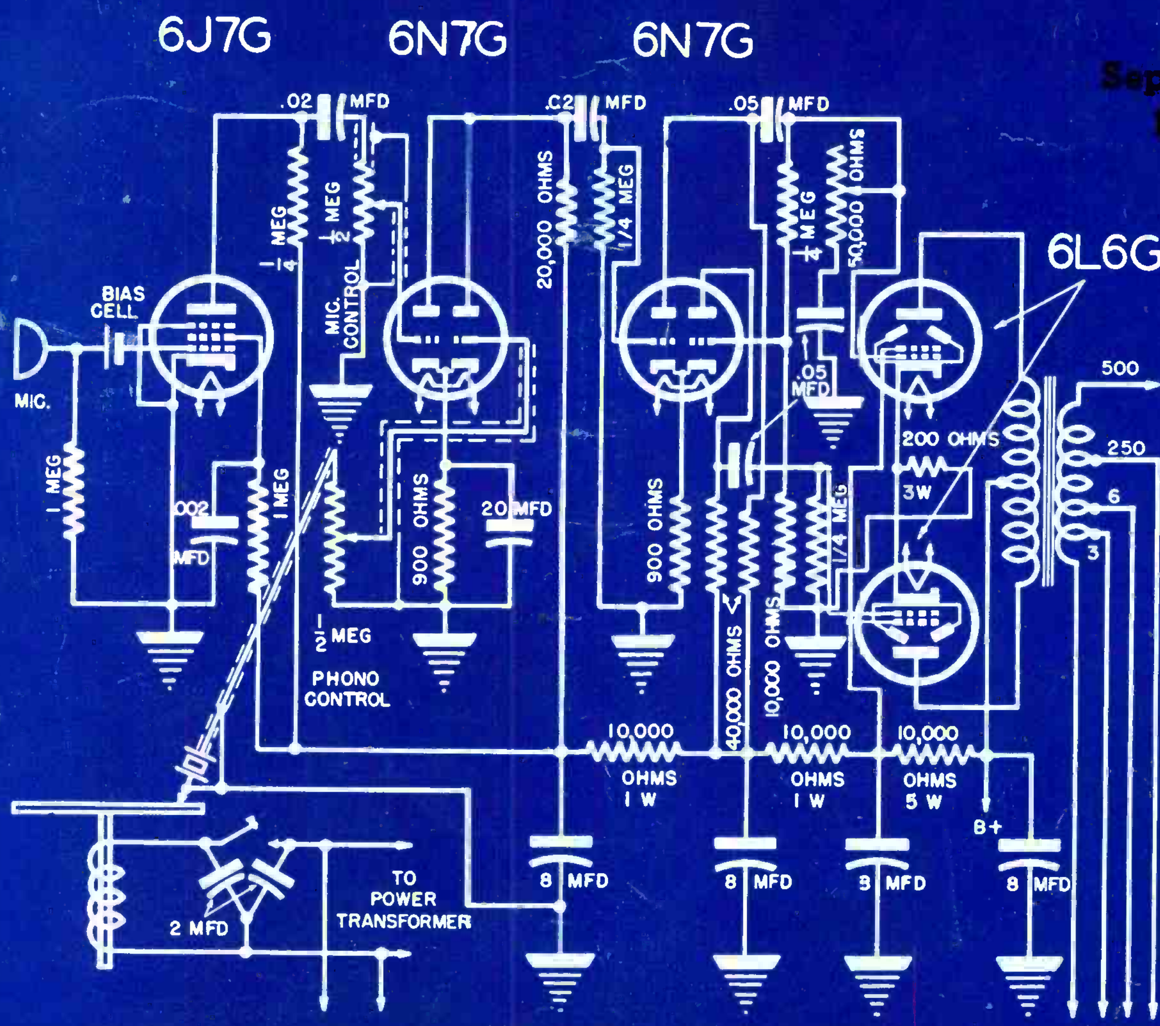
RADIO • TELEVISION • ELECTRONIC

SERVICE

Sept 45

September
1945



Four-stage, 6-tube, 20-watt mobile p-a unit that can be used on 6-volts d-c or 115-volts a-c. (See page 51.)

(See page 51.)

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE

FIRST AGAIN!

CORNELL-DUBILIER *THE TOP NAME IN CAPACITORS*

GIVES YOU THIS TIMELY SELLING TOOL

Your customers are tired of inferior merchandise. They certainly won't want shoddy, war-weary surplus. So get off to a good start in the competitive days ahead by sticking to the standard of quality in capacitors . . . Cornell-Dubilier. Put this card in your window, as a mark of reliable service and as proof that you stand by standards.

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We use only New Genuine Replacement Parts

[NO WAR WEARY SURPLUS]

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WE REPLACE ALL DEFECTIVE CAPACITORS WITH GENUINE CORNELL-DUBILIER CAPACITORS

The Quality Standard Since 1910

FREE

See your C-D distributor today, he will give you one of these handsome, colorful 11x14 displays. If your distributor can't supply you, write to Cornell-Dubilier, New Bedford, Mass. Dep't A.

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CORNELL DUBILIER

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NATIONAL ADVERTISING

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METAL TUBES
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KEN-RAD
MADE IN U.S.A.
Better than Ever
New radio sets coming from production lines demand new heights of tube quality and performance. New research and manufacturing facilities superbly equip Ken-Rad to meet these higher requirements. In the future, just as today, user enthusiasm produced by the clear dependable tone from Ken-Rad sturdy Metal Tubes will spell profits for Ken-Rad dealers.
Write for your copy of "Essential Characteristics" the most complete digest of tube information available.
KEN-RAD
DIVISION OF GENERAL ELECTRIC COMPANY
OWENSBORO, KENTUCKY
178-D9-882C

EDITORIAL

THE countless unknown brands of receivers that are being sold now, until the popular brands appear, will introduce many problems for the Service Man. For unfortunately there will be no circuit diagrams or operating data available for many of these models. While many of these receivers have been designed along basic patterns, we also find many circuit changes dictated by material economies and hasty production factors. In many instances, these factors may cause early receiver failure. Servicing of these receivers will thus become a knotty problem. Solutions will only be possible if a thorough knowledge of circuit and component design and application is available. We recommend a close study of the data appearing monthly in SERVICE, and in the many books on radio fundamentals. Offered are a variety of information that will prove invaluable in tracing circuits and checking components.

If you have a balky problem, write us; we'll try and lend a band.

WITH the estimated Christmas set allotment of 3,500,000 being lowered daily and now estimated at around 2,000,000 because of a parts production bottleneck and pricing difficulties, repairs will become increasingly important in the months to come. Service Men will really have to step along to maintain their schedule. While many more parts will be made available, shortages may occur from time to time. In this event, it may be wise to use many of the wartime emergency measures to accelerate delivery and keep receivers on the air. However, the consumer should be told of the type of repair, particularly where a new part is not available and a substitute procedure has been applied. If, of course, the substitute procedure is perfectly satisfactory, the consumer should be so told. However, if the repair is temporary it would be wise to admit this to the consumer, indicating, too, that the repair will be completed with a new component as soon as possible. Some may object to this double service, but many will not if the original charge is kept low in anticipation of the return repair visit.

This practice should be applied carefully with justified charges. Otherwise consumers will balk, and not only will the return visit be cancelled but the initial visits will disappear. A chart with the two charges in full view would prove helpful.

Remember, too, that ceilings have not been lifted and it's still necessary to keep your charges consistent with previous practices. Thus, if a dual charge is necessary, the total must be in line with a total evaluation of the complete repair . . . emergency and new . . . and all variable factors should be justified in your billing.

Play ball with the consumer . . . it will pay dividends!

SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office

Vol. 14, No. 9 — September, 1945

LEWIS WINNER
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Advisory Editor

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Managing Editor

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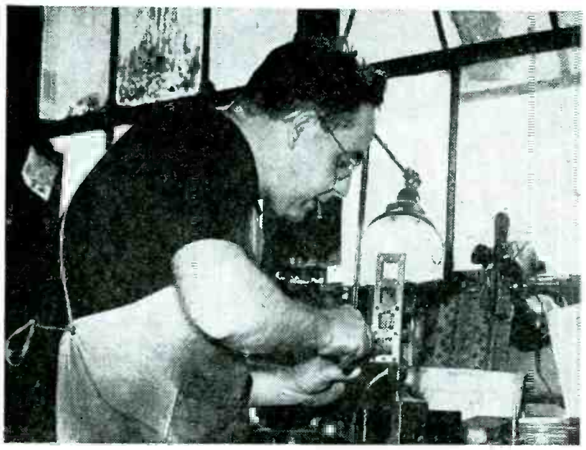
PRECISION
is a hobby
in MT. CARMEL, ILL.

Yes, precision is the hobby of the men and women who make up Meissner's famed *"precision-el."* The high quality electronic equipment that their skilled fingers produce each day is proof enough that they enjoy the work as thoroughly as they enjoy their after-hours hobbies. You'll find more proof in the photographs on this page.

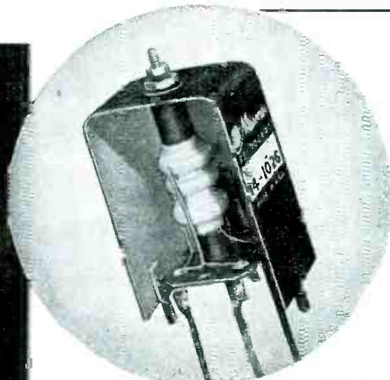
It could be a new grandson or a 3-pound bass that brings a smile like this, but it's not! It's pride in a precision electronic job well done. It's a reason for higher quality in Meissner products.



This "precisioneer" takes the same interest in his work at Meissner as he does in his home. He proves it with a smile that is typical of *precision-el* — as typical as the precision quality of Meissner products.

Baseball broadcast? Not on your life. But it's a "homer" for this member of Meissner's laboratory staff. The satisfied smile means that the instrument he's testing is "on the Meissner quality beam."

Here's a member of Meissner's *precision-el* whose smile is contagious. Delicate adjustments properly made are the reason. Higher quality in Meissner electronic equipment is the result!



Replace Broadcast Band Coils Easily

These Adjustable-Inductance Ferrocart (iron core) coils will replace Antenna, RF or Oscillator coils without the trouble of locating "exact duplicates" because they are continuously variable in inductance over a wide range. The inductance of the old coil is easily matched by simple screwdriver adjustment. Ferrocart iron cores add gain and selectivity to the receiver. Available shielded or unshielded, shipped with complete instructions. Order by number. 14-1026 Univ. Ant. Coil; 14-1027 Univ. R.F. Coil; 14-1028 Univ. Osc. Coil. Price $1.50 each.

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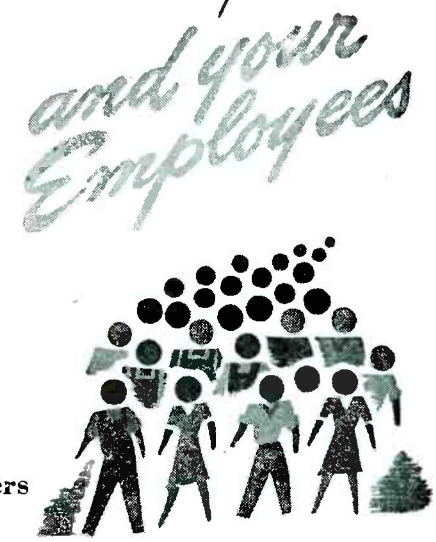
MANUFACTURING COMPANY • MT. CARMEL, ILL.

ADVANCED ELECTRONIC RESEARCH AND MANUFACTURE

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

what the PAYROLL SAVINGS PLAN *means*



Facts and figures prove **the Payroll Savings Plan to be a tremendous national asset. Through this plan, no less than 27,000,000 workers have so far saved more than $13½ billions to help speed victory . . . forestall inflation . . . and build peacetime prosperity!**

Did you know that yours is one of 240,000 companies maintaining a Payroll Savings Plan? Not only is this combined effort fostering national security, but also creating a lucrative postwar market for you . . . and all American industry!

Have you realized that 76% of all employed in industry are now enrolled in the Payroll Savings Plan . . . averaging a $25 bond each month per employee? Through this plan, millions are now looking forward to homes, educational opportunities and old age independence!

Surely, so great an asset to your country, your company and your employees is worthy of your continued . . . and increased . . . support! Now is the time to take stock of your Payroll Savings Plan. Use selective resolicitation to keep it at its 7th War Loan high! Keep using selective resolicitation to build it even higher!

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 the Treasury Department and War Advertising Council

Peak Performance

Raytheon High-Fidelity Tubes are the *serviceman's* tubes . . . performance-engineered and precision-built to provide complete satisfaction for your customers.

To protect your interests, they are distributed only by legitimate wholesale radio parts distributors in your area.

Switch to Raytheon Tubes *now* . . . and be on the lookout for a revolutionary merchandising program developed by Raytheon to help qualifying service-dealers increase their profits through building public trust and confidence.

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

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A FREE Buy-Exchange-Sell Service for Radio Men

Five times cited for distinguished wartime service.

. . . NOW, in Peace

you can count on Sprague—just as the nation counted on Sprague in war!

WANTED—Phono motor for 110 v., 25 cycles a-c rim or gear drive 78 r.p.m., Keith McCrea, 773 Eastwood Cres., Niagara Falls, Ont., Canada.

FOR SALE—Bodine phonograph motor, 60 cycle, 110 v., 7 amp. 1/14 h.p. a-c operated. Mrs. E. W. Rumble, Joseph, Ore.

WANTED—RCA Service notes stock #101 for 1929-1930. Yen Radio Service Lab., Rockford, Mich.

FOR SALE—RCA Instantaneous recorder and play back eqpt. with microphone and stand, stellite cutting needle. Adolf F. Saul, 18 E. Philadelphia Ave., Boyertown, Pa.

WANTED—70L7GT tube. Will trade any other type. Sanco Radio, 220 S. Pulaski St., Chicago, Ill.

FOR SALE—X-rayometer, V. T. multimeter with 7½" meter scale. Need slight repairs. J. Bazewick, 300 N. Christiana St., Chicago 18, Ill.

WANTED—958 midget tube in workable condition. Henry Innen, Rt. 2, Box 224-A, Anaheim, Calif.

FOR SALE—G-E motor generator 24-50 v. output 750 v. 200 mil. am., ball bearings, filter in base. H. A. Keys, Kinder, La.

URGENTLY NEEDED—New or used 6G6 and two type 30 tubes; 2—midget 140 mmf. or 110 mmf. & 1 midget single-gang (365) mmf. b.c. var. cond.; 1—250,000 ohm or ¼ meg. & 5,000 ohm midget volume controls and one set plug-in short wave 4 prong coils. H. B. Stepanian, Rte. #3, Box 70, Tulare, Calif.

FOR SALE—Complete radio eqpt.; Zenith V-O-M; tube tester; 132 tubes; volume controls, etc. C. B. Howard, 312 N.E. 7th, Amarillo, Texas.

WILL TRADE—Log Log duplex slide rule in case with instructions. Want late dynamic microphone. Garland Winn, Macon, Mo.

FOR SALE—National FB7 short-wave receiver; Motorola car set #80; Superior set and tube tester 1130S; etc. Want testing equipment or what have you? Glenn Watt, Chanute, Kans.

WANTED—German tubes and tube characteristic sheets on Phillips, Telefunken and other European makes; tester for tubes and service notes. Richard G. Devaney, 216 W. 60th St., Philadelphia 39, Pa.

WANTED—Used ac-dc V-O-M. Alvin Osekavage, 105 Iroquois Drive, Bright Waters, N. Y.

WILL TRADE—10 phono motors less turntables; 25Z6 and 1A7GT new tubes; 35Z5 and 50L6GT new tubes. Want 70L7GT tubes. also trade Radiart vibrator checker for 35 mm candid camera. Keeler Radio Service, 1629 S. Keeler Ave., Chicago 23, Ill.

WANTED—Condenser checker to measure .00001 to 240 mfd. Send code. Raymond L. White, 45 Central Street, Providence, R. I.

FOR SALE — Readrite 550 Oscillator; Western Electric hearing aid; also 3" ac-dc meters; 12SK7GT and 3Q5GT tubes. Edward Vockeroth, 1746 N. Campbell St., Chicago 47, Ill.

WANTED—Signal generator and V-O-M, a-c operated. W. C. Bredbenner, Jr., 322 E. 8th St., Berwick, Pa.

FOR SALE—Instructograph tapes in American Morse, 75c ea. Jay Haley, Mayeton Hotel, Superior, Wisc.

WANTED—Tube checker, sig. gen. and other test eqpt. What have you? George Grant, 2845 Avondale Road, Cleveland 18, Ohio.

FOR SALE—Supreme tube tester #589. Perfect $42.50. W. Lough, 20 Polhemus Place, Brooklyn 15, N. Y.

WANTED—Part #5125 for Philco 70A radio; b-c resistor. Bogert's Radio Service, 680 Sackett St., Brooklyn, N. Y.

FOR SALE—184, 2A5, 6J5GT, 25Z6GT new and 6A8, 6A8G, 6K7, 6Q7G, 6K8G, 35, 6U5/665 and 47 used tubes. H. Manoogian, 130 Post Ave., New York 34, N. Y.

WANTED—1000kc-100kc bar with holder, or same complete with oscillator. Raymond T. Stephens, 814 Rudd st., Clear Lake, Iowa.

WANTED—New or used all wave sig. gen. 110 v. a-c preferred. John VanTol, 95 N. 6th St., Patterson 2, N. J.

FOR SALE—Weston voltommeter in carrying case. Miller Electronic Services, 282 N. Broad St., Elizabeth, N. J.

WANTED—25B8GT and 25Z5 tubes. Cash or trade 5Y3GT/G, 12SK7, 12SQ7, 6A7, 6C6. Eddie Boomhower, 234 Elliot Ave., Portsmouth, Va.

SELL OR TRADE—3", Marion milliammeter 0-1; 50 ohms $8.50; and 2" Westinghouse ammeter 0-400 amps.; $12 or will trade for tube tester. William E. Hagara, P. O. Box 224, Slickville, Pa.

WANTED—Hallicrafter receiver. H. White, 483 McDermott Ave., Winnipeg, Canada

FOR SALE—Battery radio using "A", "B" and "C" batteries. Tubes and batteries all new. Glen Cruzan, Osgood, Ind.

WANTED—Two reflex projectors or similar units. Cowles Electric, Wellington, Ohio.

FOR SALE—Professional recorder Radiotone R-16, with playback. Bill Gall, RFD #1, Harrisburg, Ill.

WANTED—#CCH signal tracer complete or kit. V. K. Sandin, 4421 W. Cortez St., Chicago 51, Ill.

SELL OR TRADE — G-E time switch #3T17, 2-pole, 8-throw. W. Thiel, 96 Westbury Blvd., Hempstead, N. Y.

WANTED—Power supply to old Kolster K-45 receiver. Cash or trade registered mirror type G-E precision multi-voltmeter and other items. Manassas Radio & Electric Repair Co., P.O. Box 298, Manassas, Va.

FOR SALE—30 new tubes 10% off ceiling. Send for list. Goodwin Radio Shop, Rankin, Ill.

URGENTLY NEEDED — Communications receiver; 1A7GT tube; and record player with amplifier. D. N. Anderson, 917 E. Kemp Ave., Watertown, S. Dak.

FOR SALE—Echophone EC-1 converted to use of 6v tubes; variable condensers and other parts. R. W. Kurth, 1610 Sixth st. West, Seattle 99, Wash.

SELL OR TRADE—Pair T-20; pair 10-T; Pair 807; UTC S-20 transformer; Jewell 0-15 DC voltmeter. Want UTC S-22, S-31, S-32, S-34, S-47 and type 815 tubes. R. Brandt, Star Route 1, Red Bank, N. J.

WANTED—Chart for RCP model 308 tube tester. Will sell 12SA7, 35Z5, 35Z4, 25Z5, 25Z6, 1A7, 1N5, 1P5, 1H5, 12SK7 and 12SQ7 tubes. Standard Radio Service, 428 Main St., Hamilton, Ohio.

FOR SALE—F. M. P. Checkatube model C-111 tube tester and Browning preselector 50XD from 5 to 185 meters with 1852 tube. William Puchalski, 207 Pharis St., Syracuse 4, N. Y.

WANTED—Triplett or other 0-1 sq. 2" milliammeter. Cash or trade Audels Machinist handbook. Daye Mote, 1122 College Ave., Alameda, Calif.

SELL OR TRADE—1937 F.N.T. television course; ham built super-regen. all wave receiver. Want C.R.E.I. course; phonograph; F-M converter; television set, communications receiver and late auto radio. K. H. Stello, 925 Monroe St., N.E., Washington 17, D. C.

WANTED—Clough Brengle sig. generator; Supreme tube tester and Rider's; also all standard tubes. John Gabriel, 73 Oakland Terrace, Hartford 5, Conn.

FOR SALE—Hallicrafters S-20 less batteries. Earl C. Pace, P.O. 1096, Midland, Texas.

FOR SALE—Sprayberry Radio course 85 lessons and short wave parts. Also complete vac-o-lite hearing aid with batteries. August Palermo, 223 S. Winebiddle Ave., Pittsburgh, Pa.

WILL TRADE—New 813 or 100TH for fresh water fishing tackle boat or fly rod preferred. B. Jacobus, 484 Clifton Ave., Newark 4, N. J.

SELL OR TRADE—Rek-O-Kut 12" recording mechanism with 2 leadscrews; dual-speed G.I. recording motor. Want 4 x 5 press or reflex camera with accessories; 30-watt high fidelity amplifier; Jensen 12" speakers or power supply in case. Stanley Rogers, 22 Ellington ave., Rockville, Conn.

YOUR OWN AD RUN FREE!

For three wartime years, the Sprague Trading Post helped radio men sell, trade or buy needed materials. Now, with the advent of Peace, this free advertising service will continue as long as the need exists.

We'll gladly run your ad free in the first available issue of one of the 5 magazines in which the Trading Post appears. All we ask is that it be written clearly and concisely, that it be confined to radio materials, and that it fit in with the spirit of this service.

