 42*)

The same smoothness and dependability which have always characterized General Industries phonograph mechanisms will be found in peacetime models when their production is resumed.

Whether it's combination record-changers-recorders, recording assemblies or *Smooth Power* motors, they'll have that quick pickup, unvarying speed and velvety smoothness that is so essential for faithful reproduction. They'll deliver that time-proved satisfaction to manufacturers, dealers and users.

For your postwar selling—count on General Industries equipment.

THE GENERAL INDUSTRIES COMPANY
DEPT. M **ELYRIA, OHIO**

THE GENERAL INDUSTRIES COMPANY
Smooth Power

FIFTH EDITION
WARTIME RADIO SERVICE
75 PAGES—OVER 1500 TESTED TUBE SUBSTITUTIONS

The only book of its kind—Will save its cost over and over in time saved—Though you may know the substitution, you save the time it takes to figure the changes.

Each Substitution Set Down Like the Example Below

TUBE	SUBSTITUTE	CIRCUIT CHANGES NECESSARY
12SA7	12K8	Make adaptor as follows: no. 1 on base to no. 1 on top no. 2 on base to no. 2 on top no. 3 on base to no. 3 on top no. 4 on base to no. 4 & 6 on top no. 5 on base to no. 5 on top no. 6 on base to no. 8 on top no. 7 on base to no. 7 on top no. 8 on base to cap

THE LAST THIRTEEN PAGES CONTAIN A VERY COMPLETE TUBE CHARACTERISTICS CHART WITH CLEAR BASE VIEWS

REPAIRING BURNED OUT TUBES

CHANGING 1.4 & 2.0 VOLT FARM RADIOS FOR ELECTRIC OPERATION

BEST METHODS FOR MAKING ADAPTORS

Price $3.00 Postpaid

Get this money making time saver from your distributor today or order from

CITY RADIO CO.
The RADIO CITY of PHOENIX, ARIZONA
EAST WASHINGTON AT FIFTH STREET
DISTRIBUTORS AIRMAIL TODAY FOR PROPOSITION

TUBES—PARTS
RADIO DEALERS—SERVICEMEN

Send for our list of available tubes and repair parts. Sylvania, Tung-Sol, National Union.

M. V. MANSFIELD CO.
937 LIBERTY AVE. PITTSBURGH 22, PA.

Ted McElroy
World's Largest Manufacturer of Wireless Telegraphic Apparatus
COMPLETE CENTRAL OFFICE EQUIPMENT
McElroy Manufacturing Corp.
82 Brookline Avenue • Boston, Massachusetts

UNIVERSAL MIDGET TOOLS
DANDY SIXTEEN PIECE SET

Midget Pliers, Diagonal Cutters, Four Midget End Wrenches, Needle-nose Pliers, Srewholder, 5 Punches and Chisel, Round File, Midget Adjustable Wrench. $14.85. IMMEDIATE DELIVERY. Remit Today. Price List and Order Blank Free with Order. DEALERS TOOL SUPPLY, 1527 Grand S., KANSAS CITY, MO.

WHEN YOU CHANGE YOUR ADDRESS

the new address, and do this at least four weeks in advance. The Post Office Department Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies Be sure to notify the Subscription Department of SERVICE at 19 E. Forty-seventh St., New York 17, N. Y., giving the old as well as mailed to the old address. We ask your cooperation.

SER-CUITS

(*Continued from page* 30)

exact minimum and the limiter circuit is restored to normal.

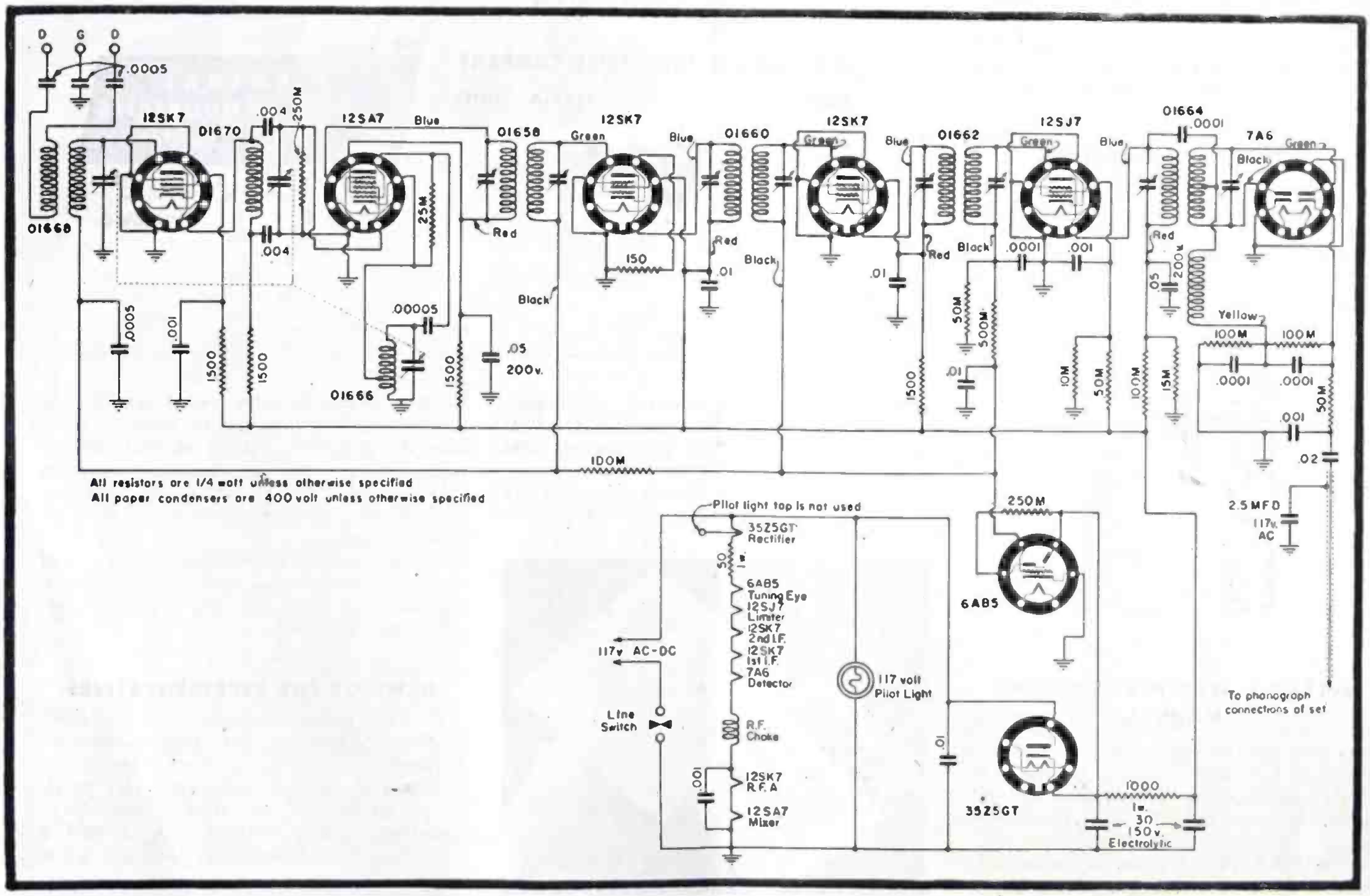


Fig. 2. Meissner f-m adaptor that can be used on a-c or d-c inputs.

W-J PORTABLE 30-WATT AMPLIFIERS

A 30-watt amplifier with two mike inputs and one phono input has been announced by Walker-Jimieson, 311 South Western Avenue, Chicago. Output impedances of 4, 6, 8, and 500 ohms are available. Frequency response is said to be 50-10,000 cycles; record gain is 69 db, mike gain 116 db. Tubes used are 3-6SJ7, 2-6l6, 6N7 and an 83. Cabinet is 17" x 10½" x 19½".

* * *

WESTON PORTABLE TEST INSTRUMENT

A portable test unit featuring a rectifier type voltmeter which provides readings in decibels and volts has been announced by Weston Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey. Known as model 695, type 11, the unit has a constant impedance of 20,000 ohms. Eleven db ranges are provided from −4 to +36 db at zero on the db scale. This is said to provide a total spread at 55 db (scale: −10/0/+5). Seven a-c ranges from 2 to 200 volts also are available.

NEW PRODUCTS

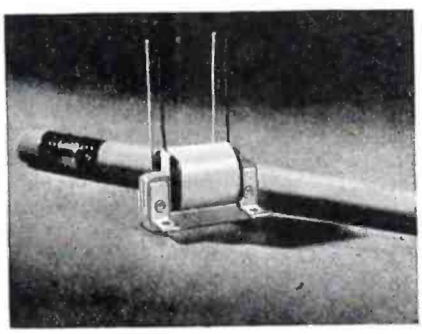
A self-contained condenser, available through a separate pinjack, is provided for blocking any d-c component. The instrument is calibrated for 500-ohm lines with a zero level of 6 milliwatts or 1.732 volts. Each instrument is supplied with a chart giving interpolation values on lines other than 500 ohms (from 5 to 10,000 ohms at 6 milliwatts zero level). Test leads supplied. Dimensions, 5½" x 3¾" x 3⅛" approximately.