As always we know we can count on you to use Sprague Condensers and Koolohm Resistors—*and to ask for them by name!*

HARRY KALKER, Sales Manager

Dept. S-85, 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

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A

24-KT. PROPOSITION

With these advantages to offer you:

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- a Special Industrial Application Department to cooperate with customers on new and unusual applications
- trouble-free performance and right price have practical appeal among progressive engineers and purchasing agents
- a hard-hitting, consistent advertising campaign, with full color advertisements in leading electronic journals
- and, of course, a good margin of profit, completely protected throughout the line

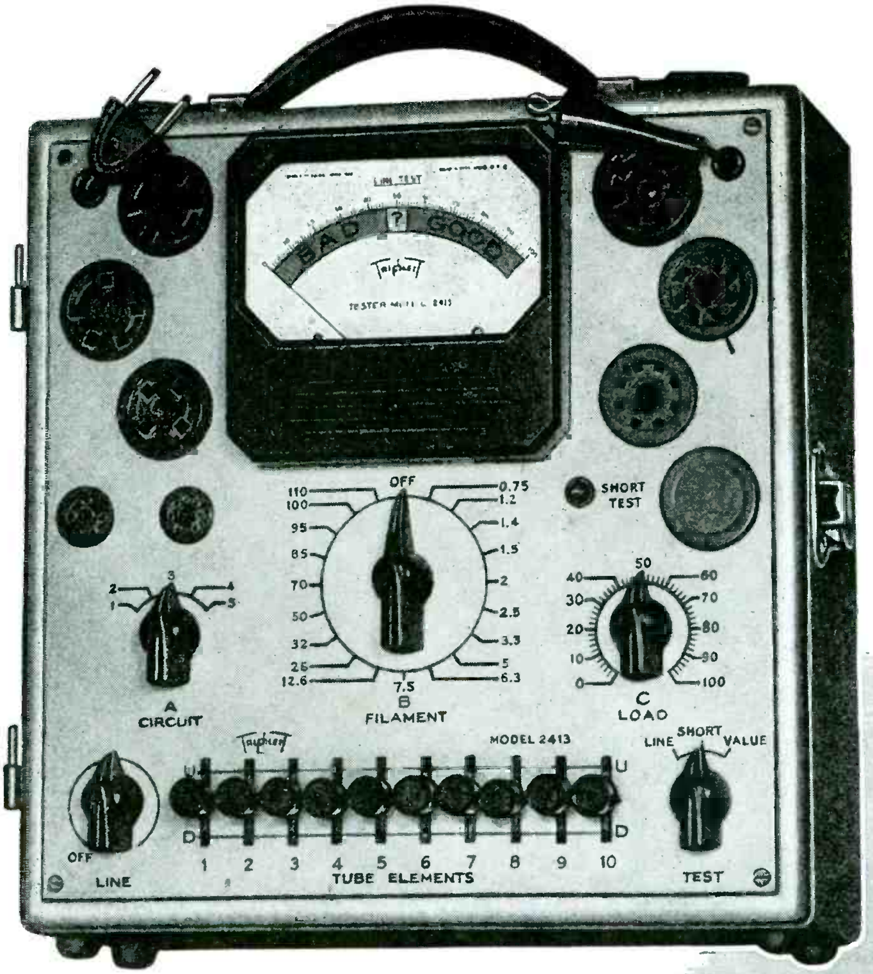
Marion has plenty of "ideas" for your growth as well as for new instruments. For complete details regarding a Marion Franchise, write to our Jobber Sales Division.

MARION ELECTRICAL INSTRUMENT CO.

MANCHESTER, NEW HAMPSHIRE

Jobber Sales Division: Electrical Instrument Distributing Co.
458 BROADWAY NEW YORK, N. Y.

ANOTHER 24-KT. PROPOSITION — UNITED STATES WAR BONDS



MODEL

2413

is another member of the NEW TRIPLETT Square Line

The New Speed-Chek Tube Tester

MORE FLEXIBLE • FAR FASTER • MORE ACCURATE

Three-position lever switching makes this sensational new model one of the most flexible and speediest of all tube testers. Its multi-purpose test circuit provides for standardized VALUE test; SHORT AND OPEN element test and TRANSCONDUCTANCE comparison test. Large 4" square RED • DOT life-time guaranteed meter.

Simplicity of operation provides for the fastest settings ever developed for practical tube testing. Gives individual control of each tube element.

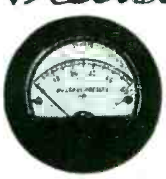
New SQUARE LINE series metal case 10" x 10" x 5½", striking two-tone hammered baked-on enamel finish. Detachable cover. Tube chart 8" x 9" with the simple settings marked in large easy to read type. Attractively priced. Write for details.

Additional Features

- **Authoritative tests for tube value; shorts, open elements, and transconductance (mutual conductance) comparison for matching tubes.**
- **Flexible lever-switching gives individual control for each tube element; provides for roaming elements, dual cathode structures, multi-purpose tubes, etc.**
- **Line voltage adjustment control.**
- **Filament Voltages, 0.75 to 110 volts, through 19 steps.**
- **Sockets: One only each kind required socket plus one spare.**
- **Distinctive appearance with 4" meter makes impressive counter tester — also suitable for portable use.**

STANDARDS ARE SET BY TRIPLETT

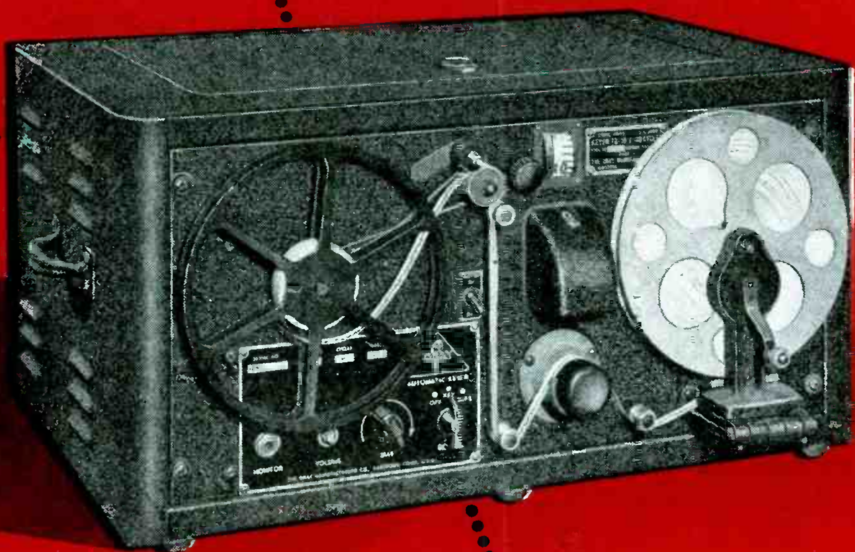
Precision first ... to last



Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

JUST ONE



JUST ONE of numerous government radio and electronic items now available through the Hallicrafters Co., Chicago, agent for Reconstruction Finance Corporation.

This is a Keyer TG-10-F, an automatic unit for providing code practice signals from inked tape recordings. Excellent for group instruction, sufficient power to operate up to 300 pairs of head phones. Can be adapted as amplifier of 10 to 15 watts output for use with crystal mike or phono pick up. Completely checked and reconditioned by Hallicrafters engineers. Send coupon for further details and lists of other available items.

THESE VALUABLE ITEMS *Available Now*

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American

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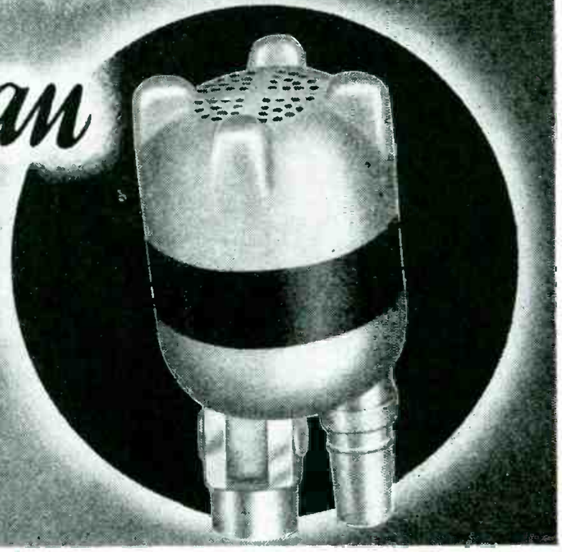
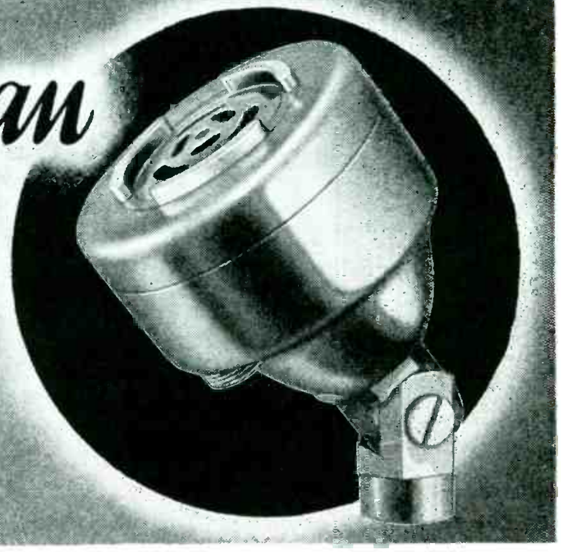
All American Microphones have design advantages derived from continuous ACOUSTICAL PICKUP experience since 1929.



American

DYNAMIC MICROPHONE D6

When the job requires *specific* microphone characteristics, such as the excellent D6 DIRECTIONAL response, insist on American.



American

DYNAMIC MICROPHONE D8

The D8 NONDIRECTIONAL model has the same structural stability that typifies the entire American Microphone line.

BULLETINS AVAILABLE—JOBBERS OR HOME OFFICE

American MICROPHONE CO.

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SYLVANIA NEWS
RADIO SERVICE EDITION

SEPT. *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1945

Free competition is the life of trade . . . and progress;

Only independent means of distribution preserves freedom of competition;

There will always be a place at the top for independents who work together to provide an even higher standard of American living.

SYLVANIA ELECTRIC PRODUCTS INC.

Appearing in special advertisments, this plaque reaffirms Sylvania's basic policy of merchandising its products through independent wholesaler channels — as the most efficient and economical means of distribution.

Established radio servicemen will experience an unprecedented volume of business during the months to come, while large numbers of returning, radio-trained veterans (from the Signal Corps and related activities) will be setting up their own shops.

Although many servicemen now have wider technical experience than ever before, they will find it increasingly important to have a good working knowledge of business methods — to make the best of a profitable situation and become firmly placed as part of the community's radio trade.

As one of its helps to oldtimers during this upswing of repair activity — as well as to newcomers with limited experience as shop owners — Sylvania has devised a simplified accounting system entitled "Business Record for Income Tax Purposes." This book is ideal for keeping a complete and accurate record of business transactions, payroll, profit-and-loss — and making out income tax returns quickly and easily. Available now at your Sylvania distributor, and priced nominally at $1.00, you can start using this handy system immediately. Order yours today.

RADIO SERVICEMEN URGED TO WORK CLOSELY WITH DISTRIBUTORS

Sylvania Distributors Offer You Helpful Business and Technical Aids

Now that wartime restrictions on radio parts have been relaxed, the radio serviceman will depend more than ever on free-flowing channels of distribution for an efficient and economical parts supply.

That is the reason for Sylvania's sponsorship of an even closer co-operation between the independent distributors and radio servicemen and dealers. Through advertisements on the above "Declaration for Independents," Sylvania is urging even further teamwork than before.

And Sylvania is backing up these ads with real aid to the radio serviceman. Simple and exact bookkeeping methods, technical information, better business suggestions, point-of-sale material and many other helpful ideas are available through Sylvania Electric distributors.

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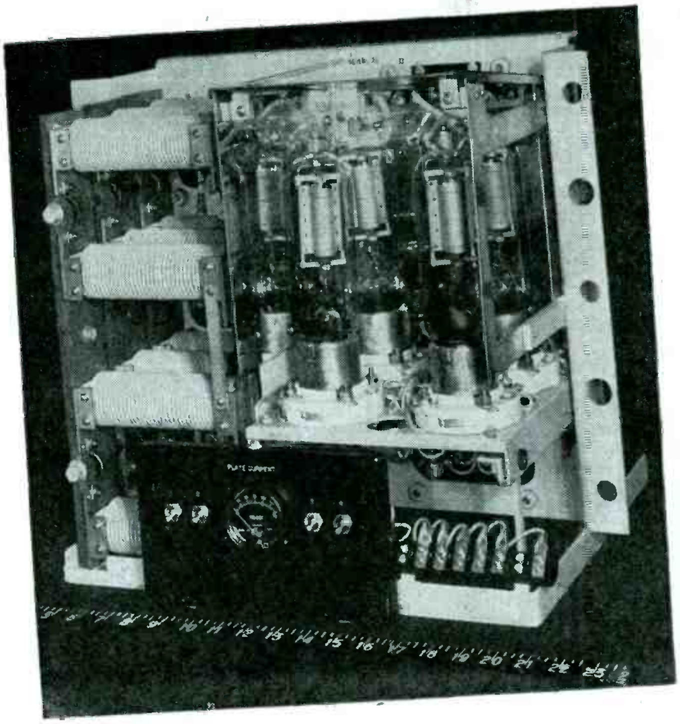

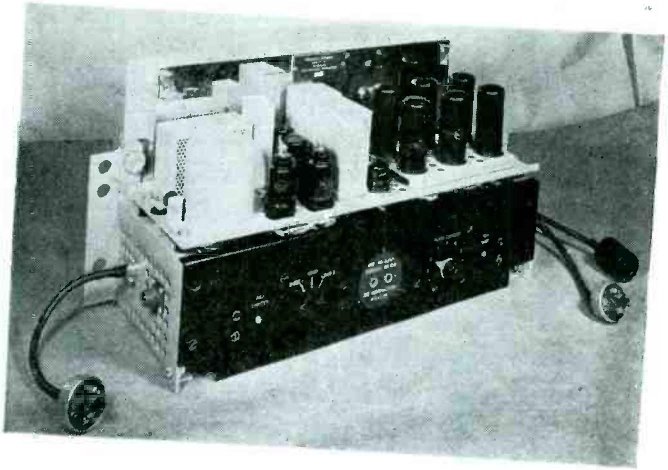

Figs. 1 (left) and 2 (below). Fig. 1 illustrates a 500-watt power amplifier used aboard warships. This amplifier is driven by the 40-watt preliminary amplifier shown in Fig. 2. Note the small size of the power amplifier.

MARINE P-A SYSTEMS

by MARTIN W. ELLIOTT

WITH the war at an end and the military permitting disclosure of many developments, we find that p-a systems played quite a role in land and particularly sea operations. On warships for instance, the p-a system served many purposes; it was unusually large and yet quite flexible.

A typical warship sound-system installation used during the war had to transmit messages or signals to nearly 3,000 men at one time. The messages were prosaic, sometimes, involving the calling together of a group for work detail, or paging an officer, or calling men to mess. At other times special alarm signals raced over the p-a system for warning purposes.

Speech and Tone Tests

In designing the systems, engineers had to conduct intelligibility tests under shipboard conditions for optimum speech frequency characteristics. Tone signal characteristics were analyzed to determine the most attention-arresting signals consistent with limitations of amplifiers and loudspeakers.

The general system was usually called the commanding officer's system. Announcements on this system were usually made from the point of ship control; the bridge, while under way; the quarter deck, while at anchor; or the central station, deep in the most protected part of the ship, during special conditions. Some ships had as many as two-hundred or more loudspeakers, located in the most effective positions, internally and externally.

Alarm signals, such as the bell tone for general alarm and the special signal for gas attack, were generated by electronic means, and then sent out over the loudspeakers. During a battle, the systems carried a running commentary on the progress of the fighting.

Two-Way Announcers

Turrets on cruisers and battleships, incorporating a maze of compartments, and intricate machinery, carried a special two-way announcing system over which the turret officer gave orders for operating the turret and the loading, aiming and firing of the guns.

Loudspeakers at the guns transmitted verbal orders from this officer, and also special tone signals to begin and cease firing.

Aircraft Carrier System

The flight deck of aircraft carriers presented another interesting use of the p-a system. Several super-power loudspeakers were located in the island structure, and pointed so that the entire flight deck was covered. Each of these loud-speakers was driven by an audio amplifier of 500 watts output capacity. These loudspeakers formed part of the system over which the Air Officer, located at the fly control station above the flight deck, could give orders to pilots and deck crews during flight operations and while the airplane engines were being warmed up. The system was also used for transmitting warning signals in flight deck emergencies.

Basic System Designs

The basic patterns of most of these systems were similar. Frequency re-

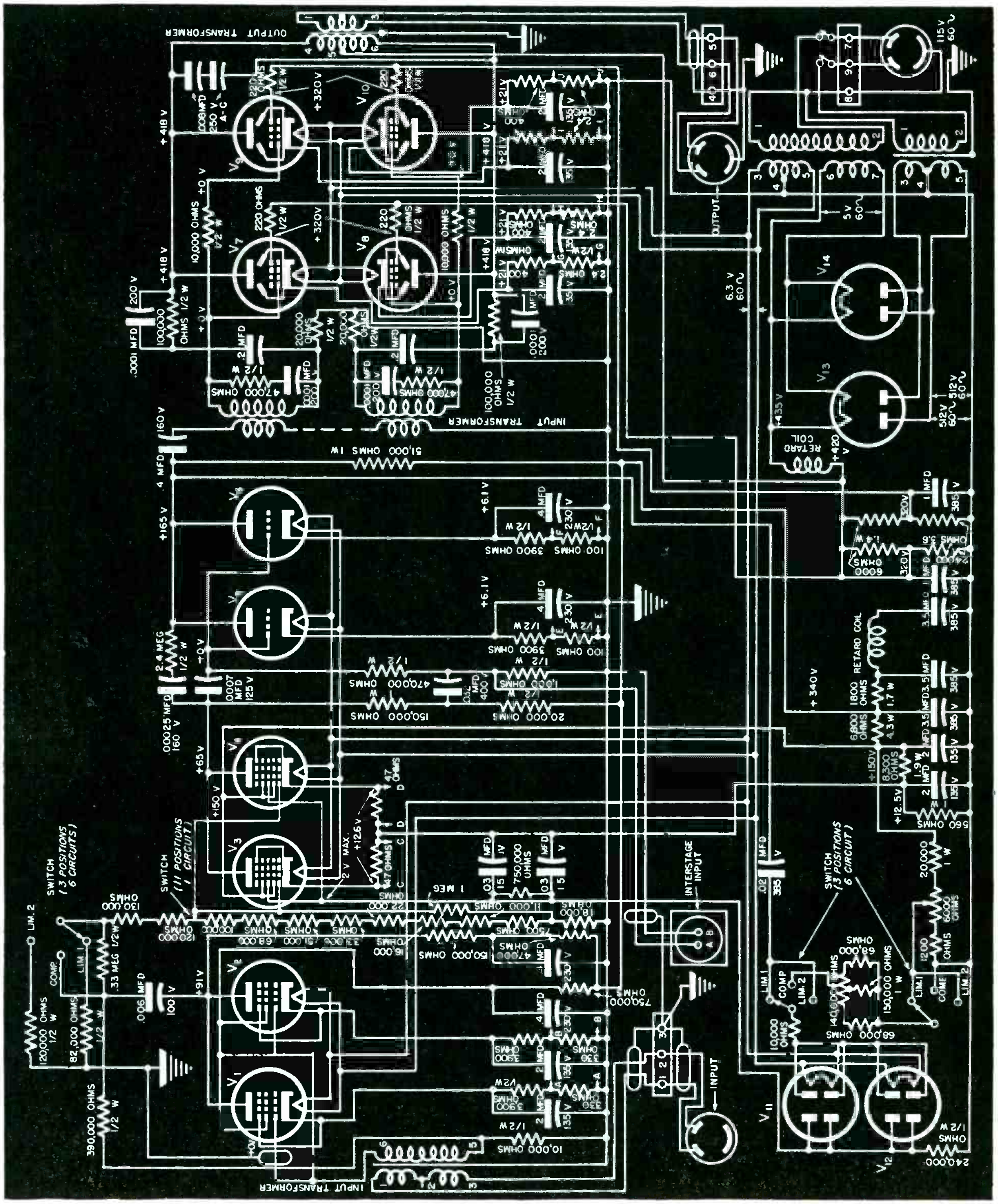

Fig. 3. Preliminary amplifiers schematic. V_1 and V_2 are 6J7s; V_3 and V_4, 6L7s; V_5 and V_6, 6C5s; V_7, V_8, V_9 and V_{10} are 6L6s; V_{11} and V_{12}, 6H6s; and V_{13} and V_{14} are 5T4s. This amplifier of 40-watt capacity was used either as a preamplifier to the 500-watt unit, or alone. In turret or anti-aircraft systems, the 40-watt unit was sufficient.

sponse of the system, microphone and speakers, were approximately 500 to 6,000 cycles. The low end was cut off at about 500 cycles, partly because these lower frequencies did not add materially to the intelligibility, and in fact often served to reduce intelligibility in noisy, reverberant spaces. In addition this low-end cut-off permitted the use of smaller and lighter loudspeakers and amplifiers. The higher frequencies were accentuated to give better intelligibility in noisy spaces.

Volume compression averaged 2:1, thereby compressing a 40-db volume range into a 20-db volume range. This method served to bring up the volume of the weaker syllables, and thus improve intelligibility in noisy locations. As full amplifier output was approached, the compression ratio increased until at rated output the compression was about 10:1, helping to prevent overload and blasting of the loudspeakers.

Types of Amplifiers

Two types of amplifiers were standardized for these installations. One was the .40-watt, 120-db gain amplifier, Figs. 2 and 3. In small systems,

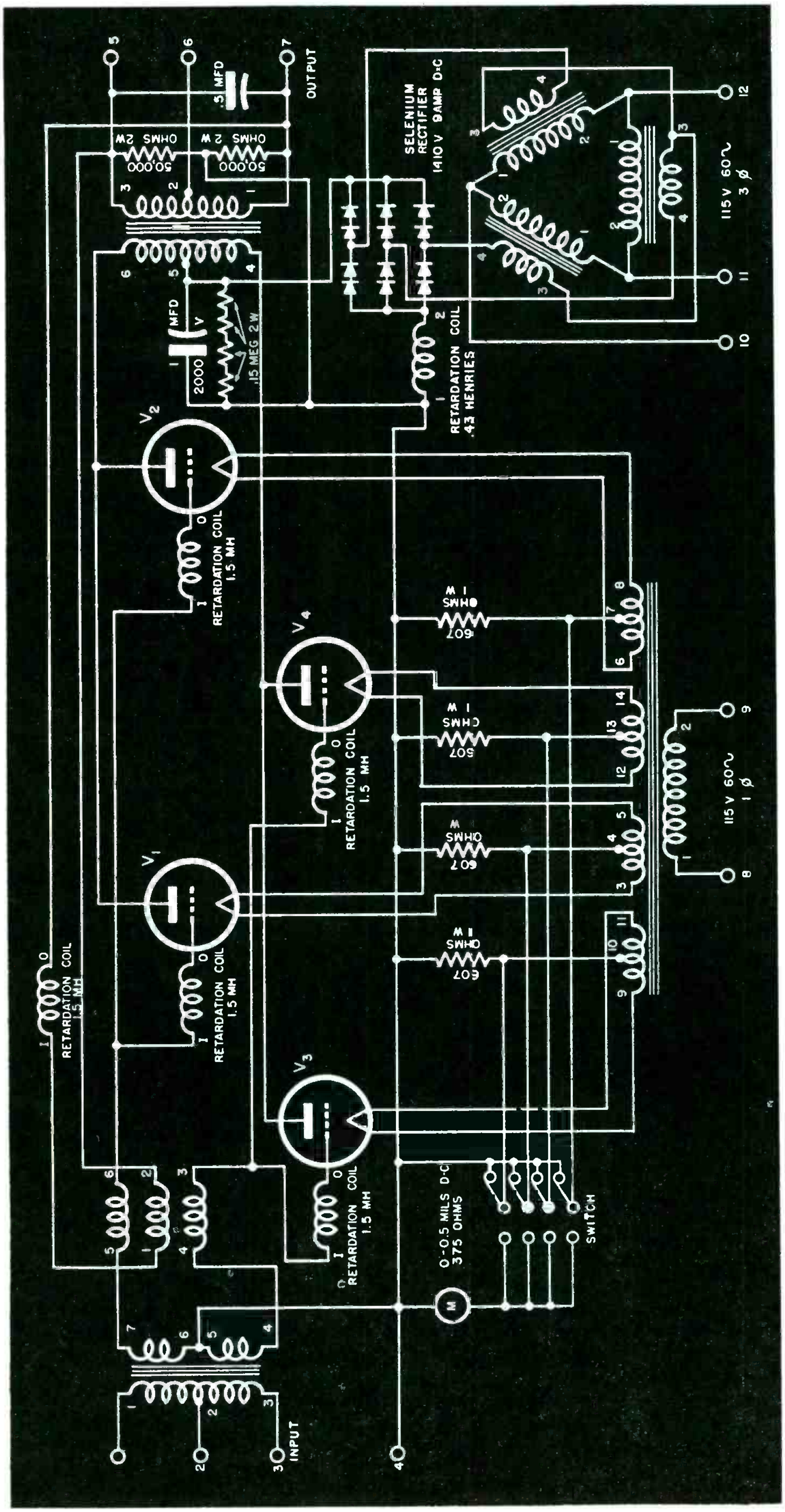

Fig. 4. Schematic of 500-watt* amplifier. All tubes are of the 805 type, class B. Selenium rectifiers are used. (*While the amplifier is rated 500 watts, it is capable of delivering a maximum power of 600 watts into a 15-ohm non-inductive resistance load from output terminals *6* and *7*, or into an 18-ohm non-inductive resistance load from terminals *5* and *7*, with less than 10% total harmonics.)

such as the turret or anti-aircraft systems, this was the only amplifier used. In larger systems, this amplifier drove one or two 500-watt amplifiers.