* * *

PERMOFLUX MIDGET TRANSFORMERS

A 31/32" x 37/64" x 7/16" transformer has been developed by Permoflux Corporation, 4900 West Grand Avenue, Chicago 39, Illinois.

The transformer is said to have a uniform frequency response of 100 to 8,000 cycles, ± 2 db. Can be made with windings to provide impedances as high as 200,000 ohms and, when used as a choke coil, with inductive reactance as high as one megohm. They may be potted, shielded or hermetically sealed if desired.

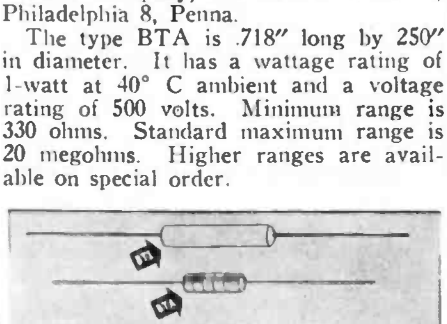


* * *

I R C 1-WATT INSULATED RESISTORS

Insulated 1-watt resistors, type BTA, have been announced by International Resistance Company, 401 N. Broad Street, Philadelphia 8, Penna.

The type BTA is .718" long by 250" in diameter. It has a wattage rating of 1-watt at 40° C ambient and a voltage rating of 500 volts. Minimum range is 330 ohms. Standard maximum range is 20 megohms. Higher ranges are available on special order.



NATION-WIDE MAIL ORDER DISTRIBUTORS SINCE 1928

B-A

RADIO AND ELECTRONIC DEVICES

For...
TRADE
INDUSTRY
VOCATIONAL
COMMUNICATION
PUBLIC UTILITY
and
EXPERIMENTAL
APPLICATIONS

BURSTEIN-APPLEBEE CO.
1012-14 McGEE ST.
KANSAS CITY 6, MISSOURI

● Just eight numbers—a mere handful—yet these selected capacitances in Aerovox wartime paper tubulars can take care of most of your service needs for the duration—or until other types are again available for civilian use. Keep these Aerovox Type "84" paper tubulars handy for your everyday work.

AEROVOX TYPE "84"

Non-inductive paper section in sturdy tubular casing.

Extra-wax-sealed ends. Thoroughly wax-impregnated paper casing.

Bare pigtail terminals that won't work loose or pull out.

Colorful yellow-black-red label jacket stamped with working voltage and capacitance.

Eight selected wartime or general-purpose values are: 600 v. D.C.W., in .001, .002, .005, .01, .02, .05, .1 and .25 mfd.

• Ask Our Jobber

AEROVOX Capacitors
INDIVIDUALLY TESTED

AEROVOX CORP., NEW BEDFORD, MASS., U. S. A.
In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.
Export: 13 E. 40 ST., NEW YORK 16, N.Y. · Cable: 'ARLAB'

RADIOMEN

1700 ANSWERS

TO YOUR HARDEST PROBLEMS

1178 Illustrations
1000 Pages
130 Tables — 105 Graphs

GET THE ANSWERS NOW!

Here, in one big volume, you'll find all the time saving answers to your radio problems . . . and time saved is MONEY EARNED. Written in easily understood language, yet accurate enough for an engineer. Completely revised and cross indexed for quick reference, this handy reference book for your tough jobs covers radio transmission and reception, public address systems, television, photocells and data on their important parts. It's a book you'll always use. And . . . it's only........ $5.00

ANOTHER TIME SAVING BOOK!

ELECTRICAL AND RADIO DICTIONARY. Over 3800 definitions of technical words and terms used in all branches of radio and electricity. 300 Pages—550 Illustrations.......... $2.50

GATEWAY PUBLISHING COMPANY
32 N. STATE — Dept. S-3 — CHICAGO 2

Clip This Coupon NOW

GATEWAY PUBLISHING CO.
32 N. State, Chicago 2, Ill. Dept. S-3.
☐ Send me the new Drake Cyclopedia IMMEDIATELY.
☐ And the 300 Page Radio Dictionary.

Name ....
Address ....
City.............................. State..........

RADIO REPAIR MEN

24 hour Delivery Service on this MULTITESTER

YOUR COST ONLY $18.75

Model No. MT 100

UNCONDITIONALLY GUARANTEED SATISFACTION OR MONEY BACK

Latest meter design in all metal case; compact-rugged; the answer to your need for an all purpose, accurate Multitester. Send signed certificate or write for form. ORDER YOUR TESTER TODAY.

Omaha RADIO PRODUCTS CO.
368 Saunders-Kennedy Bldg.
OMAHA, NEBRASKA

MAIL TODAY

OMAHA RADIO PRODUCTS CO.
368 Saunders-Kennedy Bldg.
Omaha, Nebraska

Enclosed is full remittance of $18.75, or my Deposit of $....... and ship Multitester #MT 100 C.O.D. for balance.

NAME ....
ADDRESS ....
CITY.................... STATE..................

NEWS

(*Continued from page 39*)

steering committee of the chapter, consisting of the outgoing and incoming officers, or a total of seven members. Kenneth Moyer has been named secretary of the new board.

The chapter recently added the following three associate members: James L. Nichols, Byron C. Deadman and Kenneth J. Moyer.

Emmett N. Hughes, 1709 W. 8th St., Los Angeles 14, Cal., recently became a member of the Los Angeles chapter.

Mose Branum of the Southwestern chapter is now at 407 Guardian Life Building, Dallas 1, and E. L. Wilks, vice president of the chapter, has removed to 1212 Camp St., Dallas 2, Tex. A. L. Berthold is the new president and R. M. Campion, the new secretary-treasurer.

R. W. Farris has been named president of the Missouri Valley chapter. W. T. McGary was elected vice president and E. D. Lundgren is now secretary-treasurer. The chapter accepted the membership of Zell S. Myers, a partner in the R. W. Farris Co., 406 W. 34th St., Kansas City, Mo. Jim Kay has transferred to the Missouri Valley chapter.

Frank X. Brennan of the Atlantic Eng. Prod. Co., 26 Waverly Place, New York 3, N. Y., has joined the New York chapter. The chapter also accepted the application of Howard Fairbanks for associate membership. Mr. Fairbanks is with Perry Saftler, 53 Park Place, New York 7, N. Y. Adolph Schwartz, 262 Grayson Place, Teaneck, N. J., has been reinstated as a member.

* * *

WEBSTER-CHICAGO BUYS WEBSTER PRODUCTS

Webster-Chicago Corporation, 5622 Bloomingdale Avenue, Chicago, has purchased Webster Products, 3825 West Armitage Avenue, Chicago. The former Webster Products organization and facilities will be retained intact and will operate as the electronics division of Webster-Chicago Corporation. Personnel at the parent company also remains unchanged.

The electronics division is now manufacturing dynamotors and voltage regulators for the war program. For peacetime production the new division will resume manufacture of record changers.

The Bloomingdale plant of Webster-Chicago will continue to make laminations for motors and transformers.

R. F. Blash, president, Webster-Chicago.

* * *

INDUSTRIAL INSTRUMENT BULLETIN

A bulletin describing direct-indicating comparison bridges, capacity and resistance limit bridges, resistance and capacitance decades, Wheatstone bridges, voltage breakdown testers and test fixtures, Kelvin bridges, megohm bridges, meghommeters, and conductivity equipment has been released by Industrial Instruments, Inc., 17 Pollock Ave., Jersey City, N. J.

* * *

AMPHENOL CABLE CATALOG

Twenty-six types of u-h-f cables are described in a catalog which has been released by American Phenolic Corporation, 1830 South 54th Avenue, Chicago 50, Illinois. The catalog is identified as section *D*.

* * *

SHAFFER NEW STANCOR DETROIT REP

Grant Shaffer has been appointed representative for the jobber and industrial divisions of Standard Transformer Corporation in the Detroit area, with offices at 6432 Cass Avenue. Mr. Shaffer was associated with Stancor for several years in an engineering capacity.

* * *

RMA CANCELS ANNUAL JUNE SHOW

The annual industry war conference, RMA membership meetings and tentative Parts Trade Show, scheduled next June at Chicago, all have been cancelled be-
at Chicago, Ill., all have been cancelled because of governmental travel restriction by mail, through proxies. The only

For Soldering in Tight Places . . .