Output Current Drain

At full audio output, this system draws 100 amperes from a 115-volt three-phase power supply.

Systems Uses

The three systems combined were used sometimes simultaneously to transmit announcements to three separate parts of the ship. Each amplifier channel, however, is capable of handling the loudspeaker load of the three systems combined. In case of amplifier trouble, the facilities normally associated with the disabled channel may be combined with those of another channel until repairs can be made. Even if two of the three channels are disabled, messages can still be transmitted throughout the whole ship.

Design Problems

Interesting design problems prevailed because of special requirements for service on naval vessels. Short circuits on any loudspeaker were not permitted to interfere with operation over other loudspeakers. Short circuits or possible grounds on microphone circuits or control wiring at microphone locations had to be avoided. Otherwise the system could not be used from any other microphone location.

Loudspeaker and microphone diagrams were designed to withstand the blasts of nearby gun muzzles. The amplifiers were also designed to withstand these shocks as well as the severe vibration of the ship's engines. All equipment located on weather decks were protected from salt-water corrosion by specially-treated coverings. Some of the units were made watertight. However, in some instances, the equipment was designed with the expectation that water will enter. Drain holes were therefore provided. Under these conditions, all components were made immune to corrosion.

These and many other difficulties were overcome to provide p-a systems that were always in service.

[The writer is grateful to the Bell Laboratories Record for all data, illustrations and diagrams appearing in this discussion. The p-a equipment described are Western Electric products.]

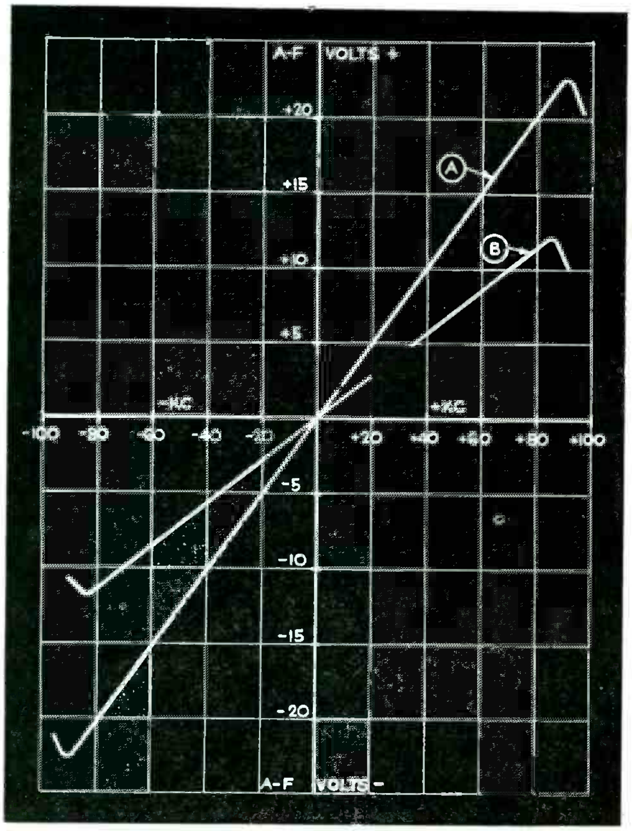

Fig. 1. Typical characteristic curves for an f-m discriminator. The curves represent the differential audio voltage output in terms of the frequency swing; curve *A* represents the characteristic for a given value of input; *B* shows the curve for a smaller value input. Note that the output voltage is a direct function of the input voltage.

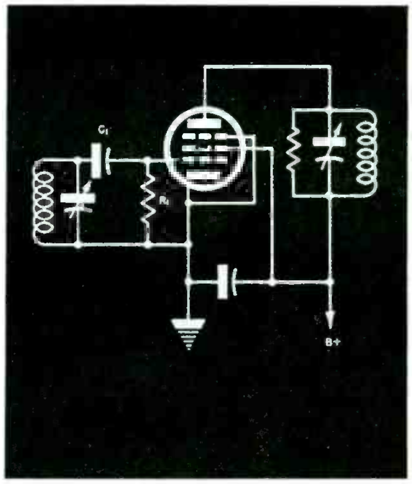

Fig. 2. A typical limiter stage. No bias is used, and its action is dependent on the value of plate and screen voltages applied.

F-M LIMITERS

by J. GEORGE STEWART

FOR proper operation of the discriminator in an f-m receiver, the signal applied to it must be of constant amplitude. Not only must this signal have constant amplitude, but it must also be of some exact, predetermined value. In Fig. 1 appears a characteristic curve of a discriminator for two different values of input voltage. Curve *A* represents the voltage characteristic for a given value of voltage input to the discriminator. Curve *B* shows the characteristic curve for a smaller value of input voltage. As we can see, the audio response and amplitude fidelity of the receiver is dependent on an input of constant amplitude to the discriminator, with its exact value determined in the original design.

Since the field strength of the various f-m transmitters will vary, depending on their location with reference to the receiver, some means must be provided in the receiver for delivering a uniform input to the discriminator, no matter what the signal strength is at the antenna. This function is served by the limiter.

Simply stated, a limiter is a device which delivers uniform output for a wide range of input voltages. In addition, it also helps to reduce the effects of static crashes and loud local noise signals. In this respect, it is very similar to the peak noise limiter used in some a-m receivers.

Typical Limiter

A typical limiter is shown in Fig. 2. In some respects it is similar to an i-f stage, in others, it closely resembles a grid-leak type detector. Its operation is dependent on the proper selection of screen-grid and plate voltages, and the values selected for the grid leak and condenser.

Grid-Leak Condenser Action

The action of the grid leak and condenser, R_1 and C_1 in Fig. 2, is the same as in the usual detector. On the positive half of the input cycle, the grid draws current, since there is no cathode bias on the tube. This current develops a bias voltage across the grid resistor, which reduces the plate current. Since there is no r-f bypass condenser in the plate circuit, the input voltage waveform appears also in the output. To limit the voltage developed in the plate circuit, low plate and screen-grid voltages are used. The low plate and screen-grid voltages, usually on the order of 45 to 75 volts, limit the peak value to which the developed signal in the plate circuit can rise, since large values of input signal only cause plate saturation. Thus, once the input signal exceeds some given value, the output from the plate circuit remains constant.

Since reduction of static and noise interference is also a major consideration in the design of limiters, the time constant of the associated *RC* networks is important. Small time constants reduce static and noise best, but also tend to weaken the constant-output characteristic of the limiter for high value inputs. Larger time constants are better for good regulation, but permit static crashes to influence the signal. Since both systems cannot be used in the one circuit, some compromise is necessary where a single limiter is used.

Two Limiters

Where the maximum in both features is desired, two limiters are used, one for best regulation, the other for best noise limiting. Thus, in Fig. 3

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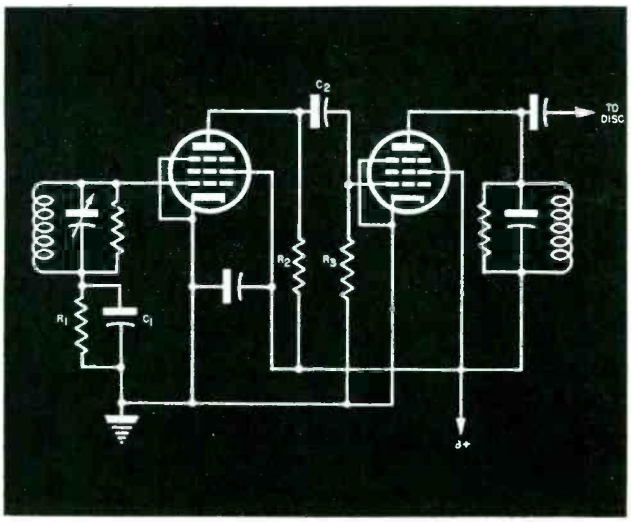


Fig. 3. A double limiter stage. One limiter is used to reduce static and interference, the other to improve the voltage regulation characteristic.

the first limiter reduces static and interference by the use of a small time constant for R_1C_1, and the second limitor uses a larger time constant in the $R_2R_3C_2$ network, thereby increasing the voltage regulation characteristic of the limiter system. In addition, some stage gain is realized, usually about 2 to 6, which increases the effectiveness of the receiver for weak signals.

Variations of both systems, and typical circuit values are shown in Figs. 4 to 7.

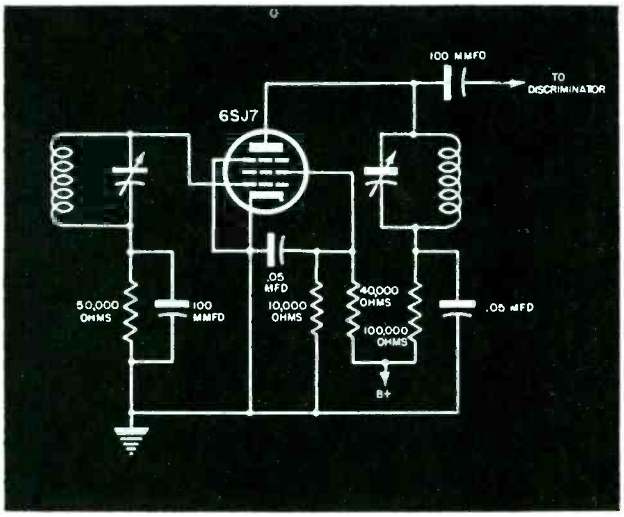


Fig. 4. A single limiter stage as used in the Freed model 40 f-m receiver. Low plate and screen voltages, and a small time constant in the grid *CR* circuit supply the necessary regulation.

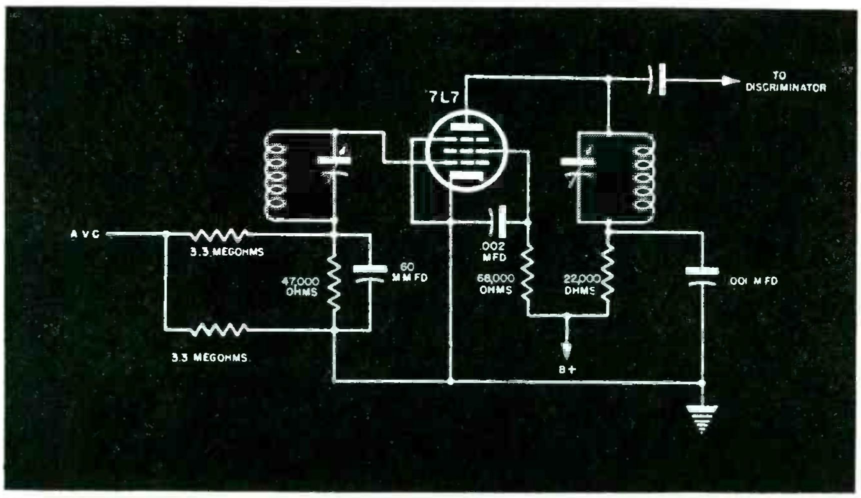
Freed 40

Fig. 4 shows the single limiter used in the Freed model 40 f-m receiver. We note that the grid leak and condenser are both unusually small in value for a small time constant, and that the plate and screen-grid voltage dropping resistors permit only small values of supply voltage. When replacing defective parts in limiter circuits, it is best to use values as established by the manufacturer, since even small deviations will tend to decrease the efficiency of the receiver, or cause circuit instability.

Emerson FM 460

In Fig. 5 we have the limiter used in Emerson's a-c/d-c FM 460. The low values of plate and screen-grid bleeder resistors are due to the low initial plate voltage. Here, the developed bias in the grid leak circuit is used for avc. Most f-m limiters use high gain tubes such as the 7H7 to improve the limiter action.

Fig. 5. The Emerson FM 460 limiter. This limiter is used in the a-c/d-c model, which accounts for the low value plate and screen voltage dropping resistors.



G. E. 40

Fig. 6 shows a cascade type limiter used by G. E. in their model 40. Resistance coupling is used for interstage coupling to reduce the hazards of feedback and stage oscillation. The time constant of the *RC* network in the first limiter is .0000033 second; in the second limiter it is .0000039 second. The time constant for the second limiter does not need to be very different from that of the first, since its task has been greatly reduced by the action of the previous limiter. In other words, the input to limiter *2* is already limited in range by the action of limiter *1*.

Motorola FM 82

Fig. 7 illustrates the limiter circuit used in the Motorola FM 82. Here, transformer coupling is used between the two limiters. The time constant for the second limiter is supplied by the 50-mmfd capacitor and .1-megohm resistor in the grid circuit for a time constant of .000005 second. This is

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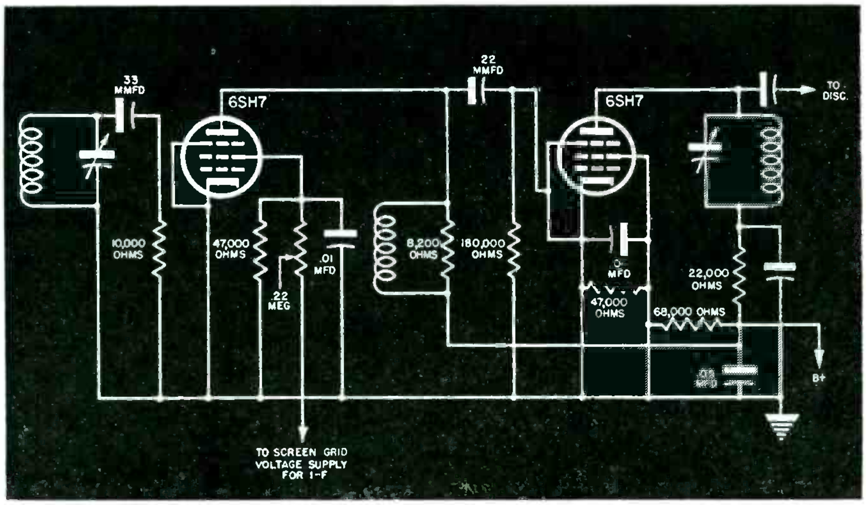

Fig. 6. Cascade limiter used in the G.E. model 40. Resistance coupling is used interstage to reduce the hazard of feedback. Both limiters have almost the same time constant, since limiter *1* has already limited the range of input to limiter *2*.

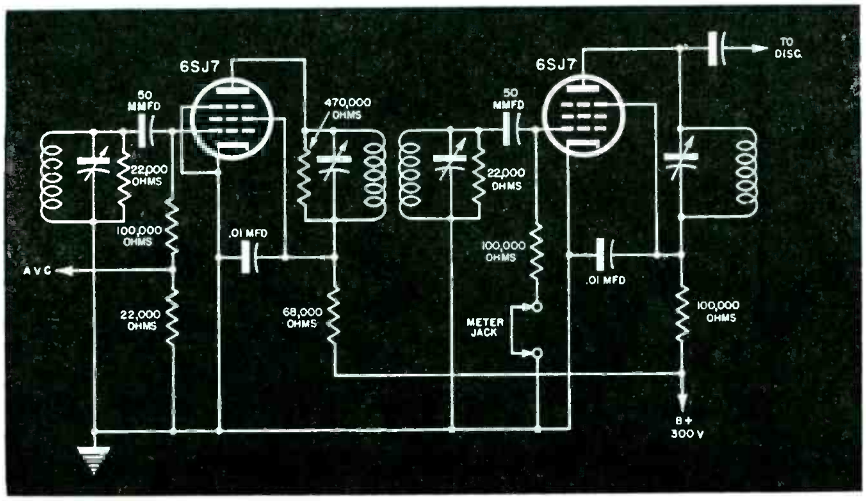

Fig. 7. Cascade limiter of Motorola FM 82. The time constants of the *RC* grid networks is identical for both limiters. Adequate shielding of components permits the use of transformer coupling, with corresponding improved stage gain.

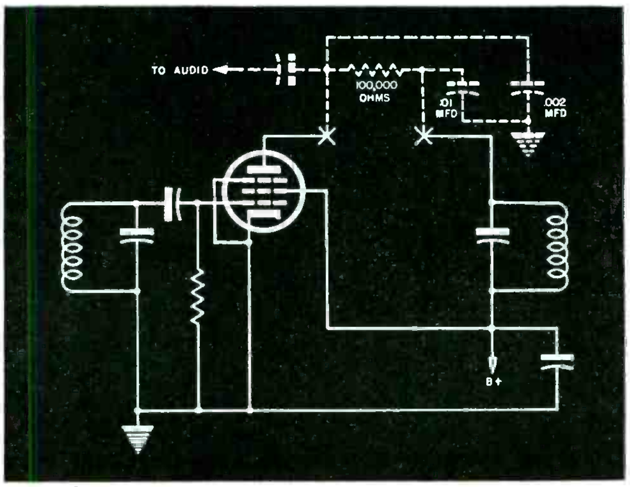

Fig. 8. A method of checking and aligning a limiter stage with an a-m signal generator. The limiter has been converted to a grid-leak type detector. The stage is then aligned for maximum output and checked for its limiting action by applying excessive input.

identical to the time constant for the first limiter. A meter jack is also provided for measuring the input to the second limiter for alignment purposes. A low current ammeter with a 500-microampere movement or better is necessary for this operation. The signal from an a-m signal generator is fed into the i-f section, and the stages are aligned for highest reading on the meter. A quick check for oscillation or feedback in the i-f section may be made by cutting out the signal generator and noting if any reading is obtained on the meter. Any small reading is indicative of oscillation, and the i-f stage should be checked for feedback until the meter reading is zero.

Alignment Method

Still another method used in alignment is to convert the limiter to a grid-leak type detector. A typical circuit is shown in Fig. 8. Where an i-f transformer is used in the plate circuit of the limiter, the resistor is connected in series with the plate of the tube, and the two components bypass to ground. In aligning the G. E. 40, Fig. 6, the coil in the plate circuit of the first limiter should be disconnected, and a .002-mfd bypass capacitor should be connected from plate to ground. The output is then connected to the audio system through an audio coupling capacitor and the set aligned the same as an a-m receiver with a modulated signal.

The signal input from the signal generator must be kept at a level which does not overload the converted limiter stage. If the input signal is too high, the converted limiter stage may overload, so that increases in signal accompanying alignment will not be apparent. Incidentally, this limiting action may be checked once the set is aligned, by increasing the signal input and noting the effectiveness of the limiter action.

When aligning f-m receivers, the limiter should be checked for uniform output. Receivers should deliver uniform output to the discriminator for signal inputs of 50 microvolts or more. However better performance will result if the limiter output starts to flatten off at less than 50 microvolts.

To check the limiter characteristic for amplitude modulation, an amplitude-modulated signal is applied to the input of the receiver at a level which should saturate the limiter. Very little of the modulation should appear in the output. A loud signal in the output is indicative of poor limiter action, and the circuit should be checked for abnormal voltages or improper grid-leak or grid-condenser values.

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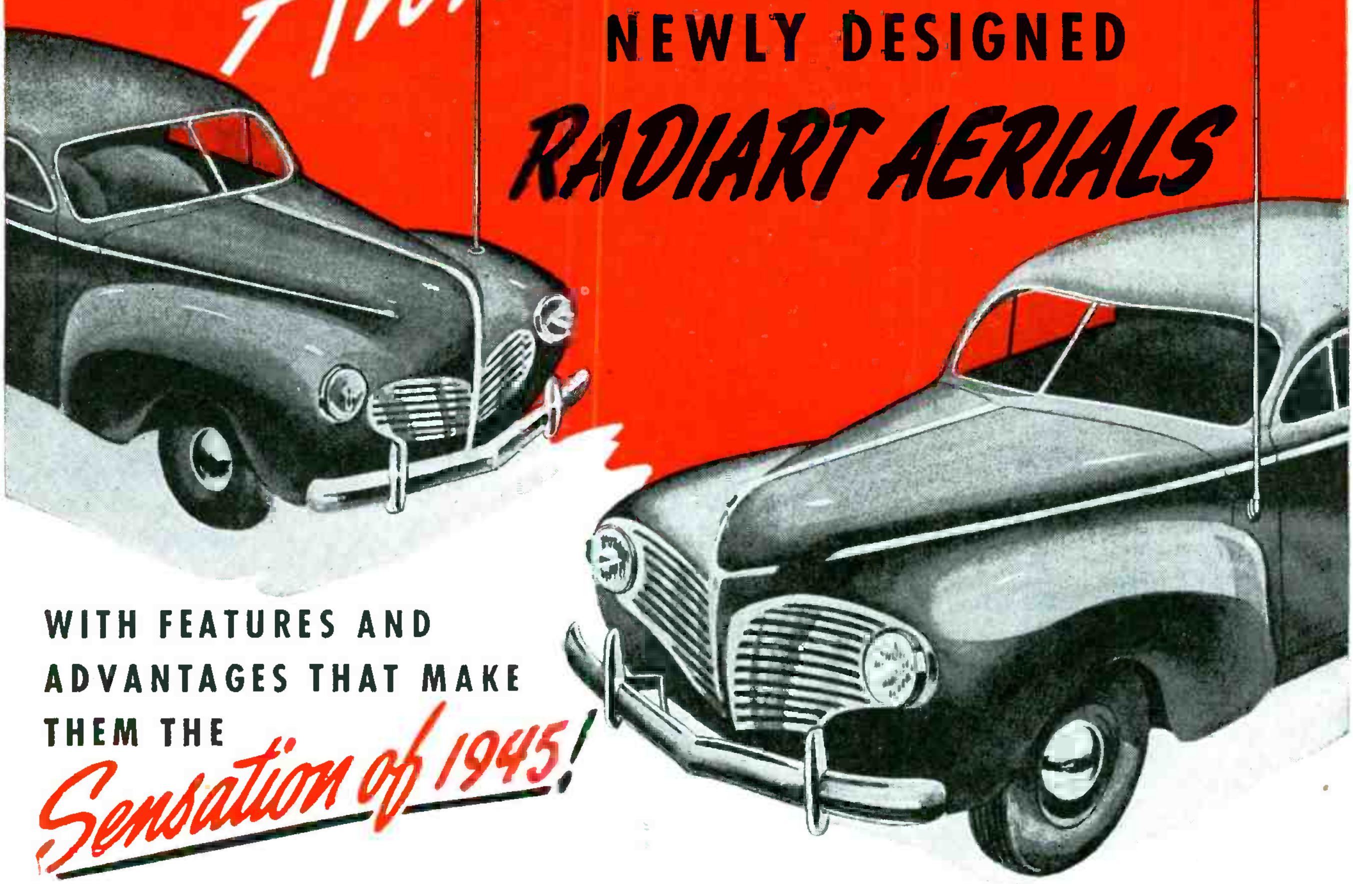

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APPLICATIONS . . . SERVICING . . .

Fig. 1. Oscillograph with 5" screen *(Courtesy Du Mont)*

[*Part Three of a Series*]

by S. J. MURCEK

FUNDAMENTALLY, the cathode-ray tube is an electronic device which permits visual observation of rapid changes in electrical circuit voltages. Since the device is a tube, however, its operation must depend directly on certain electrical circuit components with which tubes are usually associated. In a cathode-ray oscillograph, for instance, we have such components as a-c tube-type rectifiers, filtering circuit units, two or more dynamic-voltage amplifiers (these being necessary for amplification of small dynamic voltage changes which would otherwise effect little deflection of the cathode-ray beam), and a suitable linear time base oscillator. The linear time base oscillator provides an output voltage which varies directly with time, that is, a voltage which increases directly with unit increments of elapsed time. Provision is also included in the conventional oscillograph, for the incorporation into the linear-time-base oscillator circuit, of a suitable means for synchronization of the output frequency with that of the voltage variation which is under observation to provide a stationary wave image for visual observation.

Most commercially available oscillographs are arranged as portable units similar to the *Du Mont 208B* unit, Fig. 1. In this form, the unit is portable and may even be carried into the field for electronic circuit investigation. The circuit of an instrument of this type, but of less complex nature, *Du Mont 164E,* appears in Fig. 2.

In this unit we have a c-r tube without an intensifier electrode. The unit uses a twin power supply-rectifier system with dual *80* rectifiers. Both rectifier circuits derive their operating voltages from the various secondary windings of the common power supply windings of the common power supply transformer T_1. In addition, the unit is provided with two separate dynamic voltage amplifiers using *6C6* pentodes and a linear time base oscillation system with a *2B4* thyratron. The latter develops suitable wave images on the electron screen of the *3AP1* cathode-ray tube, and is unique in that the thyratron is thus provided with a control grid.

In the twin-rectifier system, the left hand *80* tube functions as a full-wave rectifier, whose output is delivered to the filter network consisting of L_1, C_4, and C_5.

The d-c potential which is thus available across the terminals of the filtering output capacitor C_4 is impressed across the terminals of the output voltage divider, consisting of three fixed resistors, R_{14}, R_{13}, and R_{13A}. In general, this voltage divider is a part of the oscillograph time base oscillator and dynamic voltage amplifier d-c power supply system, Fig. 3.

Essentially, the d-c voltage divider functions to sectionalize the rectifier-filter power supply output potential for the correct operation of the dynamic voltage amplifiers and the linear time base oscillator. The junction of divider resistors R_{13} and R_{13A}, in Fig. 3, is shown to be directly connected to the screen grids of the voltage amplifier pentode tubes, at a potential of approximately 100 volts to chassis. The function of the bypassing capacitor, C_3, will be discussed during the analysis of the pentode-voltage amplifier stages.

The pentode-plate potentials are obtained directly from the positive terminal of the d-c voltage divider, in series with the plate loading resistors R_{17}, in the vertical amplifier, and R_{21}, in the horizontal amplifier. Further, to insure the complete dynamic isolation of each voltage-amplifier stage from the other, the insertion of the series audio-frequency *chokes,* L_2 and L_3, in series with each plate loading resistor interposes a high series impedance, in each plate circuit to large


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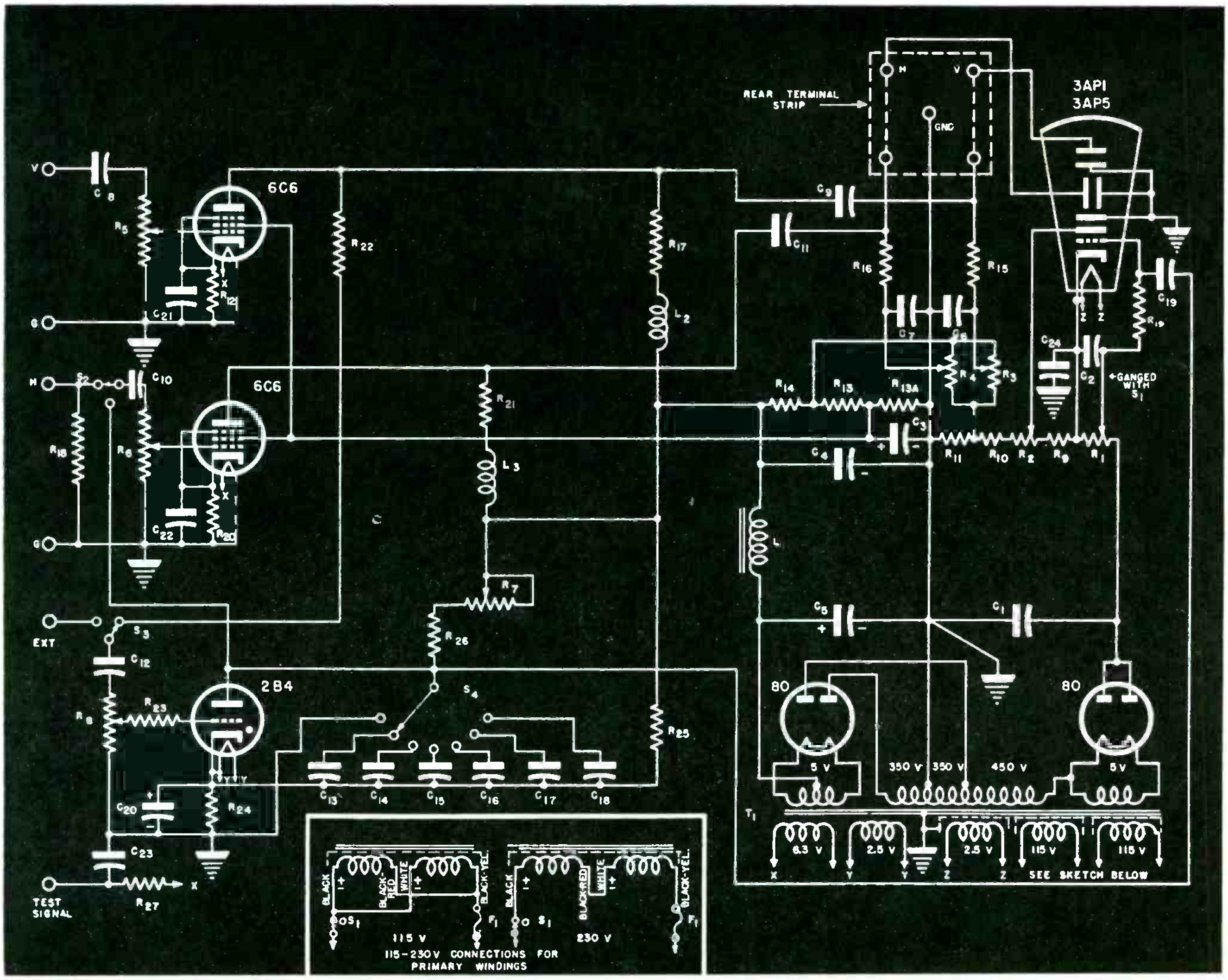


Fig. 2. Circuit of oscillograph using 3" tube; Du Mont 164-E.

variations in the plate current drawn by either tube.[1]

An auxiliary voltage divider, consisting of the resistors R_{25} and R_{24}, is also connected across the output of the rectifier-filter d-c power supply system. Since resistor R_{24} is interposed between the thyratron cathode and chassis, the function of this particular auxiliary voltage divider is to keep the cathode of the *2B4* thyratron positive with respect to the chassis to maintain the control grid of the tube negative with respect to the cathode during such periods when the tube is not conductive. The thyratron plate potential is obtained directly from the positive terminal of the d-c voltage divider, this potential being impressed across the plate and cathode of the thyratron in series with the timing control potentiometer R_7 and the maximum frequency limit resistor R_{26}. The latter resistor prevents the short-circuiting of the d-c power supply by the thyratron tube should the timing control potentiometer R_7 be turned to the minimum resistance, maximum frequency position.

The right hand *80* rectifier, Fig. 2, rectifies the *negative* half-cycles of the 800-volt a-c potential between the filament or cathode of this tube and chas-

(*Continued on page 40*)

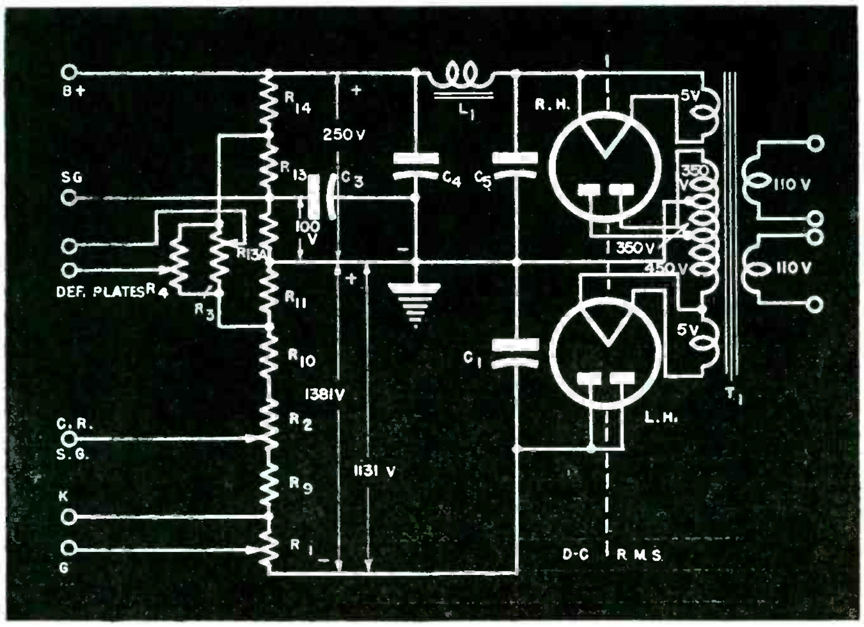
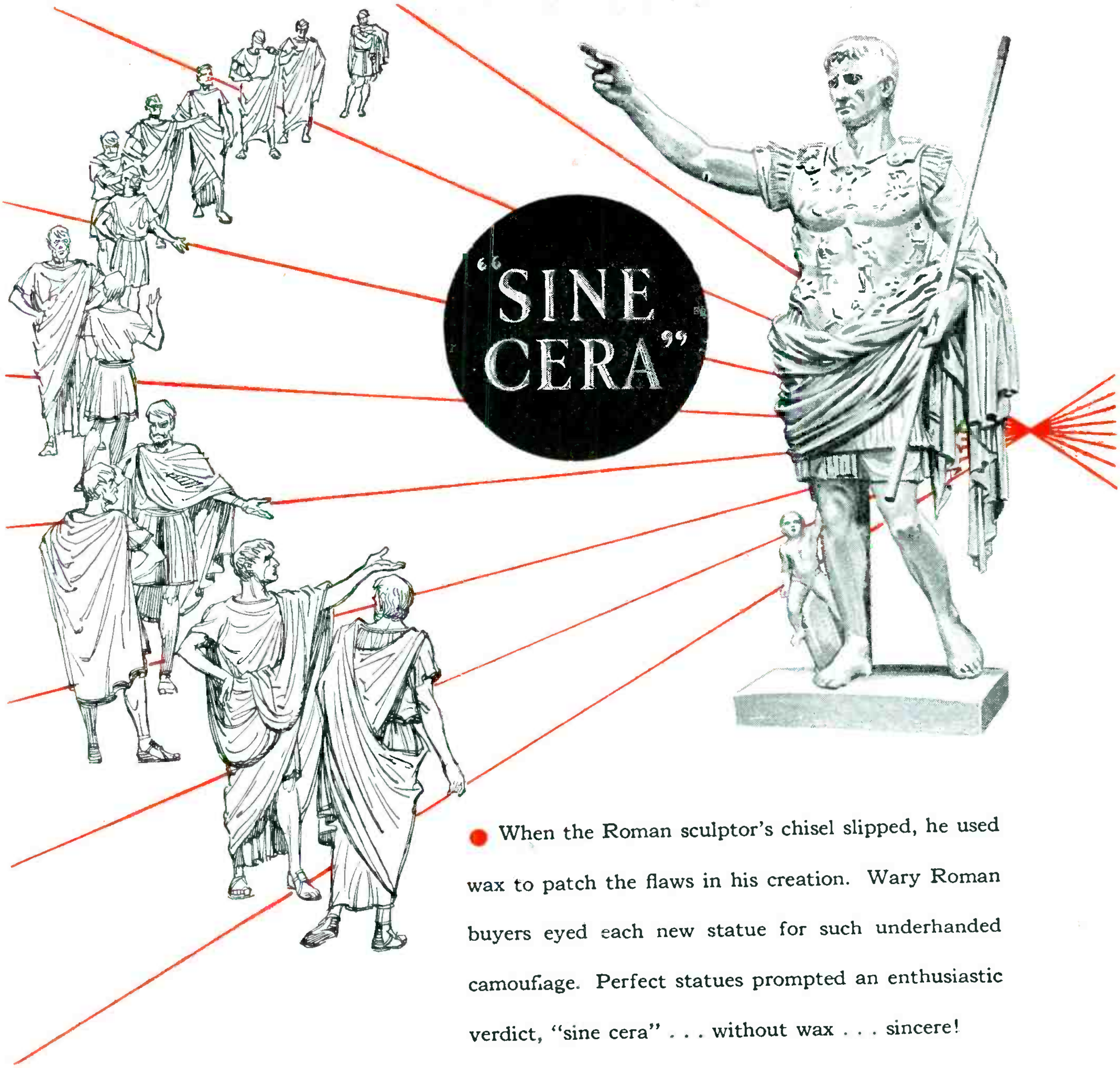


Fig. 3. The d-c circuits of the oscillograph shown in Fig. 2. The only departure from resistance-capacitance coupled amplifiers appears in the c-r tube electrode supply circuits. Note that the maximum potential present in this system is the sum of the output voltages provided by the two rectifier systems.

[1]The series plate inductance also serves to increase the response of the deflection amplifier to the higher audio frequencies, particularly those above 5,000 cps.



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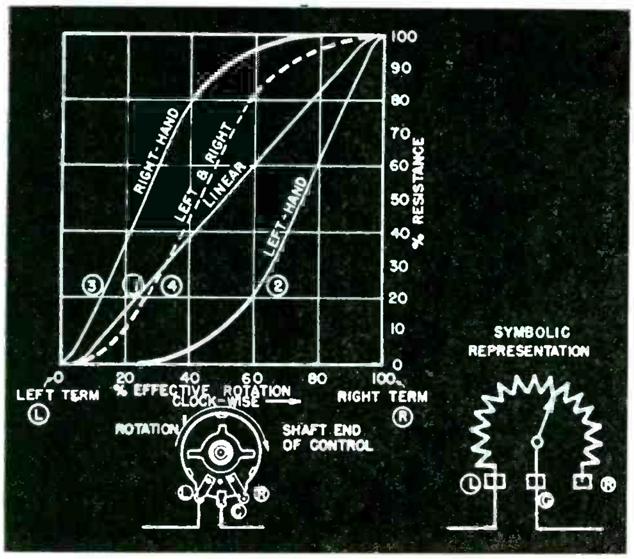
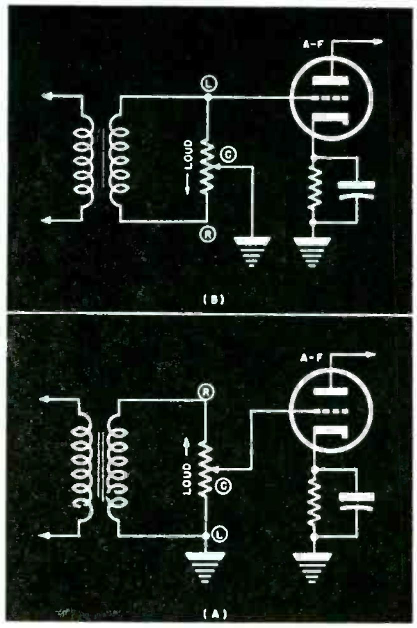


Figs. 1 (left) and 2 (right). In Fig. 1, we have resistance characteristic curves illustrating linear, left-hand, right-hand, and combination left-and-right-hand taper. Fig. 2 shows two variations of an audio shunt type of volume control. Both require a control having left-hand taper, but the control terminals are connected differently in each case.



VOLUME AND TONE

Part Seven of a Series on Receiver Components

by ALFRED A. GHIRARDI

Advisory Editor

IT is not sufficient that volume and tone controls be merely smoothly-operating variable resistors of the wire-wound or composition-element types explained in the last article of this series. In most applications, the manner in which the resistance varies with angular rotation of the control shaft is of vital importance as well.

The Volume Control and the Ear

It is well known that the sensitivity of the human ear varies approximately as the logarithm of the sound intensity. Therefore, equal changes in the sound intensity do *not* produce equal changes in loudness as perceived by the human ear. The purpose of a manual volume control is to cause changes in the receiver's electrical output and sound *intensity* with the object of producing changes in loudness. It is obvious, therefore, that in order for the volume control to produce an *apparent linear control of the loudness* as the control knob is turned, the volume control should actually vary the electrical output and sound intensity in approximately a logarithmic manner. If this logarithmic variation is achieved, the change in loudness will appear smooth and uniform to the ear. If this control characteristic is not attained, at some points an adjustment in the control setting will seem to make little or no change in the signal, while at other points the signal will change so abruptly and widely that the control-knob adjustment will be extremely critical. Such a volume control would be annoying to adjust.

Smooth control of loudness can be effected by special design of the volume-control element so that as the control knob is turned the resistance varies (is *tapered*) in the correct manner to produce the required approximately logarithmic variation in electrical output and sound intensity. Several fairly well standardized resistance tapers have been developed by replacement control manufacturers to meet the requirements of the many different volume-control circuit arrangements employed in receivers. Replacement controls of the proper resistance values and taper characteristics to work satisfactorily in each type of control circuit are available.

Linear Taper

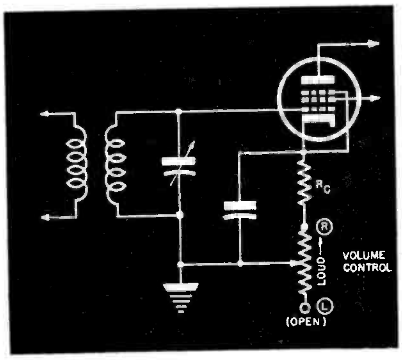
The *linear* control is one employing a resistance element in which the resistance is uniformly distributed along its length, hence whose resistance change per degree of rotation is uniform throughout the total rotation. In such controls, the resistance value varies directly with the degree of rotation. At ¼ rotation, ¼ of the total resistance is included between the end and middle terminal; at ½ rotation, ½ of the total resistance is included, etc.

Graph *1* in Fig. 1 illustrates the variation of resistance with control-knob rotation that results when the *C* and *L* terminals of such a resistor are employed. Notice that the characteristic is *linear* (a straight line), and the resistance *increases* as the knob is rotated clockwise. (If the *C* and *R* terminals were employed instead, the resistance would *decrease* as the control knob is rotated clockwise). Strictly speaking, this linear type of characteristic is not a taper, but popular usage has defined it as *linear taper* and such controls are known as *linear-taper controls*. A control having linear taper is used wherever the control should be such that voltage is proportional to the degree of rotation. This type of resistor was used as a volume control in early receivers in which the control was effected by using it as a simple rheostat in one leg of the filament circuit of one or more vacuum tubes. By this means the filament voltage or emission, as well as the amplification factor or gain of the tube, was varied.

Left-Hand Taper

In addition to the so-called *linear* taper, there are two general classes of tapers, left-hand and right-hand. A *left-hand tapered* control is one in which the smaller (tapered) resistance change per-unit-of-rotation occurs when the movable contact is moved over the region near the *left-hand* (*L*) terminal. Graph *2* in Fig. 1 illustrates a left-hand taper characteristic. Notice that the left-hand side of the resistance element has its resistance variation tapered out or made gradual; that is why it is called a left-hand tapered control.

Tone controls generally employ left-hand taper, as they usually have the



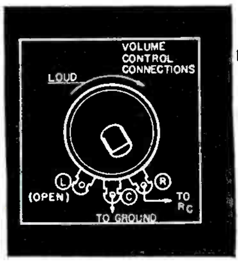
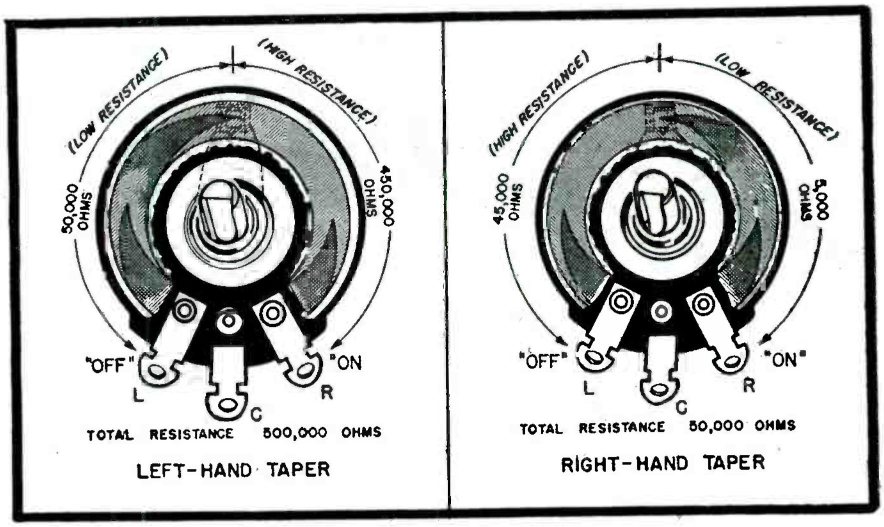


Fig. 3. A bias type of olume - control circuit equiring a resistor aving right-hand taper; Rc is a fixed minimum-bias resistor.

Fig. 4. How the resistance coating is made to taper in left-hand and right-hand tapered composition-element controls.
(*Courtesy P. R. Mallory & Co.*)



CONTROL RESISTORS

bass position at the left of the knob. When the *bass* position is at the right of the knob, a right-hand taper is usually required.

Several types of manual volume-control circuits—especially those of the *shunt* or *short-out* types—require a control having left-hand taper of suitable resistance characteristic to obtain smooth, uniform control of volume. The volume-control circuit illustrated at (*A*) of Fig. 2 is of this type. The control is connected as a potential divider shunting the secondary of the audio transformer. It enables any desired fraction of the audio voltage developed by the secondary to be applied to the grid circuit of the audio tube. Full loudness is obtained when the movable contact *C* is at the full-resistance (*R*) end of the volume control resistor, for then the full audio-voltage is applied to the grid. Since it is desired that full loudness should occur when the volume control knob has been turned (clockwise) fully toward the *R* terminal of the control, the control must be connected into the circuit with its *L* and *R* terminals arranged as shown in the diagram, i.e., contact arm *C* approaches right-hand terminal *R* for the full-loudness position.

Suppose that we were to apply a certain measured volume of audio signal to the input of the circuit, with the volume control at the full *on* position, and note the loudness. And in the next step suppose we turned the volume control down until the signal sounds only half as loud to the ear, and we measured the signal voltage being applied to the grid of the tube under this condition. Our measurement would show that we have had to reduce the signal to approximately 1/10 its former value! The fact that the sensitivity of the human ear varies approximately logarithmically makes it necessary to reduce the intensity of the sound to 1/10 its original value in order that it shall sound ½ as loud. Accordingly, if we wish to obtain half-loudness when the volume control is set at the mid-point of its rotation, the resistance of the control will have to be tapered so that only approximately 1/10 of its total resistance is included between its mid-point and the *L* end. It is apparent that a left-hand taper is required (characteristic *2* in Fig. 1), so that as the volume control is turned up, the resistance included between the *L* terminal and the contact arm *C* will increase slowly at first, reaching only 1/10 of the maximum control resistance when the arm has reached its half-way (mid-volume) position. Thereafter, the resistance should increase more rapidly. In fact, this type of control requires approximately a logarithmic-resistance characteristic if the control of volume is to be smooth and uniform.