DRAKE

No. 400 Soldering Iron

Smallest Industrial Iron Ever Designed

60 Watts — ¼ in. Tip
Only 9 in. long. Wt. only 8 oz.

This mighty mite is backed by DRAKE's 25 years of soldering iron manufacturing experience. The high quality and long-service of DRAKE Soldering Irons have made them outstanding favorites with all types of radio men everywhere. The DRAKE No. 400 is an outstanding value at

Only $4.50 List

Drake Has an Iron for Every Purpose. Ask Your Radio Parts Jobber

DRAKE ELECTRIC WORKS, INC.
3656 LINCOLN AVE., CHICAGO 13, ILL.

meetings next June at the Stevens Hotel will be of the association's board of directors and the executive committees of its five divisions, with new directors elected by mail proxies.

* * *

H. S. HAYS NOW OPA CONSULTANT

Herman S. Hays, manager of field service engineering at Philco has been appointed a consultant to the Service Trades Price Branch of the OPA.

Mr. Hays, who will serve on a part time basis, will advise OPA's national office chiefly on matters relating to radio and household appliance repairs.

* * *

DEE BREEN JOINS U.M.C.

Dee Breen has become sales manager for the Universal Microphone Co., Inglewood, Cal. He was formerly western division sales manager of the El Monte, California plant of Littelfuse, Inc.

* * *

ED DE NIKE APPOINTED N. U. DISTRIBUTOR DIVISION S. M.

Ed DeNike who has been director for public relations of National Union Radio Corporation has been named sales manager of the distributor division.

* * *

JOHN F. RIDER NOW LT. COL.

John F. Rider has been promoted to Lieutenant-Colonel.

From June 1, 1942 to November 17, 1943, Colonel Rider was stationed at the Southern Signal Corps School, Camp Murphy, Fla. Here he organized and became the director of the Training Literature Division. Transferred to Fort Monmouth he organized the Radar Literature Section at the Signal Corps Publication Agency. Colonel Rider was subsequently advanced to Executive Officer of the Agency and is at present Deputy Director in charge of all operations of the Agency.

* * *

TOM JOYCE RESIGNS FROM RCA

Tom Joyce, general manager of the radio, phonograph and television department of the RCA Victor Division of the Radio Corporation of America, at Camden, N. J. announced his resignation recently.

His future plans will be announced shortly.

* * *

WHITE STAR TO CROWLEY

The third white "E" flag star has been awarded to Henry L. Crowley & Company, Inc., West Orange, N. J.

* * *

ADAPTOL ADAPTOR CARTONS

Colored cartons for tube adaptors have been announced by Adaptol Company, 260 Utica Avenue, Brooklyn, N. Y. Adaptol produces adaptors for 177 types of tubes.

MUELLER

CLIPS

For Quick Temporary Connections

- Made in 10 sizes—from the tiny wee-pee-wee to the 300 ampere Big Brute.
- Offered in both steel and solid copper.
- Red and black rubber insulators to fit each size.
- A complete line with

A CLIP FOR EVERY PURPOSE

Send for free samples and catalog 810

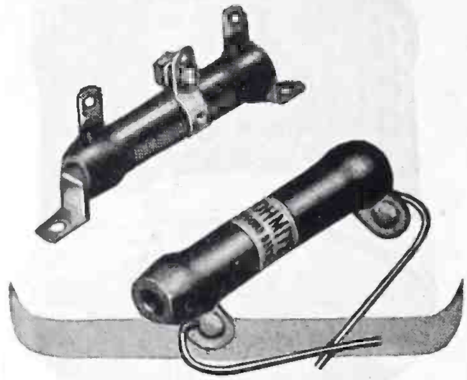
Mueller Electric Co.

1565 E. 31st St. • Cleveland, Ohio

OHMITE RESISTORS

for accurate trouble-free

SERVICE

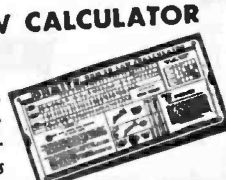


Time-proved, battle-proved, service-proved... Ohmite Brown Devils and Adjustable Dividohms are used today in critical war equipment. After Victory . . . these dependable units will again be the favorite of radio servicemen who want and use the best for resistor replacements.

For information about these and other Ohmite Resistors, write for Stock Unit Catalog 18.

SEND FOR HANDY OHM'S LAW CALCULATOR

Figures ohms, watts, volts, amperes—quickly, accurately. Solves any Ohm's Law problem with one setting of the slide. Send only 10c in coin for handling and mailing. (Also available in quantities.)



OHMITE MANUFACTURING CO.