A slight variation of this circuit is illustrated at (*B*) of Fig. 2. Here the contact arm is connected to ground. Since maximum audio voltage will now be applied to the grid circuit of the tube when the contact is at the lower end of the resistor, full volume will be produced when it is in this position. Therefore, the control must be connected so that its left-hand, *L*, terminal goes to the grid and its right-hand terminal to the lower end of the transformer, as shown. Notice that this is just the reverse of the control connection that had to be employed in the circuit arrangement of (*A*). This illustrates why it is important that the terminals of volume controls be connected into the circuit properly. Of course, a control having the same *left-hand* taper would be required for the circuit of (*B*).

Right-Hand Taper

A right-hand tapered control is one in which the smaller (tapered) resistance change per-unit-of-rotation occurs when the movable contact is moved over the region near the *right-hand* (*R*) terminal. Characteristic *3* of Fig. 1 illustrates right-hand taper. In general, controls employing a right-hand taper are used in most *series* control circuits, such as the plate voltage, screen voltage, cathode or *bias* control and *series losser* types of circuits.

Application of Right-Hand Tapered Control

Fig. 3 illustrates a widely-used manual volume-control circuit that makes use of a variation of the bias voltage applied to the tubes as a means of controlling the loudness of the receiver. Now, increasing the bias of the tube lowers its mutual conductance and *reduces* the *gain* of the stage; on the other hand, decreasing the bias, *increases* the gain and loudness. Accordingly, decreasing the resistance of the manual volume-control resistor decreases the *C* bias and hence *increases*

(*Continued on page* 30)

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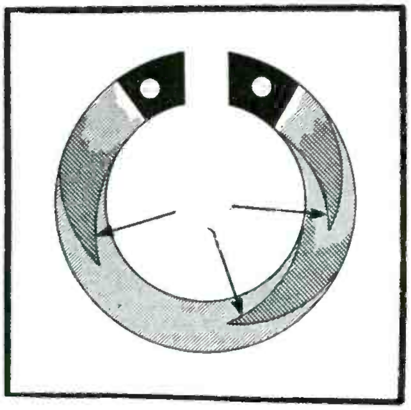


Fig. 5. The resistance element of a composition-element control; one method of obtaining smooth taper.
(*Courtesy P. R. Mallory & Co.*)

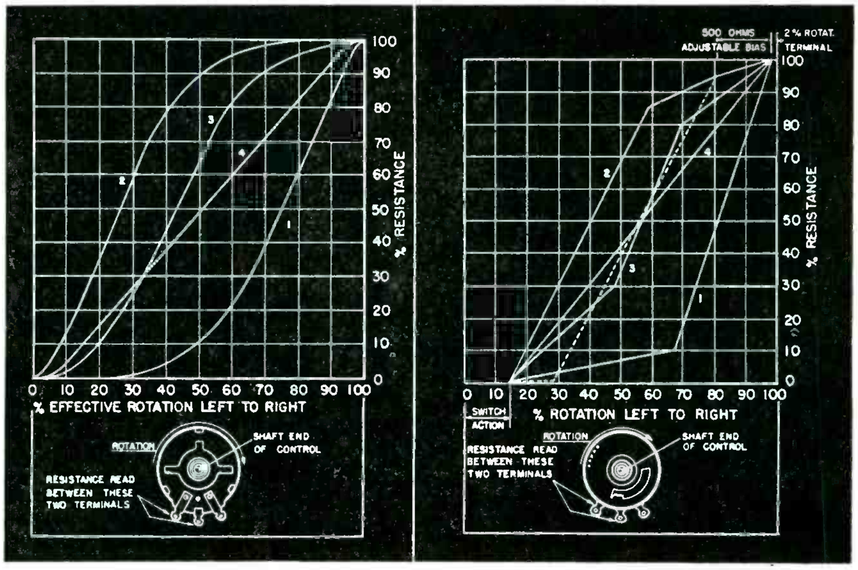


Fig. 6. Typical tapers obtainable in composition-element and wire-wound controls for meeting all replacement requirements. Left-hand illustration covers composition-element controls; right-hand illustration for wire-wound controls.
(*Courtesy P. R. Mallory & Co.*)

the amplification and loudness. Therefore, to make the volume (loudness) *increase* with clockwise rotation of the control, the right-hand terminal *R*, of the volume control must be connected to the cathode end of the circuit, as shown. Thus the resistance will *decrease* as the control knob is turned clockwise toward the maximum volume position.

Resistor R_c is used to supply the minimum bias which is required by the tube at full volume. As will be explained later, it may be built into the volume control.

As movable contact *C* is moved away from terminal *R*, the increase in *C*-bias voltage is at first quite rapid. However, its increase becomes less and less rapid as the volume control is advanced after that, because increasing the *C*-bias decreases the plate current of the tube. Since it is this plate current flowing through R_c and the volume-control resistor in series that produces the *C*-bias, larger and larger series resistance is required in the cathode lead to produce appreciable increases in *C* bias. What is needed then, is a volume-control resistor which changes resistance *slowly* at first, and then more rapidly as the contact is moved away from the *right-hand* terminal, *R*, toward the *left-hand* terminal *L*. This would be a right-hand tapered resistance, of the type whose general characteristic is represented by curve *3* in Fig. 1.

In general, when the current through the volume-control resistance changes in value as the position of the movable contact is varied, a volume control having *right-hand* taper is used.

Combination Left and Right-Hand Tapers

Some controls are made with a combination left- and right-hand taper, as illustrated by characteristic *4* in Fig. 1. In these, as the control shaft and arm are turned clockwise, the resistance increases slowly at first (left-hand taper), then more rapidly and fairly uniformly, and finally slowly again (right-hand taper). This type of taper is required in relatively few control circuits.

How Taper Is Produced in a Control

In composition-element type controls, taper is produced by suitably varying the resistance material throughout the length of the resistor element. This usually is accomplished commercially by either of two methods: (*A*) varying the *mix* so as to apply a coating of resistance material of different specific resistance to the several sections of the resistance element; (*B*) by depositing a coating of varying thickness. Taper is a much more easily reproducable characteristic in composition-element controls than it is in wire-wound controls.

Carbon-element controls may have as many as two to five different resistance sections carefully blended to provide a resistance with several types and degrees of taper, but no sudden *steps* or *jumps* in resistance must occur. This is extremely important if the units are to provide *silent* smooth control whether employed in a sensitive antenna circuit where the slightest defect is subjected to the tremendous amplification of the rest of the receiver following it, or in an audio circuit where highly amplified voltages must be handled. The illustrations in Figs. 4 and 5 show how one manufacturer prevents sudden changes in value where a tapered section joins that of a different section. The element shown in Fig. 5 is that employing a right-hand taper. Notice that the *tails* of each section fade into the next section (indicated by the circle and arrows at the center) and that the contact roller contacts a *gradually* increasing or decreasing area of each section. This prevents any *steps* or *jumps* in resistance value at these points, and results in smooth operation.

In wire-wound controls, resistance taper can be produced by three methods: (*A*) by using a different wire (of suitable resistance characteristics) for each definite section, winding the wires uniformly for definite lengths and then joining them in some suitable manner; (*B*) by pre-shaping the winding strips and winding the wire at a non-uniform rate; (*C*) by a combination of the above methods for the desired taper.

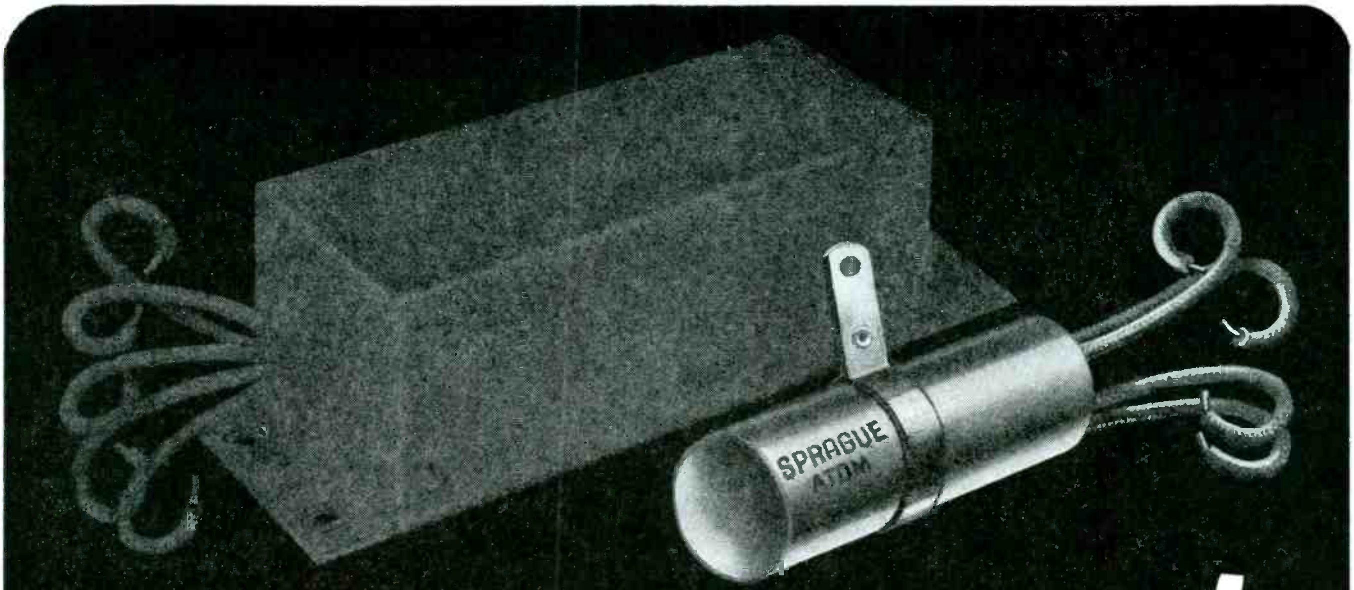
The first method produces a linear resistance change in each winding section—the rate of change in the successive sections may be different. Care must be taken to limit abrupt electrical and mechanical changes at the junction of these sections. Although feasible, tapers requiring more than three linear sections are not generally available. The second method of tapering is employed wherever large differences in change of resistance are not required.

The difficulty of making, in production, accurate though inexpensive wire-wound resistors in any but the simplest tapers can well be appreciated.

Tapers Obtainable in Standard Replacement Controls

Manufacturers of volume and tone

(*Continued on page* 41)



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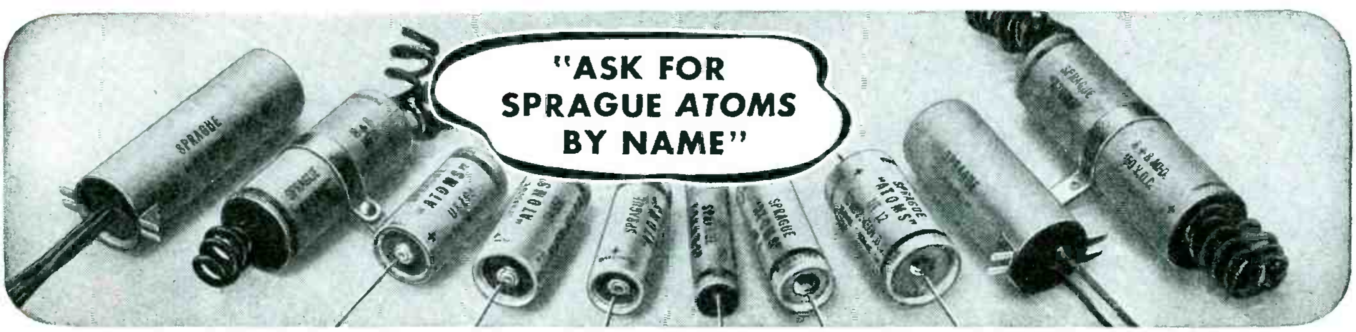

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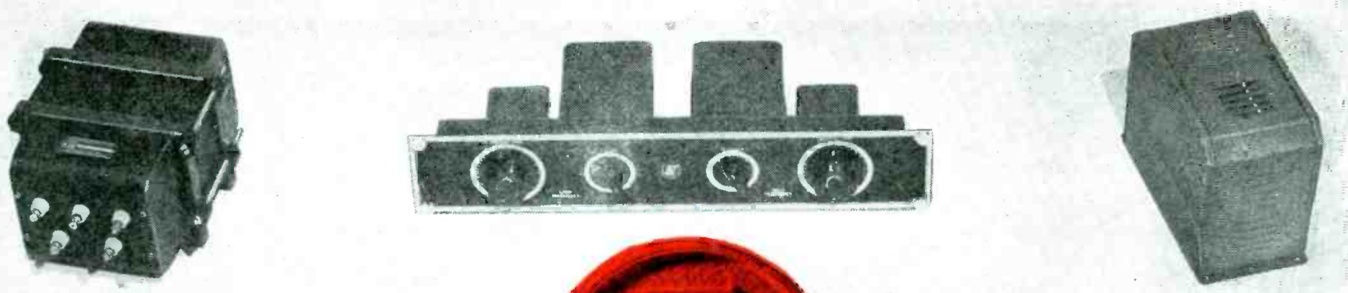
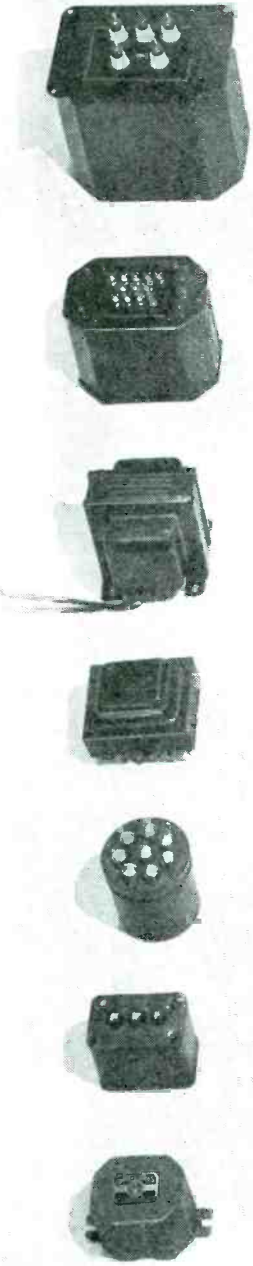


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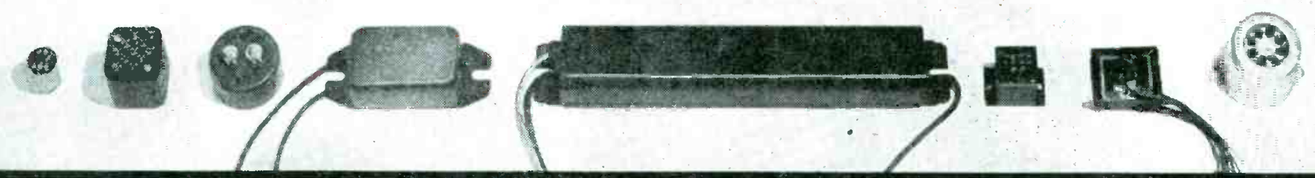

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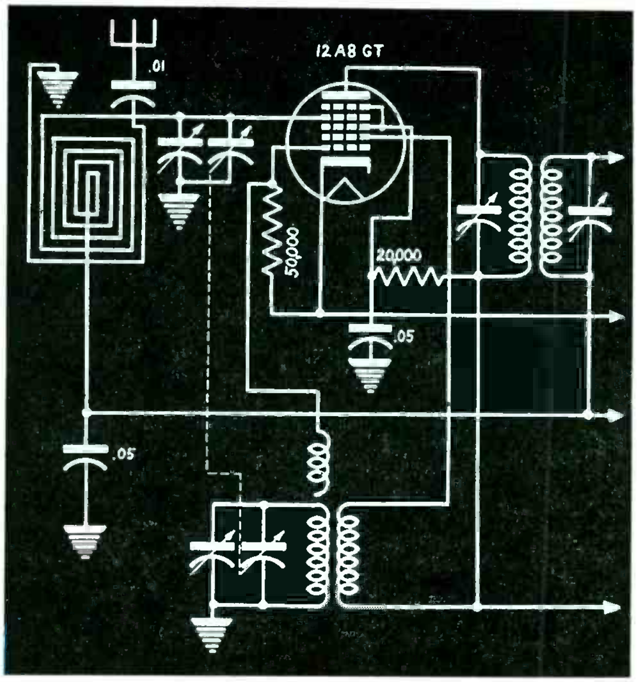
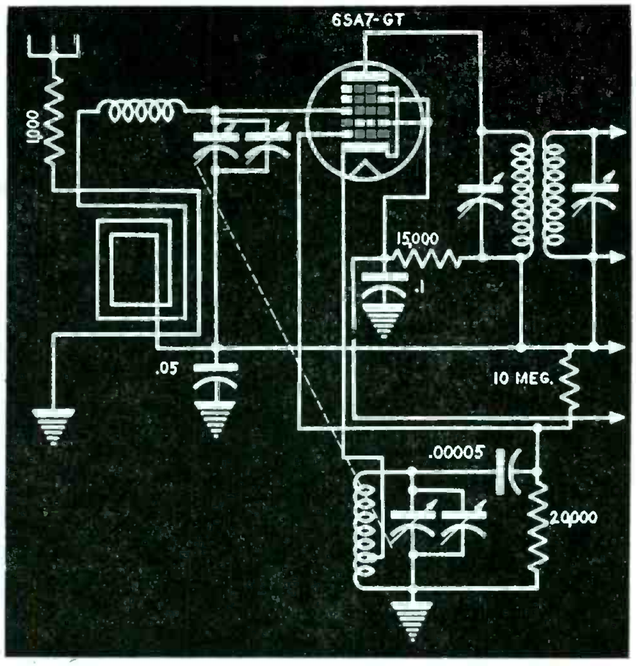




RECEIVER INPUT CIRCUITS

by L. E. EDWARDS

WHEN the first triode-type receivers were produced, the input systems were quite simple. Most sets used single or dual winding inductive or capacitive coupling. With the development of multi-element tubes and circuits to increase sensitivity and selectivity, came many types of unique input systems, particularly loop circuits.

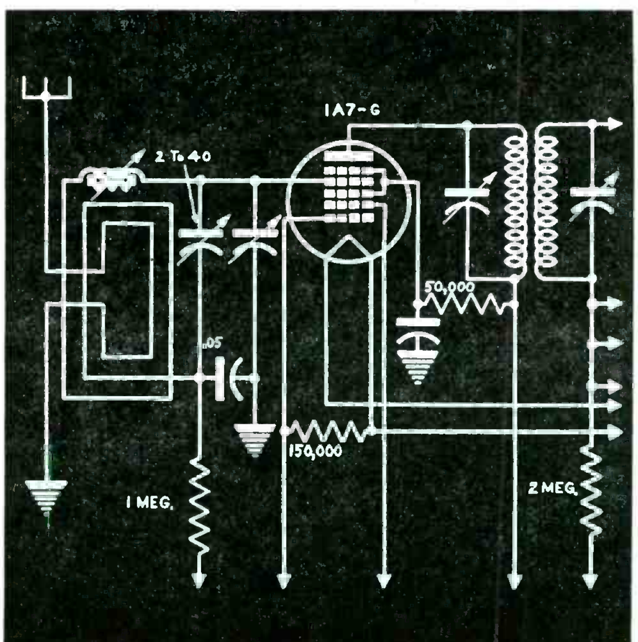
High-Impedance Loop Input

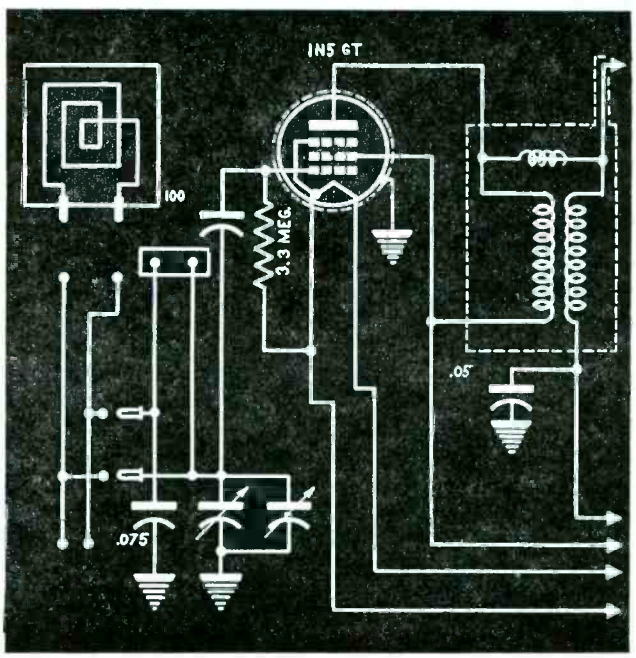
Fig. 1 (Allied 1174) shows a simple, standard high-impedance loop circuit which directly replaces the secondary of the antenna transformer of a standard receiver. The further the loop is placed from the chassis, the higher the *Q*, the lower the distributed capacity, the sharper the tuning and directional effects. Since the voltage pickup is proportional to the loop area, the winding is made as large as the receiver dimensions permit. The *Q* of most loops is low because they must be placed only an inch or two from the chassis to save space.

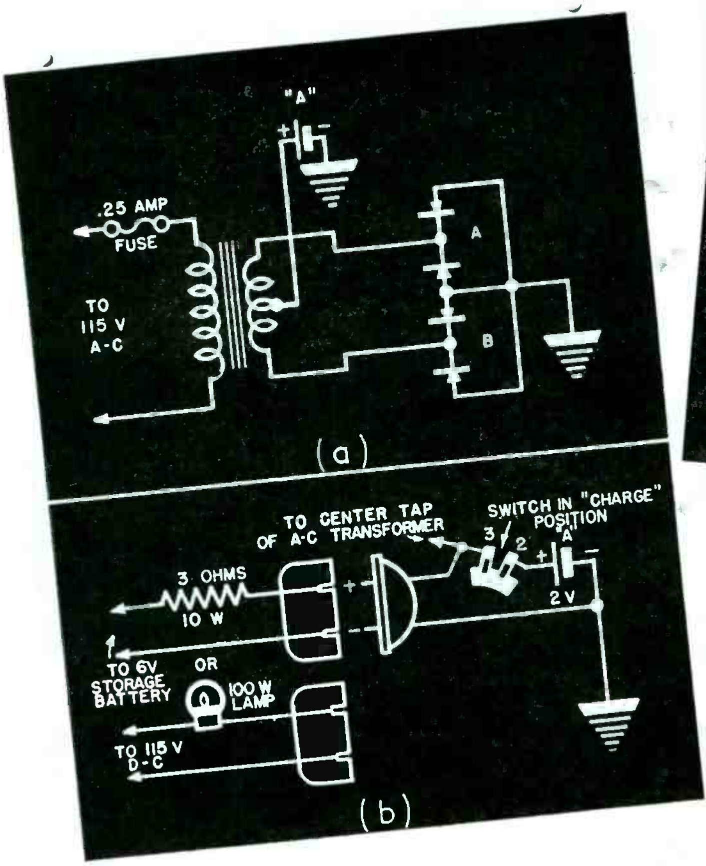
For additional pickup, most loops

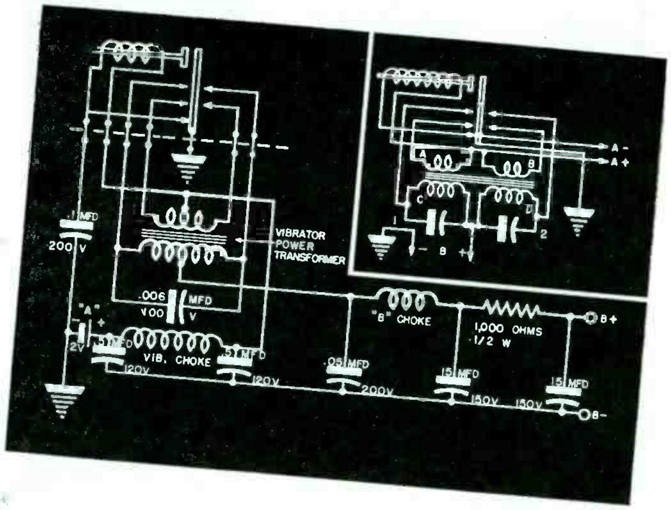
(*Continued on page* 48)

Figs. 1 (top left), 2 (top right), 3 (below left), and 4 (below right)
Four types of loop-antenna systems used in table receivers are shown in Figs. 1 to 4. Fig. 1 is the input circuit of Allied D-174. In Fig. 2 (Air King 4136), a resistor is used in series with the antenna to reduce the sensitivity at the high end of the tuning range. Loading coils are used in series with the loops of Figs. 2 and 3 (General Television 530) to reduce the distributed capacity, thereby extending the tuning range. Fig. 4 shows the input of Motorola 61L11/61L12.









Figs. 1 (left) and 2 (above). Fig. 1. In *a* we have the charging system for a battery in the G.E. set, using copper oxide rectifiers, *A* and *B*. Charging systems which may be used with a car battery, or 110 volts d-c, are shown in *b*. Fig. 2. Synchronous vibrator circuit of the 2-volt battery receiver. The insert shows a simplified version of the vibrator system, indicating how the vibrator also acts as a rectifier.

SERVICING HELPS

Maintenance Data on the G. E. A-C/2-Volt Battery Set

by FRANK C. KEENE

ONE of the last receiver models to come off the prewar production line, the G.E. LB 530 a-c/2-volt battery type, has been widely publicized lately, and will probably be the forerunner of many similar postwar models. Accordingly its design is of special interest now, particularly the power supply which has several novel features.

The power supply centers about a Willard 2-volt storage cell, rated at 20 ampere-hours, and housed in a clear plastic case. This battery has a self-contained hydrometer which consists of three colored balls; red, white, and green. These balls float in the electrolyte, and may be viewed through one end of the plastic case. When the green ball sinks, the battery is 90% charged. The white ball sinks when the charge is reduced to 50% of capacity, and the sinking of the red ball indicates a 90% discharged battery.

The battery may be charged from either 115 volts a-c, or a 6-volt storage battery; a special charging cable is necessary for the latter operation.

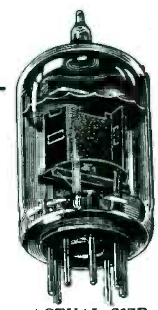
In Fig. 1*a* we have the charging circuit used in this receiver. A step-down transformer incorporated in the power supply system reduces the 115 volt a-c voltage into the receiver to 5.5 volts for 60-cycle a-c or 6.6 volts for 25-cycle a-c. This secondary voltage is then rectified by a copper-oxide rectifier unit in a full-wave circuit, designated *A* and *B* in the figure. The power consumption on 60 cycles is 6 watts on 25 cycles, 10 watts.

With a special charging cable, a 6-volt storage battery may be used to charge the battery. For this service, a plug built into the power unit has been provided. The battery may also be charged from 115 volts d-c with the secondary circuit shown in Fig. 1*b*. Also shown in Fig. 1*b* is a charging cable which may be constructed for charging off a car battery. This unit operates when the power-selector switch is in *charge* position. However, due to circuit layout, it is advisable to remove the adapter when not in use.

The synchronous-vibrator circuit, with its associated equipment is shown in Fig. 2. Synchronous vibrators, by their construction, are self-rectifying. The insert in Fig. 2 shows how a synchronous vibrator acts as a full-wave rectifier. It will be noted that two contacts on the grounded reed are connected to the secondary of the vibrator-power transformer. Thus, when a voltage surge is induced in winding *A*, a polarized surge is induced in winding *C*. The same is true of windings *B* and *D*. The polarity of points *1* and *2* are therefore identical. By connecting points *3* and *4* together, these identical surges induce a recur-

(*Continued on page* 38)

more efficient ...in miniature


ACTUAL SIZE

To clean and generally maintain the bulky, smelly oil lamp was a daily chore. In contrast, the compact incandescent lamp that gives many times the light, requires no maintenance except a rare and easily installed replacement. Its operation is safe and simple.

Just as the incandescent lamp opened up new avenues for more efficient lighting, so the miniature electronic tube presents new possibilities in the science of electronics. More compact sets—greater durability because of small rugged parts and better performance when used in high frequency circuits, are advantages of using Tung-Sol Miniature Tubes.

So many and important are the advantages of miniatures that post-war equipment will unquestionably include many of them. Tung-Sol Jobbers and Dealers will be in position to furnish miniatures as well as the G-Gt's-metal and large glass tubes for servicing every type of equipment.

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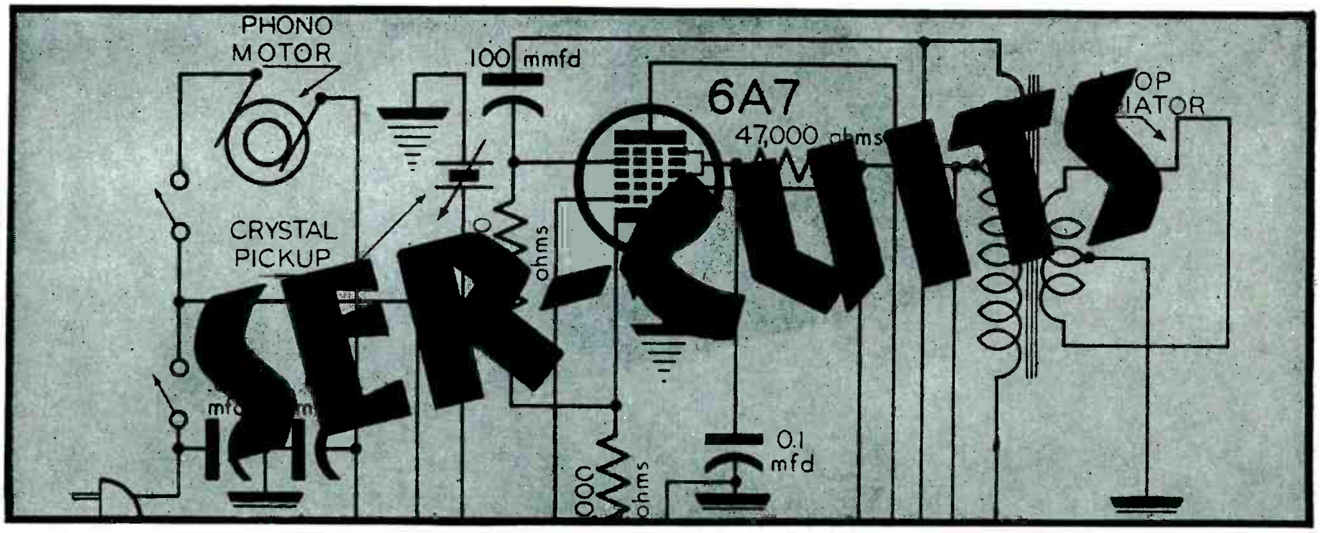


by **HENRY HOWARD**

WITH the return of battery production, portables are becoming increasingly popular. Shelved sets are again in the field. And servicing problems have accordingly begun to increase. It is prudent, therefore to review some of the types of battery portables that have been produced. In Fig. 1, we have an interesting model with several innovations, Truetone D1182, which can also be used on a-c/d-c via a 35Z5.

Using a plate tickler type of oscillator, a 1A7GT has a 3000-ohm stabilizing resistor in series with the anode which is grid 2. This helps to keep the oscillator output constant over the entire band. Grid condenser and leak values are .0001 mfd and 0.2 megohm. The converter bias is from avc only. A 1N5 i-f has a 15-megohm grid leak bias with a .01-mfd bypass.

A series filament string is used for both battery and power line operation requiring both r-f and a-f filament bypass capacitors to ground. The high side of the converter filament is tied down with a .1-mfd capacitor for r-f while a 1H5 first audio uses a 20-mfd a-f bypass. A .25-mfd capacitor is used

(*Continued on page* 39)

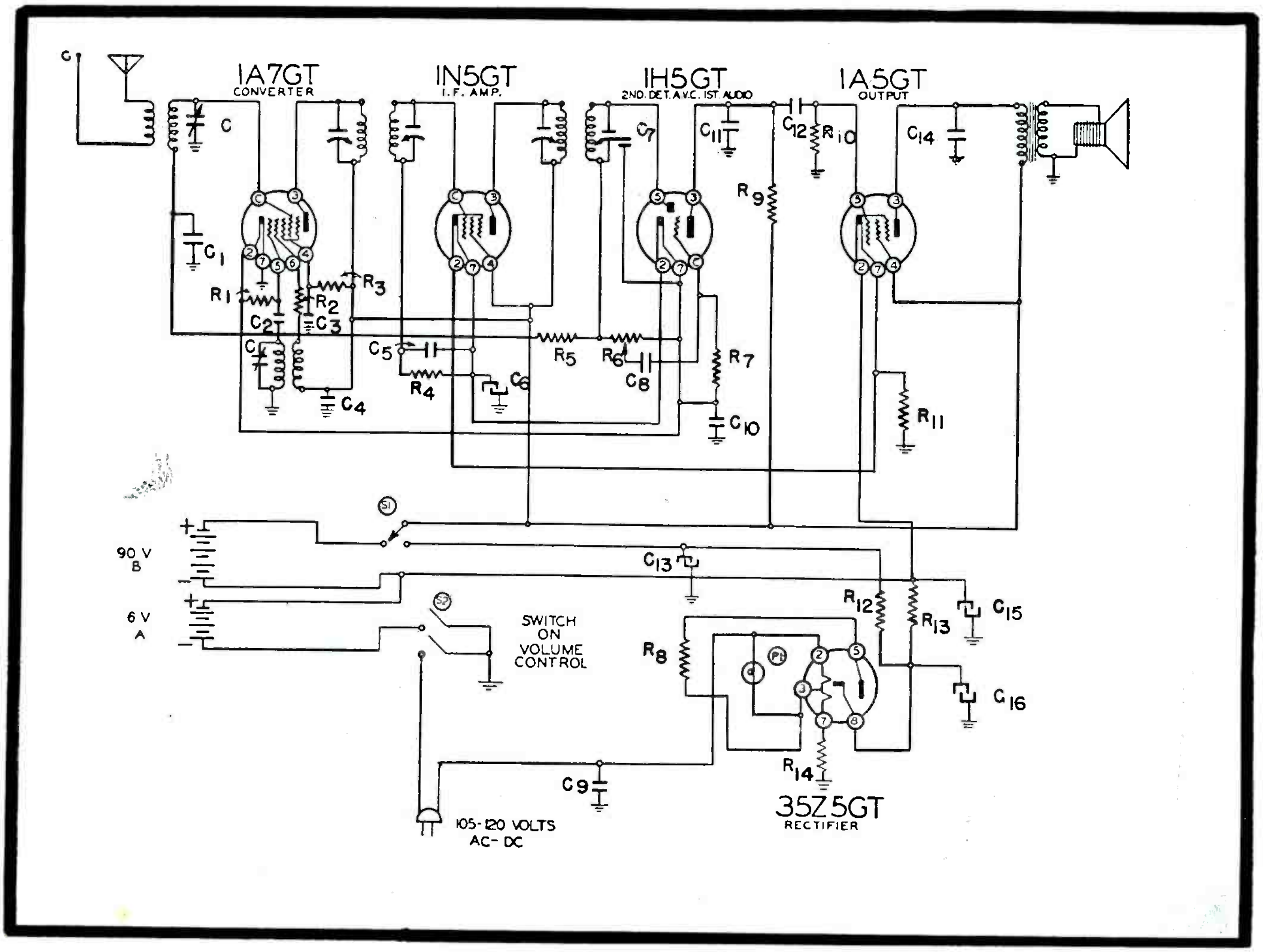
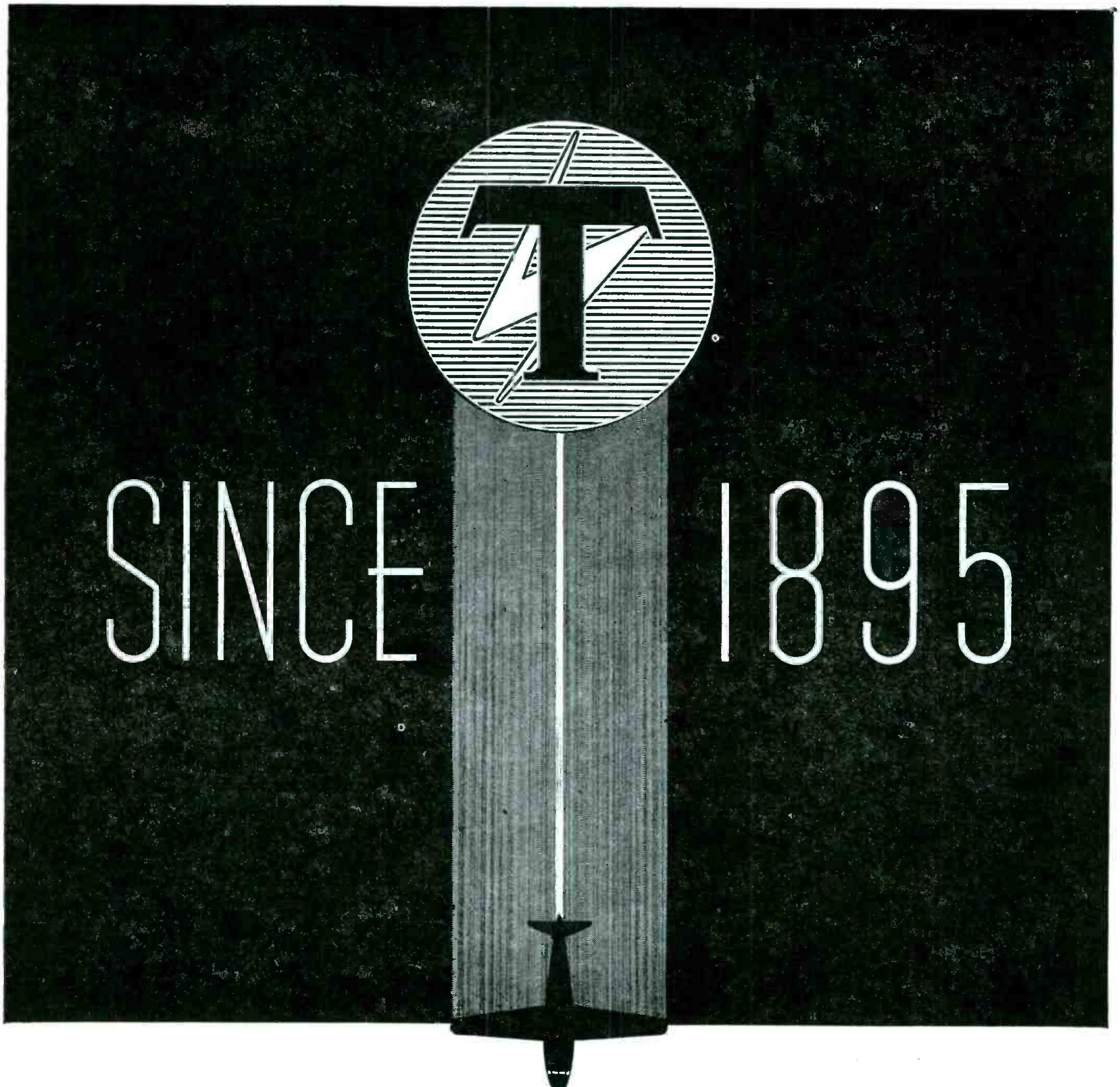


Fig. 1 . . . Truetone D1182 a-c/d-c battery portable. Series filament string is used for both battery and power-line operation. See page 39 for component values.



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THORDARSON

ELECTRIC MANUFACTURING DIVISION

MAGUIRE INDUSTRIES, INCORPORATED

SERVICING HELPS

(*Continued from page* 34)

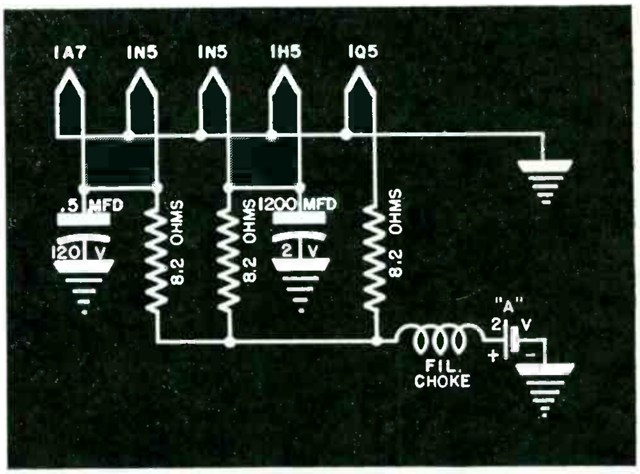


Fig. 3 . . . Filament circuit of the 2-volt receiver. A 1200-mfd 2-volt electrolytic and an 8.2-ohm resistor act as a filter network to prevent any a-c hum from entering the detector stage. The resistors also reduce the 2 volts supplied by the battery to 1.4 volts.

rent voltage shape, such as that delivered by a full-wave rectifier. This pulsating d-c is then smoothed out by the filter network.

Fig. 3 shows the filament circuit. Since the battery delivers 2 volts, and the tubes used are of the 1.4-volt type, appropriate voltage dropping resistors are used. The 1200-mfd capacitor in the *RC* network feeding the 1H5 detector is necessary to remove any a-c ripple. A four-position switch on the panel marked *off, battery, a-c,* and *charge,* permits operation of the receiver directly from the battery or while plugged into an a-c outlet. In the *a-c* position, the battery is being charged while the set is operating. Some a-c ripple is therefore present in the filament supply; that is why we have to have the 1200-mfd capacitor for filtering.

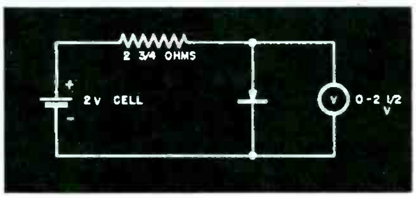
Most service repair involves the power supply or charging circuit. Two likely sources of trouble are the copper-oxide rectifier discs or the synchronous vibrator.

To check the rectifier discs for proper operation, the line cord is plugged into an a-c outlet and the selector switch is set to *charge* position. An ammeter is then inserted in series with the negative lead from the battery to ground. A current of about 1.35 amperes indicates proper disc action. To check individual discs G.E. recommends the circuit shown in Fig. 4. The voltage drop across the disc should read .5 volt. A higher voltage indicates a defective disc. The characteristic is such that a voltage drop of .5 volt across it will induce a .5-ampere current through it.

The reverse, or non-conducting ac-

(*Continued on page* 39)

Fig. 4 . . . Method used to check copper-oxide rectifier units. The voltage drop across the unit is indicative of the condition of the rectifier.



SERVICING HELPS

(*Continued from page* 38)

tion of the rectifier disc is equally important. With 2 volts across the rectifier, in reverse, the current should read 2.5 ma or less.

If any trouble develops in the *B* supply, the vibrator should be checked first. Since there are five contacts on the reed switch, the trouble will usually be found there. A check across the secondary of the vibrator transformer either with an a-c voltmeter, or an oscilloscope, will indicate which set of contacts are at fault.

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SER-CUITS

(*Continued from page* 36)

as an oscillator bypass directly at the tickler coil to minimize feedback through the *B* supply. A 1000-ohm filament equalizer is connected from the low side of a 1A5-power tube filament to ground and *A*-. This compensates for the 4.5-ma plate and screen current which would otherwise cause an additional voltage drop across the remaining filaments, thereby overloading them and reducing their life.

Fig. 1*a* . . . Component values for Truetone D1182

C	Gang condenser
C1	.05 x 200 v. condenser
C2	.0001 mica
C3	.05 x 120 v. condenser
C4	.25 x 120 v. condenser
C5	.01 x 120 v. condenser
C6	20.0 mfd.—50 w. v. Lytic
C7	Approximately 100 mfd. in I.F. can
C8	.006 x 120 v. condenser
C9	.05 x 400 v. condenser
C10	.1 x 120 v. condenser
C11	.0001 mica
C12	.01 x 120 v. condenser
C13	40.0 mfd.—150 w. v. Lytic
C14	.002 x 600 v. condenser
C15	200.0 mfd.—10 w. v. Lytic
C16	40.0 mfd.—150 w. v. Lytic
	C6. C13, C15 and C16 are in one unit
R1	200M ohm—⅓ w.
R2	3M ohm—⅓ w.
R3	65M ohm—⅓ w.
R4	15 megohm—⅓ w.
R5	3 megohm—⅓ w.
R6	1 megohm—Volume control
R7	10 megohm—⅓ w.
R8	20 ohm—⅓ w.
R9	1 megohm—⅓ w.
R10	3 megohm—⅓ w.
R11	1M ohm—⅓ w.
R12	2500 ohm—⅓ w.
R13	1975 ohm—6 watt
R14	545 ohm—14 watt

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MODERN STORE INTERIOR

Well planned interior of shop of Harry Reed Radio and Supply Co., Springfield, Mo., recently appointed distributor for John Meck Industries.

C-R OSCILLOGRAPHS

(*Continued from page* 24)

sis. Here, the high potential under rectification by this tube is the sum of the voltages developed by the right-hand 350-volt section of the common power supply winding, and that existing across the single 450-volt winding section, since these two-winding sections of transformer T_1 are connected in series. Further, since the *cathode* of the rectifier tube is connected to the ungrounded end of the high voltage winding section, the plates of the tube, which are connected in parallel, are always *negative* with respect to the chassis of the unit, and the crest potential which exists between the tube plates and chassis is the maximum a-c potential which is developed by the high-voltage transformer winding sections, less the resistive voltage drop which occurs within the tube itself.

The negative half-cycles of the alternating current which are conducted by the right-hand rectifier tube, in Fig. 3, charge the high voltage filtering capacitor C_1 to approximately the crest potential of the 800-volt a-c source windings. Since the resistance of the d-c voltage divider connected across the terminals of this capacitor is of the order of several megohms, and the current drawn by the *3AP1* is negligible, the ripple modulation imposed on this resultant d-c voltage is small.

In the d-c circuit diagram of Fig. 3, the high-voltage divider is shown to comprise the resistors R_9, R_{10}, and R_{11}, in series with the *focussing* control potentiometer, R_2, and the *intensity* control potentiometer, R_1. The cathode of the *3AP1* kinescope is connected to the junction of the intensity-control potentiometer and the resistor R_9 and is, therefore, positive with respect to the control grid of the tube. The control grid of the tube is always negative with respect to the cathode, a condition of tube operation which is expressly stipulated by the manufacturer. Completing the d-c voltage supply system shown in Fig. 3, we see that the vertical and the horizontal *spot position* controls, R_4 and R_3, respectively, are connected in shunt with the junctions of the low-voltage divider resistors R_{13} and R_{14}, and the high-voltage divider resistors, R_{10} and R_{11}. Hence, from the latter condition, we find that the slider arm of either spot position control potentiometer may assume a position, in voltage level, which is either positive or negative with respect to the chassis of the unit.

Although the vertical and horizontal dynamic amplifiers perform separate functions in the operation of the com-

(*Continued on page* 44)

TONE-VOLUME CONTROLS

(*Continued from page* 30)

controls have directed considerable research toward developing specific tapers that will provide most uniform and smooth loudness control when employed in the many popular types of volume control circuits used in radio receivers, audio amplifiers, etc. As a result, each manufacturer offers controls in the various resistance values commonly employed, and with the proper taper characteristics required, for each of the common control circuits. Literature of these manufacturers lists the various tapers and gives them arbitrary numerical and alphabetical designations. Most also supply *replacement control guide booklets* that contain comprehensive tabulations listing the specific controls (with correct resistance and taper characteristics) recommended to be used as replacements in specified receivers, and so allocate their controls to the replacement purposes they can best serve. The Service Man should by all means possess such booklets, especially for the make of replacement controls he commonly uses, and should become familiar with the wealth of helpful and important information they contain.

It will be found that the exact taper and resistance-variation characteristic curves of the controls recommended by different manufacturers for the same general use differ somewhat, but in general, each can be relied upon to give satisfactory control if used in accordance with the manufacturer's recommendations.

Fig. 6 illustrates the standard resistance tapers offered in composition-element and wire-wound controls by one prominent manufacturer. Examination of these, and a study of the following recommendations for their use (as supplied by the manufacturer) will prove instructive in showing the general type of resistance-variation characteristic required for each different type of control circuit:

"Taper 1 is a modified logarithmic left-hand taper in the composition-element type of control (left-hand illustration), and an approximation to this logarithmic taper in the wire-wound type (right-hand illustration)."

Notice that in the composition element control the taper is such that at 50% of rotation (half-loud position) only approximately 1% of the total resistance of the control is in the circuit. This is in accordance with the logarithmic sensitivity characteristic of the human ear, since the signal voltage must be reduced to approximately 1/10 maximum value in order to make the sound ½ as loud.

This left-hand taper should always be used in shunt-type control circuits (as

(*Continued on page* 42)

TONE-VOLUME CONTROLS

(*Continued from page* 41)

in usual antenna and audio volume control circuits) or where only the center and left-hand terminals are used. It also is useful in tone controls that have the *bass* position at the *left* of the knob.

"Taper 2 is a hight-hand logarithmic taper in the composition-element type control, and an approximation to this in the wire-wound type. . . . This right-hand taper is used in series control circuits, as in cathode-voltage controls, or where only the center and right-hand terminals are used. It also is useful in tone controls that have the *bass* position at the *right* of the knob.

"Taper 3 is a combination left- and right-hand taper. This taper has a limited use in circuits where the control must perform *both* as a shunt and as a series circuit control, as in combination *antenna-shunt-plus-bias circuit*. This is the most common use for such a taper.

"Taper 4 is a linear taper. Strictly it is not a *taper,* although it is commonly referred to as such.

"A linear taper is used wherever a control should be such that uniform resistance change is required, or the voltage is to be proportional to the degree of rotation.

"Taper 7 is made only in the wire-wound control and is a form of left-hand taper. This taper is desirable for the *antenna-shunt-plus-bias control,* wherein greater attenuation is obtained by increasing the bias voltage. The slight left taper then suffices to gradually reduce the signal to zero volume by the shunting action in the antenna circuit."

The movable contact operates up to the 80% rotation position. From that point a 500-ohm adjustable bias resistor is in the circuit.

It is interesting to note that due to the winding complication involved, and the cost limitations, the tapers achieved in the wire-wound controls are necessarily only approximations to the more complicated tapers that are actually desired, and which are easily produced in the corresponding composition-element controls.

In general, composition-element volume controls which have abrupt tapers are more likely to become noisy in a short time than those which have more gradual tapers. In selecting the proper control, where several tapers are offered for the same application in the controls of different manufacturers, choose for audio work a taper which does not show too sharp a resistance change in about 65% of rotation. Of course, all controls suitable for audio grid use require a taper that is gradual over approximately the first 65% of rotation, and much steeper thereafter (see curve *1* in Fig. 6 for the composition-element controls). However, it will be found that the controls for this purpose made by some manufacturers have tapers which are more abrupt in change of resistance than others. Noise generally develops at such abrupt changeover points.

Reduced Wattage Rating When Control Has Taper

The maximum safe power dissipation rating (applying to the maximum-resistance setting) of tapered controls is *less* than that of corresponding linear controls of similar physical size, depending on the taper curve. In general, those controls having the steeper curve have the lower rating. For example the power ratings of a certain type of wire-wound control in different tapers (but all of the same physical dimensions) as made by one manufacturer are as follows:

Linear—3 watts
V and *W* tapers—2 watts
L, *N* and *U* tapers (steeper)—1.5 watts

As these controls are all identical in external appearance and dimensions it might be assumed at first thought that they would all have the same wattage rating. Such is not the case.

Another important thing to remember is that the wattage rating specified by the control manufacturer always applies to the *maximum-resistance* setting only. For intermediate points of rotation, the dissipation rating in watts *decreases*—the amount depending upon the steepness of the taper of the resistance element, and the rotational setting of the control. The steeper the taper, the lower the rating for a given position of the control. For a control having linear taper, the power dissipation rating for any intermediate resistance setting is equal to

$$P_{\text{Int}} = \frac{\text{Intermediate Resistance}}{\text{Maximum Resistance}} \times \text{Max. Power Dissip. Rating}$$

(To Be Continued)

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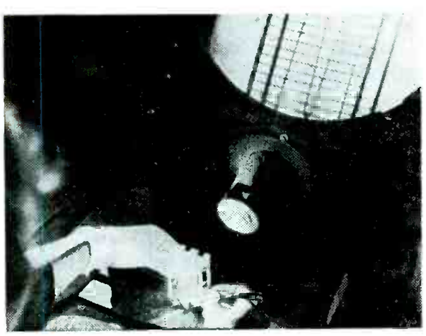
TUBE GRID CHECKER



Checking dual grids with a shadowgraph at the Dobbs Ferry, N. Y., plant of North American Philips Company. A powerful light source is projected upon the tube mount. Then, a lens system picks up the shadow-image and throws it on a ground glass plate. Grids must be in perfect alignment laterally.

C-R OSCILLOGRAPHS

(*Continued from page* 40)

plete cathode-ray oscillograph, the same fundamental circuit is utilized in either amplifier, and the operational functions of the two are alike. Thus, with respect to the vertical amplifier, incorporating the upper *6C6* pentode in Fig. 2, when a rapidly rising potential is impressed across the vertical amplifier input terminals *V* and *G*, the dynamic-coupling capacitor C_8 charges in series with the resistance element of the *vertical gain control* potentiometer R_5. The ungrounded terminal of the resistance element is positive with respect to the unit chassis, since the electrons comprising the capacitor-charging current are attracted to the potentiometer end of the coupling capacitor. Hence, the control grid of the *6C6* pentode swings positive with respect to its cathode, for this electrode is common with the slider of the vertical gain-control potentiometer.

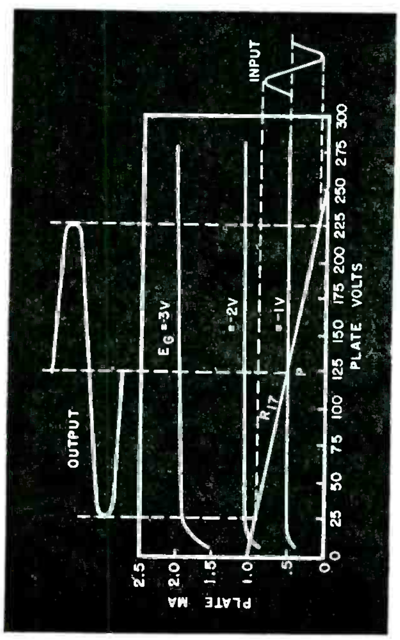
The cathode of the vertical amplifier pentode is maintained positive with respect to the unit chassis by the small potential which appears across the cathode-biasing resistor R_{12}. This resistor is so selected that the tube plate current is limited to the operating value specified by the tube manufacturer. Hence, when the grid of the tube is driven instantaneously positive with respect to the cathode by the potential which appears between the slider arm and the grounded terminal of the gain-control potentiometer, the pentode plate current increases momentarily. This momentary increase in the tube plate current is accompanied by an accompanying decrease in the tube plate voltage. In turn, the decrease in the tube plate voltage is brought about by the increased voltage drop apparent across the plate loading resistor R_{71} in view of the plate current increase. The plate of the tube swings *negative* with respect to the positive terminal of the d-c voltage divider when the tube control grid is driven positive with respect to its cathode. Here, it should be observed that the cathode bypass capacitor, C_{21}, maintains the cathode-to-control grid voltage relation constant during the large variations in the tube plate current. This capacitor may be said to *bypass* the audio-frequency portion of the tube plate current, since the *RC*, or time-constant of the cathode resistor-capacitor combination is greater than that required for the completion of a single cycle of a low audio-frequency wave.

If a rapidly decreasing potential is impressed across the input terminals, *V* and *G*, of the vertical amplifier, the dynamic coupler capacitor C_8 discharges in series with the potentiometer R_5 resistance element. Under these conditions, since the input terminal *V*, in Fig. 2, is positive with respect to the unit chassis, the terminal of the capacitor which is connected to the potentiometer resistance element is negative with respect to the same point, and the control grid of the *6C6* vertical amplifier pentode swings negative with respect to its cathode. The resultant decrease in the plate current of the tube effects an increase in plate potential, inasmuch as the voltage drop present across the plate-loading resistor, R_{17}, decreases. Under the condition that the decrease in voltage level is an instantaneous occurrence in an otherwise stationary voltage level, we see that the plate of the tube swings *positively* with respect to its cathode when the control grid swings negatively, or is subject to a rapidly decreasing input voltage level. This condition of operation, as well as that discussed in the preceding paragraph, with respect to the operation of the dynamic amplifier, is of fundamental importance in the proper deflection of the oscillograph cathode-ray beam.

The conditions of dynamic-amplifier operation may be studied closely from the graphical illustration of the tube operation shown in Fig. 4. Here, we see that the plate current of the *6C6* amplifier varies directly with the de-

(*Continued on page* 46)

Fig. 4. Graph of the deflection amplifier operation. The load line, R_{17}, has a slope which is proportional to the resistance of the plate-loading resistor. Intersection of each plate resistance characteristic with this load line provides the plate-to-cathode voltage and the plate current proportional to each particular value of the amplifier tube grid-to-cathode voltage. For dynamic operation, the constant d-c biasing voltage component present between the tube grid and cathode is determined by the operating point *P*.



C-R OSCILLOGRAPHS

(*Continued from page 45*)

crease in the negative-voltage relation of the control grid with respect to the cathode. The *load line AB* represents the resistance of the plate-loading resistor, R_{17}, in Fig. 2. To check this, we must remember that this load line is drawn between the maximum plate voltage condition, 250 volts, and the current, one milliampere, resulting from the introduction of the load resistor in series with the tube plate. Consequently, if the tube-control grid is biased negatively, by a voltage of 4½ with respect to the cathode, the normal operational current of .5 ma results. And the tube plate-to-cathode voltage, immediately below the *operational point P*, in Fig. 4, is shown to be the product of this operating current and the resistance, in ohms, of the plate loading resistor, or approximately 125 volts.

If, now, the tube grid-to-cathode negative biasing potential is reduced to 4, the tube plate current rises to a value of .8 ma, and the plate voltage decreases to a level of approximately 44 with respect to the cathode. Again, if the grid voltage is increased to 5, the plate current of the tube falls to approximately .2 ma, and the tube plate voltage rises to a value of 200. Therefore any alternating voltage which superimposes these maximum and minimum control grid-to-cathode voltages on the steady-state 4½-volt control grid bias, superimposes the plate voltage and current variations on the steady state or operating plate current. These conditions are also shown in Fig. 4. The amplification resulting here is obvious when the ratio of the maximum plate voltage variation to the maximum control grid voltage variation is taken under consideration, since the plate voltage variation is obviously many times greater than that which occurs in the control grid voltage.

The function of the vertical and horizontal voltage amplifiers is the amplification of small dynamic-voltage changes to voltage values which are sufficient to effect appreciable deflection of the cathode-ray beam. In Fig. 2, we note that one plate of each deflection plate pair in the *3AP1* is common with the unit chassis and is, therefore, highly positive with respect to the cathode of the tube. If the beam is not to be deflected under conditions wherein neither of the deflection amplifiers amplifies a deflection signal, the voltage difference which exists between the plates of each deflection plate pair must be zero, since the cathode-ray beam would then be subjected to equal attractive influence from each of the deflection plates. Hence, to bring about this condition, the free plates of each deflection plate pair are supplied with an approximately equal positive potential from the slider arms of the vertical and horizontal position control potentiometers, R_3 and R_4, respectively, in series with the deflection plate-series resistors, R_{15} and R_{16}. It is the function of the series deflection plate resistor to isolate the high-voltage d-c power supply from the a-c signal potential which is superimposed on the steady-state deflection plate potentials by the vertical and horizontal deflection amplifiers. The fixed capacitors, C_6 and C_7, shown connected between the position control potentiometer slider arms and the unit chassis, serve to bypass any portion of the a-f signal voltage which does not appear across the associated deflection plate series resistor, in each instance.

Constant-Voltage Modulation

From Fig. 2, it may be seen that the vertical and horizontal dynamic-voltage amplifier-plate output voltage waves serve to modulate the constant voltage which is supplied to each of the free deflection plates in the *3AP1* kinescope. In this respect, it is further evident that any rise in the vertical amplifier plate potential results in the charging of the series-coupling capacitor, C_9, the charging current developing an instantaneous positive voltage crest across the terminals of the series deflection plate resistor, R_{15}, thus driving the deflection plate more positive. Again, a decrease in the vertical amplifier plate voltage effects a discharge of the series coupling capacitor, C_9, and the discharge current produces a *negative* voltage crest across the terminals of the series deflection plate resistor, R_{15}, causing the deflection plate to assume a voltage level which is less positive. Consequently, the direction of the beam deflection is in a direction opposite to the implied direction, or *polarity,* of the dynamic voltage change which is impressed across the input terminals of the amplifier. In the practical oscillograph, this incongruity is corrected by placing the tube so that the polarity of the amplifier input potential, whether positive or negative, results in either an upward or downward respective deflection of the fluorescent spot. Thus, in the practical oscillograph, the application of a positive a-c half-cycle across the vertical amplifier input terminals results in an *upward* deflection of the luminous spot on the screen of the tube, and, conversely, amplification of a negative half-cycle by the vertical

(*Continued on page* 48)

C-R OSCILLOGRAPHS

(*Continued from page 47*)

amplifier effects a *downward* deflection of the spot.

Horizontal Deflection Amplifier

In the horizontal deflection amplifier, the impression of a positive input potential, or a positive a-c half-cycle, across the input terminals results in a horizontal deflection of the spot on the electron screen of the *3AP1,* and the direction of the deflection, or movement of the luminous spot, is from the left to the right hand. Briefly, the imposition of a positive a-c half-cycle across the horizontal amplifier input terminals causes the luminous spot to move in a *clockwise* direction, where the rotary motion so implied is not actually present. Again, the amplification of a negative a-c half-cycle by the horizontal amplifier results in a spot deflection direction which is opposite, and may be stated to be *counter-clockwise.*

Gain Controls

The amplification or gain provided by the vertical or the horizontal amplifier is readily controlled by means of the vertical, or the horizontal, gain control potentiometer, R_5 and R_6, respectively. Here, the position of the gain control potentiometer slider arm determines the actual portion of the input signal potential which is to be amplified, the gain of the amplifier remaining fixed at all times. This feature of the amplifier gain control is important in providing a means for the calibration of the oscillograph where the device is to be utilized in the measurement of a-c voltages, or in the measurement of dynamic voltage changes.

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STRATOVISION TRANSMISSION

Westinghouse stratovision television /f-m airplane operation. Large circle shows how coverage is increased when programs from ground station are "beamed" to an airplane flying at 30,000 feet and broadcast from that altitude.

. . . the war is over—

MANUFACTURERS: - Be certain to send us all technical data on your peacetime products for publication editorially.

SERVICEMEN: - - - Send us information on servicing methods or short cuts you might have developed during the wartime emergency. We'll pay you for them.

INPUT CIRCUITS

(*Continued from page 33*)

are provided with some sort of antenna primary coil to induce voltage from an external antenna to supplement that picked up directly by the loop. Used in this manner, the loop becomes the secondary of an antenna transformer. In Fig. 1 the antenna primary consists of a single turn around the outside of the loop adjacent to the low potential side, the avc end, so as to minimize capacity coupling. This method of coupling favors the high-frequency end of the band, but the response may be flattened by simply inserting a series resistor of about 1000 ohms, as in Fig. 2 (Air King 4136). Great care must be taken not to obtain too close coupling, for then we have hum modulation and the adjacent channel selectivity becomes poor.

The range of tuning of simple loops, as in Fig. 1, is usually 1700 to 540 kc although new sets will probably cover 1720 to 535 kc. A given variable condenser will tune over a wider band if a loading coil is connected in series with the loop on the high side, as in the model shown in Fig. 2. The presence of the loading coil lowers the impedance of the loop which results in a net lowering of the distributed capacitance, permitting the wider range. The loop being large, and being placed close to the chassis, has a large distributed capacity while the small, high-Q loading coil has a comparatively low distributed capacitance. Note the 1000-ohm antenna series resistor, previously referred to, which reduces the high-frequency pickup and, therefore improves the selectivity.

Adjustable Loop Loading Coil

The General Television & Radio Company model 530, shown in Fig. 3, has an adjustable loop loading coil, permeability tuned, which has the characteristics of Fig. 2 plus a high Q. The adjustment is used to trim the set on the low frequency end. Antenna coupling is obtained through a single turn as before.

Plug-in Loop

In the portable Motorola model 61L11, Fig. 4, the loop is a plug-in type which is placed in the cover. When the cover is open the loop is placed away from the chassis, making the absorption negligible and the Q much higher than in fixed loops. This cover may be plugged in at the front or rear by means of a special receptacle and provision is also made for an external loop similar to the ones used by Zenith (Wavemagnets) or G.E. (Beam-a-Scopes). These types of flexible, remote loops have proved quite effective in difficult locations such as in a car, train or plane where, in order to get any signals at all, the antenna must be placed close to a window. Incidentally, the loops are tuned directly by a gang condenser, but capacity coupled to the r-f amplifier grid through a 1000-mmfd capacitor. A 3.3-megohm grid leak completes the grid circuit to the negative filament leg.

Coupling Coil Link

In Fig. 5 we have Firestone model S-7400-1 which uses a removable loop fitted with a plug and a high-impedance antenna coupling coil. High-impedance primaries are better than single-turn primaries, providing more uniform coupling with varying frequency. However the expense is often too high for small sets. Many receivers using high-impedance coils have a shorting link to short circuit the primary when the external antenna is not used. This prevents absorption from the loop at resonant points of the primary coil within the broadcast band.

The loop plug is a good feature. It provides better calibration stability since placing of the leads does not affect the tuning.

This Firestone model is a 2-band unit with a plate antenna on the rear of the cabinet for short-waves. A loop loading coil is also used. A 110-mmfd high-frequency bypass capacitor across the antenna primary prevents the primary from acting as a r-f choke on short-waves, permitting however most of the broadcast signal to get through. This eliminates switching. The external antenna feeds the loop primary through a short-wave transformer, but the inductance of this primary is so low that it doesn't attenuate broadcast frequencies.

Philco Low-Impedance Loop

An unusual loop circuit is used by Philco in some of their receivers, as in Fig. 6, model 42-1004. Here we have a low-impedance loop which is coupled to the r-f amplifier by means of an antenna transformer. Actually this transformer is an extremely critical, very high-Q autotransformer which provides for very close coupling between the tapped lower section (primary) and the remainder of the coil. The loop itself has only a few turns and is insensitive to capacity effects and calibration changes. Both the Q and the response change little within the broadcast band. The external antenna is connected through a plug to the same tap as the loop. This low-impedance loop system lends itself readily to band-switching by means of taps on the coupling transformer.

The loop circuit is isolated from the input grid by a 100-mmfd blocking capacitor, the grid circuit being completed by a 1-megohm resistor to the avc bus. This receiver uses an untuned r-f transformer for coupling between r-f amplifier and first detector. A 15,000-ohm secondary loading resistor is used to broaden the response sufficiently to cover the entire broadcast band.

It is interesting to note that low-impedance loops are being used in most all modern radio compasses, direction finders and loop homing devices aboard aircraft. The loop is coupled to the receiver through a low-impedance transmission line which is free of capacity loading and other capacity effects and may be of any length without affecting the tuning of the receiver. This is not the case with conventional high-impedance loops.

Continental Radio Coupling System

An ingenious coupling arrangement

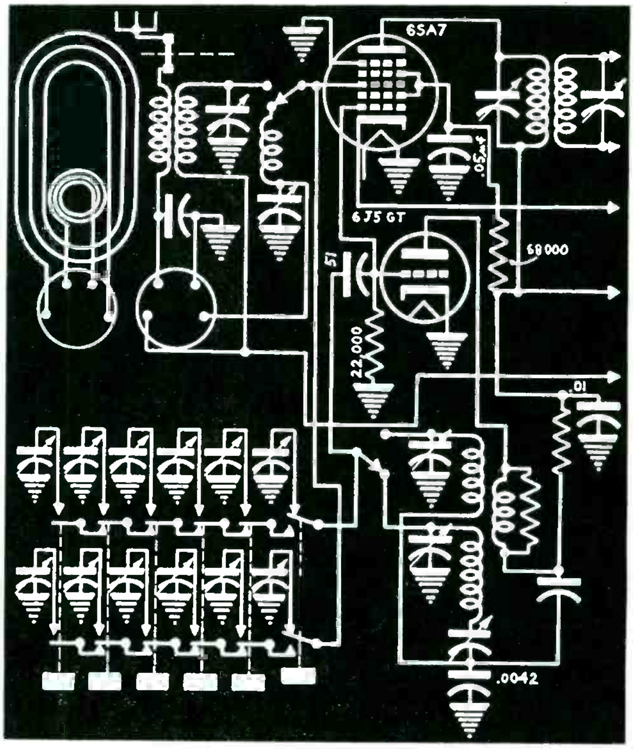
(Continued on page 50)

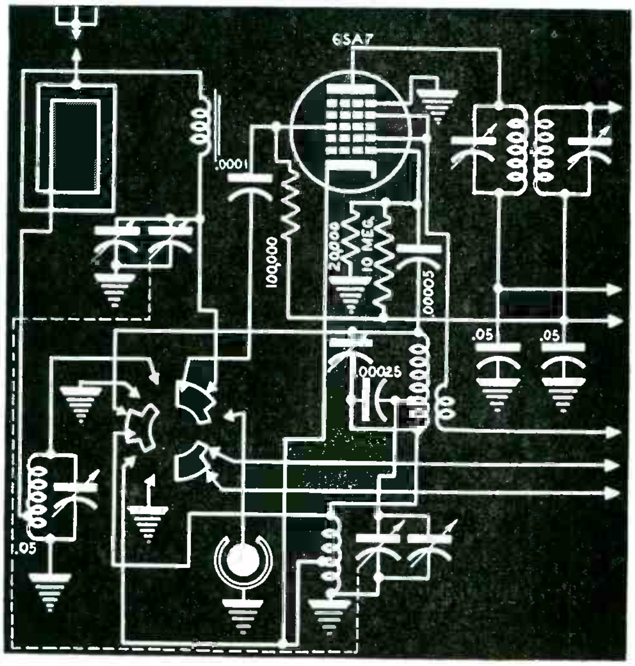
INPUT CIRCUITS

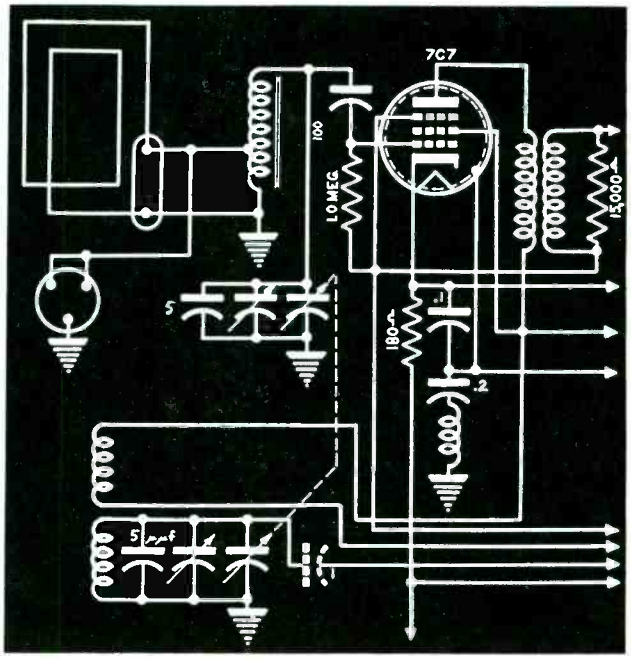
(Continued from page 49)

for broadcast and short-wave bands is used in the circuit of Fig. 7 (Continental Radio & Television Corp., model C 7). A tapped loop, tapped short-wave antenna transformer and an iron-core loop-loading coil are used. The loop circuit runs from chassis through a few turns of the short-wave transformer, through the loop and loading coil to a 6SA7 grid. The external antenna is coupled to the loop by direct connection to a low-impedance tap (near the low potential end). On short-waves the loop acts as a capacity antenna connected to a low-impedance tap on the autotransformer. If the external antenna is added, so much the better, but no change in circuit is required. The loading coil acts as a r-f choke on short-waves, preventing shunting of the signals to ground through the tuning condenser which is

Figs. 5 (right), 6 (below right) and 7 (below left). Fig. 5 . . . Loop antenna system used in the Firestone S-7400-1. A high-impedance primary is used with the loop to provide uniform frequency response. Figure 6 . . . Loop circuit of the Philco 42-1004. The loop is a low-impedance type, and is coupled to the r-f tube through an autotransformer type antenna coil. Fig. 7 . . . Two-band loop used in the Continental C7. External antenna requires no additional switching, because of the autotransformer-type coupling arrangement.







WHEN YOU CHANGE YOUR ADDRESS

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INPUT CIRCUITS

(*Continued from page* 50)

not used on this band. Again, an isolating capacitor of 100-mmfd is used, but the grid leak is of a lower value, 100,000 ohms.

Two-Band Input System

Fig. 8 shows the antennas used in the 2-band a-m section of the Laureate model of the E. H. Scott Radio Labs. There are two separated high *Q* loops, one for each band, and each loop has a loading coil. Note that the trimmers for both loop circuits are located on the low (loop) side of the loading coils rather than at the grid input, the point of highest impedance. The external antenna is coupled by the single-turn method to the large loop and by stray coupling to the short-wave loop. The latter consists of a single large turn rather than a number of smaller turns. This arrangement gives greater pickup.

The tuning range of the short-wave band is reduced by the insertion of a 175-mmfd fixed capacitor in series with the tuning condenser. Another 250-mmfd capacitor isolates the loops from the r-f amplifier grid. This amplifier uses a 1000-ohm cathode bias resistor to supplement the avc bias.

Tapped Low-Impedance Loop

The input circuit of the Philco models 42-853, 42-854, use a tapped low-impedance loop, the tap being used for antenna coupling for a large external antenna and also for short-wave loop performance. On broadcast, the loop feeds in iron core, very high *Q* autotransformer exactly as in Fig. 6, except for the low-impedance tap which permits a better match with a long- or high-capacity antenna. This is connected to the center binding post on the antenna strip.

Triodes as Converters

The right hand post is connected to the outside of the loop and is for a short or low-capacity antenna, as in Fig. 6. On short-waves, the loop tap is connected to the chassis and the outside is connected across a simple coil, the net inductance being correct for proper ganging. In this receiver, the oscillator voltage is fed to the converter by a very small grid-to-grid capacitor on the bandswitch. Whereas most manufacturers use the conventional multi-grid converter tubes, Philco often uses triodes for converter

(*Continued on page* 52)

20-WATT MOBILE P-A

(*See Front Cover*)

A 4-STAGE a-c/d-c 20-watt dual-purpose amplifier (Silvertone 8919) which accommodates a high-impedance crystal, velocity or no-voltage velotron microphone and a high-impedance phono pickup is diagrammed on the cover this month. This amplifier designed for either 6-volt d-c or 115-volt, 60-cycle operation, uses multi-point plugs and appropriate cables to change over from one current supply to another.

The microphone feeds into a 6J7-pentode stage, wide open, with a 1-megohm grid leak and bias cell, and a 250,000-ohm plate load. The use of a bias cell permits the direct grounding of the cathode; this eliminates some hum difficulties. The overall gain from the mike input is 124 db. The 6J7 feeds a ½-megohm microphone gain control into a 6N7 triode. The phono input, through a gain control, is connected to another 6N7 triode. The plates and cathodes are paralleled, a common bias resistor being used. Still another 6N7 is used as a third stage and phase inverter for feeding push-pull 6L6s. Current degeneration is provided by a 900-ohm cathode resistor for both cathodes.

INPUT CIRCUITS

(Continued from page 51)

functions. This requires an additional triode for the local oscillator.

Dual Loop Input

A dual-loop, 2 band design with novel external antenna coupling and a simple bandswitching method is featured in the G.E. model L-642. Here the antenna is coupled to the broadcast loop by means of the usual single turn primary and a 680-ohm series resistor which has two separate functions; flattening of the frequency/coupling curve and as a substitute for a r-f choke to prevent shunting of the short-wave signals through the loop primary to ground. On the other hand, a small capacitor, 39 mmfd, is used as a series condenser to couple the external antenna to a short-wave loop at a low-impedance tap. This capacitor also reduces the shunting effect of broadcast frequency signals. The short-wave loop has a second tap for the tuning condenser providing band-spread action, in conjunction with a 250-mmfd series capacitor.

Bandswitching is accomplished by a double-pole, double-throw switch. In this receiver the short-wave loop is placed horizontally on top of the cabinet while the broadcast loop is in a vertical plane below. A fixed-tune r-f transformer is used between the 12B7 r-f amplifier and 12SA7 converter which also contains an i-f wavetrap.

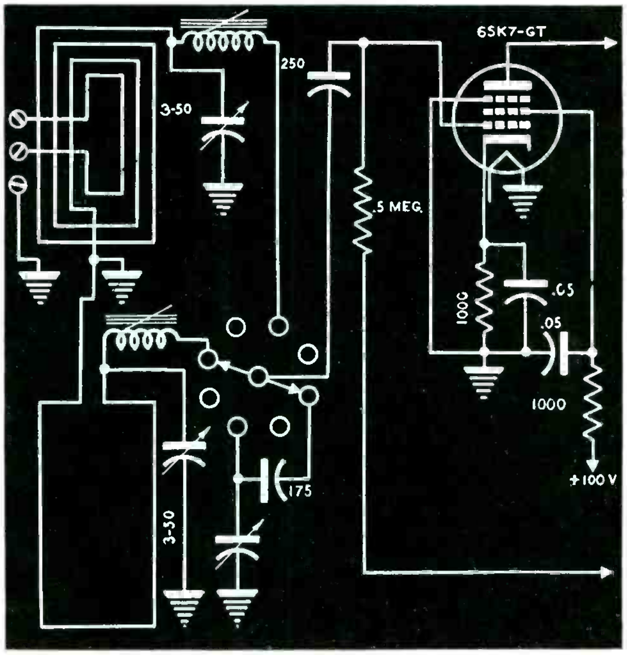


Fig. 8 . . . Loop system of the Scott Laureate. Two loops are used, one for each band. Loading coils are inserted in series with the loops to provide uniform frequency response.

OLD TIMER'S CORNER

by SERVICER

A FEW DAYS after V-J day I decided to visit the island and do a bit of swimming and fishing. I soon found that quite a few others had the same idea. Yes, quite a few, particularly Service Men. And when Service Men get together, it doesn't take too long before everybody is talking shop. Postwar servicing seemed to be on the program at this gathering.

"I don't thing there'll be much servicing in the postwar era," opined Perry. "Everyone is going to buy new sets."

"That's where your imagination is taking a nose dive," responded Johnny. "On the contrary, I think that servicing will take an enormous upswing. And I, for one, am going after the business!"

"That doesn't make sense," drawled Joe who, while not a Service Man, still listened in on our shindigs every now and then and threw in a word on business conditions in general.

"You mean that you don't think that there will be much servicing, Joe," queried Johnny?

"Naw," said Joe, "I mean that there will be servicing. And plenty of it too. I can't see Perry's remark. That's all!"

"How do you figure that, Joe," Perry wanted to know. "With new sets, why bother with the old ones or fixing them up?"

"Well," said Joe, "here's how I figure it out. Not that I know your business, 'cause I don't. But nearly all businesses are alike in one or another respect. You boys will have both new radios to sell and the old to fix. Old man Jason, down at the *MotoRepair Shop* has the same thing coming up with his cars . . . he has old ones to repair, and will have new ones to sell.

"There have been a lot of surveys, in your business and in mine. And they have all tried to show that the public is going to buy something new. Maybe it will be a new car, or a piano or a refrigerator or even a radio set. Perry has been telling me that the Government had shifted the f-m bands so that new sets will have to be built to receive them. Johnny told me that some companies will make a gadget that could be attached to the old set to receive the new f-m bands. That might mean no new-set sales. That sort of complicates matters, doesn't it?

"Oh, we'll have plenty of buying, but it won't all take place in a few weeks. First, there won't be anything for many to buy, for quite a while yet."

We all sat there hypnotized, listening to a non-Service Man tell us our business, and he was doing a grand job.

"Take Bill Boles down the street. He's had a swell spot at the metal works ever since Pearl Harbor day. His income has been high, very high. While he was getting that amount of money, he was *surveyed* and he told the poll fellow that he was going to buy a radio, car, refrigerator, new fishing pole and an outboard motor. He was thinking of his wartime salary, and furthermore while he said that he was going to buy it after the war, he didn't say how *soon* after. Well Bill is home now. He'll be home for about a week to ten days while his firm takes inventory of the snow of cancellations, and reconverts to peacetime work. During that time Bill is going to live on his savings. And he's going to do a bit of thinking.

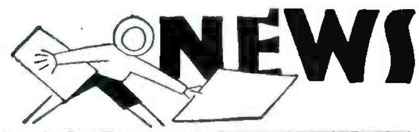
"He is going to reason that, sure he'll have a good job in time, just as soon as he can get back to work. And he hopes that the pay will be the same as for war work, which it won't be because there won't be as much overtime.

"Then his wife may tell him to forget about buying . . . at least for awhile . . . that new radio, refrigerator, car and fishing pole and outboard motor. Not forget it forever. No, sir. Just until things sort of shake themselves down to their old level of normal work and hours. Then she's going to tell Bill that when that has happened there will be money for most of the things that they want.

"Well, men, the whole country is full of Bills and their families. While they are waiting, they'll be thinking of repairing this and that, particularly the radio, especially since there are parts available now. And they are going to jog into the *MotoRepair Shop* and get that set fixed up.

"Know what I'd do if I were in the radio business? I'd tell my customers

(*Continued on page* 54)



NEWS OF THE REPRESENTATIVES

Five new members have been elected by the Dixieland chapter. They are: William Chaddock Cartwright, 1276 Peabody Avenue, Memphis 4, Tenn.; C. W. Chapman, 314 Luckie Street, N. W., Atlanta, Ga.; Frank C. Fassett, P. O. Box 1335, Tampa 1, Fla.; J. T. Fulwiler, 314 Luckie Street, N. W., Atlanta, Ga.; and Rolfe H. Van Dusen, 940 Lake Elbert Drive, Winter Haven, Fla.

Frank W. Taylor has recently removed to 131 Orvilton Drive, DeWitt, New York. H. A. Roes & Company are now located in the City Bank Building, 1805 Grand Avenue, Kansas City 8, Missouri.

* * *

JENSEN MONOGRAPH DISPLAY

A combination counter and window display and dispenser for the Jensen monographs has been released by the technical service department, Jensen Radio Manufacturing Company, 6601 S. Laramie Ave., Chicago 38, Illinois.

The display measures 17½" by 21". Pockets are provided for a half dozen copies of each of two monographs.

Jensen distributors are offered these displays without charge.

* * *

HERB SCHNEUR FORMS DISTRIBUTING UNIT

Herbert Schneur, formerly with the U. S. Army Signal Corps and the Radio Material Office of the U. S. Navy, has formed his own company, the National Radio Distributors, 140 W. 42nd St., N. Y. 18, N. Y.

* * *

MECK SALES APPOINTS DISTRICT MANAGERS

Twelve district managers have been appointed by John Meck Industries Sales Corporation. They are: R. M. Brotherson, Chicago, Illinois; W. A. Hendrickson, Scituate Center, Massachusetts; J. W. Marsh, Los Angeles, California; L. D. Marsh, Seattle, Washington; L. W. Maynard, Clayton, Missouri; L. R. Schenck, Livingston, New Jersey; W. G. Steward, Philadelphia, Pennsylvania; M. F. Taylor, Silver Springs, Maryland; R. H. Van Dusen, Winter Haven, Florida; P. A. Boyd, Pittsburgh, Pennsylvania; J. M. Maynard, Dallas, Texas; and Gail Halliday, Denver, Colorado.

* * *

GAROD NAMES LIFETIME SOUND OF TOLEDO REPRESENTATIVE

Garod Radio Company, Brooklyn, N. Y., has appointed The Lifetime Sound Equipment Company, 1101 Adams Street, Toledo, as distributor for Garod radios and television sets in 18 counties of Northwestern Ohio and Southwestern Michigan.

Wm. H. Manoff is general manager of the Lifetime Sound Equipment Company.

* * *

WCEMA AND NEDA HOLD JOINT COAST MEETING

The Los Angeles council of the West Coast Electronic Manufacturer's Association and the Southern California chapter of NEDA held a joint meeting recently in Los Angeles.

Lew Howard of Peerless Electrical Products, was chairman. Speakers included H. L. Hoffman, Hoffman Radio; R. V. Weatherford, Radio Specialties Company; T. A. Lynch, Radio Product Sales; Harold H. Scott, Scott Radio Supply; and James L. Fouch, Universal Microphone Company.

* * *

CONCORD SOUND EQUIPMENT DATA

Two folders presenting listings of *available now* sound equipment units and sound accessories, have been released by the Concord Radio Corporation, 901 W. Jackson Boluevard, Chicago 7, Illinois. Descriptions cover amplifiers, intercommunication systems, recording equipment and accessories.

* * *

IRC SUPPLEMENTARY CATALOG

An 8-page supplemental catalog data bulletin, covering BT metallized insulated resistors and BW insulated wire-wound resistors, has been published by the International Resistance Company, 401 North Broad Street, Philadelphia 8, Pa.

* * *

KNOWLES ELECTED ACOUSTCIAL SOCIETY PRESIDENT

Hugh Knowles, vice president and chief engineer of the Jensen Radio Manufacturing Company, was recently elected president of the Acoustical Society of America.

•

OLD TIMER'S CORNER

(*Continued from page* 53)

that if they had their radio sets repaired *now*, so that they were in good condition when they turned them in against those brand-new receivers, I'd allow them a bit extra for them because of their better resale value."

Well believe it or not, that's just what Johnny did. And right now he's got quite a list of prospects for those new radios that will be bought on the trade-in idea, prospects who know they'll get a better deal from Johnny. Now Johnny is the only man who has had to hire extra help to keep up with the repair jobs flocking into his store!

NEW PRODUCTS

U. M. C. NITE LIGHT

A small nite light or pilot lamp, designed to plug in an a-c or d-c circuit and remain in continuous operation day and nite at a low cost, has been announced by the Robolite division of Universal Microphone Co., Inglewood, Cal.

Jackson M. Kling has been named exclusive sales rep for mail order houses and driveways. Mr. King lives in East Orange, N. J. Dee Breen, Universal sales manager, will distribute through regular jobbing and retail outlets.

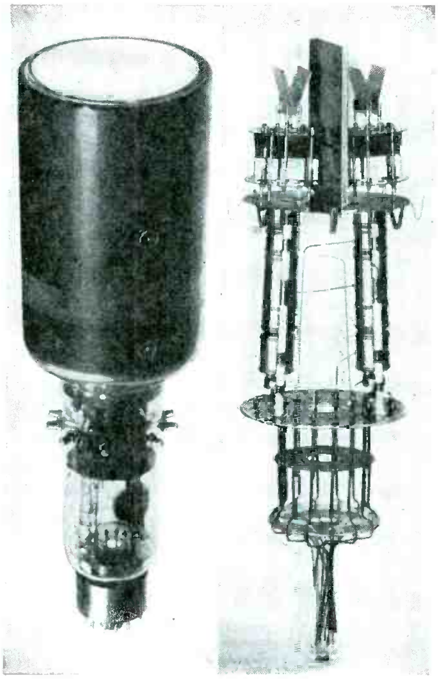
* * *

Du MONT DOUBLE-BEAM C-R TUBES

A double-beam cathode-ray tube, 5SP, providing two complete *guns* in a single glass envelope, both aimed at or converging on the single screen for simultaneous and superimposed traces, has been developed by Allen B. DuMont Labs., Inc., Passaic, N. J.

Heretofore simultaneous comparison of two phenomena could be accomplished either by using two separate tubes or oscillographs placed side by side, or by using an electronic switch to present first one phenomenon and then the other on the same tube screen in rapid succession.

The two independent *guns* are contained in a 5" envelope. Adequate shielding between *guns* and plates is said to minimize cross-talk particularly at high frequencies.



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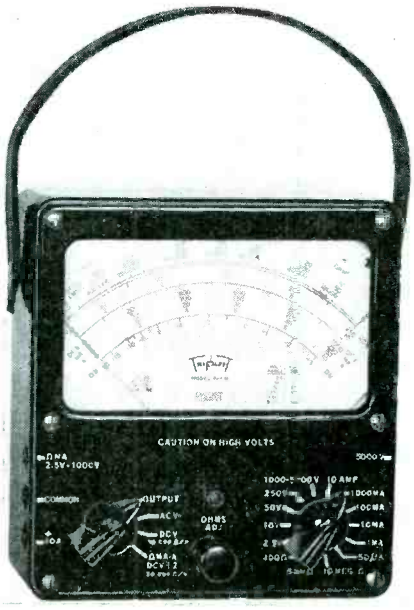
TRIPLETT VOLT-OHM-MILLIAMMETER

A volt-ohm-milliammeter, model 625-N, with dual sensitivity voltage ranges (10,000 and 20,000 ohms-per-volt) has been announced by the Triplett Electrical Instrument Company, Bluffton, Ohio. Ranges are: 0-1.25-5-25-125-500-2500 d-c volts, at 20,000 ohms-per-volt; and 0-2.5-10-50-250-1000-5000 d-c volts, at 10,000 ohms-per-volt.

Current ranges: 0-50 d-c microamperes; 0-1-10-100-1000 d-c milliamperes and 0-10 d-c amperes, at 250 mv.

Resistance ranges: 0-400 ohms (60 at center scale); 0-50,000 ohms (300 at center scale); 0-10 megohms (60,000 ohms at center scale).

Direct reading output level decibel ranges: —30 to +3 +15, +29, +43, +55, +69 db. Meter is 6", 5" scale. Black, molded case, 6" x 5½" x 2½".



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JOTS AND FLASHES

MOST manufacturers began receiver production October 1. Some deliveries will probably begin toward the end of November. . . . Increased production of parts and tubes has also begun, with deliveries scheduled for early November. . . . Hallicrafters will build a new plant on Fifth and Kostner Avenues in Chicago . . . James E. Rasmussen has left Crosley as general sales manager to become a vice president of the United Wall Paper Company, Chicago. . . . Harry Lefkowitz has opened a new radio and appliance store at 243 Broadway, New York City. . . . L. C. F. Horle has been named chief engineer of the RMA engineering department . . . C. H. Carey will cover the Michigan-Ohio territory for Operadio as a sales engineer. . . . W. Bert Knight will represent Operadio in Southern California and Arizona. . . . "E" awards have gone to Webster-Chicago and John E. Fast Company, Chicago. . . . Insuline Corporation of America and the Burgess Battery Company won their second white stars for their "E" flag recently. . . . A third star was added to the "E" flag of the McElroy Manufacturing Corporation. . . . J. Gordon Lippincott will design Meck receiver cabinets. . . . Harvey Tullo is now vice president in charge of purchases at Zenith Radio. . . . Gail Halliday has been named National Union representative for New Mexico, Colorado, Utah, Wyoming, Montana and Southern Idaho, including Boise, Pocatello and Twin Falls. . . Carl P. Sorenson is now a consulting standards engineer for the Cherry Rivet Company, Los Angeles. . . . L. S. Gershon, 436 Ridge Building, Kansas City, Missouri, has been appointed factory sales representative for the Howard Radio Company, Chicago. . . . William J. McHugh has become director of industrial relations at Emerson Radio and Phonograph Corporation, New York City. . . . Oscar Hammarlund, founder of the Hammarlund Manufacturing Company, New York City, died recently. . . . T. R. McElroy, president of the McElroy Manufacturing Company, Boston, Mass., has established a distributor division for Hallicrafters equipment in Boston. . . . Holliday-Hathaway Sales Company, 176 Federal Street, Boston 10, Mass., will represent the Carter Motor Company in Massachusetts, Maine, Vermont, Rhode Island, Connecticut and New Hampshire. . . . Earl F. Noyes has become employment director for the Hoffman Radio Corporation, Los Angeles.

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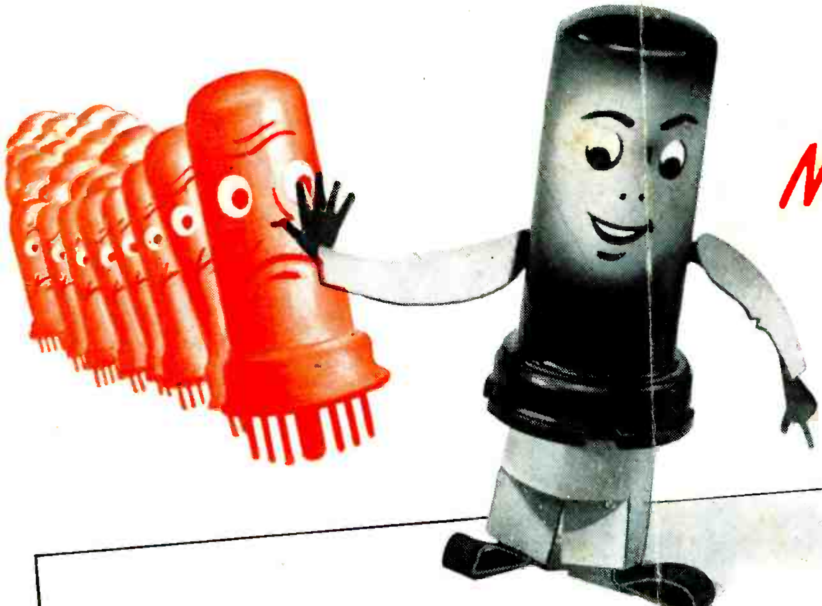

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- Uniballast—the universal ballast tube—small—compact—easy, quick installation.
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- Provides proper operating current conditions regardless of variations in line voltage and in the characteristics of tube heaters and pilot lights.
- Even if one or more pilot lights burn out Uniballast continues to operate the tube filaments in the string, at efficient current range.
- Resistance is self-compensating—adjusts itself automatically—true ballast action. Voltage dropping range is indicated on every Uniballast.

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