4878 Flournoy Street • Chicago 44, U.S.A.

Be Right with OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES

Plug-in RESISTORS AND BALLASTS

★ Troubled by fluctuating line voltage? Just plug in a Clarostat Automatic Line Voltage Regulator between set and outlet. At 110 volts the resistance of ballast is low. Voltage drop is negligible. But as line voltage increases, the resistance builds up so as to maintain a uniform and safe voltage delivered to the set.

The Clarostat Interim Line (essential wartime items) includes these ballasts for accessory or external use. Also replacement ballasts for use in old type receivers designed to include a line ballast. A choice of universal numbers meets most requirements.

★ **Ask Our Jobber . . .**

Ask about those Clarostat wartime items for better servicing. Ask about the Clarostat Interim Line Catalog. Or write us direct.

CLAROSTAT Controls and Resistors

CLAROSTAT MFG. CO., Inc. · 285-7 N. 6th St., Brooklyn, N. Y.

JOTS AND FLASHES

Large-screen (16"x21") television demonstration by RCA a huge success . . . read everything you can on television . . . there's plenty to learn and you'll need every bit of possible information in the not-too-distant future . . . J. H. "Robby" Robinson, American Radio Hardware Company s-m, on a swing through the mid-west . . . Hoffman Radio, Los Angeles, appoints D. D. Spence public relations manager . . . Army-Navy "E" to Karp Metal Products Company, Brooklyn . . . Popular Ben Miller appointed general s-m by United Transformer Corp . . . Samuel L. Baraf of UTC assumes overall direction of sales and merchandising . . . Recent radio visitors in New York . . . Cinaudagraph Speakers president Paul Tartak, E. H. McCarthy, s-m of Farnsworth and Joe Friedman, president of Trav-Ler-Karenola . . . Hytron Corp. changes name to Hytron Radio & Electronics Corp . . . Regret to report death of Al J. Slap, partner in distributing firm of Raymond Rosen & Co., Philadelphia . . . Al was really a radio pioneer . . . Also sorry to report death of Harry C. Stackpole, chairman of the board of Stackpole Carbon Co. . . . Bendix Home Radio division appoints Lehr Distributors as distributors in Greater New York . . . S. J. Novick, president of Electronic Corp. of America spoke at New York Times Forum on March 26th . . . Are you getting the "arty" Universal Microphone monthly calendars . . . if not, better talk to your distributor . . . H. Z. Benton joins engineering staff of American Phenolic Corp., Chicago . . . Congrats to Fred R. Ellinger on completing 20 long years as a manufacturer's rep in the mid-west territory . . . J. M. Cartwright now representing Carter Motors in the Memphis territory . . . Butler Brothers Chicago and Minneapolis branches appointed distributors for Olympic Radio and Television . . . R. A. Adams to represent Sentinel Radio in the state of Michigan and in the Toledo, Ohio area . . . Won't be long now before the 7th War Loan Drive gets under way . . . late May and early June . . . be prepared to do more than your share . . . let's make it a real Victory Loan . . . Be certain to read the new series of articles by A. A. Ghirardi starting in this issue . . . you'll find plenty of valuable data in them which should help materially in your daily service work.

Buy War Bonds

ADVERTISERS IN THIS ISSUE
MARCH, 1945

SOLAR

CAPACITORS...

Trustworthy in every climate

SOLAR PRODUCTS

DRY ELECTROLYTIC CAPACITORS
WET ELECTROLYTIC CAPACITORS
PAPER CAPACITORS
MICA CAPACITORS
"ELIM-O-STAT" SUPPRESSORS
CAPACITOR ANALYZERS

Solar Mfg. Corp.

SOLAR SALES CORPORATION

285 MADISON AVE. • NEW YORK 17, N. Y.

REMEMBER NATIONAL UNION SERVICE DEALER ADVERTISING

AFTER THE WAR MORE THAN BEFORE

OF COURSE, you remember the cooperative advertising plans that National Union offered you before the war. Radio service dealers all over the country built up their business at minimum cost, using this powerful N. U. plan. They obtained free electros, mats and copy for telephone book and newspaper advertisements—a handsome four-color metal highway display at very low rental—a generous advertising allowance. National Union gave radio service dealers all this in *addition* to the plan that equipped their shops with 60,000 pieces of fine test equipment *free!*

After Victory, look for more and better N. U. cooperative advertising to back you up. *Count* on N. U. to bring you more business—more profits—MORE than before.

NATIONAL UNION RADIO CORPORATION, NEWARK 2, N.J.
Factories: Newark and Maplewood, N. J., Lansdale and Robesonia, Pa.

NATIONAL UNION
RADIO AND ELECTRONIC TUBES

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs