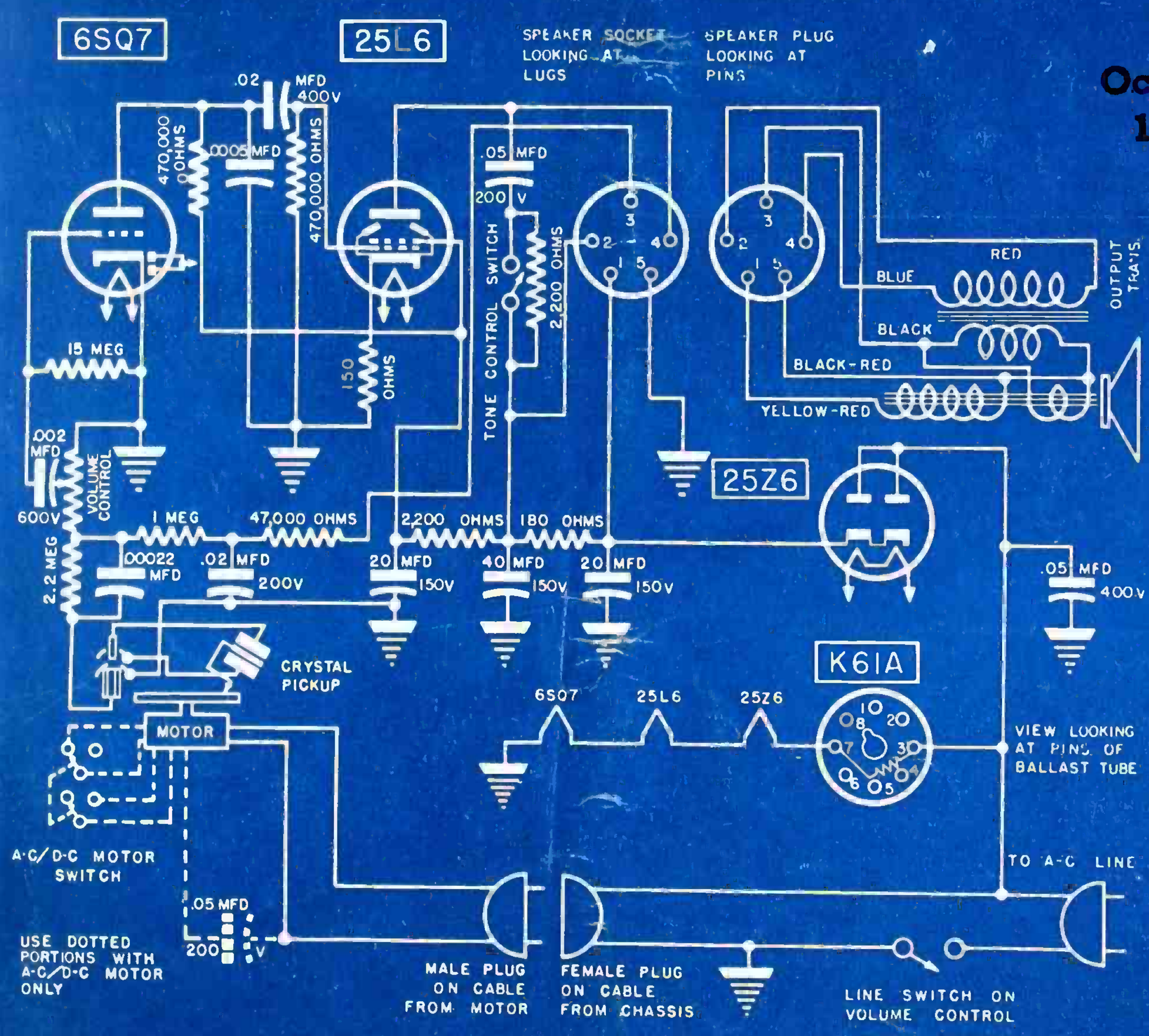
RADIO • TELEVISION • ELECTRONIC

SERVICE

October
1945



A self-contained two-watt phono amplifier featuring a rumble attenuator. (See page 51.)

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE

busy as a beaver?

Telephones buzzing...shopping for parts...accounts to balance...and jobs lined up 10 deep. Doubling on "desk duty" sure cuts into a fellow's at-the-bench time, but not the smart servicer's. He gets extra working mph (minutes per hour) by buying replacement parts he can trust...parts that do the job right first shot.

★ Take these C-D dry electrolytic "Beavers." 35 years of capacitor research and manufacturing experience make them better. Conscientious workmanship and rigid inspection make them longer-lasting. That's why C-D Beavers have been working for the experts. They're reputation builders.

high temperatures don't bother them

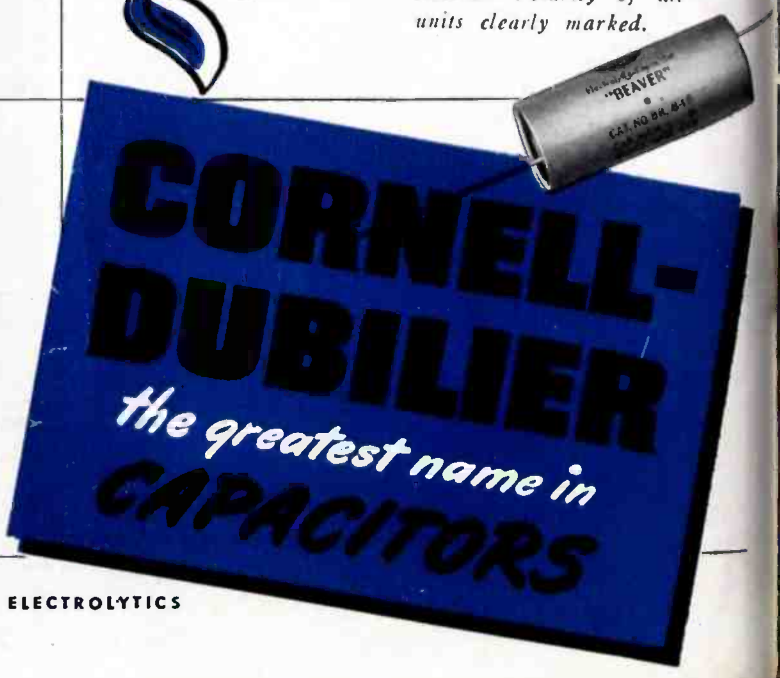
You don't catch these C-D Beavers wilting under heat and humidity. They're "over-size" in quality, "under-size" in physical dimensions. They come in a wide range of capacities and voltage ratings.

real time-savers

C-D Beavers are quick, sure-fits for tight spots, under chassis mounting. Two or more can be strapped together to obtain a wide variety of capacity combinations. Polarity of all units clearly marked.

get this free catalog

A couple of minutes reading time gives you the lowdown on the most complete line of capacitors in the business. Write for catalog No. 195 today! Cornell-Dubilier Elec. Corp., Jobber Division, New Bedford, Mass.



CORNELL-DUBILIER CAPACITORS CD

MICA • DYKANOL PAPER • WET AND DRY ELECTROLYTICS


KEN-RAD
METAL TUBES
6AC7
1852
KEN-RAD
MADE IN U.S.A
Better Than Ever
Ken-Rad Tubes have played a vital part in bringing about higher standards of home radio reception . . . Now, to tube quality already foremost, are added great new research and engineering facilities . . . Ken-Rad Radio Tubes consequently are *better than ever*, increasing the desirability and profit opportunities of the Ken-Rad sales franchise.
Write for your copy of "Essential Characteristics" the most complete digest of tube information available.
178-011-8650
KEN-RAD
DIVISION OF GENERAL ELECTRIC COMPANY
OWENSBORO, KENTUCKY

EDITORIAL

THE multi-million dollar community-housing developments recently announced for New York City and also scheduled for other cities throughout the nation, have alerted many Service Men to the large-scale servicing possibilities of these programs. To provide expert radio maintenance and repair for the thousands of tenants who will occupy these buildings, some Service Men have projected group servicing plans and submitted them to the multiple building owners. The plans have included complete single-manned shops for each building to larger shops that can service a series of buildings. In the larger shops Service Men assigned for each building would repair the receivers. In addition, the shops would feature a specialist on a-m, f-m, television and antennas, so that it would be simple to cope with any particular receiver problem in any of the buildings. Since servicing would actually be on the premises, balky repairs could be completed with a minimum of delay. And since in many instances the same antennas could be used for on-the-air testing, the field tests would be more accurate too. Where the repair would require the receiver to be kept in the shop for more than a day, a loan set service is planned. This plan was utilized quite successfully during the war.

Since servicing many receivers simultaneously requires quite a complex instrument setup, a simplified portable-fixed arrangement has been planned by several Service Men. In this setup, the instruments would be housed in a rack mounting and arranged so that they could be plugged into position for fixed use, or removed via a multi-pin plug jack for portable work. Thus, full utilization of the instrument would be possible at all times. In addition, a practical housing would be provided and there would be less possibility of damage. All instruments would be properly identified and supplied with top and side folding handles that would sit in recesses when not in use so as to permit compact mounting.

Novel ideas that merit close study!

MANY letters received recently have con contained intriguing questions with problems that should be of interest to all Service Men. We plan to publish these letters and invite solutions to the problems presented. For every question published, we will pay $1.00 and for every answer submitted and published, we will offer $2.00. So Service Men if you have a question, send it in. Not only will you receive an effective answer to your problem, but a reward if it is published. Let's hear from you!

THE new year will probably see many novel receivers, particularly of the miniature type. Several now planned fit into a coat pocket and use hearing-aid ear pieces. With these units the Service Men will meet for the first time the popular use of the hearing-aid type tubes; tubes that will undoubtedly be used in a variety of receivers and test devices next year. To acquaint Service Men with these tubes and their unusual circuit possibilities, we have scheduled a series of analysis papers. The first installment will appear in December. Be sure to read this series!

SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U S Patent Office

Vol. 14, No. 10 — October, 194

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Editorial Director

ALFRED A. GHIRARDI
Advisory Editor

F. WALEN
Managing Edito

Pag

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The Reader's Digest, in its Aug., 1941 issue, ran an article saying that investigators on its staff found that radio service-dealers cheated the public on 64 out of 100 repair jobs. After citing several examples, the article ended with a warning that radio owners should "beware" of the repair man.

N. Y. HERALD TRIBUNE
JANUARY 24, 1945

City License Law Urged For Radio Repair Men

Magistrate James A. Blanchfield declared yesterday in Flatbush Court that he would ask the City Council for a law requiring ... bonded in order to do business.

SHOULD RADIO SERVICE DEALERS BE LICENSED?

THE NEW YORK TIMES
JANUARY 24, 1945

RADIO RACKETEERS ASSAILED BY COURT

Repair Men Should Be ... Licenses

N. Y. WORLD-TELEGRAM
JANUARY 23, 1945

Irked Magistrate Lashes at Racket in Radio Repairs

Declaring that radio repairmen were fleecing customers by charging all the traffic would bear, Magistrate James A. Blan... Flatbush Court, Brookl... take up the ...

RAYTHEON

HAS THE ANSWER!

watch for announcement to be made soon

No intelligent radio service-dealer will deny the fact that the reputation of his industry has suffered in recent years.

Unethical servicemen who have taken advantage of manpower and parts shortages have done great damage to public opinion. They have caused so much adverse publicity in national magazines and influential newspapers that dealer-licensing, federal regulation and even finger-printing are being suggested for the public's protection.

Raytheon began many months ago to *remedy* this situation, and now has the answer in a strong merchandising program to be announced soon.

It will be revolutionary in every respect, enabling the public to tell *which* service-dealers deserve complete trust and confidence.

Dealers who can qualify will immediately have a tremendous competitive advantage. Watch for our announcement!

RAYTHEON Radio Tubes

Raytheon Manufacturing Company

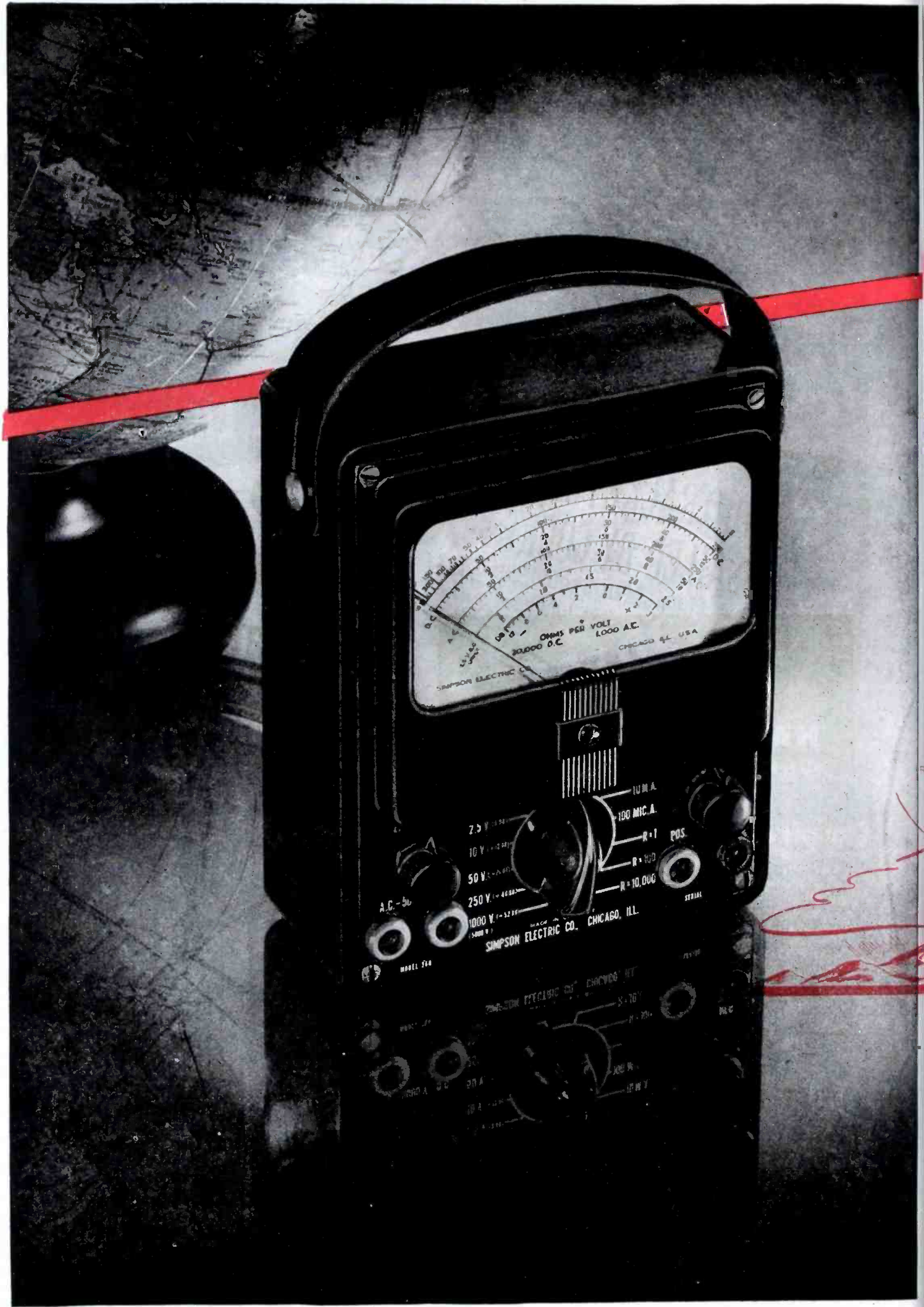
RADIO RECEIVING TUBE DIVISION

NEWTON, MASS. · LOS ANGELES · NEW YORK · CHICAGO · ATLANTA

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

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

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


OHMS PER VOLT
20,000 D.C.
1,000 A.C.
SIMPSON ELECTRIC CO.
CHICAGO ILL. USA
10 M.A.
100 MIC. A.
R×1
R×100
R×10,000
POS.
2.5 V.
10 V.
50 V.
250 V.
1000 V.
A.C.-50
SIMPSON ELECTRIC CO. CHICAGO, ILL.

The most honored instrument of the war

This is not our own appraisal of the Simpson 260. We knew, before the war, that it was a fine instrument but, frankly, we didn't know *how* good it was until war wrote the record. Now the story of the 260 is written into the records of such wartime industrial developments as that of synthetic rubber, and into the vast and secret research and servicing of radar.

Originally designed as a radio serviceman's test unit, the Simpson 260, because of its sensitivity and wide range was found adaptable to general service duties in the entire electronics and electrical fields. Not a warborn instrument, the 260 was given thousands of essential war jobs in the production and servicing of communications equipment. It made a vital contribution to the success of tactical operations.

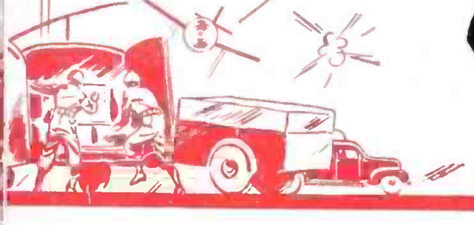
Over 300 government agencies and university laboratories of the United States and Canada procured every one of these test instruments Simpson could deliver on an expanded war production schedule. They were turned out by the thousands. Every branch of the armed services—Army, Navy, Marines, Coast Guard—carried them to the far ends of the earth. They were compelled to perform under conditions often so arduous that testimonials of amazement at their ability to function at all became commonplace as the record grew.

Chosen on its merits, the Simpson 260 became uniquely *the* test instrument of the war.

AVAILABLE NOW TO YOU

Now the Model 260, always the preferred instrument of radio servicemen, is available again to a widened field of peacetime services. We ask you to remember its record as an example of the quality and advanced engineering that goes into all Simpson instruments, as evidence that other new Simpson developments are well worth waiting for. They will be released as soon as Simpson standards for their manufacture are satisfied. They will continue the leadership that has given Simpson a world-wide reputation for "instruments that *stay* accurate" with ideas that *stay* ahead.

SIMPSON ELECTRIC COMPANY
5200-5218 W. KINZIE ST., CHICAGO 44, ILL.



Simpson

INSTRUMENTS THAT STAY ACCURATE

SIMPSON 260, HIGH SENSITIVITY SET TESTER FOR TELEVISION AND RADIO SERVICING

Ranges to 5000 Volts—Both A.C. and D. C. ***20,000 Ohms per Volt D.C.—1000 Ohms per Volt A.C.***

At 20,000 ohms per volt, this instrument is far more sensitive than any other instrument even approaching its price and quality. The practically negligible current consumption assures remarkably accurate full scale voltage readings. Current readings as low as 1 microampere and up to 500 milliamperes are available.

Resistance readings are equally dependable. Tests up to 10 megohms and as low as ½ ohm can be made. With this super sensitive instrument you can measure automatic frequency control diode balancing circuits, grid currents of oscillator tubes and power tube, bias of power detectors, automatic volume control diode currents, rectified radio frequency current, high-mu triode plate voltage and a wide range of unusual conditions which cannot be checked by ordinary servicing instruments. Ranges of Model 260 are shown below.

Price, complete with test leads..................$33.25
Carrying case 4.25

ASK YOUR JOBBER

WATCH FOR NEW SIMPSON DEVELOPMENTS. THEY WILL BE WORTH WAITING FOR!

Volts D.C. (At 20,000 ohms per volt)	Volts A.C. (At 1,000 ohms per volt)	Output	Milliamperes D.C.	Microamperes	Ohms
2.5	2.5	2.5 V.	10	100	0-1000 (12 ohms center)
10	10	10 V.	100		0-100,000 (1200 ohms center)
50	50	50 V.	500		0-10 Megohms (120,000 ohms center)
250	250	250 V.			
1000	1000	1000 V.			
5000	5000	5000 V.			

(5 Decibel ranges: —10 to +52 DB)

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

READ WHAT THESE SERVICEMEN SAY!

"I'll never forget the favor you did for me through the Sprague Trading Post!" A.L., Salem, Ill.

"Thanks a million! I only hope I can again sell and install your excellent products after this emergency!" Cpl. S.S., Louisiana.

"The results were terrific! I'll not forget Sprague's 100% service." B.R.S., Ohio.

"Thanks for running my ad. It was very successful. This service of yours should and will keep Sprague in the minds of all radio men after the war!" C.J.S., New York.

"My ad brought 12 replies to date. Thanks for this service—and I, for one, am going to use all the Sprague parts I can!" E.R.S., Kentucky.

"I used Sprague Condensers before the war, and intend using them as long as I can get them during the war and after it!" E.A.F., Georgia.

"Thank you again—and be assured I'll not forget this favor when making my purchases!" L.G., Miss.

"Thank you for running my ad. When I return to business from the war, you can count on me to use Spragues as usual!" H.H.P., Wisconsin.

"I couldn't name another service that benefits the radio trade at this time like your Sprague Trading Post." F.M.M., Kans.

WANTED — Hallicrafter Super Skyrider SX9 or Sky Champion S-20R. Matthew Healey, 681 Harris ave., Providence 9, R. I.

FOR SALE—Philco 077 sig. gen.; Million tube tester; Superior #1230 sig. gen.; shop made multi-meter 3½" meter with precision resistors; 6 to 250 d-c volt. genemotor; 6AC7, 6AB7, 1619 tubes; tube tester transformers, and Stewart Warner #G85243 vibrators. Radio Center, 111 S First st., Tucumcari, N. Mex.

SELL OR TRADE—Philco VTVM and circuit tester #028 with diagram, $25; signal tracer CA-10 with audio stage, $15. Both portable. Also Riders & Coyne's books and all numbers of Radio Craft, ½ off. Edwin Larason, Martinsburg, Ohio.

FOR SALE—Used record player in good condition, $50. J. R. Whitaker, Farmersville, La.

WILL TRADE—Navy radio with power supply. Want Hallicrafters S-29 Sky Traveler or S-39 Sky Ranger. Will accept cash. Donald E. Griffith, 51 Ridge road, Quonset Point, R. I.

FOR SALE — Jensen high-fi. 8" p.m. speaker PM8CT, $6; Cinaudagraph heavy 8" p.m. speaker, $6; 5" RCA speaker, $2, and 5" p.m. speaker, $1.50. Also used 57, 58, 2A5, 24A, 35, 80, and 5Y3 tubes; used power transformer 2½v fil., 5v rectifier, and 300-0-300 at 70 mil windings and used crystal pickup. Herbert Jacobowitz, 1412 Franklin ave., Bronx 56, N. Y.

FOR SALE—Rider's #3 and #6 manuals, $6 ea. B. & L. Radio, 112 Park st., N. Attleboro, Mass.

FOR SALE—Thorardson 60-watt booster amplifier with tubes suitable for any low power amplifier; also Audak magnetic pickup. Ed. Monahan, Shawomet, R. I.

SELL OR TRADE — Electro-dynamic speaker 6v field and two 6F6, one 6B5 and one 59 tubes. Want schematic of 1- and 2-tube short-wave recorder, 20m to 30,000 k.c.; also need line cord resistance elements. Wierick Radio Service, Box 263, Warran, Mo.

WANTED—Sig. generator, Rider's chanalyst, scope or other similar testing eqpt. L. C. Phelps, Sheridan Park, Bremerton, Wash.

FOR SALE—Rider's 1 to 11 new; RCP #312 tube tester; Electronic multi-tester R.C.P. #661; 800 ½ & 1 & 2 watt resistors above, all new; 350 condenser filters & by passes assorted, some used in testing, and 60 tubes used only in testing. $250 for lot. August Palermo, 223 S. Winebiddle ave., Pittsburgh 24, Pa.

FOR SALE—Coyne books; Trouble Shooting Manual; Electricians Handbook; Electronics; 150 Shop Prints; Vols. 1, 2 & 3 of Electrical and Radio Reference set; Electrical and Radio Dictionary. All new, $25. Woodrow Lewis, Bolinger, Ala.

WANTED—Rider's Manuals 6 to 14 inclusive—any or all. Ray Butts, 408 Thirty-fifth st., Cairo, Ill.

SELL OR TRADE—Complete radio shop and equipment. Write for full details. Warren Wigner, 1220 Fairview st., Fort Wayne 4, Ind.

FOR SALE—Hickok T-53P dynamic mutual conductance tube tester with built-in roll chart. Almost new. The Radio Laboratory, 912 W. 151st st., East Chicago, Ind.

WANTED—Inoperative G-E auto radio C-61 complete with tuning mechanism. William E. Mallory, 360 S. 40th st., Apt. 2A, Richmond, Calif.

WILL TRADE—Back issues Radio Craft; 1—Modern Servicing; 3 vol. Radio for Millions and Radio Electronic Manual. Want used phonograph. Henry Skoritowski, 828 Fig st., Scranton 5, Pa.

FOR SALE—Franklin D-33-A set analyzer; combination V-O-M, analyzer and tube checker, a-c operated with instructions $20, or what have you? Need good signal generator. C. E. Brickley, Farmland, Ind.

WILL TRADE—New 12B8GT tube for new 25B8 or 25B8GT and one 70L7 or 70L7GT. Both tubes must be new. S. Rosenwasser, 219 E. Jefferson, Mishawaka, Ind.

FOR SALE—Professional Federal recorder, dual-speed, 112 lines per inch, 12" weighted turntable, synchronous motor rim drive, overhead cutting mechanism. Built-in amplifier & T.R.F. tuner, with individual control of 2 mikes, 1 phono, 1 radio. Accessories include SR80 amperite mike & floor stand, 7JH amperite chest mike, 50' mike extension cord, speaker extension core, cutting needles. Don Ruskjer, 166 Lathrop ave., Battle Creek, Mich.

FOR SALE—01A, 19, 1G5, 22, 24A, 27, 30, 32, 34, 35, 40, 42, 47, 48, 58, 6C6, 6F6, 6K7GT/G, 6Q7G, 6SK7, 6U7, 76, 77, 70, 80, 12K7GT/G, 12Q7, 25L6, 1LN5, 12J7, 35L6, 50L6 and other tubes. Write for complete list. Rayford's Radio Clinic, Brentford, S. Dak.

WILL TRADE—Two Leeds & Northrup, zero center galvometers, with breakage guarantee; also 2-tube variable code practice oscillator in cabinet with key and buzzer attachment. Arthur Ginsberg, 1454 Grand Concourse, Bronx 57, New York, N. Y.

FOR SALE—Supreme 89 deluxe combination V-O-M and tube tester with schematic and tube test chart; also Readrite tube tester #430 with chart. $40 for both. George Miller, 94 Holland ave., Elmont, Long Island, New York.

FOR SALE—New tubes, including 50L6, 35L6, 35A5, 35Z5, 12SA7, 1A7, 1LA6, 75, etc. Write for details. Discounts to servicemen. Ben W. Mueller, North Tonawanda, N. Y.

FOR SALE OR TRADE—P.A. amplifier tubes and transmitter eqpt. Want recording eqpt. and Abbott DK-2 or DK-3 transceiver. B. F. Peyton, 3306 Arch st., Little Rock, Ark.

FOR SALE — RCA oscillator, vibrator transformer; 5 adaptors, speaker cone; 80 new, in carton tubes; Official Radio Service, Supreme manual 1940 and 1941 Motorola manual. $115. Stanley W. Diroff, 3090 S. Custer road, Monroe, Mich.

WANTED—Green Flyer phono motor 115v, 60 cycle with 12" turntable or similar. Have for sale or trade, Silvertone automatic record changer with Astatic crystal pick-up. R. C. Gleiforst, 38 Howson st., Vallejo, Calif.

FOR SALE—RCA tube tester #156-B; Superior dynameter; Superior signal tracer CA-10; Superior signal generator #850 and set six Supreme circuit manuals. All A-1 condition with instructions and test leads. $120. Gene's Electric Service, 108 Newhard st., Carey, Ohio.

FOR SALE—Supreme diagnometer #585; Supreme sig. gen. #580; Monarch sig. gen. $12; Triplett tube tester #1213; 3" oscilloscope. H. D. Laurence, 3025 Elizabeth st., Denver 5, Colo.

FOR SALE—Philco and Sprague resistors and condensers; also other radio parts and eqpt. Henry A. Czarkowski, 2620 Ash st., Phila., Bridesburg, Pa.

FOR SALE OR TRADE—Philco 5-tube a-c rec. table model 37-62, $40; Freed-Eisemann 8-tube a-c broadcast and short wave, $35; ac-dc converter generator, $20; and Majestic console 8-tube a-c receiver, $45. Want precision VTVM or RCA junior voltohmyst. Frnklin C. J. Slay, 243 West 107 st., New York 25, N. Y.

FOR SALE—Hallicrafters SX25, $75 and 1000v .5amps d-c generator and 115v exciter generator. George A. Carroll, 70 Capistrano ave., San Francisco 12, Calif.

URGENTLY NEEDED—A-117Z4GT tube for soldier's radio. Paul W. Zoellner, 930 Adams st., LaCrosse, Wisc.

FOR SALE—Eight radio and electronic books, 10% off. Write for list. Kenneth A. Stohl, 25 Wanamassa Pt. Rd., Wanamassa, N. J.

FOR SALE — Meissner 9-1040 analyst; RCA 195 voltohmyst; Precision P-844 VOM; G-E TC-3 tube tester; Weston 772 VOM; Solar CE-1-60; Aerovox 75; Solar BQC, and C-D BF-50 cond. analyzers; RCP 492 VOM; Meissner 10-1199 6-tube kit; Precision 912-P tube tester and Weston 697 VOM. All new or in A-1 condition. Alexander A. Mogull, 305 Adams ave., West Hempstead, N. Y.

WANTED—Tube tester and multimeter. J. Dowdell, 3474 Milverton road, Cleveland 20, Ohio.

FOR SALE—Webster phono-record changer new, and rim-driven phono motor with 9" turntable. Reasonable. William Blaha, 2233 S. 59th ave., Cicero, Ill.

WANTED—Complete set Rider manuals; sig. gen. and tubes of 12, 25, 35 and 50v types. G. L. Condrey, Route 8, Box 231, Richmond, Va.

FOR SALE—Back-issues radio magazines. Complete volumes only. Write for list. Carl H. Fastje, Denison, Iowa.

SELL OR TRADE—New capacity bridge; Readrite 710A analyzer; late model tube checker; line cord resistors; condensers; 5 new Delco car radio vibrators; mounting kits for car radio and other misc. items. Earl Triplett, Route 2, Bixby, Okla.

WANTED—New 4-pronged plug-in coils for short-wave and broadcast bands. John Flaherty, 47 Mountain ave., Norwood, Mass.

FOR SALE—Three 35Z5; 2 ea. 50L6 and 6K7G; one 25L6 used tubes. $3. Bill Buehrle, Jr., 120 Epple Place, Ferguson 21, Mo.

WANTED—Used tube tester and V-O-M. Write details, J. N. Gibson, 110B, Concord st., North Charleston, S. C.

FOR SALE—New Starrett universal dial test indicator complete and Wollensak 250 power microscope. George Baum, Hagerman, New Mexico.

FOR SALE—Instructograph with 10 rolls of tape; oscillatone and Pilot key. All like new, $25. Eber E. Cline, 915 Sheridan road, Chicago 13, Ill.

FOR SALE—New tubes 20% off list, eight 6H6; six 6J5; five 6S7; four 6K6; four 6K8; four 6SJ7; fifteen 6SK7; four 78, and four 27. Also inverter 32v to 110, 100-watt capacity. Seifert Motor & Impl. Co., Utica, Minn.

FOR SALE—Never used 1S5, 3S4, 7B8, 1R5, and 6SC7 tubes. Also new Radioman's Guide. H. L. Brown, 747 Manor S.W., Canton 4, Ohio.

YOUR OWN AD RUN FREE!

During the past three years, over 9,000 buy-trade-sell advertisements have been run free of charge in The Sprague Trading Post—and as long as the need exists this unique service to members of the radio profession will be continued. Send your ad today. Confine it to scarce radio materials. WRITE CAREFULLY or print. Hold it to 40 words or less. Sprague, of course, reserves the right to rewrite ads as necessary, or to reject those which do not fit in with the spirit of this service.

HARRY KALKER, Sales Manager

Dept. S-105, 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

HERE'S WHAT YOU'LL GET FROM RCA IN PROJECTION-TELEVISION TUBES...

How the RCA Television Optical System Provides Newspaper-Size Images from a Specially Developed 5-Inch Kinescope Tube.

)WER COST OF TUBES: Simple bulb design in soft glass nds itself to low-cost quantity production.

)W-COST POWER SUPPLY: New electrostatic-focus electron un avoids cost of a magnetic-focus coil and, at the same me, permits use of a low-cost power supply having mod-rate regulation.

IGH CONTRAST AND HIGH LIGHT OUTPUT: New method of pplying fluorescent particles to the glass face results in gh contrast and high light output.

IGH RESOLUTION: Improved gun design provides high esolution.

ILORED TO PROJECTION OPTICS: Spherical face of RCA rojection kinescopes matches RCA reflection-type optical stem.

Already, RCA has demonstrated to hundreds of engi-eers and radio experts television of tomorrow as made ossible by these new tubes. Screens as large as a newspaper page, with clear, bright images, enable dozens of persons to see the program . . . and this is but one example of RCA electron-tube development, engineering and leadership.

Make sure you have the advantage of this leadership in building your radio and television service business. Carry the tubes with the best-known name . . . RCA.

The Fountainhead of Modern Tube Development Is RCA

BUY VICTORY BONDS

RCA

RADIO CORPORATION OF AMERICA

TUBE DIVISION, HARRISON, N. J.

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

JENSEN RADIO MANUFACTURING COMPANY • 6615 SOUTH LARAMIE AVENUE, CHICAGO 38, ILLINOIS
IN CANADA—COPPER WIRE PRODUCTS, LTD., 137 RONCESVALLES AVENUE, TORONTO

old man Centralab

can supply you with plenty of

RADIOHM REPLACEMENTS

CENTRALAB Radiohms are always available on your jobber's shelves.

For more than twenty years Old Man Centralab has stood for QUALITY in volume Controls, and today more than ever before, the familiar blue and white carton is your guarantee of goodness. These are desperate days in the replacement business . . . which is all the more reason why it is gratifying to know that Centralab parts are as dependable as ever . . . so if you want to be doubly sure . . . ALWAYS SPECIFY CENTRALAB.

Centralab

Division of GLOBE-UNION INC., Milwaukee

Producers of: Variable Resistors • Selector Switches • Ceramic Capacitors, Fixed and Variable • Steatite Insulators and Button-type Silver Mica Capacitors.

JENSEN RADIO MANUFACTURING COMPANY • 6615 SOUTH LARAMIE AVENUE, CHICAGO 38, ILLINOIS
IN CANADA—COPPER WIRE PRODUCTS, LTD., 137 RONCESVALLES AVENUE, TORONTO


old man Centralab
can supply you with plenty of
RADIOHM REPLACEMENTS
CENTRALAB Radiohms are always available on your jobber's shelves.
For more than twenty years Old Man Centralab has stood for QUALITY in volume Controls, and today more than ever before, the familiar blue and white carton is your guarantee of goodness. These are desperate days in the replacement business . . . which is all the more reason why it is gratifying to know that Centralab parts are as dependable as ever . . . so if you want to be doubly sure . . . ALWAYS SPECIFY CENTRALAB.
Centralab
CRL
Division of GLOBE-UNION INC., Milwaukee
Producers of: Variable Resistors • Selector Switches • Ceramic Capacitors, Fixed and Variable • Steatite Insulators and Button-type Silver Mica Capacitors.

Your combat days are not over!

GET BEHIND THE VICTORY LOAN!

There's plenty of action ahead for fast-thinking industrial leaders in putting over the new Victory Loan! Your Victory drive is important because:

EVERY VICTORY BOND HELPS TO

1. Bring our boys back to the America for which they were willing to give their lives!
2. Provide the finest of medical care for our wounded heroes!

BOOST THE NEW F. D. ROOSEVELT MEMORIAL $200 BOND!

Urge all your employees to buy this new Franklin Delano Roosevelt Memorial $200 Bond through your Payroll Savings Plan! At all times better than ready cash, Victory Bonds are industry's "Thanks" to our returning heroes!

START YOUR VICTORY DRIVE TODAY!

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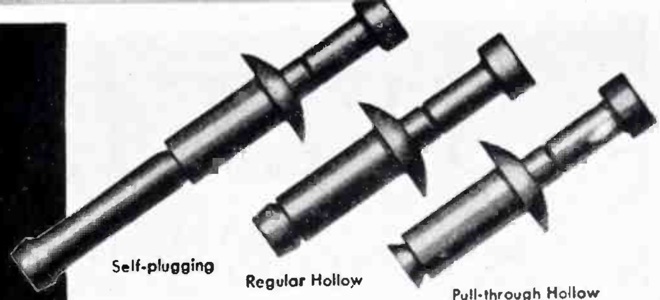

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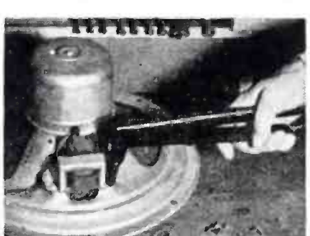

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SYLVANIA NEWS
RADIO SERVICE EDITION

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

PROFIT PERIOD FAST APPROACHING AS WHEELS OF RADIO INDUSTRY BEGIN TO TURN FOR PEACE

60 MILLION TUBES TO BE NEEDED, ESTIMATE SHOWS

Radio Servicemen May Double Prewar Business

In 1941, about 34 million replacement tubes were sold. In contrast to this is the recent authoritative report (from one of America's leading research organizations) that no fewer than 60 million replacement tubes will be required to handle the expanding radio market. This means that the Dealer and Serviceman can look forward to about doubling their prewar tube replacement business.

In addition to this, is the widespread acceptance of record players, FM and television. It has been estimated that within a few short years, approximately 75 million home radios plus 25 million auto sets will be sold.

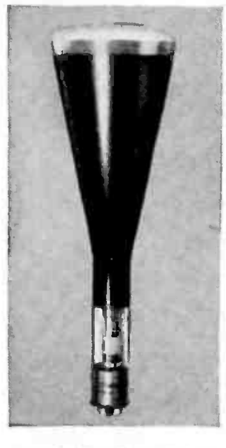
These facts not only back up the estimated tube replacement sales, but indicate the extent to which the demand for electrical and mechanical parts will be boosted. As far as the radio tube market is concerned, the serviceman *knows* he can depend on the high quality standards and large production facilities of Sylvania Electric.

DID YOU KNOW...

Ninety per cent of Sylvania's radio tube production went toward hastening the day of total victory. (Each B-29 used 700 radio tubes!)

Radio Servicemen Assured Of Receiving Highest Quality Products To Meet Rising Demand

As the period of reconversion gradually takes active form and spreads over the nation, the radio industry can look forward to one of the most profitable spans in its history. Millions are waiting for radio sets of improved design. Meanwhile millions of sets are in need of repairs.



CATHODE RAY TUBES

This peace-time expansion means a *profit* period for radio servicemen everywhere. Backed up by Sylvania's more than 40 years' research and experience in manufacturing, the radio serviceman can with confidence look forward to the expansion of his business. Note this list:

Television: experience in design and the production of untold thousands of Sylvania Cathode Ray Tubes for war requirements have contributed greatly to peace-time applications.

High frequency sets (FM, television): the Sylvania Lock-In Tube is so electrically and mechanically perfect in construction that it can handle ultra-high frequencies with ease.

Radio: manufacture and distribution of the famous high quality Sylvania lock-in "Glass" and miniature tubes will continue to satisfy the exacting circuit requirements of modern radio receivers.

LOCK-IN RADIO TUBES

"GLASS" RADIO TUBES

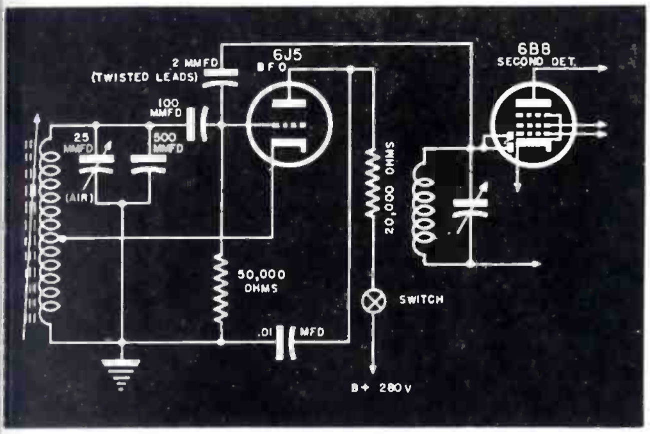
Now that the go-ahead signal has been given to the radio industry, servicemen know they can depend on the Sylvania Electric wide-scale production facilities that have served our government so well.

SYLVANIA ELECTRIC

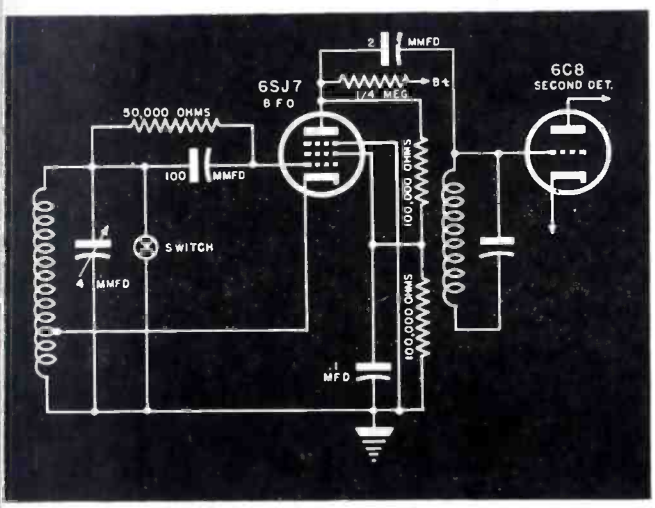
Emporium, Pa.

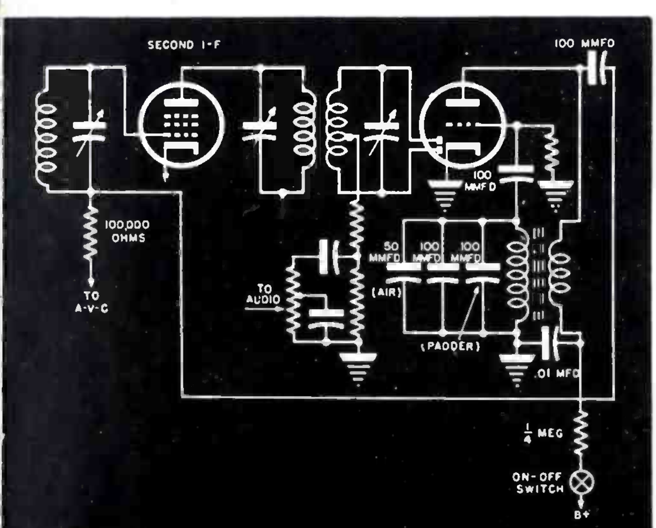
MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

COMMUNICATIONS RECEIVERS' BEAT-FREQUENCY OSCILLATORS



by THOMAS T. DONALD





Figs. 1 (above), 2 center), and 3 (below). Fig. 1 shows the b-f-o circuit of the Hallicrafters SX28. This circuit uses a 6J5 in a Hartley oscillator. The 25-mmfd capacitor, used for adjusting the beat note, is adjusted by a panel control. In Fig. 2 appears the b-f-o circuit of the National NHU. Here a pentode is used in a Hartley oscillator. To cut out the b-f-o, a shorting switch is used in shunt with the oscillator coil. Fig. 3 illustrates the b-f-o circuit of the RME 41-43. A duo-diode-triode is used as a combination second detector and triode b-f-o oscillator. The b-f-o signal is fed back to the low side of the input of the second i-f.

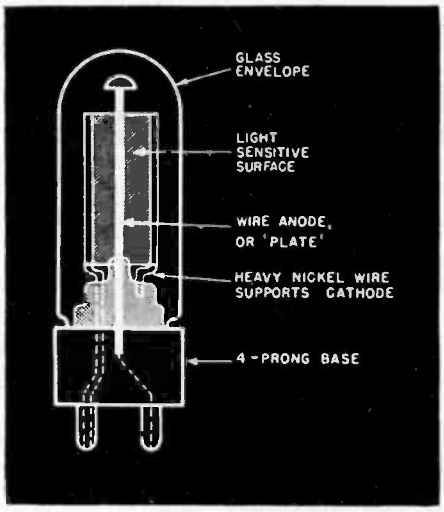
THE extensive use of communications type receivers by the military during the war has alerted many to the versatility of this equipment. As a result we shall undoubtedly see quite a sales increase of these receivers. Service Men will therefore find it increasingly important to become acquainted with all of the models produced and being made now. In this and subsequent papers analyses of all types will be offered.

Communications type receivers are basically the same as home types, with such added features as b-f-o, a-n-l, crystal filters, *S* meters, variable i-f, separate r-f and audio volume controls, antenna tuning systems, and band-spread tuning. In addition, circuit values are kept to very close tolerances, and alignment is more complex.

One feature common to all communications receivers is the *beat-frequency oscillator*. A b-f-o is a tunable oscillator which generates a local signal within audio range of the frequency of the receiver's intermediate frequency. By mixing the b-f-o with any signal coming through the i-f amplifier, an audible tone is produced in the speaker. It is used for the reception of coded signals which are merely r-f carriers, interrupted in coded

(*Continued on page* 48)

PHOTOELECTRIC



by WILLARD MOODY

Fig. 1. A typical photoemissive cell. Light falling on the light-sensitive surface increases the emission and consequently the current flow. This variation in current flow may be used for the control of either visual or aural devices.

THERE are four main types of photoelectric cells . . . photoemissive, photoconductive, photovoltaic and electron-multiplier. All of them respond to light; more specifically they change light variations into electric variations.

Photoemissive Types

The photoemissive cell is sometimes identified as a photocell, or phototube. They depend upon electron emission for operation. That is, when light shines on the cell, electrons are emitted from the cathode and move to the anode or plate which is at a positive potential with respect to the cathode. This is similar to the action that takes place in the usual vacuum tube. In Fig. 1 we have a drawing of a typical photoemissive cell. As the light intensity decreases, the emission is decreased and less current flows in the tube. In effect, the tube is a variable resistance, whose resistance decreases with an increase in light.

The cathode is a semi-circular cylinder of oxidized silver, or some other suitable metal, supported by stiff wire leads of nickel. The surface of the cathode facing the plate is covered with a thin film made of caesium oxide, sodium, potassium, or lithium, or other light sensitive chemical compound. The plate is a plain nickel rod or wire placed in the center of the cylinder.

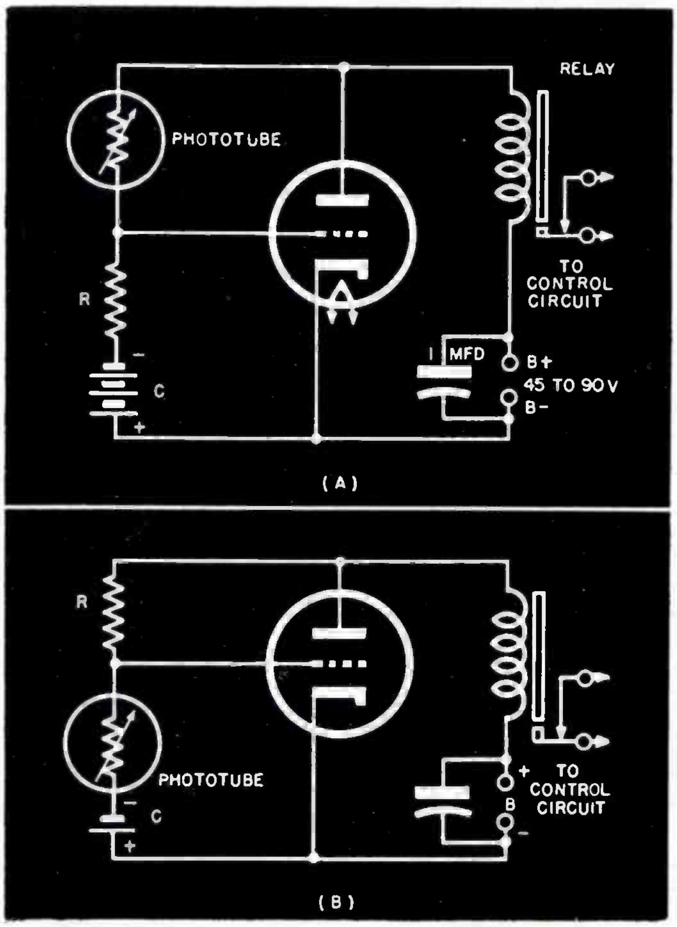
The glass envelope is soda-lime glass for many inexpensive cells, while higher priced cells may use pyrex or fused quartz, which have lower light losses and permit more ultra-violet light to pass through. Lead glass is not used, because it is a poor transmitter of light and reacts chemically in an undesirable way with the cathode materials, causing envelope discoloration.

The plate is the smallest electrode so that it won't cast a shadow on the cathode and reduce cell efficiency. Two types of cells are used; one is a high vacuum, the other gas filled. Using gas, increased output current for a given amount of light is obtained through gas ionization. The gas also reduces the effects of space charge.

Basic Control Circuit

In Fig. 2 appears a typical application of a phototube, either high vacuum or gas filled. With no light on the cell, its resistance is high and the grid potential is negative. When light shines on the cell, the resistance drops and the grid of the control tube becomes less negative. The cell resistance is in series with *R*, the *C* battery, and the relay and *B* supply. The effect of the plate voltage on the grid becomes greater when the cell resistance is decreased. The operating conditions are usually set so that the grid is always negative, but is simply made less negative when light hits the cell. The tube plate current, which passes through the relay coil, thus increases. The result is a stronger magnetomotive force in the relay magnetic circuit, which attracts the armature, closing the contacts to the control circuit.

The reverse action can be obtained by placing the cell in the position now occupied by *R*, and placing *R* in the cell position, Fig. 2b. The two elements then form a voltage divider in the circuit. When no light shines on the cell, its resistance is high. This resistance is in series with the resistor, which is between plate and grid, using



Figs. 2 *a* and *b*. Here we have two electronic applications of the phototube. In the circuit in *a* light falling on the phototube increases the plate current, and closes the relay in the plate circuit. In *b*, we have a circuit performing the reverse action. When the light on the phototube is interrupted the plate current increases and closes the relay.

CELLS

[r]eversed arrangement. Accordingly, [th]e grid becomes less negative and the [pla]te current rises, causing the relay [to] close. When light hits the cell, the [ce]ll resistance drops, and less voltage [is] developed across the cell resistance. [Th]e grid, therefore, is highly negative, [an]d the plate current correspondingly [sm]all, so that the relay is open. In this [ca]se, light failure, caused by the inter[ru]ption of the beam would increase [ce]ll resistance, reduce the grid bias, [in]crease plate current and thereby [ca]use the control circuit to swing into [ac]tion and sound the alarm.

Photoconductive Cells

In the photoemissive cell there was [el]ectron emission. In the photoconduc[ti]ve variety, we have a variation in [ce]ll resistance, but no emission. Sel[en]ium cells are the most common [ty]pes and consist basically of two elec[tr]odes having between them a deposit [of] selenium. The electrodes themselves [m]ay be of copper, iron, nickel, or other [su]itable conducting material. The [m]ounting block may be slate, mica, [ba]kelite, or equivalent insulating ma[te]rial. Most selenium cells have a high [se]nsitivity to red and infra-red (invis[ib]le) light. A typical cell may have a [re]sistance of about 10 megohms dark [an]d 2 megohms for an illumination of [1]) foot candles. Since its action is [si]milar to the photoemissive type it [m]ay be substituted, or used for similar [a]pplication such as that shown in [F]ig. 2.

The cell must be kept cool and dry [a]nd not too much current can be [p]assed through it; about 4 ma should [b]e the maximum.

Photovoltaic Cells

The photovoltaic cell generates a [v]oltage, while the previous types dis[cu]ssed developed electron emission [an]d changed resistance. The funda[m]ental construction of a photovoltaic [ty]pe is shown in Fig. 3. The iron [d]isc may be only 1/16" thick. It forms [th]e positive terminal of the cell. The [li]ght causes electrons to be forced to [th]e surface of the sensitized layer, to [b]e collected by a thin translucent film [w]hich serves as the negative terminal. The loss of electrons in the metal disc [m]akes it positive. The voltage dif[fe]rence between the terminals is used [fo]r control of a super-sensitive meter [ty]pe relay, as shown in the lower part [o]f the figure. When light shines on [th]e cell, the control voltage is developed. The fact that the cell uses selenium does not mean it is a variable resistance type. The sensitive relay may, in turn, control a heavier relay which operates a control circuit to ring an alarm or perform some other operation. In one type, an output voltage of .15 volt for an illumination of 1 lumen is obtained. This is for a no-load condition. However, cells of this type give a linear response when used in low resistance circuits. Thus, the resistance in Fig. 3 might be quite low in value to give a response directly proportional to the light, as in some photelectric light-intensity meters. By putting cells in parallel, greater output current can be obtained. Photovoltaic cells are low-impedance

(*Continued on page* 49)

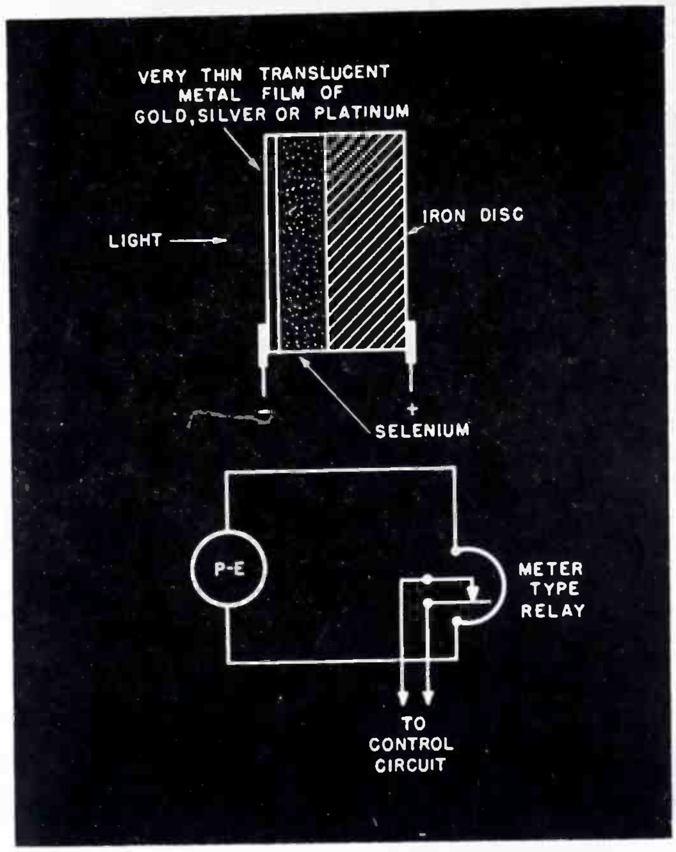


Fig. 3. A cross-sectional view of a typical voltaic cell; a circuit application appears below. Light falling on the selenium through the thin translucent metal film generates a voltage, which may be used in control circuits.

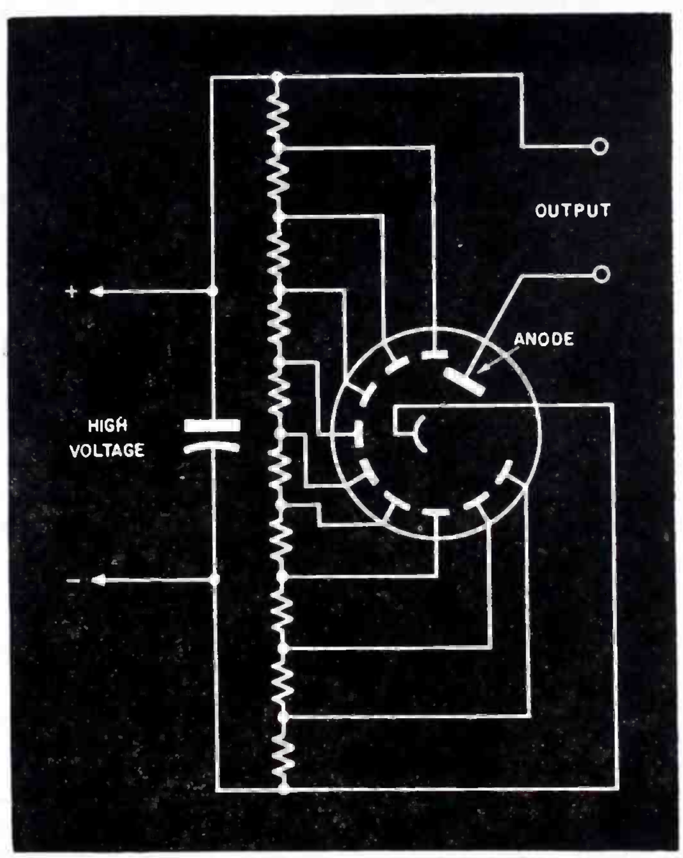


Fig. 4. An electron multiplier cell. This tube has not been used too widely, but may be used more extensively in the near future. The tube uses the principle of secondary emission for amplification, each successive plate amplifying from the previous one. High plate potentials are used, since each plate is at a higher voltage level than the previous one.

Fig. 1. Circuit of the electron-eye indicator. At zero bias the eye is open, closing as the bias is increased negatively.

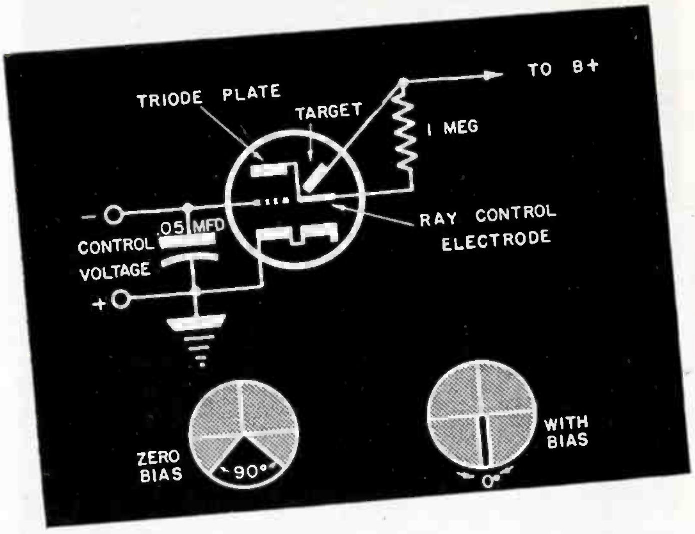
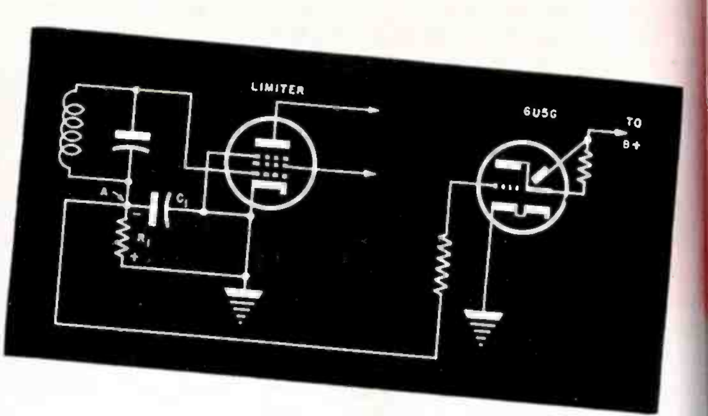


Fig. 3. Magic eye as used in an f-m receiver. The actuating voltage for the eye is supplied by the limiter stage. As the center frequency of the signal is approached the voltage across R_1 increases, biases the eye grid, and closes the eye.



F-M TUNING INDICATORS

by J. GEORGE STEWART

ALL f-m receivers require some form of tuning indicator for proper reception of f-m signals. Two types are in general use; a meter to indicate that the station signal is properly tuned in, and a magic-eye tube such as the 6U5G for the same purpose.

The operation of a meter type indicator is quite simple to understand, since it involves a direct reading of some voltage or current, whose amplitude is a function of the correctness of alignment of the signal. The electron ray, or magic-eye tube serves the same purpose, electronically.

Magic Eye Tube Circuit

Fig. 1 shows a circuit diagram of a typical magic eye tube. It consists of a triode amplifier, and a cathode-ray indicator. In action, a variation in grid voltage changes the plate current of the triode portion of the tube. Since the plate is connected to the ray-control electrode, and since both are in series with the *B* + through a 1-megohm resistor, the voltage drop across this resistor will also vary. The target is directly connected to the B +, so that variations in the triode's grid voltage will increase or decrease the voltage difference between the target and the ray-control electrode.

The fluorescence area of the target is a function of this voltage difference; the shadow angle decreases as the potential difference decreases. Or, stated another way, the shadow angle decreases with an increase in grid bias. An increase in bias will close the eye, and conversely, a bias decrease will open it.

Tube Types

In Fig. 2 appears a list of electron-ray tubes and their characteristics. The twin-indicator types have no internal triodes, but are operated with external amplifiers, in essentially the same circuit as that shown in Fig. 1. They are usually used where one indicator is for weak signals and the other for strong signals.

When used as a tuning indicator, the electron-ray tube is coupled to the receiver at some point where a d-c voltage variation occurs upon tuning. Since the grid of the tube draws no current, it can be used at any point where a voltage change occurs, with no appreciable loading effect. The usual point of connection is the avc system in a-m receivers. However, due to the broad response of f-m receivers, this presents a problem, since the function of the tuning indicator is to indicate center frequency of the received signal.

Type	Bias for 0°	Plate Voltage	Plate Resistor (megohms)	Remarks
6AB5/6N5	—15.5v	135	1	Used in a-c/d-c models
6U5/6G5	—22 v	250	1	Remote cut-off type; increases sensitivity to weak signals
6E5	—7.5v	250	1	....
6AD6G	....	150	..	Twin type, —75 v for 0°, —8 v for 90° on ray-control electrode
6AF6G	....	250	..	Twin type, —160 v for 0°, —0 v for 90° on ray-control electrode

Fig. 2
Electron-ray tube types and their applications.

F-M Eye Circuits

A popular hookup for f-m receivers is shown in Fig. 3. Here, the limiter stage is used to furnish the voltage for tuning indication. As the center frequency of the received signal is approached, the voltage across R_1 increases. This voltage is the result of the grid of the tube drawing current on positive pulses of the input signal. The action in the grid circuit of the limiter may be likened to that of the diode detector. Condenser C_1 acts as a filter condenser, smoothing out the resultant voltage. The polarity of the developed voltage is such that the ground end of the resistor is positive with relation to point *A*. Therefore, any increase in the developed grid voltage will bias the grid of the 6U5G more negative, causing the eye to close.

Another system is shown in Fig. 4. Here, the electron-ray tube is con-

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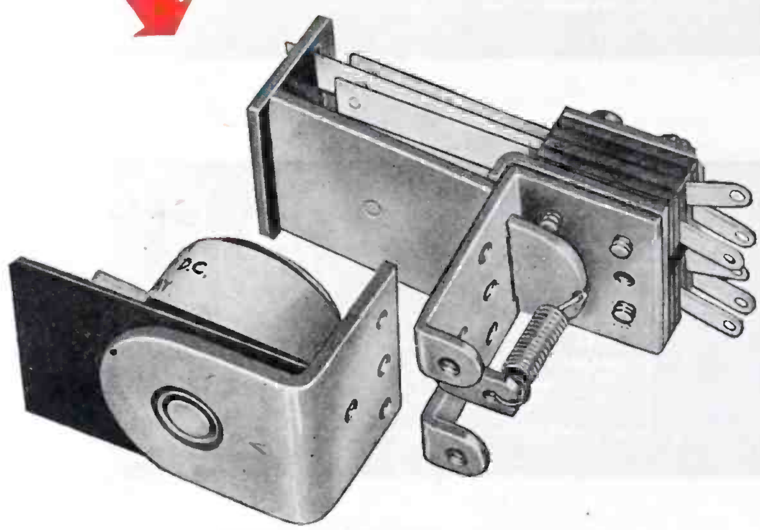

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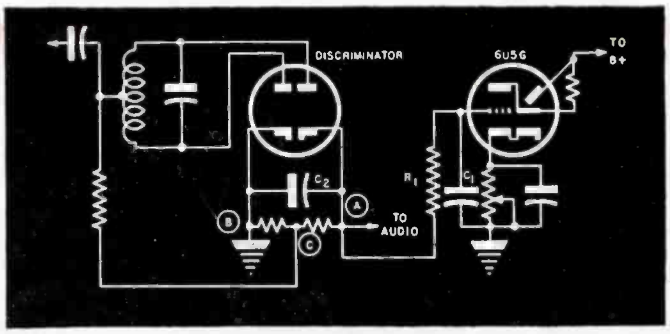


Fig. 4. A pentode magic-eye circuit. The voltage developed by the discriminator across points *A*, *B*, and *C* is used to actuate the eye.

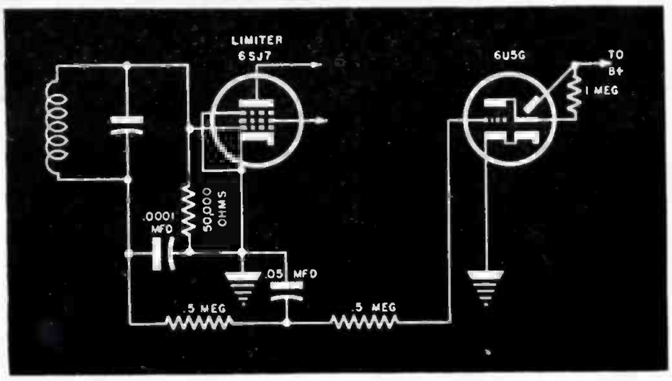
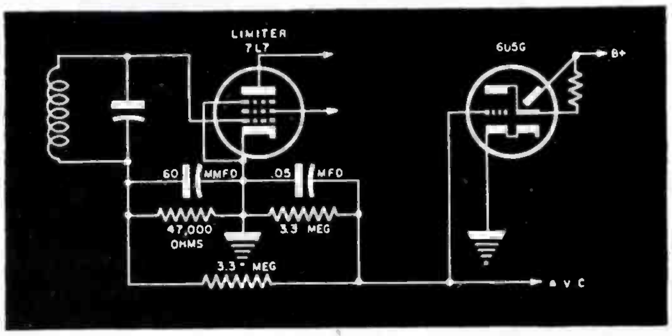
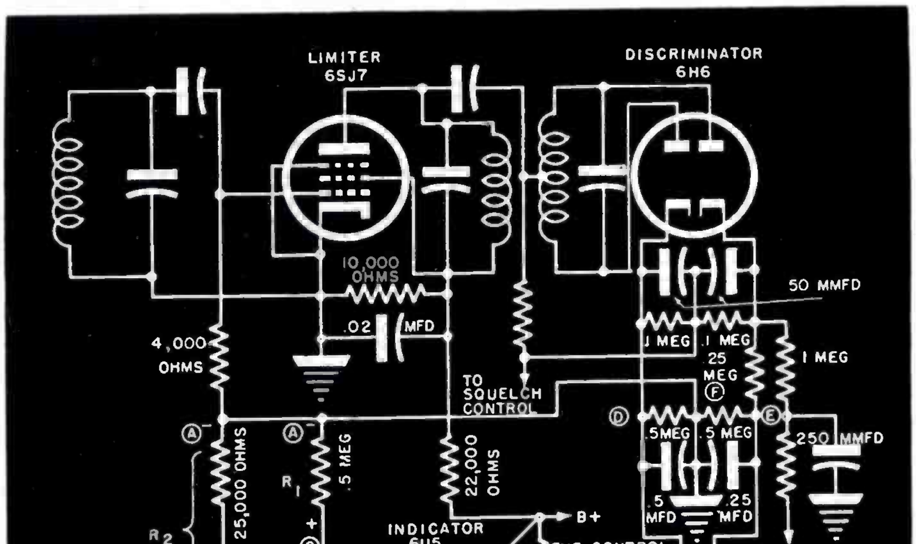


Fig. 5. Indicator system used in the Freed model 57-71. Since the discriminator is not used to supply the avc voltage, the action of the eye is sharpened.



Figs. 6 (left) and 7 (below). Fig. 6 shows the indicator circuit of the a-c/d-c Emerson FM 460. Fig. 7 is the magic-eye circuit of the Espey 2170. A diode-eye control tube is used to increase the efficiency of the tuning indicator. (See page 49 for complete circuit data.)



nected to the discriminator cathode which is above ground. The 6U5G i cathode biased, so that the eye remain closed when no signal is applied.

Discriminator Behavior

When no signal is being receive no voltage exists across points *A*, and *C*. As a signal is approache point *A* becomes positive with rela tion to point *B*. When the receiver tuned to the center frequency, the vol age between points *A* and *C* is equ to that between *B* and *C*. Howeve these voltages are opposite in polarit so that the net voltage between *A* an *B* is zero. As the dial passes th center frequency, *B* becomes positi with reference to A. The highest vol age difference is registered 75 kc awa from the center frequency.

This voltage variation influences th action of the tuning indicator in th following manner. As the signal i approached, the positive voltage a point *A* cancels the self bias on th grid of the 6U5G. The eye, which i normally closed, therefore opens. A the center frequency is approached, th voltage between points *A* and *B* re duces to zero, and the eye returns the closed position, due to the cathod bias voltage. As the center frequen of the signal is passed, point *A* b comes negative with respect to poi *B*. This negative voltage, added the cathode-bias voltage, causes t two images of the eye to overl Therefore, correct tuning is indicat by the point where the two imag meet, just before they overlap.

Most f-m receivers use either th limiter- or discriminator-actuated i dicator systems, or some combinatio of the two. Figs. 5 to 7 show som typical systems.

Freed 57-71

Fig. 5 shows the magic eye circu used in the Freed model 57-71; no its similarity to Fig. 3. In this circu the limiter is used to supply the ind cator tube only, and is not used fo a-v-c. This tends to sharpen the re sponse of the 6U5G, since there is n signal-compensating voltage to reduc r-f gain.

Emerson FM 460

In Fig. 6 we have a similar syste used in an a-c/d-c f-m receiver, th Emerson FM 460. Because of the re duced plate voltage available in a-c/d sets the 6U5G opens and closes at re duced grid voltages. This accoun for the divider network in the gri return of the 7L7, which reduces th

(*Continued on page* 49)

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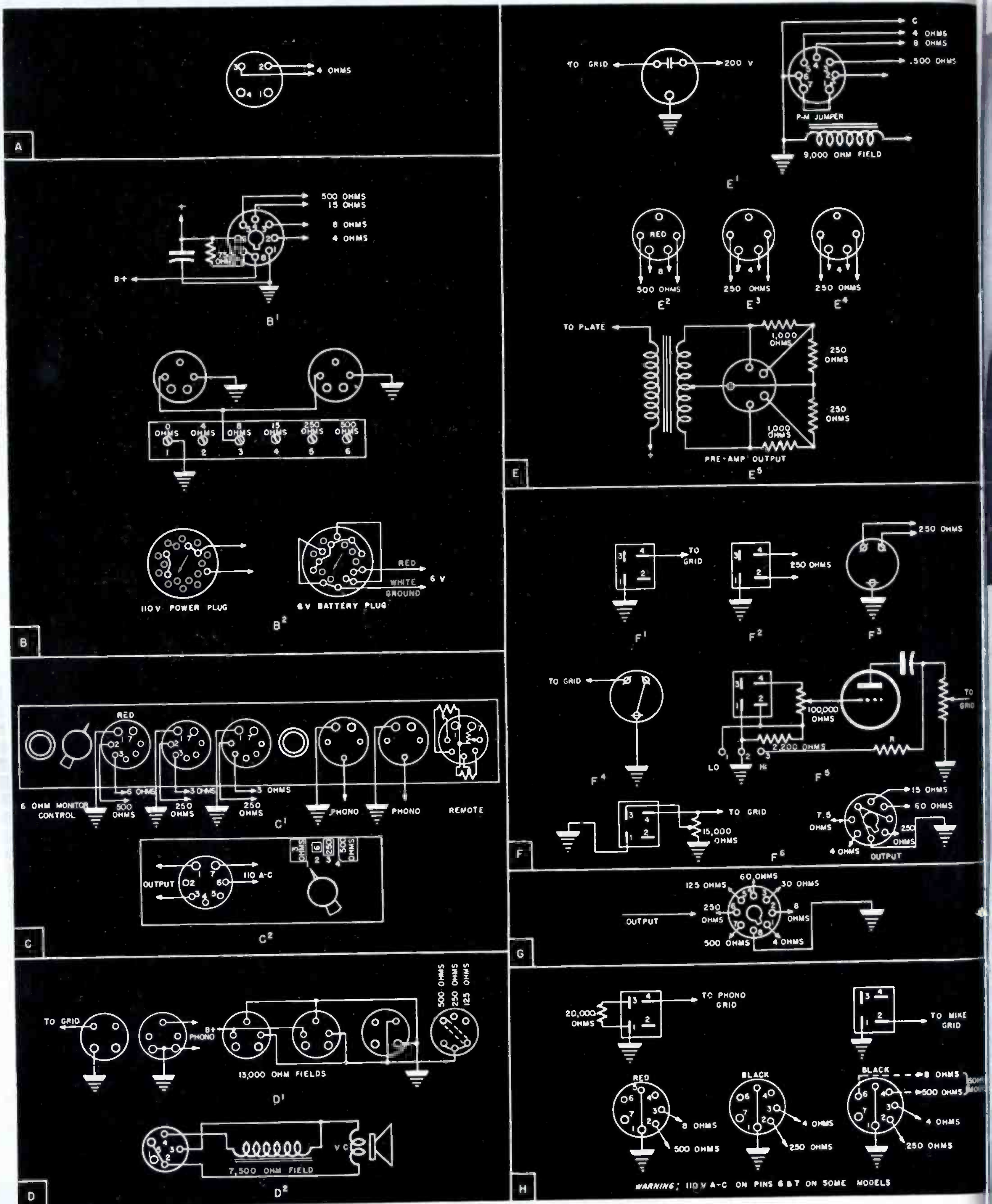
CONNECTIONS FOR UNLABELED AMPLIFIER TERMINALS



Reference chart for unmarked amplifier connections; all views from outside. A, Audiograph AMR 15C. B′, Bogen E-8. B², Bogen E-620. C′, Erwo 35-watt deluxe. C², Erwood models 412 and 4120 with speaker plugs as above. D′, Magnavox 3023. D², Magnavox 922. E′, Operadio 108 (right 835 (left). E², Operadio 162. E³, Operadio 1010. E⁴, Operadio 1025. B⁵, Operadio 950 pre-amplifier output. F′, RCA 12756. F², 12212,14,2 F³, RCA 12214,39. F⁴, RCA 12224,30,57. F⁵, RCA 12204,9. F⁶, RCA 12754 mobile. G, Stromberg-Carlson. H, Webster-Rauland. (*Courtesy V* *Sickle Radio Supply Co. . . . See page 51 for further data.*)

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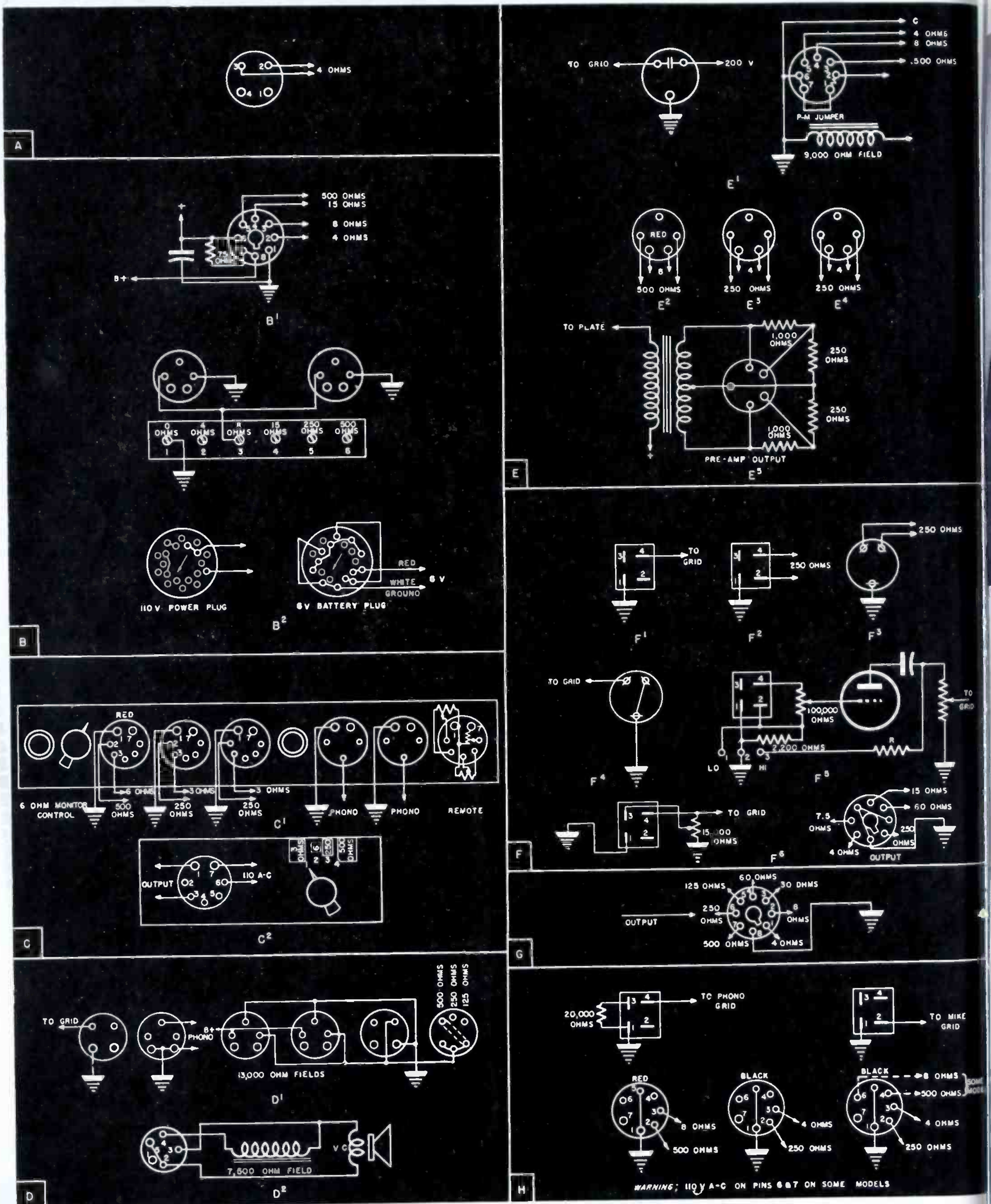
CONNECTIONS FOR UNLABELED AMPLIFIER TERMINALS



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SUPERHETERODYNE

by MARTIN W. ELLIOTT

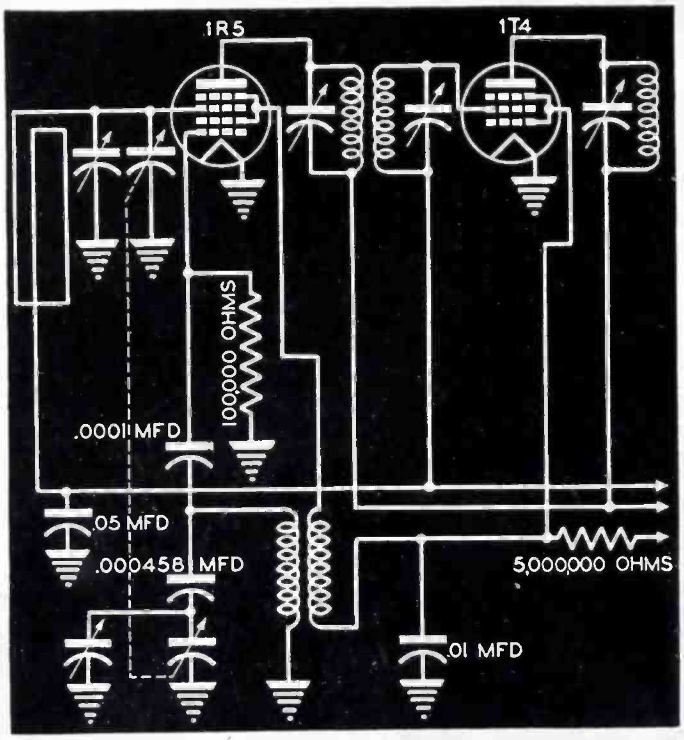


Fig. 1. Circuit of the converter and i-f stages of the Continental model G4. Since the entire receiver consists of four tubes, the converter stage must also supply high r-f gain. Avc is applied to the converter for uniform reception.

THE gain and selectivity of an r-f amplifier depends to a great extent upon the particular r-f of the signal, a high frequency allowing less gain and selectivity than a low frequency. This is due, in part, to the higher r-f losses at high frequencies. Hence, the popularity of the superheterodyne in which the signal frequency is converted to a desirable low frequency where optimum amplifying and selectivity conditions prevail. This desirable frequency is, of course, the i-f, and the frequency conversion is accomplished in the mixer stage by beating the signal with a local oscillator.

Producing I-F

The production of the intermediate frequency is not accomplished by the simple addition or subtraction of the two frequencies but, rather, by a modulating or detecting process in which the mixer tube operates on a nonlinear part of its characteristic. A strong oscillator signal is applied to one of the mixer grids, usually grid *1*, causing the tube to reach cut-off on the negative part of the oscillator cycle. This allows detection of a wide range of signal voltages with little change in mixer efficiency, the output i-f voltages being approximately proportional to the product of the oscillator and signal voltages.

I-F Transformers

In the detecting or modulating process the plate current of the mixer tube contains various modulation products in addition to the desired i-f. It contains the oscillator frequency, signal frequency, the sum and difference

Fig. 2 (below). Converter stage of the Garod 1C712. The oscillator portion of the converter is a Hartley, with the cathode above r-f ground. A vacuum-tube voltmeter must be used to measure the cathode voltage, usually on the order of one volt.

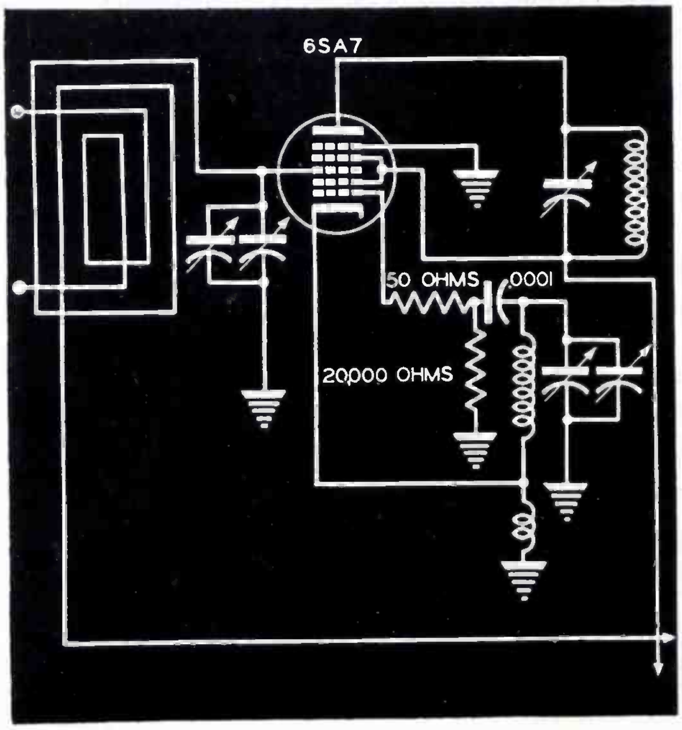


Table I (right). The more popular types of converters, together with their important operating characteristics, are presented in this table. Note the high conversion transconductance, which aids stage gain where no r-f stage is used.

	Plate Voltage	Screen Voltage	Control Grid Voltage	Plate Resistance (megohms)	Conversion Transconductance	Grid 1 Resistor	Total cathode current (ma)
1A7	90	45	0	.6	250	20,000	2.5
1R5	90	45	0	.8	250	100,000	2.75
6A8	250	100	—3	.36	550	50,000	10.6
6K8	250	100	—3	.6	350	50,000	12.5
6L7	250	150	—6	over 1	350	.....	12.5
7A8	250	100	—3	.7	550	50,000	10.8
6SA7 / 12SA7	250	100	0	1	450	20,000	12.5

MIXERS

eats and their integral multiples. It ppears as if quite a filter would be equired to select the correct i-f, and nly the i-f. But the i-f is provided y a simple double-tuned i-f transormer operating at a selected low equency favorable to sharp tuning. ince the detecting or mixing is acomplished in the grid circuit, the iixer tube acts as an amplifier at the itermediate frequency, but it is less ficient in this role than the convenonal i-f amplifier because of the peration at cut-off during the negave half cycles.

Early superhets used triode mixers nd separate oscillator tubes. This rangement is still used by some ianufacturers, notably Philco, but, nce this is not a typical practice, we iall bypass it. Most modern sets are esigned around the series of high ain multi-grid converter tubes, whose iaracteristics appear in Table 1. rids *1* and *2* usually serve as the scillator grid and plate, respectively, that a separate oscillator tube is ot required. There are a few exeptions, where separate triode oscilitors are employed. Special purpose hort-wave and communications reeivers often use separate oscillators r the very high frequencies and inreased stability.

The new converter tubes use the ectron stream as a mixing medium, iminating the various types of capacity or inductive coupling which often were guilty of causing the receiver to radiate the oscillator frequency. The electron stream is modulated at the oscillator frequency by grid *1*, the oscillator control grid. It is then intercepted by the signal grid which further modulates the stream, carrying to the plate the modulation products. This method of electron coupling causes negligible radiation making an r-f stage buffer unnecessary to kill the radiation.

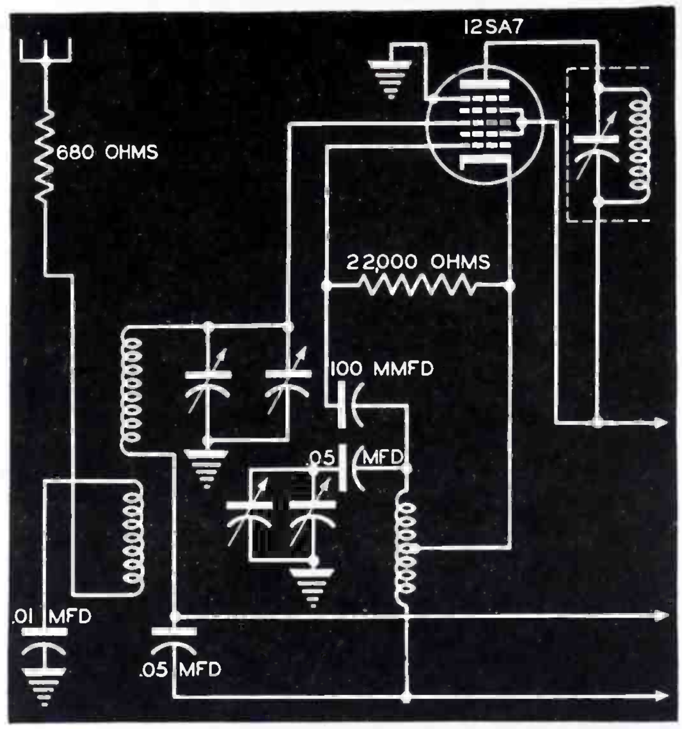
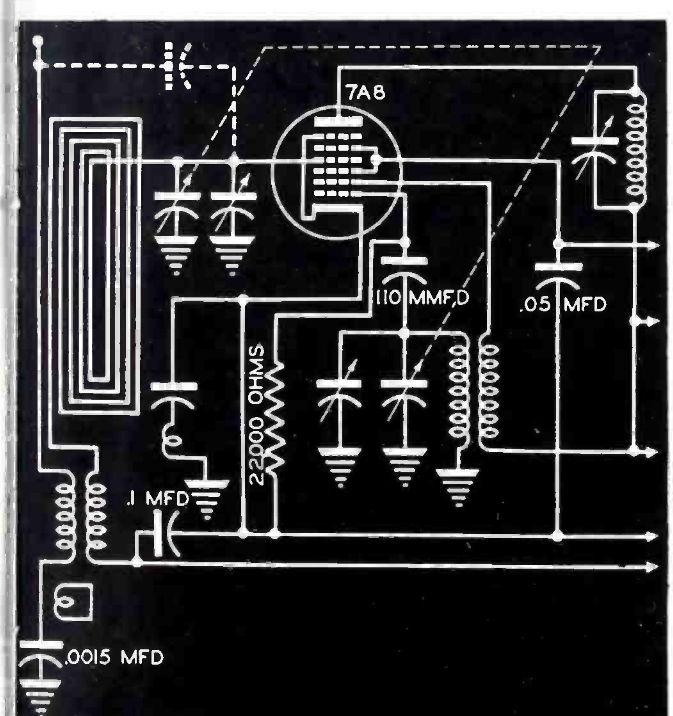


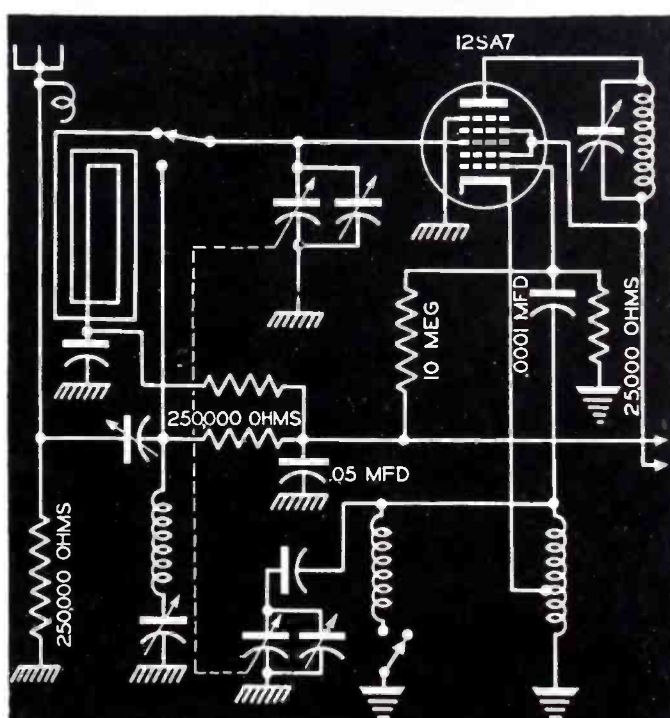
Fig. 3. The converter stage of the G. E. model L540. The oscillator portion of the converter is a Hartley, with the cathode above r-f ground.

Continental Radio G4

Fig. 1 shows a typical 4-tube portable-battery receiver's (Continental Radio and Television G4) mixer and i-f circuits. This receiver uses a quadruple-grid 1.5-volt 1R5 converter tube which has a high conversion conductance, providing a high conversion

Figs. 4 (left, below) and 5 (right, below). Fig. 4. Philco 41 KR converter stage. A separate oscillator plate permits the use of a plate feedback type of oscillator circuit. In Fig. 5, the converter of the G.E. JCP-596 is shown. A shunt coil is used to increase the oscillator frequency for short-wave reception. Chassis ground and usual ground connections are shown.





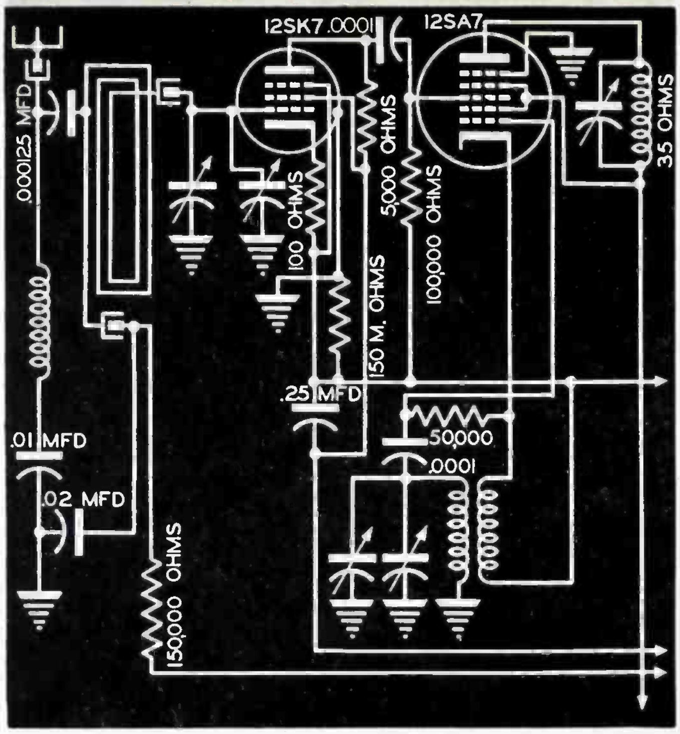


Fig. 6. R-f stage and converter of the Coronada C6D18. Here, the r-f stage is tuned, and resistance coupled to the converter stage. The use of the r-f stage does not increase the selectivity, but does improve the receiver gain, particularly at the low-frequency end.

gain. This is important because a small portable must use a small loop antenna with very limited pickup; therefore the overall gain must be very high. A substantial part of this gain must be furnished by the mixer stage. Modern mixer tubes also have remote cut-off characteristics making them adaptable for applying avc bias for controlling the gain in an inverse relation to the signal strength. This must be done with negligible detuning of the oscillator.

The low-potential end of the loop is tied to the avc system, returning to filament via a .05 mfd r-f bypass capacitor, C_1. A high-frequency trimmer is connected in parallel with the tuning capacitor. A plate-tickler, tuned-grid oscillator circuit is used, the feedback winding being connected to grids *2* and *4*, the oscillator plate and screen grid. No cut section is required in the tuning capacitor because of the low-frequency padding capacitor, C_3, which has a capacity of .000485 mfd within 2%. A high-frequency trimmer is shown connected across the oscillator tuning capacitor. The grid capacitor, C_2, has a capacity of .0001 mfd, typical values for battery portables, running from .00003 to .0001 mfd. The grid leak, R_1, is of .1-megohm value, usual values running .1 to .25 megohms. Some battery sets have oscillators with screen grid or filament feedback. It is interesting to note that sets using the larger 1A7 converter tube have more freedom in oscillator circuits because the 1A7 has a separate grid, *2*, for the oscillator plate.

Garod 1C712

A typical 6SA7 frequency converter taken from a Garod, 1C712, is shown in Fig. 2. The loop is similar to that of Fig. 1 except that a primary turn is added for connecting an external antenna. The oscillator is a typical hot-cathode Hartley which uses either a tapped coil or two separate coils. The oscillator grid, *1*, is at a high r-f potential, usually over 5 volts, while the plate, *2* grid, is at ground, or zero potential. The cathode is usually about 1 volt above ground, measured with a v-t voltmeter.

The cathode voltage of a 6SA7 must be limited to this value because overvoltage tends to block the tube, considerably reducing the gain. It should be noted that, in short-wave sets, the r-f voltage on the cathode across only ½ turn will often be excessive with improper oscillator adjustment. This oscillator has a 50-ohm series resistor at the grid to limit the voltage developed at the high-frequency end of the range. The grid capacitor is .0001 mfd, usual values ranging from .00003 to .00012 mfd. The grid leak here has a value of 20,000 ohms while other receivers use 15,000 to 30,000 ohms. The grid leak is sometimes connected across the grid capacitor instead of the grid-to-cathode connection.

G. E. L-540

In Fig. 3 we have a typical 12SA7 mixer for 150-mil a-c/d-c compact sets, G. E. models starting with L-540. This is also a loop receiver with an antenna primary and 680-ohm series resistor which tends to give uniform antenna coupling throughout the band. The oscillator circuit is similar to Fig. 2, using a tapped coil and the grid leak from grid to cathode instead of grid to ground. Note C_1, a .05-mfd paper blocking capacitor used to satisfy underwriters' requirements that prohibit a *B* – connection on the top of the chassis. The capacity is large enough to prevent padder action, or detuning. The grid capacitor is a .0001 mfd; the leak, 22,000 ohms. Here, too, the loop is connected to the avc bus with a .05-mfd bypass to *B* –.

Philco 41-KR

Philco uses a 7A8 converter in their model 41-KR, Fig. 4. This is a six-grid converter with a separate oscillator plate and requires a lower voltage on the screen grid than the plate for maximum conversion gain. Two separate types of antenna coupling are used; a small capacitor formed by a wire and eyelet which favors the high frequencies and an antenna transformer at the low potential end of the loop which favors the low frequencies. This makes an excellent flat-coupling system, but it is somewhat more expensive than the previous methods. Note the shorted tertiary winding on the transformer which reduces the *Q*, broadening the response and minimizing any resonant effects that may occur in the external antenna circuit.

A plate-tickler oscillator is used with a 110-mmfd grid capacitor and a 22,000-ohm leak. A series choke and capacitor connect the cathode with the chassis, instead of the usual capacitor. This innovation makes use of the common coupling that ordinarily exists from *B* – to chassis to make adjustments in the frequency response of the signal frequency circuits. This frequency converter is used only where no r-f stage exists.

G. E. JCP-596

Another 12SA7 mixer, this time with two wavebands, is shown in Fig. 5, G.E. model JCP-596. The antenna coupling to the loop is obtained by a small capacitor formed by a wire and the grid end of the loop Coupling to the short-wave antenna coil is similarly obtained by means of a small capacitor. A 250,000-ohm resistor from antenna to chassis prevents building up of electrostatic charges on the antenna. The bandswitch is a simple d-p-d-t unit which connects the 12SA7 signal grid to loop or short-wave coil and also applies a shunt coil to the oscillation transformer in the short-wave position. This is, perhaps, the simplest means of switching oscillator frequency, no change being required in the feedback. An oscilla-

(*Continued on page* 26)

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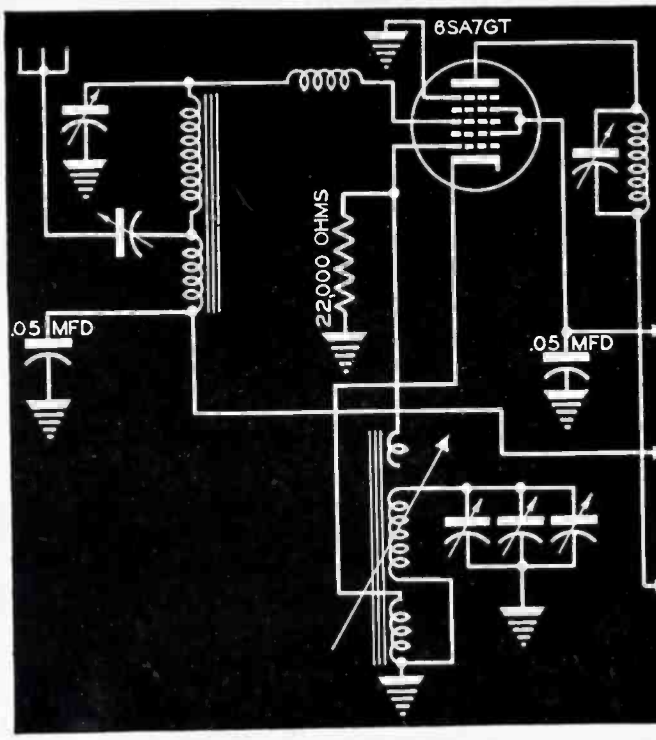

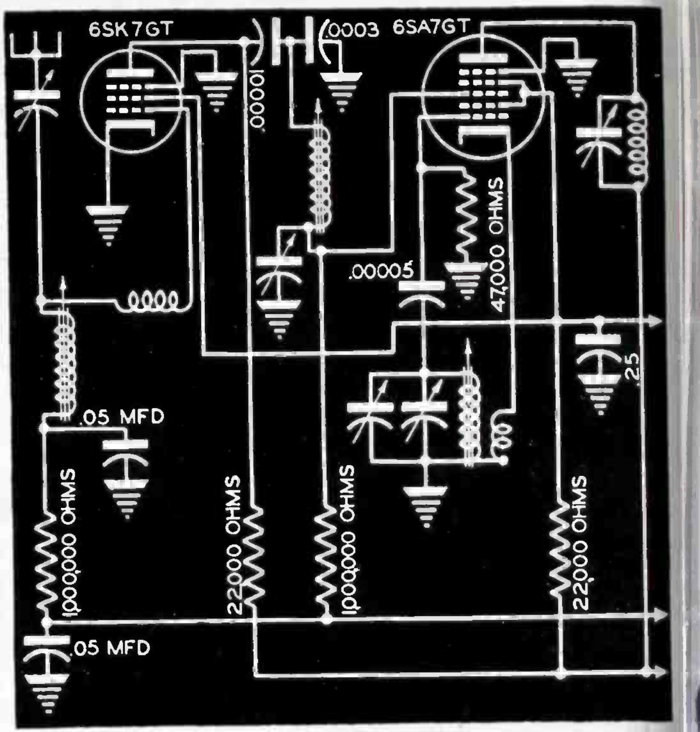

Figs. 7 (left, above) and 8 (right, above). Mixer circuits of the Silvertone models 7091 and 7093, respectively. In Fig. 7 the oscillator has a separate feedback coil. In Fig. 8 wide spacing is used on the oscillator coil for proper tracking with the r-f stage.

tor blocking capacitor is used for underwriters' approval.

Coronado C6D18

In Fig. 6 we have a tuned r-f 12SK7 amplifier which is resistance coupled to an untuned 12SA7 mixer, Coronado C6D18. In this design only a 2-gang condenser need be used and, while the extra stage contributes little in selectivity, it has a gain of about *11* on the low-frequency end and *5* on the high-frequency end. This model has combination coupling, both capacitive and magnetic, between antenna and loop. The coupling capacitor is large, .000125 mfd, but it is connected to a medium impedance tap on the loop. The other receivers used a much smaller capacitor connected at the grid end. T_2 is a high-impedance antenna primary isolated from the chassis by a .01-mfd capacitor. A 100-ohm degenerative cathode resistor supplements the avc bias on the r-f amplifier. The avc bus is connected to ground through 150,000 ohms.

The resistance coupling circuit is composed of a 5000-ohm plate load, .0001-mfd blocking capacitor and 100,000-ohm grid leak. The oscillation transformer has a separate cathode-feedback winding which permits grounding of the grid coil, eliminating the need for a grid-blocking capacitor. A .0001-mfd grid capacitor and 50,000-ohm leak are used. The latter value is unusually high.

Silvertone 7091-7093

Figs. 7 and 8 show mixers of a pair of Silvertone automobile receivers, models 7091 and 7093, respectively. In Fig. 7 an iron-core antenna and oscillation transformer is used, the latter being adjustable for low-frequency ganging. The antenna is coupled through C_1 which is also the antenna trimmer provided to match the receiver to the car antenna. This trimming is usually done on a very weak station at about 1,400 kc. A loading coil is used between the antenna transformer and grid. The oscillation transformer has a separate cathode-feedback coil and also a few turns, deadended, which act as a grid capacitor to the high side of the grid coil. Two types of shunt capacitors are used; one for trimming the high-frequency end, the other for temperature stability, minimizing frequency drift upon warming up.

The circuit shown in Fig. 8 is a permeability-tuned affair with a 6SK7 tuned r-f stage. The antenna-coupling capacitor feeds the high end of the antenna coil instead of a tap. The grid loading coil is present here, too. Coupling the r-f tube to the 6SA7 mixer is completed by a 22,000-ohm plate-load resistor, a .00001-mfd blocking and coupling capacitor, a .0003-mfd shunt and a trimmer capacitor from signal grid to ground. The permeability-tuned coil and trimmer are resonant. Thus a high r-f voltage appears across each. The voltage across the capacitor is fed to the converter tube.

The oscillator has a separate cathode-tickler coil. The grid coil has the same length as the other permeability-tuned coils, but it has fewer turns wound at a greater pitch to obtain the required higher frequency. This is the counterpart of the cut-plate capacitor in a typical capacitor-tuned oscillator where the oscillator is made to track with the r-f tuning at a fixed-frequency difference. Shunt trimmer and fixed silver-mica capacitors are used.

Allied E-10707

The mixer shown in Fig. 9 is used in Allied's model E-10707. It features the 6K8 triode-hexode mixer tube which has a separate triode section for the oscillator. The triode grid is also grid *1* of the hexode which automatically provides electron coupling between oscillator and converter. The separate triode section has a higher transconductance than the triode part of a standard converter tube. This permits operation at much higher frequencies and also adds stability, the safe upper frequency limit being about 40 mc.

The antenna transformer consists of three primary and three secondary coils in series, all three being used on broadcast, the upper two on police band and the top coil only on shortwaves. The unused coils are shorted to prevent absorption of signal energy at resonant points. Note the i-f wavetrap between the top of the primary

(*Continued on page* 59)

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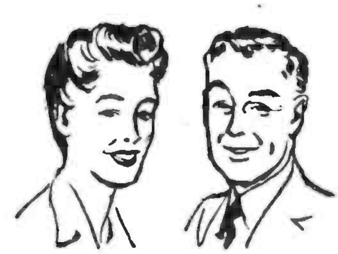
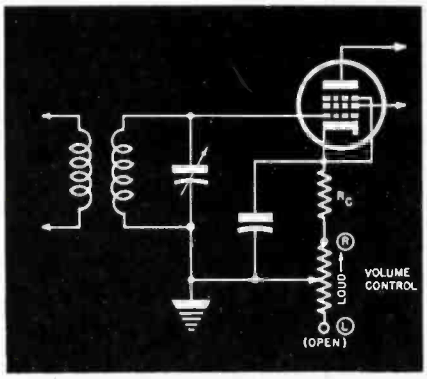


AUNT AND UNCLE are music-lovers. Their G-E radio-phonograph has given them many hours of pleasure. Buying G-E is second nature with them.

Fig. 1 (below). Typical bias-type volume-control circuit.



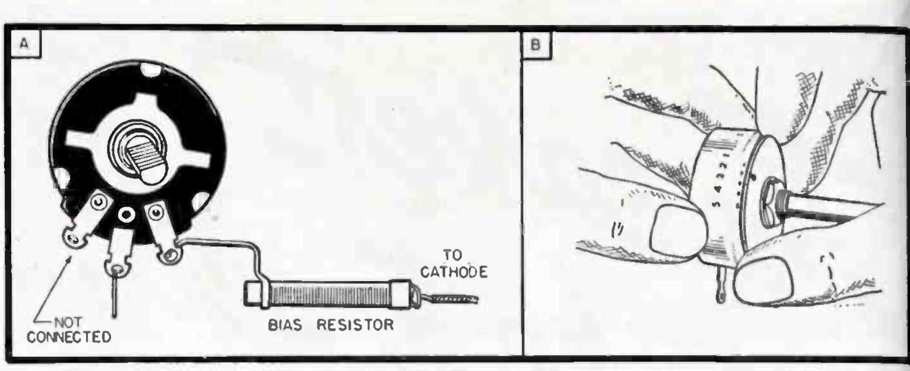


Fig. 2 (above). Volume control arrangements for bias-type control circuits, of the type illustrated in Fig. 1, that require a fixed bias resistor. In *b* appears a special type of wire-wound volume control with an adjustable stop for stopping the travel of the contact arm at any one of five marked positions. (*Courtesy P. R. Mallory & Co., Inc.*)

VOLUME AND TONE CONTROL RESISTORS

Part Eight of a Series on Receiver Components

by ALFRED A. GHIRARDI
Advisory Editor

WHILE the electrical constructional features and characteristics of volume and tone controls, previously discussed, are of vital importance to the Service Man, there are many additional details concerning their mechanical design and construction, accessories to be attached, methods of installation, etc., that require careful consideration.

Tapped Controls

Let us, for instance, analyze tapped controls; controls having one or more taps brought out from points on the resistance element. In some makes of such controls the taps are fixed, but in others their position on the resistive element is internally adjustable at suitable intervals from 25% to 75% of the total rotation.

The common use of tapped controls is a relatively recent practice, although a few old receivers did feature them. In recent receivers they have been widely employed in the *diode-bias* method of controlling volume, where the resistance unit is used as a diode-load resistor. The additional tap is used to provide an extra avc voltage of a lower value than the main avc source.

With rare exceptions there are only three basic types of control circuits that use a tapped control: (*1*)—Where the control is tapped in order to *provide different values of voltage,* such as in an avc circuit; (*2*)—where the tap is brought out so that *automatic tone compensation may be accomplished;* and (*3*)—where it is desired to *use one control to act upon two circuits* (to provide either radio or phonograph control or to act as fader controls from one phonograph pickup unit to another, one microphone to another, and similar applications). These types of circuits will be discussed in a subsequent article of this series.

Adjustable Fixed-Bias Resistor Controls

When replacing a carbon-element volume control in which the original control included a built-in minimum-bias resistor, R_c, for the type of circuit shown in Fig. 1, one of the small 500-ohm adjustable wire-wound bias resistors available for this purpose may be connected in series with the replacement volume control. This is illustrated at (*a*) of Fig. 2. The adjustable clip on the bias resistor may be clamped securely to the resistance element at the proper place by means of a pair of gas pliers to obtain the correct bias resistance required (which is usually less than 500 ohms).

When replacing a wire-wound volume control having a value between 2,000 and 20,000 ohms in *antenna cathode* and *bias* circuits of this kind, one of the special types of wire-wound volume controls made with the most suitable taper for this type of control circuit, illustrated at (*b*), may be used. This is provided with an adjustable *stop* for stopping the travel of the contact arm at any one of five marked positions near the right-hand terminal of the resistance element, permitting the control to retain a definite fixed resistance section at this end. The position of this stop may be easily adjusted to provide any of the following five values of fixed bias resistance: 100, 200, 300, 400 or 500 ohms—all with the usual commercial tolerance of ± 10%. After being adjusted for whatever value of fixed bias resistance is required by the receiver, the stop plate is locked in position by a holding nut. Whenever bias resistance values other than those specified above are required, the indicating bump may be filed off the plate and the required resistance adjustment made with the aid of an ohmmeter.

This adjustable grid-bias feature eliminates the need for an external bias resistance and also eliminates the necessity of having special controls of the same resistance value but requiring different fixed-bias resistors.

Volume and Tone Control Attachable Switches

Some receivers employ *off-on* switches (in the line, battery circuits, etc.), that are separate from all other controls. However, now most employ switches that are mounted directly on the volume control and are operated by the shaft of this control during ap-

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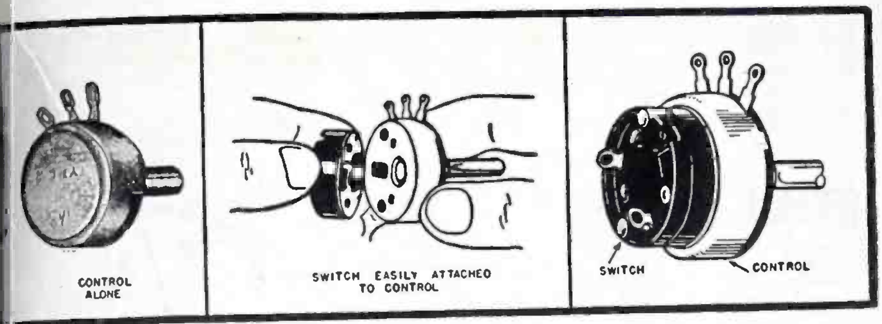


Fig. 3. How on-off-rotary-snap switches are attached to volume and tone controls. These rotary-snap switches are available with various contact arrangements shown in Fig. 4 below.

...ximately the first 10° or 15° of its rotation from the *off* (extreme counter-clockwise) position.

To supply a line of replacement controls, all equipped with switches, obviously would increase the cost of the controls in the cases where switches are not required. Consequently the problem has been met by designing most composition-element and wire-wound replacement controls so that a specially designed rotary snap switch may be easily attached to the back. The controls are provided with a switch-actuating pin and switch-mounting holes in their covers. These holes are normally covered with a blank back plate when no switch is being used. When a switch is required, the plate is removed and the switch is attached to the cover of the control by properly meshing the actuating parts, as shown in the center illustration of Fig. 3. The actuating pin meshes with the switch cam (with the contact arm of the control set at the proper extreme position), so that the switch is actuated by the insulated shaft of the control—usually during the first 10° or 15° of its rotation from the *off* position.

Attachable rotary-snap switches are available with various contact arrangements to perform any desired switching function. Those most commonly used in receivers are listed herewith, together with their most customary applications. The contact arrangement of each one is illustrated in Fig. 4.

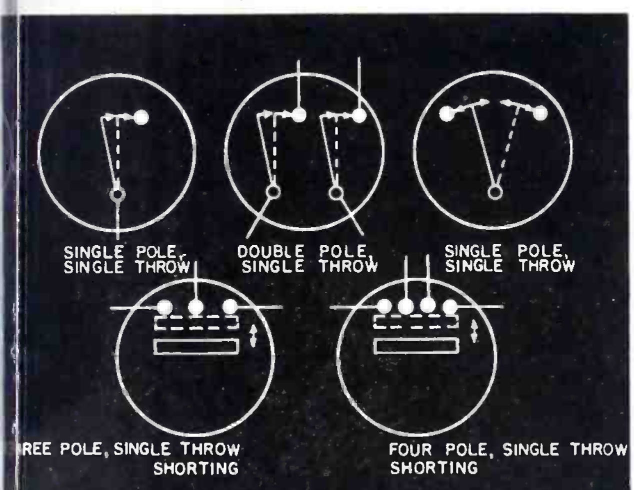


Fig. 4. Contact arrangements of the five most-used types of rotary-snap switches.

(*1*)—*Single pole, single throw*: For general *on-off* switching of either battery or power type receivers.

(*2*)—*Double pole, single throw*: For use on battery receivers where it is necessary to break both the *A* and *B*, or the *A* and *C* battery circuits. This may also be used as a three pole, single throw shorting type of switch.

(*3*)—*Single pole, double throw*: For use where it is desired to close one circuit during operation of the control, yet open this circuit and close another when the control is turned to the *off* position. This is usually found on radio-phonograph combinations.

(*4*)—*Three pole, single throw, shorting*: For use on battery-operated receivers where it is necessary to open the *A*, *B*, and *C* battery lines to prevent useless discharge of the batteries.

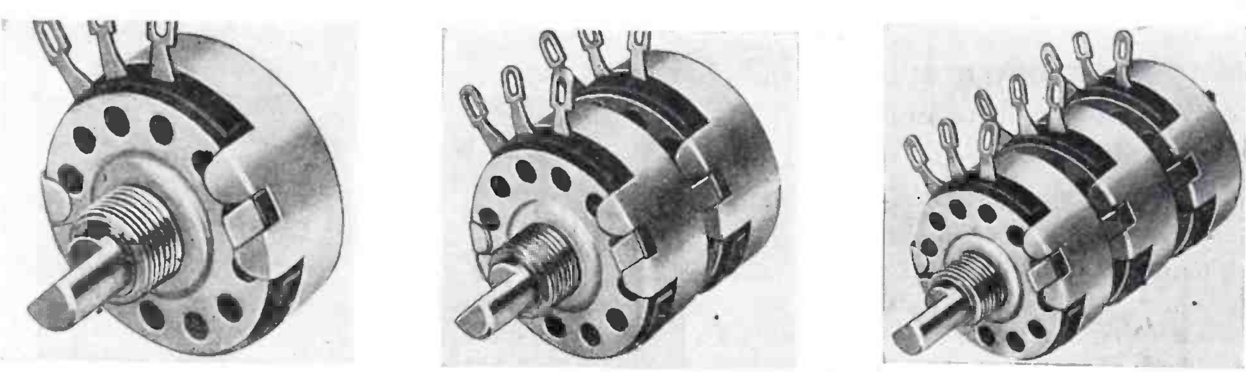
(*5*)—*Four pole, single throw, shorting*: Like the foregoing type, this switch is for use on battery-operated receivers. It allows one additional circuit to be opened. Although there are only three battery circuits (*A*, *B* and *C*), the wiring of many late model battery receivers is such that it is necessary to open four circuits.

Controls in Tandem

Volume and tone controls often are mounted in tandem. The most commonly used tandem arrangement is that of two units used as a *dual* control.

The expression *dual-control circuits* is applied to all circuits using two controls driven simultaneously by the same shaft. The two controls may be of the same, or different, resistance values and tapers, and both wire-wound and composition-element type controls

(*Continued on page* 46)



ig. 5. Single, dual and triple control assemblies, with the same type of controls used to build up multiple units. (*Courtesy Allen-Bradley Company*)

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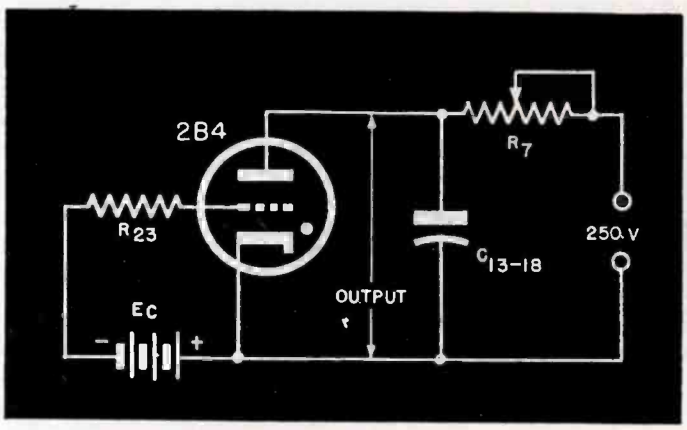


Fig. 1. Elementary linear time-base oscillator circuit. Here, the plate potential, at which the thyratron *2B4* begins to conduct, is determined by the negative grid-to-cathode potential. The timing capacitor C_{13-18} charges in series with the limiting resistance R_7, the charge eventually reaching such proportions that the thyratron tube *breaks down*, relaxing the charge and initiating a renewed charging of the timing capacitor.

C-R OSCILLOGRAPHS

SERVICING... APPLICATIONS...

[Part Four of a Series]

by S. J. MURCEK

UNDER certain conditions, it is necessary to utilize the cathode-ray tube deflection plates directly, without deflection plate-voltage amplification, for voltage measurement or wave observation, such as we often encounter in the study of commercial power-line voltage surges. It may be also necessary to use the c-r tube unit as a receiving device for testing of experimental television equipment. Hence, in the Du Mont oscillograph, the deflection plates are brought out to terminals on a suitable terminal board, which are located on the rear of the unit cabinet, and which are directly accessible without necessitating the removal of the cabinet, and consequent exposure of the high voltage wiring within the device. In this terminal-board system, two removable connecting links disconnect the free deflection plates from the vertical and horizontal amplifier coupling systems, respectively. An extra terminal is also brought out on the terminal board, connected to the unit chassis, thus providing a terminal potential level equal to that present between the fixed deflection plates and the tube cathode.

Where the wave from a power line surge is under observation, it may be desirable to utilize the direct connection to only the vertical deflection plate, leaving the horizontal plate connection to the horizontal amplifier output system intact to permit the utilization of the linear time-base-oscillator amplifier voltage output.

As has been stated, the output voltage of the linear-time-base sweep oscillator is amplified by the horizontal amplifier. This procedure is necessary to preserve the linear form of the time-base oscillator-voltage output waveform.

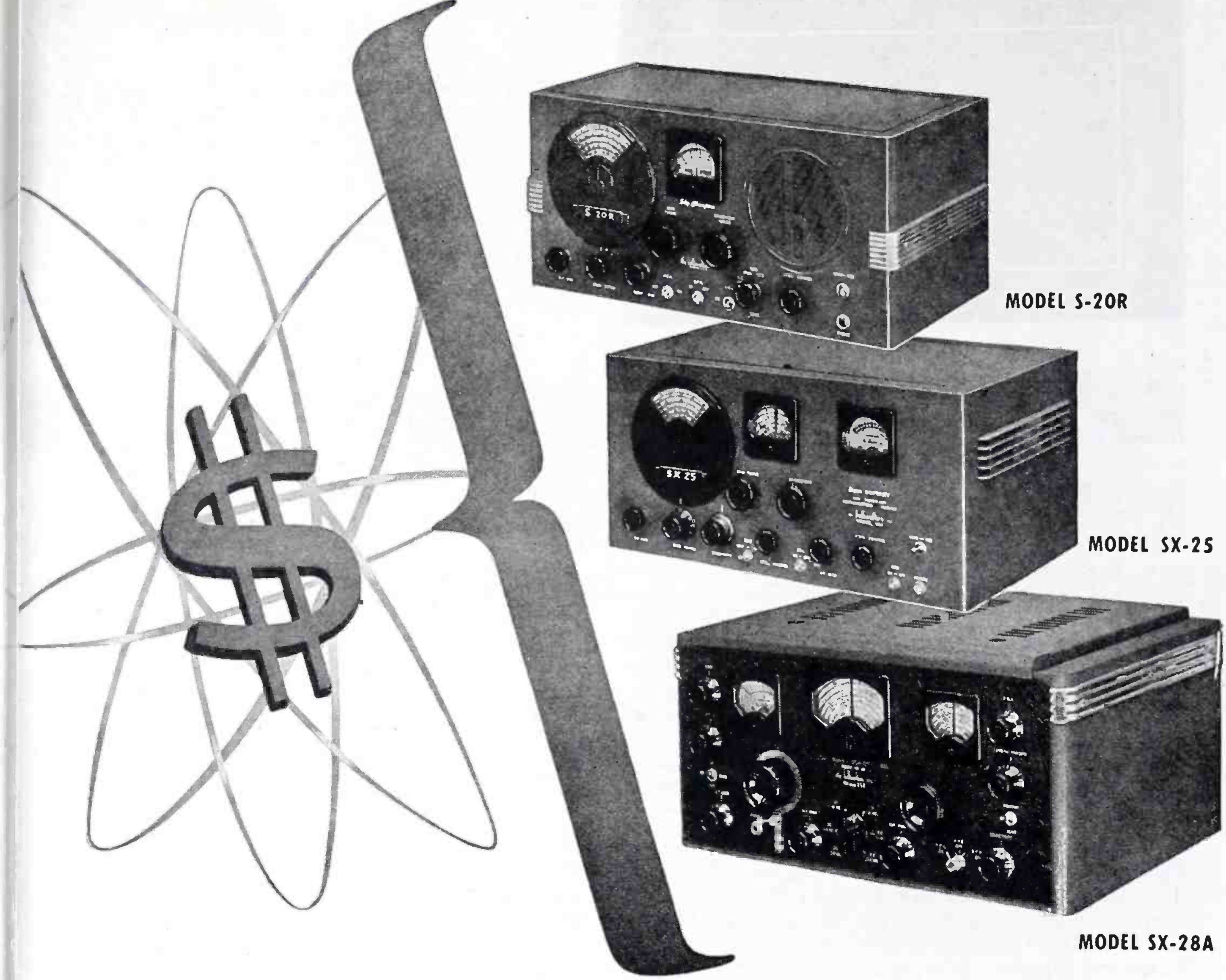
The operation of the linear time-base oscillator is based on the principle of controlled, recurrent relaxation of the electrostatic charge on a capacitor, under the condition that the capacitor be charged at a constant current rate in the period existing between the relaxations. In such a system, the charge on the capacitor is conveniently relaxed by conduction through a thyratron tube, this form of relaxation providing an approximately complete discharge of the charge on the capacitor in the smallest practical discharge time period. Further, the duration of the discharge is directly dependent on the thyratron characteristics.

Unlike the conventional vacuum tube, the thyratron tube conducts, regardless of the control-grid potential, continuously, once the control is driven positive with respect to the cathode. The only way in which the conduction may be stopped, once it is initiated by the positive swing of the control grid, lies in the reduction of the tube plate potential to a value less than the tube arc or conduction voltage drop, or in complete interruption of the thyratron-plate circuit. In commercial thyratrons, the anode-cathode arc-drop potential lies between 8 and 18 volts, and is dependent on the nature of the tube gas or vapor filling; whether it is one of the noble gases, such as neon, or mercury.

The function of the *2B4* thyratron in the linear time-base oscillator is well illustrated in the elementary linear time-base or relaxation-oscillation circuit of Fig. 1. Here, the thyratron is shown to be directly connected across the terminals of the timing capacitor, C_{13-18}. Since the control grid of the tube is maintained somewhat negative, the tube is not immediately conductive. Further, the plate voltage at which the tube begins to conduct is directly dependent on the negative grid voltage, and this, in turn, is so adjusted that the tube is conductive when the plate voltage rises to approximately 50 volts. If, however, the capacitor charge attains this latter potential, the tube breaks down and conducts, the conduction effecting a discharge of the charge on the capacitor until the capacitor voltage is less than the thyratron arc drop. Under this condition the tube ceases to conduct, since this final potential is insufficient to maintain ionization of the tube atmospheric gas, and therefore conduction of the discharge current.

The timing capacitor C_{13-18}, in Fig. 1, is continuously charged by the charging current available through the positive and negative terminals of the d-c low-voltage supply source. The charging current is limited by the timing control potentiometer, R_7, resistance. When the voltage of the capacitor being charged is small in comparison with the source voltage, the current flow through the capacitor and the series limiting, or timing, potentiometer, R_7, is relatively constant, and the capacitor charges at a relatively constant charge current rate. Hence, the rise in the capacitor terminal potential with respect to time is relatively linear, as is shown in the graph of Fig. 2. Further, the rate at which the

(*Continued on page* 36)



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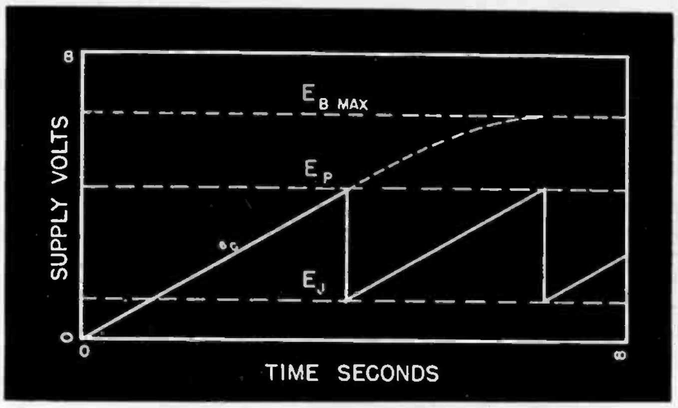

Fig. 2. Typical sawtooth deflection voltage wave produced by the linear time base oscillator shown in Fig. 1. The maximum voltage level attained by the wave occurs just before the relaxation of the capacitor charge at the point e_c and the minimum level is determined by the thyratron tube plate-cathode conduction drop characteristic, shown as E_J. Note that the voltage output of the oscillator is the voltage difference between the thyratron breakdown level and the conduction or arc-drop level.

timing capacitor is charged is directly dependent on the amount of series resistance interposed between the capacitor and the charge current source, e.g.,

$$t = RC \qquad (1)$$

where: t is the charging time in seconds, R is the limiting resistance in ohms, and C is capacitance, in farads. From equation *1*, we may determine that the capacitor charging time t may be readily varied by manipulation of the series resistance, R, since the timing capacitance, C, is fixed, or constant.

In Fig. 1 the timing capacitor C_{13-18} is constantly charged in series with the resistance of the timing control potentiometer, R_7. Therefore the potential across the capacitor eventually attains the potential at which the thyratron tube breaks down and begins to conduct; the time required to charge the capacitor is dependent on the resistance to which the timing control potentiometer slider arm is adjusted. Further, once the capacitor is discharged, and the thyratron tube ceases to conduct, the capacitor again begins to absorb a charge. Evidently, the charging and the subsequent relaxation of the capacitor, continuing as an unlimited series of operations, give rise to a fundamental waveform in which the frequency is dependent on the total time required to charge, then subsequently discharge, the timing capacitor, inasmuch as the frequency of the oscillations is, in reality, taken as the number of capacitor relaxations occurring within a given period of time. Thus, the frequency of the oscillations, in cycles per second, is

$$f = 1/t \qquad (2)$$

where: f is the oscillation frequency in cycles per second, and t is the total time elapsing for a single charging and relaxation of the timing capacitor charge in seconds.

In the linear time-base oscillation circuits presented, the timing capacitor is effectively short-circuited by the thyratron tube when the latter is conductive, no series limiting resistance being interposed between the tube and the capacitor. Further, it is known that the arc-drop potential present across the plate and cathode of the thyratron during conduction remains comparatively constant, regardless of the current conducted by the tube. The latter characteristic of the thyratron tube suggests that the volume of the gas or vapor contained in the envelope of the tube, which is ionized by the current conducted through the tube, is dependent on the intensity of the plate current flow. Inasmuch as this condition is actually present within the tube when the latter is conductive, it is evident that, neglecting the tube characteristic arc drop, the tube acts as a constant low resistance, or short-circuit, during the conduction period.

The timing period required for the complete discharge of the timing capacitor is extremely short, actually being of the order of a few microseconds, and is, therefore, negligible in the determination of the oscillation frequency. Hence, in equation *2*, the time may be taken as the required charging time of the timing capacitor, as given in equation *1*. For ease in the determination of the oscillator frequency, the two fundamental equations may be combined as a single statement, wherein the frequency is directly proportional to the reciprocal of resistance-capacitance product, or

$$f = 1/RC \qquad (3)$$

where: the frequency f is given in cycles per second, resistance R in megohms, and capacitance C in microfarads.

From equation *3*, we note that the linear time base oscillation frequency is indirectly proportional to the resistance at which the timing control potentiometer is adjusted, the capacity, in any instance, being fixed or constant. Briefly, the increase in the capacitor-charging rate through decrease of the timing potentiometer resistance results in an increase in the number of capacitor relaxations occurring within a given space of time.

The nature of the linear time-base oscillator-voltage output waveform may be seen from the graphical illustration of Fig. 2. Here the waveform is of *sawtooth form;* thus we have use of the common term, *sawtooth wave oscillator,* for the conventional relaxation oscillator. In Fig. 2, the initial slope of the output waveform is due to the rise in the timing-capacitor terminal voltage in the period between the relaxations of the capacitor charge. Once the capacitor charge potential e_c attains the thyratron tube breakdown voltage limit the thyratron conducts and relaxes the capacitor charge, the relaxation continuing until the voltage across the capacitor falls to, or below, the thyratron arc drop potential E_J. When this condition occurs, the capacitor again begins to absorb a charge, continuing the output voltage waveform.

In Fig. 1, it is shown that the voltage output from the linear time-base oscillator circuit is that existing between the plate of the thyratron and chassis, or the negative terminal of the low voltage d-c power supply source. We also note that this potential is always proportional to the capacitor potential, since the cathode bypass capacitor C_{20}, in Fig. 2,[1] serves to maintain the cathode resistor potential relatively constant at all times. Hence, in Fig. 2 of this paper we see that the oscillator-voltage output obtainable from the oscillator is the difference between the maximum charge potential and the thyratron tube arc drop potential E_J. The maximum capacitor potential is maintained at a low value to preserve the linear form of the oscillator output waveform. Accordingly the oscillator ouput voltage ranges between the maximum and minimum values of 30 to 15 volts. This condition is usual in the average commercial cathode-ray oscillograph.

Inasmuch as the linear time-base oscillator output potential is insuffi-

(*Continued on page* 54)

[1]SERVICE; September, 1945.

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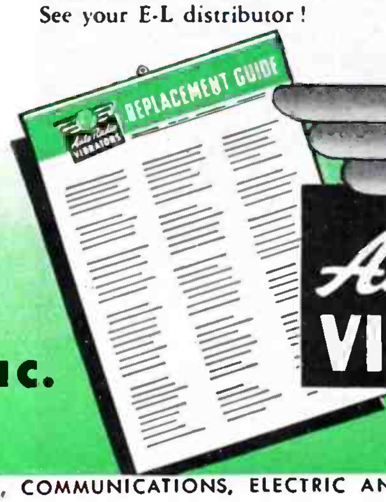

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INPUT CIRCUITS

[*Part Two*]

by L. E. EDWARDS

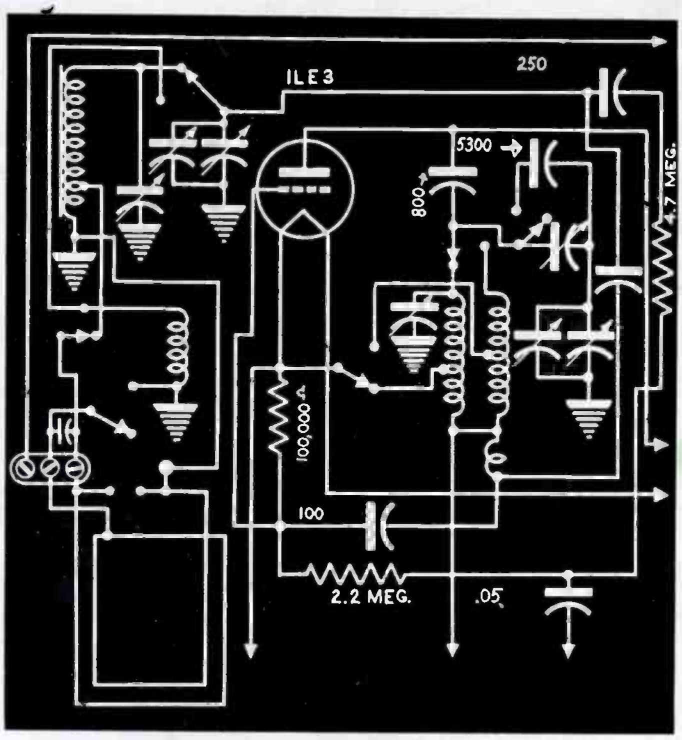


Fig. 1. Input circuit of the Philco 42-853. The tapped loop permits the use of an external antenna coupled at the tap. In addition, the tapped portion is used for short-wave pickup. (*See page 51, September* SERVICE *for complete circuit analysis.*)

AUTOMOBILE receivers require special treatment in the antenna circuit to obtain a maximum signal strength and a minimum amount of vibrator and ignition pickup. Loop antennas are unsatisfactory unless operated remotely in the clear. Such operation is too complicated and too expensive. Thus vertical rods are universally used as antennas. Because the antenna is very short, considering the wavelengths being received, the coupling must be very close and the antenna transformer must be very efficient. A gain of 10 to 30 is usual in the antenna coil.

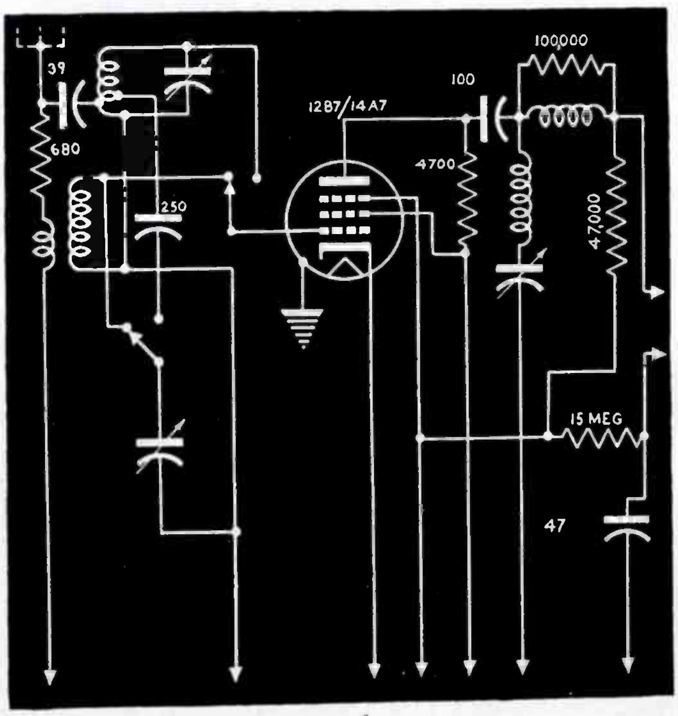
In Fig. 3 we see a typical auto set input. In this circuit, Lafayette model BB9, an iron-core antenna transformer with separate taps for matching a low- or-high capacity antenna is used.

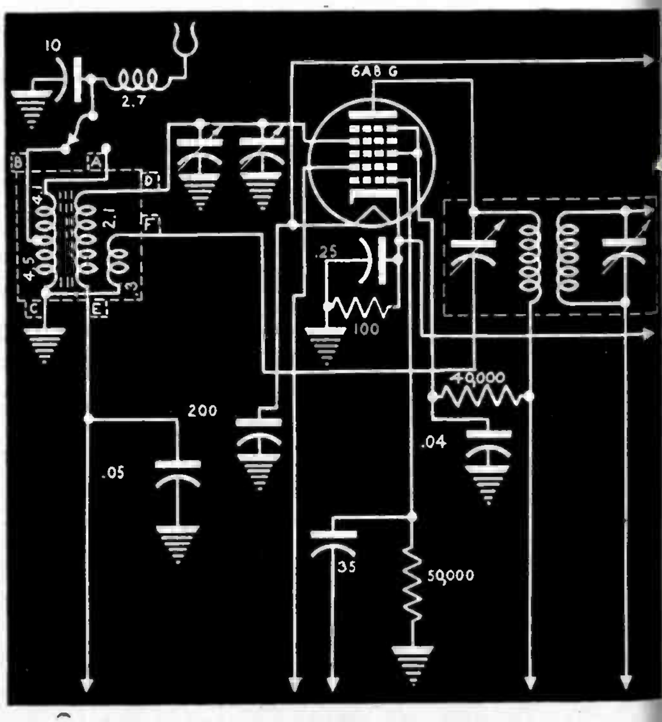
A small loading coil in series with the antenna acts as an r-f choke for high-frequency interference, particularly for the ignition system which has a maximum output of between 40 and 60 mc. A Faraday screen is sometimes used for the same purpose. This is a shield without closed loops which is placed between primary and secondary of the antenna transformer. This is very effective in preventing capacity coupling which is responsible for most of the ignition pickup. The transformer is shielded, quite important in limiting vibrator interference. A 10-mmfd by-pass capacitor also helps to eliminate high-frequency interference at the low side of the antenna choke. The transformer contains a tertiary winding which is connected to a 6A8 plate through a small capacitor for feedback.

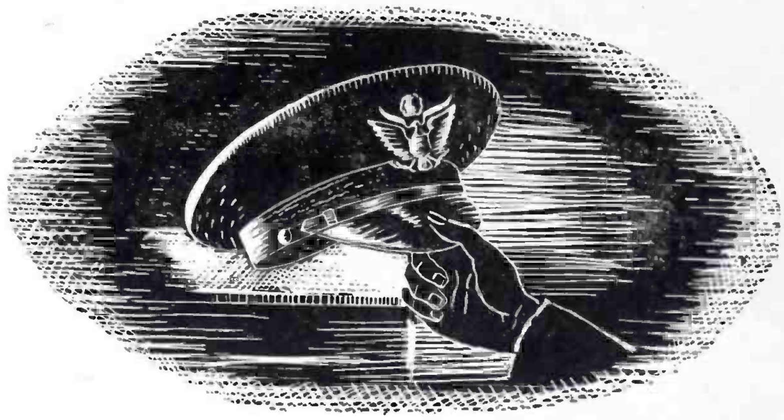
Another departure from conventional loop antennas is necessary in some permeability-tuned receivers because it is impractical to use iron in the field of a loop. In Fig. 4 we see one version

(*Continued on page* 40)

Figs. 2 (below left) and 3 (below right). In Fig. 2 appears the dual-loop system used in the G.E. L-642. A d-p-d-t switch is used for band-switching. (*A complete analysis of this circuit appears on page* 52, *September* SERVICE.) Fig. 3 A typical auto set input; Lafayette BB9. An iron-core transformer is used in the antenna circuit.







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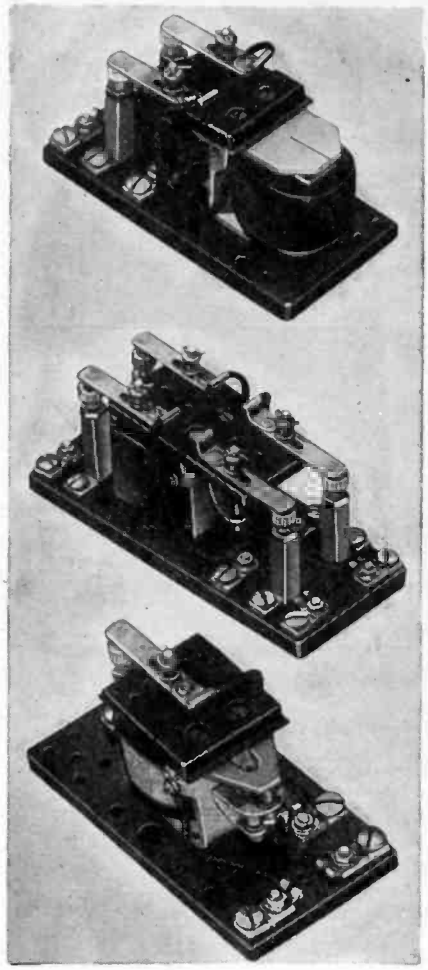

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INPUT CIRCUITS

(*Continued from page* 38)

of this type input, Detrola model 421. A plate antenna is used with high-impedance external-antenna capacity coupling. The plate consists of a large piece of foil placed in the rear of the cabinet while the coupling capacitor has a small electrode having an effective capacity of 2 to 5 mmfd. This coupling system is critical, a little excess introducing annoying interference, hum modulation, etc.

It is possible to use a type of low-impedance loop in a permeability-tuned system by simply putting the loop in series with the tuned coil, but the pick-up is poor. To permit a normal tuning range, the loop inductance must be held to a very low value which limits either the loop size or the number of turns, which in turn limits the pick-up. Also the permeability tuned coil must be of better quality with less distributed capacity than a standard coil. The circuit of Figure 5, Belmont model 533, is similar to the Detrola, having pe[rmeability] tuning and an antenna pla[te]. Here, however, the plate is isolat[ed] from the input grid by a 300-mm[fd] blocking capacitor. The external a[n]tenna is capacity coupled at a low i[m]pedance point at the low side of t[he] antenna coil and across an 800-mm[fd] capacitor. The 100-mmfd series capac[i]tor which favors the high frequenci[es] compensates for the loss in high fr[e]quency due to the shunting effect [of] the 800-mmfd capacitor. A 200,00[0] ohm grid leak also shunts the antenn[a].

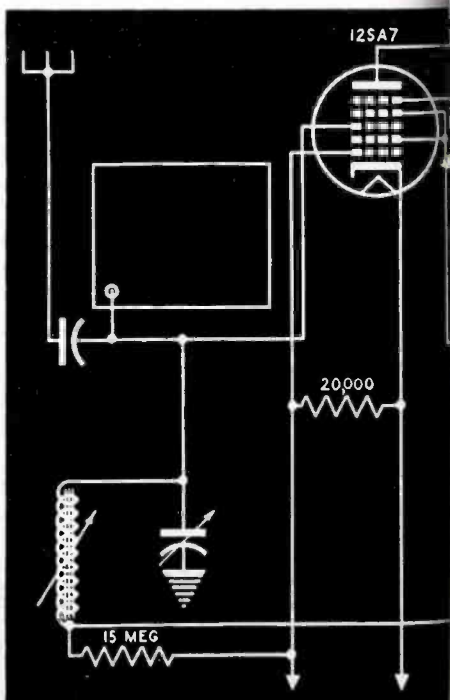
Permeability tuning will be featur[ed] in many postwar receivers, for it offe[rs] higher-Q tuned circuits with mo[re] gain and increased selectivity, spa[ce] economy, simplicity of constructio[n], simple alignment procedure and th[e] elimination of microphonics and con[tact] difficulties.

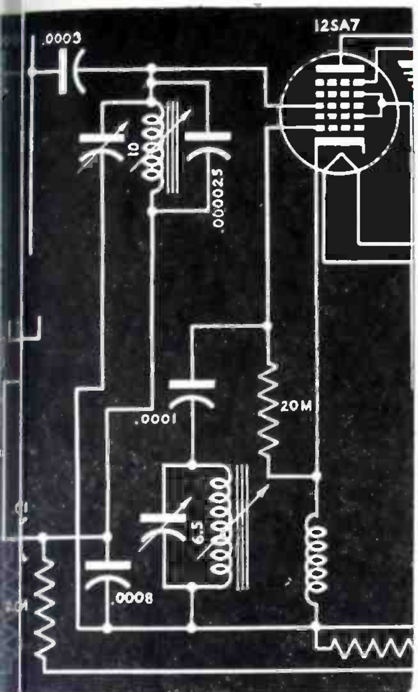
Notes

Electrostatically shielded loop[s] found in some of the better type re[ceivers], develop a signal voltage fro[m] the electromagnetic field only. Henc[e] its directional effect will be ver[y] marked, the directional pattern bein[g] a figure 8 with two sharp minim[a] when the loop is placed well awa[y] from other objects. Some unshielde[d] loops also have sharp minima, particu[larly] those mounted away from th[e] chassis. Chassis absorption tends t[o] destroy the directional effect.

Low-impedance loops tend to be

Fig. 4. A plate-antenna input system; Detrola 421. The coupling capacitor has an effective capacity of 2 to 5 mmfd. The plate is usually made up of a large piece of foil placed in the rear of the cabinet.





...5. Antenna-plate and permeability tuning ...ng system of Belmont 533. In this circuit the ...le is isolated from the input grid by a 300-...mfd blocking capacitor. The external antenna ...s capacity coupled at a low-impedance point at ...low side of the antenna coil and across an 800-mmfd capacitor.

...re directional than high-impedance ...its because they have less capacity ...kup which would minimize the di...ionality. Marked directional effects ...y be both obnoxious and useful; the ...mer when the receiver must be ...ed frequently when changing sta...is; the latter when some sort of ...n-made interference can be elimi...ted by setting the loop minimum to...ward the source of interference.

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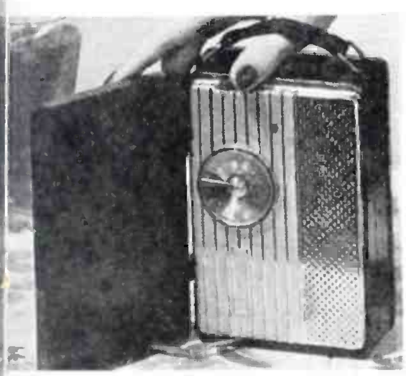
POSTWAR RECEIVERS



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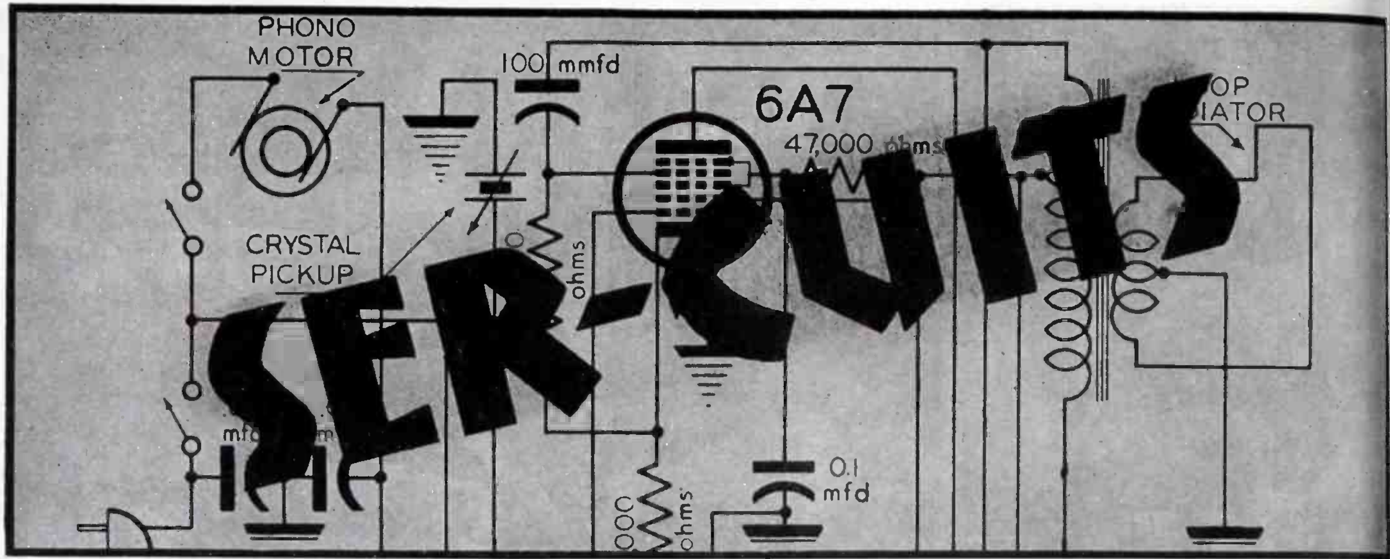

ALTHOUGH many prewar portables were quite basic in pattern, several types did include many unique features. The 3-tube Motorola shown in Fig. 1, is an example of this special design format. Tubes used, for instance, included a 1A7GT with permeability tuning, a 3A8GT diode-triode-pentode i-f, detector and a-f, and a 1Q5GT power amplifier.

The sensitivity at 600 kc is about 15 microvolts. A rod antenna having a capacity range of 10 to 200 mmfd can be accommodated by an antenna trimmer.

by HENRY HOWARD

The oscillator circuit is a shunt-fed Colpitts with the plate at one end of the coil and the grid at the other. No tap is used but a capacity voltage divider consisting of a 170-mmfd capacitor at the grid end and a 275-mmfd capacitor at the plate end, places the grounded filament somewhere near the center of the coil (from a potential standpoint). These capacity values are nominal since they are variable trimmers. A 65-mmfd trimmer-type grid capacitor is combined with the grid trimmer. The grid leak has a value of 220,000 ohms.

The pentode section of the 3A8GT serves as the i-f amplifier and is supplied with grid-leak bias via a 5.6-megohm resistor in series with the secondary of the i-f transformer at the low end, and bypassed by a .01-mfd capacitor. A 470,000-ohm resistor is shunted across the i-f primary. The transformer coupling the pentode to the diode detector has a similar re-

(*Continued on page* 44)

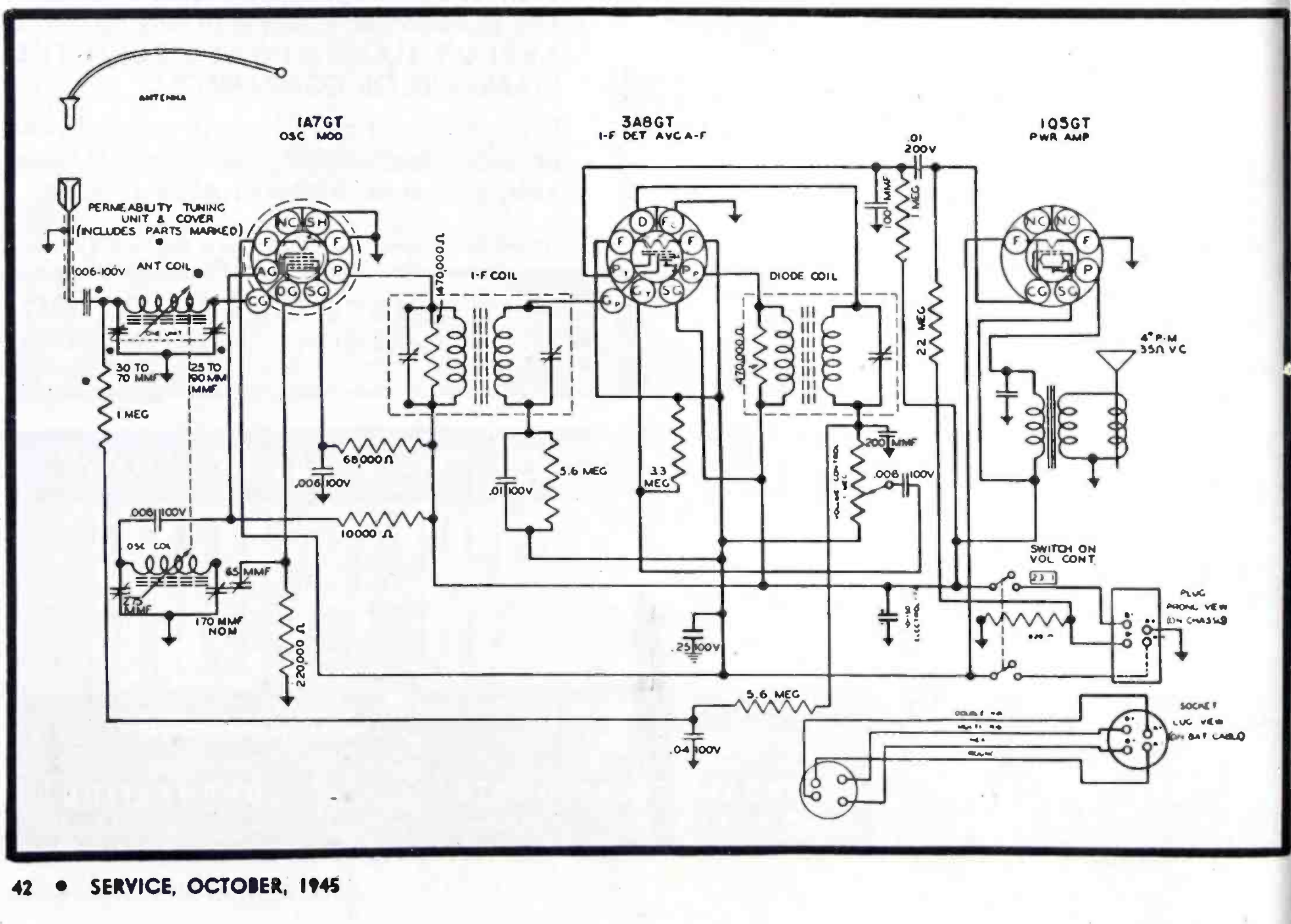

Fig. 1. Three-tube Motorola B-150, featuring a 3A8GT diode-triode-pentode as an if-detector-avc and audio amplifier.

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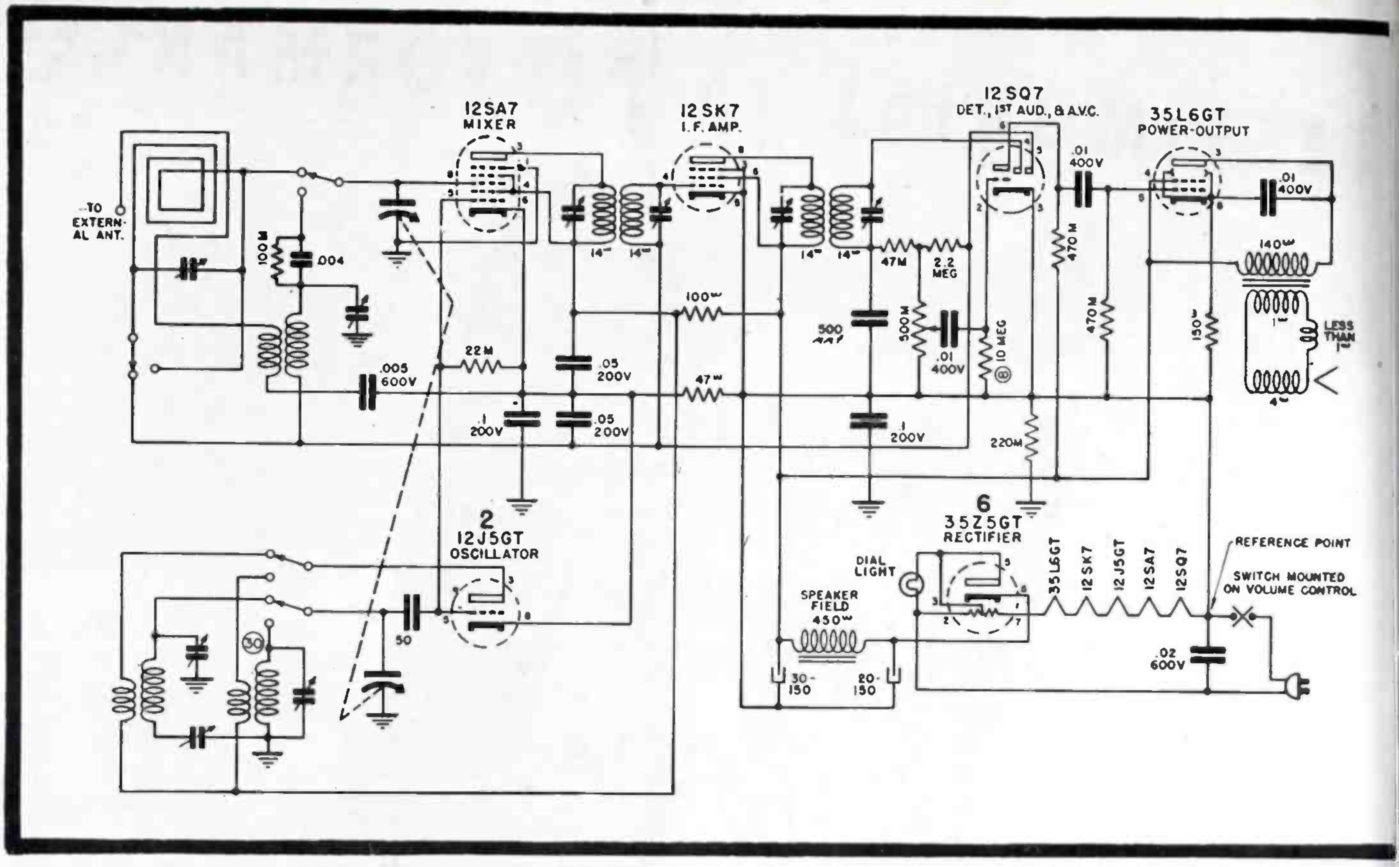


SER-CUITS

(*Continued from page* 42)

sistor load, but the primary is untuned. Avc bias is fed to the 1A7 modulator only. The 3A8GT filaments are run in parallel to accommodate a 1.5-volt *A* battery.

The audio amplifier consists of the triode section of the 3A8GT with a 3.3-megohm grid-leak bias feeding a 1Q5GT beam tetrode which derives its bias from a 820-ohm resistor in the *B*— leg of a 90-volt *B* battery. A 10-mfd 150-volt electrolytic from *B*+ to ground serves as an audio bypass around the *B* battery and 820 ohms.

Fig. 2. Farnsworth BT-22 two-band receiver with a separate 12J5GT oscillator for grid-to-grid coupling to a converter.

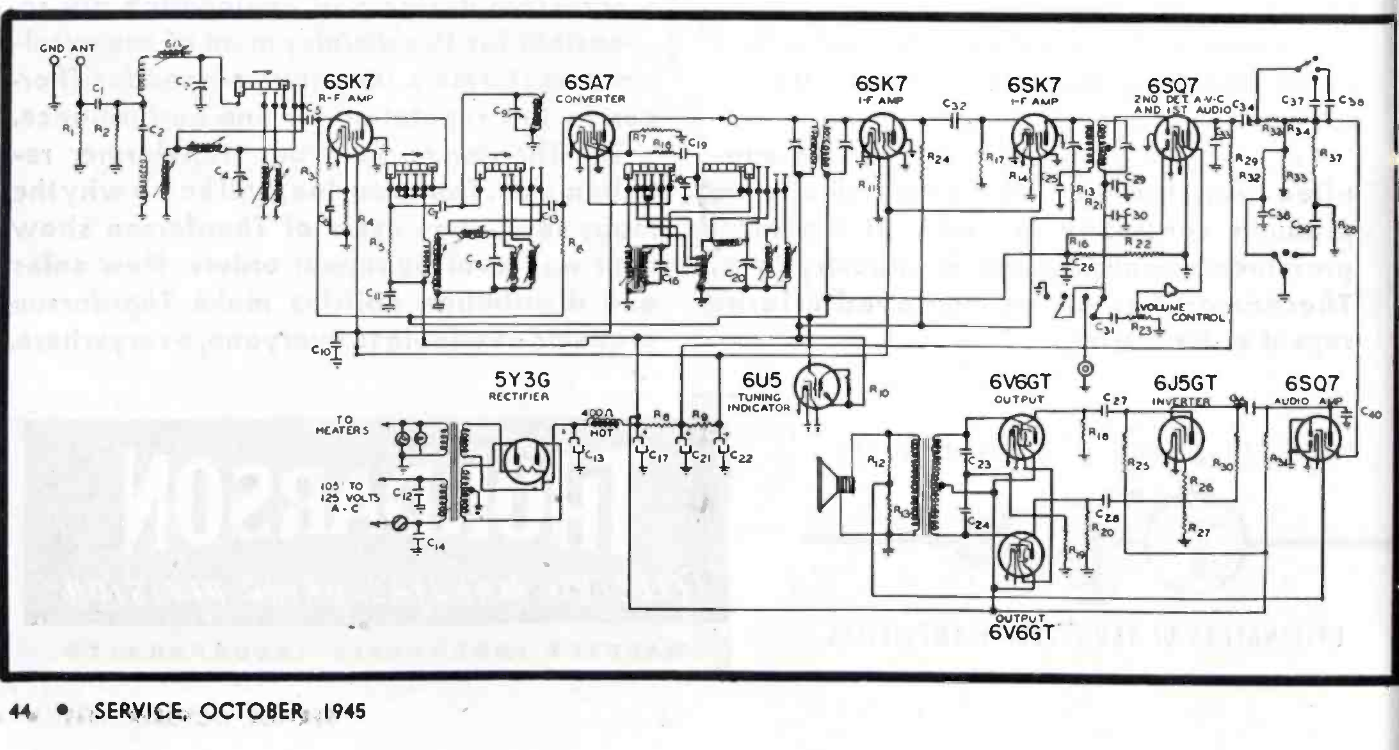
Farnsworth BT-22

In Fig. 2 we have a 2-band receiver with several interesting features. This model, uses a separate 12J5GT oscillator with grid-to-grid coupling to a converter.

The bandswitching system is quit[e] unique. The signal grid (grid 3) o[f] the 12SA7 is switched from th[e] broadcast loop to a short-wave an[-]tenna transformer through a 100,000[-]ohm resistor bypassed by a .004-mf[d] capacitor. The external antenna i[s] connected to a single-turn loop pri[-]mary which returns to chassis throug[h] the short-wave primary, a .005-mf[d] capacitor and the avc bus. Anothe[r] arm of the bandswitch removes th[e] loop from the avc bus and shorts it t[o] prevent absorption in the short-wav[e]

(*Continued on page* 52)

Fig. 3. Coronado C 1100 eleven-tube five-band model using permeability tuning and shunt coils for bandspread tuning. See page 53 for parts list.



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Harry Kalker
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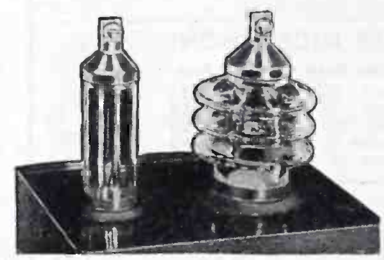

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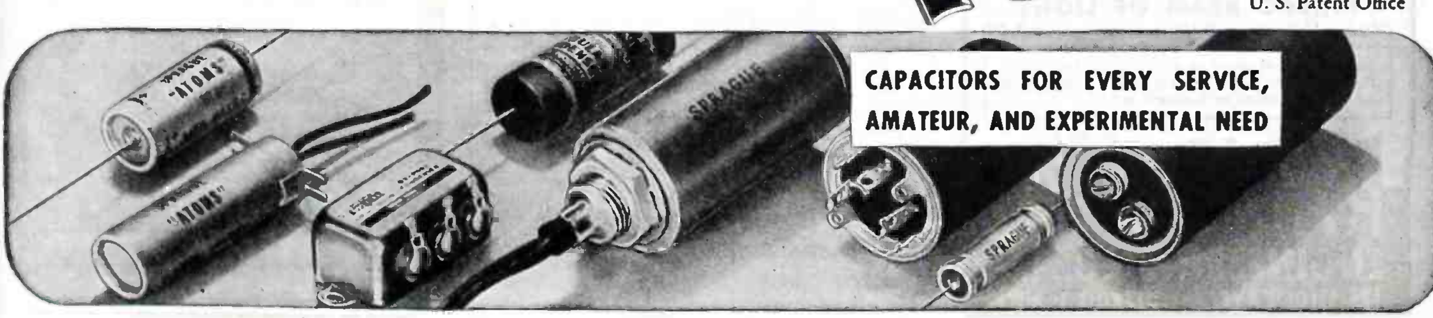

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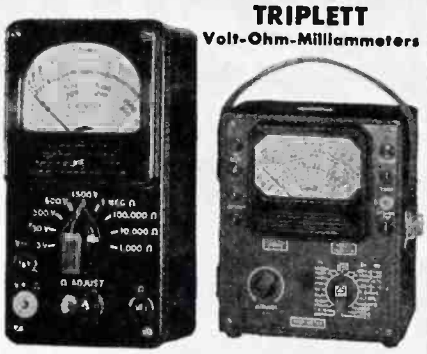

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33D	Dynam.	20'	-54	14.70

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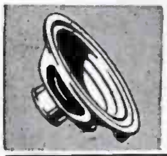

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VOLUME-TONE CONTROLS

(*Continued from page* 31)

may be used, depending on the required resistance values and taper. The reason for using a *dual* volume control is that due to the particular type of control circuit employed, dual control of two different circuits simultaneously is necessary in order to obtain smooth, even and complete attenuation of all signals.

Control Applications

During the transition period of tube and receiver circuit development, some receiver manufacturers used dual or twin controls, usually to control antenna and bias voltage, antenna and screen voltage, antenna and audio, cathode and audio, etc., simultaneously, by operation of a single control shaft. The most popular use was for antenna control by one section and screen-grid control by the other section, the customary values of maximum resistance employed in this case being 10,000 ohms and 100,000 ohms respectively.

Dual control units are commonly employed where the following combinations of control circuits are used:

(*1*)—Antenna shunt and bias voltage (volume control).

(*2*)—Antenna shunt and screen voltage (volume control).

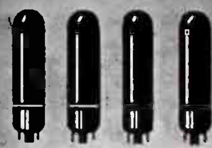
(*3*)—Grid shunt and cathode control (volume control).

(*4*)—Audio shunt in push-pull audio (volume control).

(*5*)—R-f shunt, screen voltage or audio shunt (volume control), and tone.

(*6*)—Audio shunt (volume control), and tone compensation.

Most makes of replacement controls are constructed so that they can either be used separately or assembled in tandem with a common shaft to form dual or triple units to fit any particular need for the simultaneous control of two or more separate circuits. Some makes of controls are so designed that it is possible to even combine wire-wound and composition-element controls together in tandem, where this is necessary to fit a particular control need. Standard switches may also be attached to the outer end of the tandem assembly where needed. The manufacturers of those makes of single controls that are not adaptable for dual mounting usually provide dual- and triple-type controls already made up in combinations of resistance size



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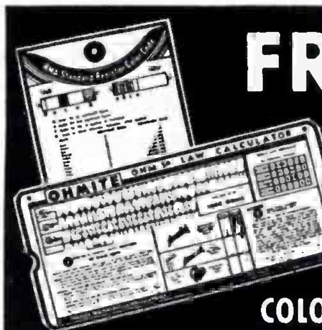

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and tapers to meet most of the popular requirements.

Fig. 5 illustrates a single control, dual-control unit and a triple unit, all made up from the same make and type of control.

(To Be Continued)

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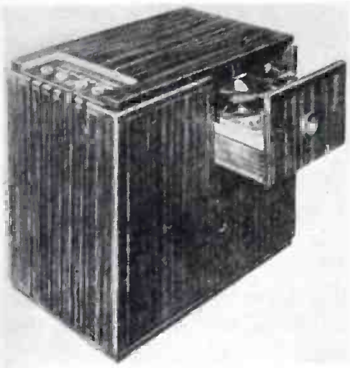
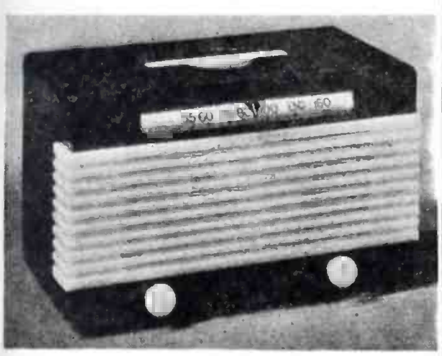
POSTWAR RECEIVERS



Above, ECA model 121, 7-tube radio-phono combination for 10- and 12-record operation; 8" speaker provided. Below, ECA model 106, 5-tube radio-phonograph for 10- and 12-record use; has built-in lop.

Below, Garod 6A1 a-c/dc super with untuned r-f stage.



Below, John Meck (left) and Henry Hutchins (right) with Meck 5-tube supers, demonstrated at recent press conference in New York City, that are sold through parts distributors.

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COMMUNICATIONS RECEIVERS

(*Continued from page* 13)

form, with no transmitted audio modulation. The tone of the received signal is controlled by varying the frequency of the b-f-o so that the beat note lies within the audio range.

A typical b-f-o circuit is shown in Fig. 1, Hallicrafters SX 28. This circuit uses a 6J5 in a Hartley oscillator. The 25-mmfd tuning capacitor is brought out to the panel for control of the beat note. The output of the oscillator is coupled to the detector, where it mixes with the i-f signal. In this particular receiver, coupling is accomplished by means of a pair of twisted wires, about 2 or 3 twists, which accounts for the 2 mmfd of coupling capacitance. Any greater coupling would load the detector so that weak i-f signals would not be heard. The b-f-o *on-off* switch is used to cut off the plate supply to the b-f-o when it is not in use.

Fig. 2 shows the b-f-o used in the National NHU. Here, a pentode is used in a Hartley oscillator, with the output coupled to the second detector through a special 2-mmfd capacitor; note that the b-f-o *on-off* switch shorts out the oscillator coil. The rest of the circuit is essentially the same as that in Fig. 1.

Fig. 3 shows the b-f-o used in the R.M.E. 41-43. A 7B6 is used as a combination second detector and b-f-o, with the oscillator signal fed to the low side of the grid input of the second i-f, through a 100-mmfd capacitor. This large value of coupling capacitance is permissable, since the LC circuit of the i-f stage acts as an effective blocking system for the b-f-o signal. Thus, only a small portion of the b-f-o signal reaches the grid of the tube. The grid return of the 7B7 second i-f is unbypassed so as not to short out the b-f-o signal. The b-f-o *on-off* switch is in the *B* supply to the oscillator.

All b-f-o circuits are characterized by low-plate and screen-grid voltages. This is done to prevent any of the oscillations from entering the front end of the receiver, or any other place where it can create trouble by causing unwanted beat notes. The circuit must be well shielded for the same reason. Alignment is similar to that followed for i-f systems. Frequency stability of the b-f-o is usually good, since air capacitors are used for tuning. The dial which controls the b-f-o is usually marked 0-10. In aligning, the zero mark is taken as the point of zero beat. An i-f signal is fed into the receiver, and the b-f-o trimmer is adjusted for zero beat at zero on the dial. Advancing the b-f-o control will then produce an audio signal in the output of the receiver.

Coupling may be adjusted by using both a weak and a strong unmodulated i-f signal, to check if beat notes can be produced with both types of signal.

•

U. S. ARMY STATION IN ITALY

Control room of the Caserta AES radio station in Italy through which transcriptions, records and live programs are piped for troops in the Mediterranean Theatre of Operations.
(*Courtesy U. S. Signal Corps*)

HOTOELECTRIC CELLS

(*Continued from page* 15)

rces, and are used with low-value stances.

Electron-Multiplier Photocells

he electron-multiplier cell is not ely used at all. Essentially, this is a multi-electrode photoemissive t with the principle of secondary ssion. In a typical cell we have en electrodes, a cathode, nine spe- plates called dynodes, and the ular plate. The dynodes are curved al plates coated on one side with ixture of chemicals. This coating ble to emit electrons when a fast ving electron strikes it. The effect ermed secondary emission.

he RCA 931-A is a typical elec- n-multiplier cell. The dynodes have her potentials as the steps are in- ased. Differences of 100 volts be- en dynodes may be used. As the trons leave the cathode and move a dynode, secondary electrons are tted and may go to another dynode ere still other electrons due to ondary emission are released. The ct continues as the electrons move m dynode to dynode. In this way the ct of a small original electron vement is greatly amplified. Cur- t amplification of as much as 200,- times may be obtained using suit- construction. Cells of this type, ever, require inconveniently high, somewhat dangerous, operating ages. A circuit showing the con- ions for a typical setup appears in . 4.

•

M TUNING INDICATORS

(*Continued from page* 18)

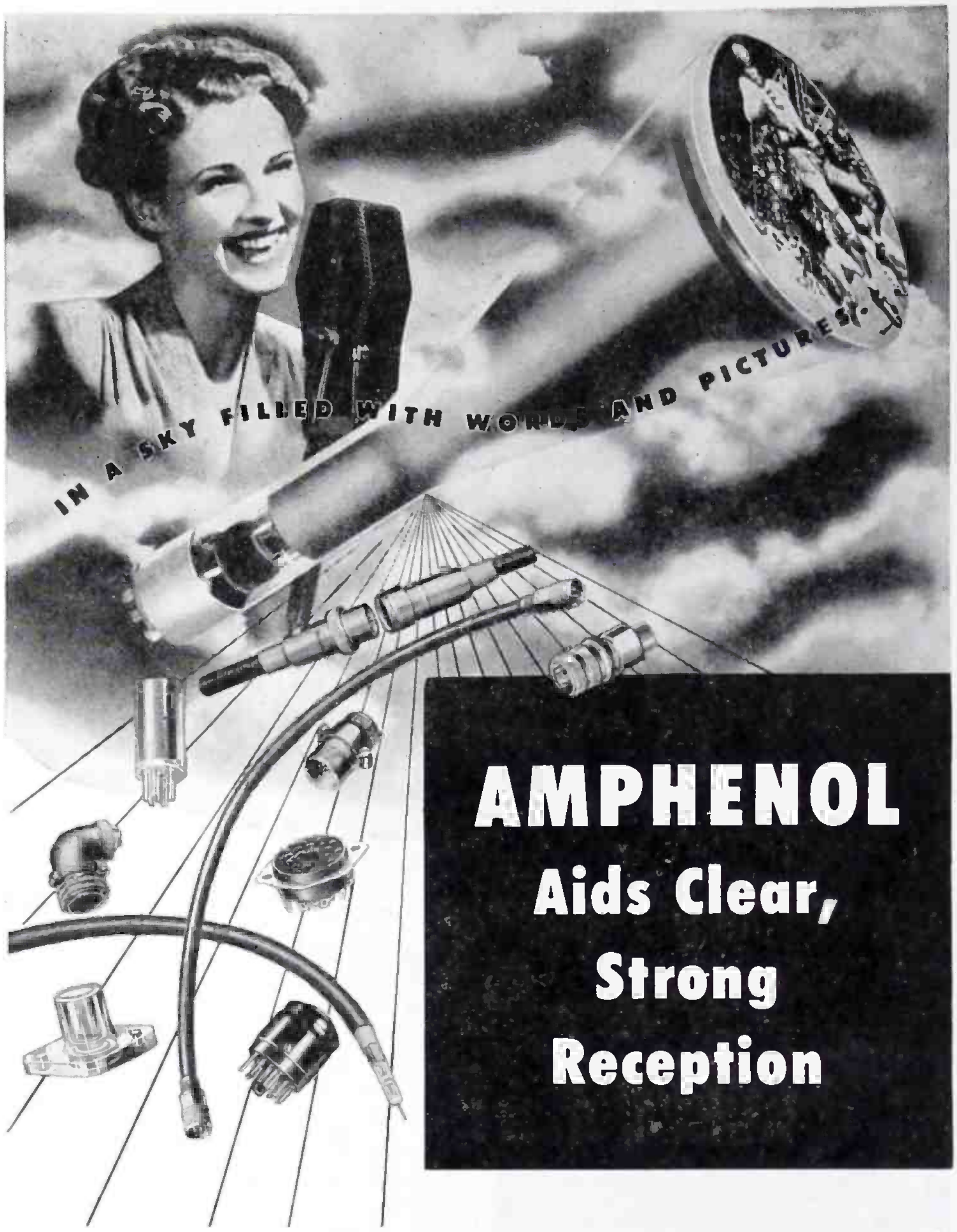
ilable voltage for the 6U5G grid.

Espey 2170

ig. 7 shows the indicator circuit d in Espey model 2170. This sys- uses a combination of the limiter discriminator systems, and is an rovement on either the limiter or discriminator systems, since it mits sharper tuning.

nitially, the eye is open. Upon ing in a signal, two actions occur. e limiter portion acts in conven- nal manner; as the signal is tuned the voltage between points *A* and ncreases, with point *B* positive with tion to point *A*. The discriminator tion of indicator system acts as orm of feedback, in that it supplies ancelling voltage, developed in op- site polarity to the limiter voltage

(*Continued on page* 50)



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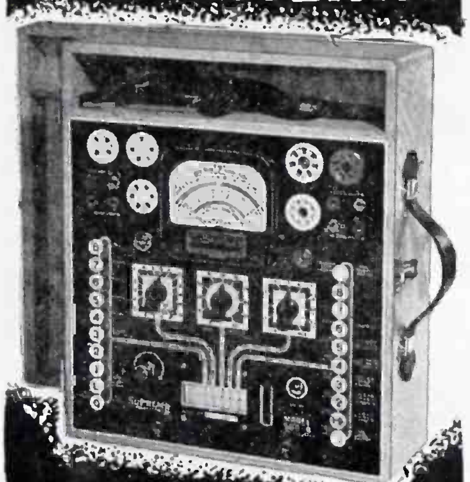
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AC VOLTS: 0-5-10-50-250-1000
OUTPUT VOLTS: 0-5-10-50-250-1000
OHMMETER: 0-200-2000-20,000 OHMS 0-2-20 MEGOHMS
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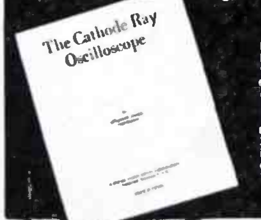

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(Continued from page 49)

across R_1 between *A* and *C*. The eye-control tube plays an important role in this action. As the desired signal is approached, point *E* assumes a positive voltage relationship to point *D*. D_2 of the control diode therefore conducts, and creates a positive voltage across R_1, which cancels part of the voltage across R_2, and tends to keep the eye open. As the center frequency is reached, the voltage between points *D* and *E* becomes zero, and neither diode conducts. Since no bucking voltage is created across R_1, the full effect of the voltage across R_2 is imposed on the grid of the 6U5G, and the eye closes. As the receiver is tuned away from the signal, point *D* becomes more positive than point *E*. Control diode D_2 then starts to conduct, creating a canceling voltage across R_1, and opening the eye. Note that in this system we have the same voltage effect when coming into the signal or going away from it, since both create positive voltages.

Another variation of this system combines the biased indicator of Fig. 4 with the eye control system of Fig. 7 to produce a closed eye version without overlapping. The limiter voltage is omitted.

The action of the eye may be used as a guide in the servicing of f-m receivers. The width of swing of the eye is indicative of the strength of the signal being received. Where the eye is used in a balanced system such that it swings twice through the tuning cycle, the alignment of the receiver is indicated by the uniformity of the two swings. Where the two swings are not uniform, an unbalanced i-f or discriminator is indicated.

A hazy edge on the two sections of the fluorescent target is due to a-c in the grid voltage. The usual cause is an open filter capacitor in the indicator's grid supply. If the a-c is being picked up in the lead to the indicator tube, a .1-mfd capacitor from the indicator grid to ground will usually cure the trouble. The addition of a small decoupling resistor in series with the grid lead will often help, if the capacitor alone is not effective. Aging of the tube is indicated by a fading of the fluorescent image in which case the tube should be replaced. An adjustment, usually found in the rear of the receiver, controls the cathode bias of the indicator tube. This control is used to set the two halves of the indicator eye so that they meet. Some idea of receiver sensitivity may be gained by feeding a signal generator into the antenna input and noting at what input voltage the eye closes.

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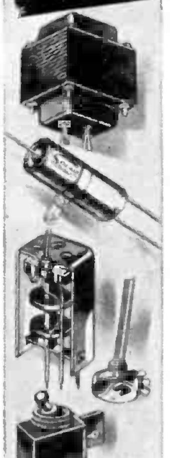
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UNLABELED AMPLIFIER TERMINAL CHART

(See Page 20 for Chart)

THERE are many models of popular commercial p-a amplifiers with unlabeled terminals on inut and output speaker plugs, and ockets and terminal strips. In most ases the work of testing or repairing ich amplifiers cannot proceed until iany hours have been spent tracing ut the wiring to such terminals or unting through the service literature overing the amplifiers.

To solve this problem the unique hart shown in Fig. 1 was recently repared by the Van Sickle Radio upply Company. The chart shows nmarked amplifier connections and ther necessary data for several of the iost popular makes and models of p-a mplifiers. *Alfred A. Ghirardi*

•

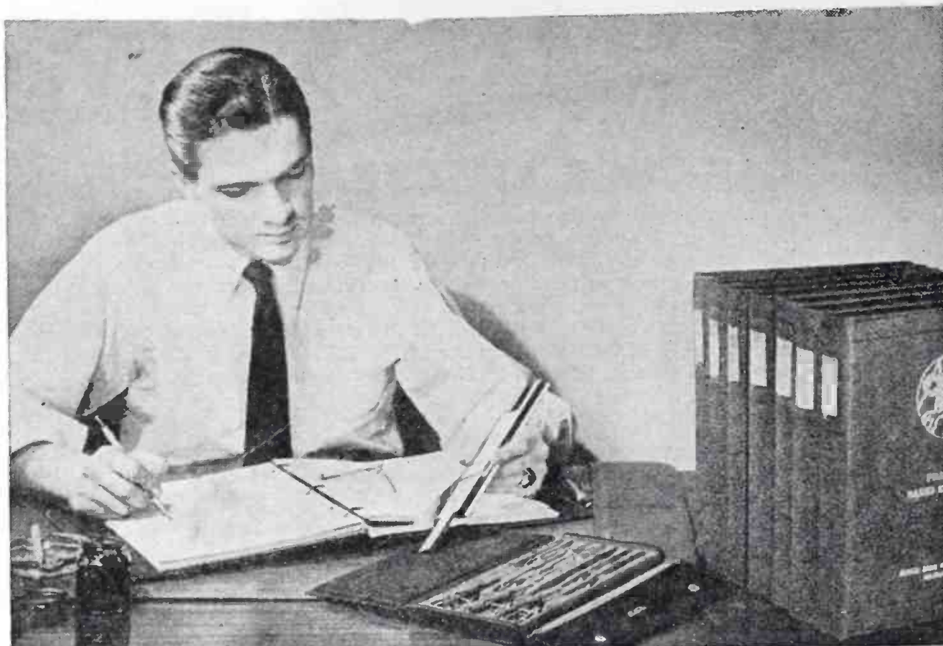
'WO-STAGE RECORD PLAYER

(See Front Cover)

A 2-STAGE record player, Emerson GL-457, featuring a rumble attenuator, is shown on this ionth's cover. The rumble attenuator in the form of a low-pass filter inrted in a degenerative link. Tracing ie circuit from the pickup, which is a ystal type, we come to a series jualizer consisting of a 2.2-megohm sistor shunted by a 220-mmfd caacitor which is connected to the high de of the volume control. A degenrative voltage originating in the peaker voice coil circuit is also fed the volume control. This voltage modified by a *T*-type filter (47,000 hms, .02-mfd and 1-megohm shunt) that only the bass notes of the proram pass through to the volume ontrol and then to the amplifier. This duces the net bass amplification hich practically eliminates rumble.

In the amplifier we have a grid leak iased 6SQ7 feeding a 25L6 with a ne control across the output. A 00-mmfd capacitor shunts the outut of the 6SQ7. Current degeneraon is provided for in the power stage rough the absence of a bypass caacitor across a 150-ohm bias resistor. he tone control consists of a .05ifd capacitor in series with 2200 hms, with a switch across the resistor.

The power supply consists of a 25Z6 vith paralleled elements and a 2tage resistance filter. The speaker eld is a shunt type connected direct to the rectifier output; the 25L6 late is connected to the first filter ection and the output screen grid and rst audio to the second filter section. he heaters are series connected with ballast resistor tube.



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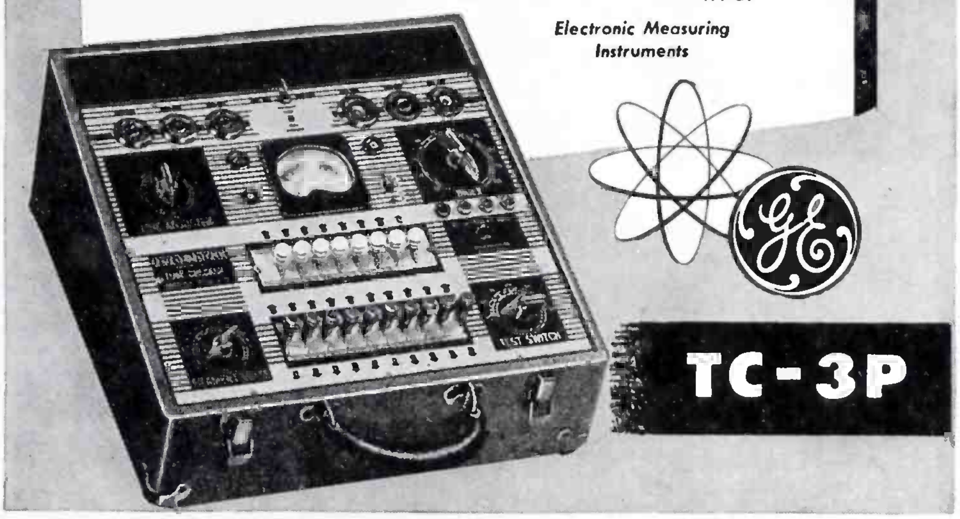


SER-CUITS

(*Continued from page 44*)

band. This also permits the loop to aid short-wave pickup through the loop primary turn when no external antenna is employed. The oscillator grid and plate are switched to two oscillation transformers in a conventional manner.

Coronado C1100

An 11-tube, 5-band receiver, Coronado C1100, featuring permeability tuning and shunt coils for bandspread tuning is shown in Fig. 3. The loop circuit contains an iron-core adjustable loading coil, a .002-mfd series capacitor and the low-impedance primary of the short-wave transformer. The external antenna is connected in an unusual manner; fed to the low side of the loop through a high-pass filter consisting of a .0005-mfd capacitor and two 25000-ohm resistors. This is primarily a low-impedance capacity coupling. On the four bandspread short-wave bands, the antenna is connected to the antenna transformer through a .002-mfd series capacitor. The permeability tuned coils are connected in series or parallel with the secondary of the transformer. Thus one primary serves to couple the various coils for all bands.

Coil Connections

For the 6-mc band, a coil is connected in series with the secondary; the 9-mc band uses the secondary only; the 12-mc band uses one shunt coil across the secondary and the 15-mc band uses another. In the latter three positions, the series coil is shorted to prevent absorption. These various tuned circuits are all coupled to the r-f amplifier grid through a .0005-mfd capacitor. A similar arrangement for bandswitching is used to couple the r-f amplifier to the converter with a single primary serving all short-wave bands. On broadcast, a 5,000-ohm plate resistor is used in combination with a 10-mmfd coupling capacitor to the converter grid and permeability tuned circuit.

Oscillator Frequency Control

In switching the oscillator frequency, similar series and shunt coils are employed but it is necessary to increase the feedback as the frequency is increased to obtain sufficient output. This is accomplished by a selection of three taps on the main oscillator coil. Two 6SK7 i-f amplifiers are used with resistance coupling between the stages.

The detector i-f transformer has a tap for connecting the diode to decrease the loading, or increase the Q of the transformer.

The audio amplifier consists of a 6SQ7, a second stage 6SQ7, 6J5 inverter and push-pull 6V6s. The first stage uses a 1.25-volt bias cell, the second resistance bias from a potentiometer in the voice coil circuit which feeds a degenerative voltage to the second stage cathode. Separate treble and bass-tone controls are located at the output of the first audio, the treble shunting series resistors with small capacitors to emphasize highs. (.0003 mfd and .000125 mfd) while the bass control connects shunting resistors or combinations of shunt resistors and capacitors.

•

List of parts for the Coronado 1100 diagrammed on page 44.

RESISTORS

R1	25M ohm—⅓ w.
R2	25M ohm—⅓ w.
R3	1 megohm—⅓ w.
R4	250 ohm—⅓ w.
R5	5M ohm—⅓ w.
R6	1 megohm—⅓ w.
R7	25M ohm—⅓ w.
R8	6M ohm—2 watt
R9	10M—2 watt
R10	1 megohm in tuning indicator cable
R11	700 ohm—⅓ w.
R12	10M ohm—⅓ w.
R13	1500 ohm—⅓ w.
R14	1500 ohm—⅓ w.
R15	2M ohm—⅓ w.
R16	1 megohm—⅓ w.
R17	100M ohm—⅓ w.
R18	500M ohm—⅓ w.
R19	250 ohm—2 watt
R20	500M ohm—⅓ w.
R21	100M ohm—⅓ w.
R22	400M ohm—⅓ w.
R23	500M ohm volume control and line switch (S4)
R24	15M ohm—⅓ w.
R25	50M ohm—⅓ w.
R26	5M ohm—⅓ w.
R27	50M ohm—⅓ w.
R28	500M ohm—⅓ w.
R29	250M ohm—⅓ w.
R30	500M ohm—⅓ w.
R31	250M ohm—⅓ w.
R32	40M ohm—⅓ w.
R33	150M ohm—⅓ w.
R34	350M ohm—⅓ w.
R35	250M ohm—⅓ w.
R36	50 ohm—⅓ w.
R37	150M ohm—⅓ w.

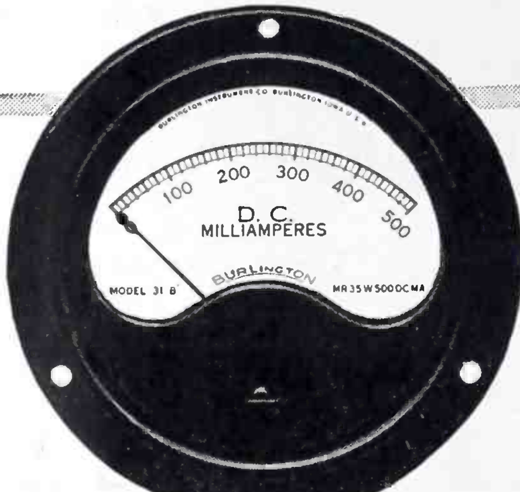
CONDENSERS

C1	.0005 mica
C2	.002 x 600 v.
C3	B.C. Antenna Trimmer
C4	9 mc. Antenna Trimmer
C5	.0005 mica
C6	.1 x 200 v. Tubular
C7	.00001 mica
C8	9 mc. R.F. Trimmer
C9	B.C. R.F. Trimmer
C10	.1 x 400 v.
C11	.1 x 400 v.
C12	.02 x 600 v.
C13	.0005 mica
C14	.02 x 600 v.
C15	30.0 mfd. lytic
C16	B.C. Oscillator Trimmer
C17	30.0 mfd. lytic x 450 w.v.
C18	.0002 silver mica
C19	.00005 mica
C20	9 mc. Oscillator Trimmer
C21	10.0 mfd. lytic
C22	16 mfd. x-350 w.v.
C23	.015 x 600 v.
C24	.015 x 600 v.
C25	.1 x 400 v.
C26	.05 x 200 v.
C27	.05 x 400 v.
C28	.05 x 200 v.
C29	.0001 mica
C30	.0001 mica
C31	.1 x 200 v.
C32	.0005 mica
C33	.00025 mica
C34	.1 x 400 v.
C35	.05 x 400 v.
C36	.008 x 600 v.
C37	.0003 mica
C38	.000125 mica
C39	.003 x 600 v.
C40	.00025 mica

C3 and C4 in same unit
C15, C17 and C21 in same unit
C29 and C30 in same unit

Burlington

PANEL INSTRUMENTS



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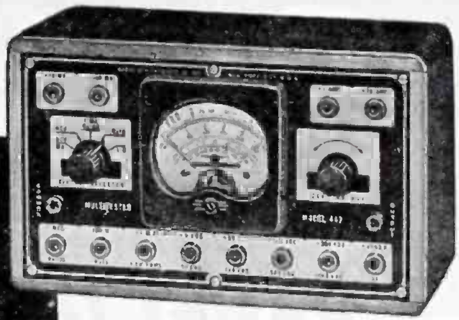

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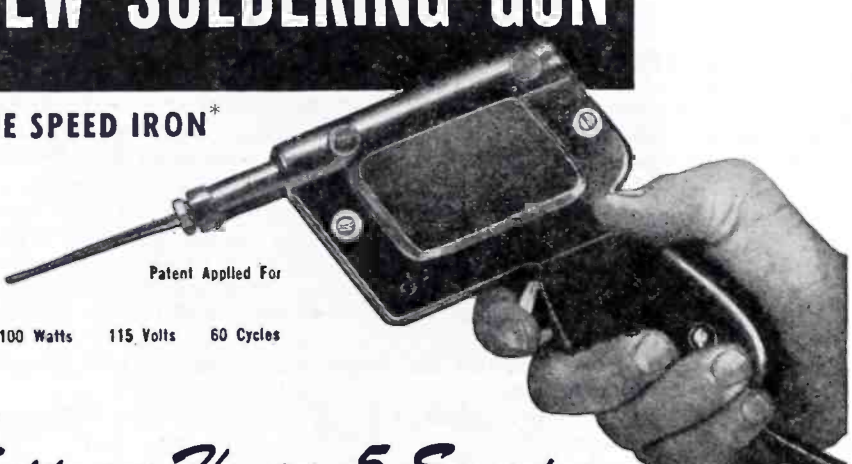

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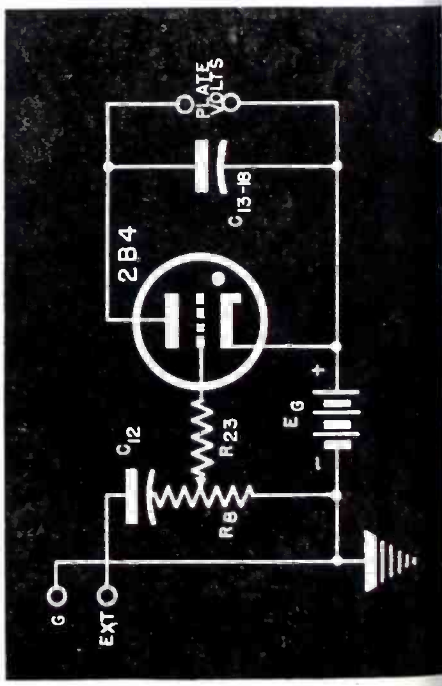
C-R OSCILLOGRAPHS

(*Continued from page* 36)

cient to provide full deflection of th fluorescent spot, it is necessary tha the output voltage of the oscillator b amplified before application to th horizontal plate system. Consequent ly, in the oscillograph circuit diagrar of Fig. 2,[1] the control switch S_2 is prc vided to introduce the voltage outpu of the linear time-base oscillator int the grid circuit of the horizontal vo tage amplifier, providing amplificatio of the linear time-base voltage. Fu ther, the linear time-base contr switch S_2 is so arranged that the hori zontal amplifier may be directly cor nected to the external signal input sys tem comprising the input terminals I and G, and the circuit or capacito discharge resistor R_8, the switchin circuit providing utilization of th horizontal gain-control potentiomete in either instance.

In the practical oscillograph, th linear time-base oscillator output volt age effects a constant deflection of th luminous spot on the screen durin the capacitor charging period. If simulaneously with the charging of th linear time-base oscillation outpu voltage rise, the vertical amplificatio circuit causes the luminous spot t vary with respect to the vertical de flection axis, the luminous spot write an image of the resulting waveform or the screen. This action is recurrent since the beam returns to the initia position when the charge on the ca pacitor is relaxed. Further, becaus of the extremely short duration of th

Fig. 3. The Du Mont linear time base syn chronizing system. A portion of the signal volt age or the variation under analysis is utilized t modulate the thyratron negative d-c grid-to cathode biasing voltage.



...ation period, the return trace ...itten on the screen is all but invis...le. However, particularly where the ...ear time base oscillates at a very ...w frequency, the return trace is suf...iently pronounced to effect distor...ns of the wave image written on the ...reen, being plainly visible as a ...antom base line to the waveform ...der observation. Again, where the ...equency of the vertical amplifier ...tage output is a few kc, a spurious ...ave image is perceptible in the com...etely written wave image, inasmuch ...s a complete wave of a voltage of this ...rder may often be written in the time ...eriod required for the return of the ...athode-ray beam to the original de...ection position.

In the Du Mont oscillograph a re...urn trace blanking circuit is provided. This suppresses the cathode-ray beam ...uring the period the charge on the ...near time-base timing capacitor is re...axed. This blanking circuit is shown ...n elementary form in Fig. 3. We ...ote here that the linear time-base ...oltage output is dynamically coupled ...o the control grid of the c-r tube ...hrough application of a resistance-...apacitance coupling system.

In the return-trace blanking circuit ...hown in Fig. 3, the dynamic coup...ing capacitor and the resistor are ...o selected that the coupling system ...orms a conventional *hipass* filtering ...tage. This serves to transmit to the ...rid circuit only those voltage varia...tions which occur within a few micro...seconds, i.e.; the circuit is so arranged ...hat the impedance of the capacitor to low frequencies is comparatively high. Thus, during the timing-capacitor $C_{10\text{-}11}$ charging period, in which the beam of the oscillograph provides a linear base for the waveform under observation, the coupling capictor C_{11} charges very slowly, and the resultant charge current through this capacitor develops little voltage across the series-grid resistor R_8. Further, since the potential across the series-grid resistor is small, the effect of the grid control on the intensity of the beam current is also negligible, and the luminous intensity of the writing spot is not visibly affected.

With the relaxation of the timing capacitor charge, the plate potential of the thyratron *2B4* falls to the characteristic arc-drop limit, and the coupling capacitor C_{11}, in Fig. 3, discharges rapidly through the atmosphere of the tube and the c-r tube series-grid resistor. The resulting discharge current develops a considerable negative potential across the series grid resistor R_8, which drives the control grid considerably negative. Here, the

(*Continued on page* 61)

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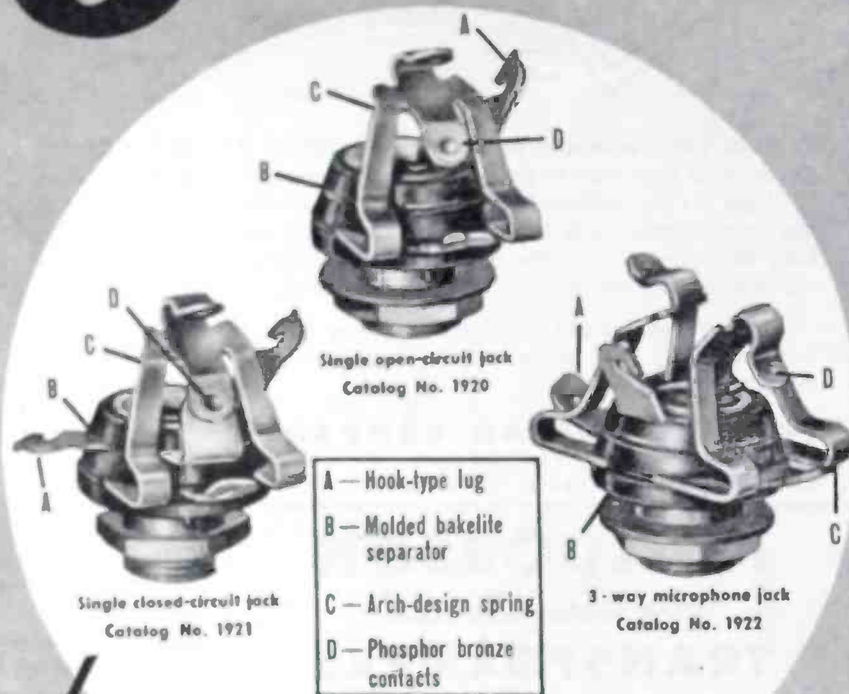

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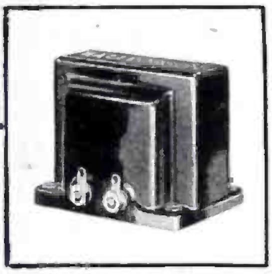

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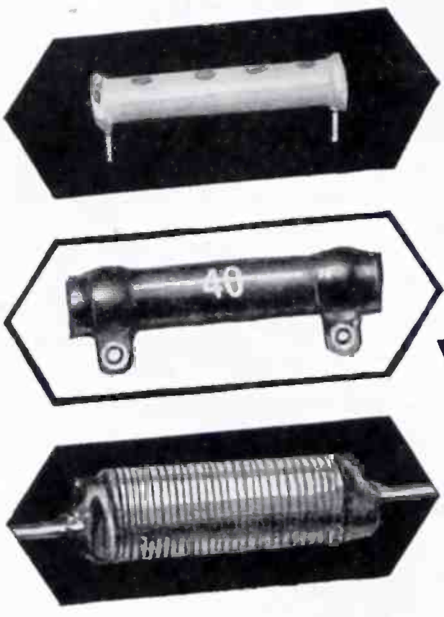

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THEY used to tell me that it w the early bird that got the wor and for a long time I used to s birds getting worms at all hours of t day, and hence got to thinking that pe haps there was not much to that o adage. But when I heard about wh Tommy had done I found that the sto had a ring of truth to it after all.

While I don't visit Tommy's store ve often, it's way over to the north end town, I had been bumping into that you man every now and then in the odde places. Once I saw him in the poore section of town. He was carrying tw broken-down midgets—one under ea arm—and yet he shouted a cheery gree ing. We stopped and talked, and I told me that he had just bought t midgets for $2 each. Both looked quit awful. The cases were half gone an parts were spilling out. I said nothin except that I couldn't imagine how h could salvage anything from those ancien sets. Tommy just smiled, and said tha he had an *Idea*, with a capital I.

Then later in that week I ran int Tommy coming out of our bank presi dent's home. Again he had a couple o midgets under his arm. They were no the ones he had bought in the other par of town, either. They were just as ba as the others. He told me he had pai $1 each for them. But he had also re paired the president's fine parlor console Net result for the call, said Tommy, wa a profit of about $12 even after payin for the midgets. But, whispered Tommy that still wasn't the *idea* he mentione earlier. So I was more puzzled tha ever.

A little later I met Tommy coming ou of our best restaurant. This time he had or was trying to juggle, about 5 midgets And their condition was bad, very bad. I asked him how he found all these museu pieces in the restaurant. He told m that the owner had been telling his customers, especially those who came i regularly, that they should leave thei midgets with him and that Tommy would pick them up and pay for them at a maximum rate of $2 each if they had all their parts and tubes, even if they would not play and even if they had broken cases.

My curiosity was so aroused that I finally had to ask just what this *idea* was all about. He asked me to hop into his car and he would would take me over to his shop where we could talk.

Well, you should have seen the midgets he had collected. They were all over the place. Guess there must have been at least a hundred. They were of all kinds. And it seemed that there wasn't one there that could play at all.

Tommy also had a large assortment of the oldest timers you have ever seen.

These, too, were in a sad state of disrepair.

"Now, Tommy, what does all this mean?"

"Gonna sell 'em," he replied.

"How in the world do you expect to sell all that junk?" I countered.

"Well," Tommy went on," I can do quite a bit with these sets. They may not sound so good, but that won't matter, for the use for these sets is such that the sound doesn't have to be too good. And the appearance isn't important either, because the listeners won't care one way or another. Guess I'll get rid of at least 50 of them tomorrow. Want to help me fix them a bit, and I'll declare you in for some of the profits?"

"I guess so," I said. Frankly it was all quite a mystery—tone unimportant, appearance secondary.

We worked the rest of the day fixing up the sets. They just had to be able to receive the local station only, said Tommy. We did everything for that. Regardless of how the set worked on other stations, we concentrated on the local station and peaked the sets so that it came in loud, even if not too clearly.

After 10 P.M. we took some time out for a bite, and then back to work again. Soon we had about 50 of the midgets fixed so that they received the local station very well.

Then Tommy came over and told me to take of the tuning knob and saw the tuning shaft off flush with the cabinet (if there was one) or flush with the edge of the chassis (if there was no cabinet). That got me; how were they to be tuned?

Nor was that all; Tommy then flattened each shaft on one side with a file and we loaded the sets into his car.

"Meet me at 4 A. M. tomorrow," Tommy said, "and I'll show you how to get $10.00 for each one of these, and pick up some extra work, too. Bring your tools and portable testers!"

Well rising at that early hour wasn't the easiest thing to do, but I managed to make it by the skin of my teeth. Tommy was already sitting in the car waiting with the motor idling when I dashed up.

"How about some food?" was my first question.

"Show you where you'll get the finest breakfast you ever tasted. But you'll have to be patient. It may take quite awhile," Tommy said.

"OK," I grumbled.

We turned out into the country and soon we were riding along nicely through the crisp morning air. It was really good to see the sun rise over the low hills, and I must admit that it had been a long time since I had seen that.

Soon Tommy turned off onto a dirt road and we drove, smoking our cigarettes in silence. Suddenly around a bend we came upon old O'Reilly's farm and Tommy drew up in front. Mr. O'Reilly was standing there looking at his hired man fetching some kerosene out of the tank in the yard.

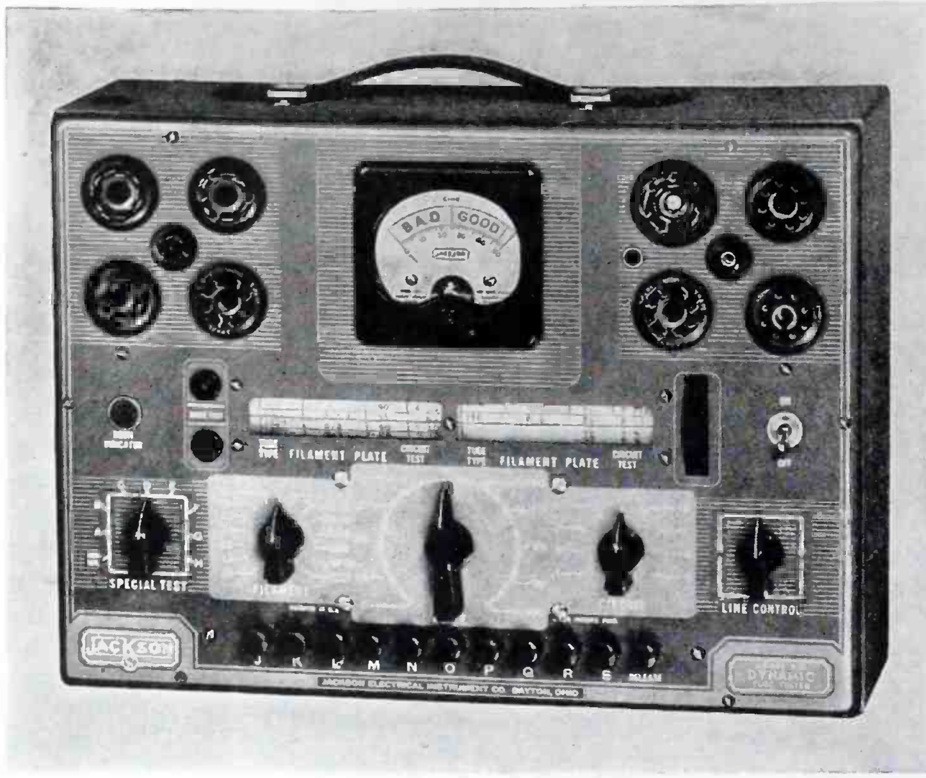
"Morning, Mr. O'Reilly," said Tommy.

"Morning, Tom. Well, I see that you got here just in time for breakfast. Who is that with you, your helper?"

"Sort-of," Tommy rejoined, "and we're both hungry as bears."

Well we went into the kitchen where we had the best breakfast I had tasted

(*Continued on page* 60)



Model 636 Dynamic* Tube Tester

With Built In Rotary Tube Chart

Tops in design and performance including the latest Jackson patented switching circuits.

Modern in every feature of construction, appearance and operation.

Complete with every valuable feature. Up to date for all newest tube types.

SPECIFICATIONS

"Dynamic" Method of Test—Makes a better test on every tube. The "Dynamic" method is more accurate, frequently finding "poor" tubes which might pass for "good" in ordinary testers.

Tests All Tubes—All of the popular receiving types and television amplifiers, including *Bantams—Loctals—Single Ended—High Voltage Filament Types and Miniatures.* Provision for many more. The tester is protected against obsolescence in every possible feature.

Roll Chart tube index—simplifies correct settings.

Full Range Filament Selection—marked directly in volts.

• • •

Bench Model 636-B (illustrated) is installed in welded steel cabinet. This instrument is also furnished (portable model 636) in a French grey leatherette case with removable lid—matched in dimensions and finish to other testing instruments in the Jackson line. It can be assembled with them in the Jackson Service Lab. Buy now with an eye ahead—on a *matched* Jackson testing set.

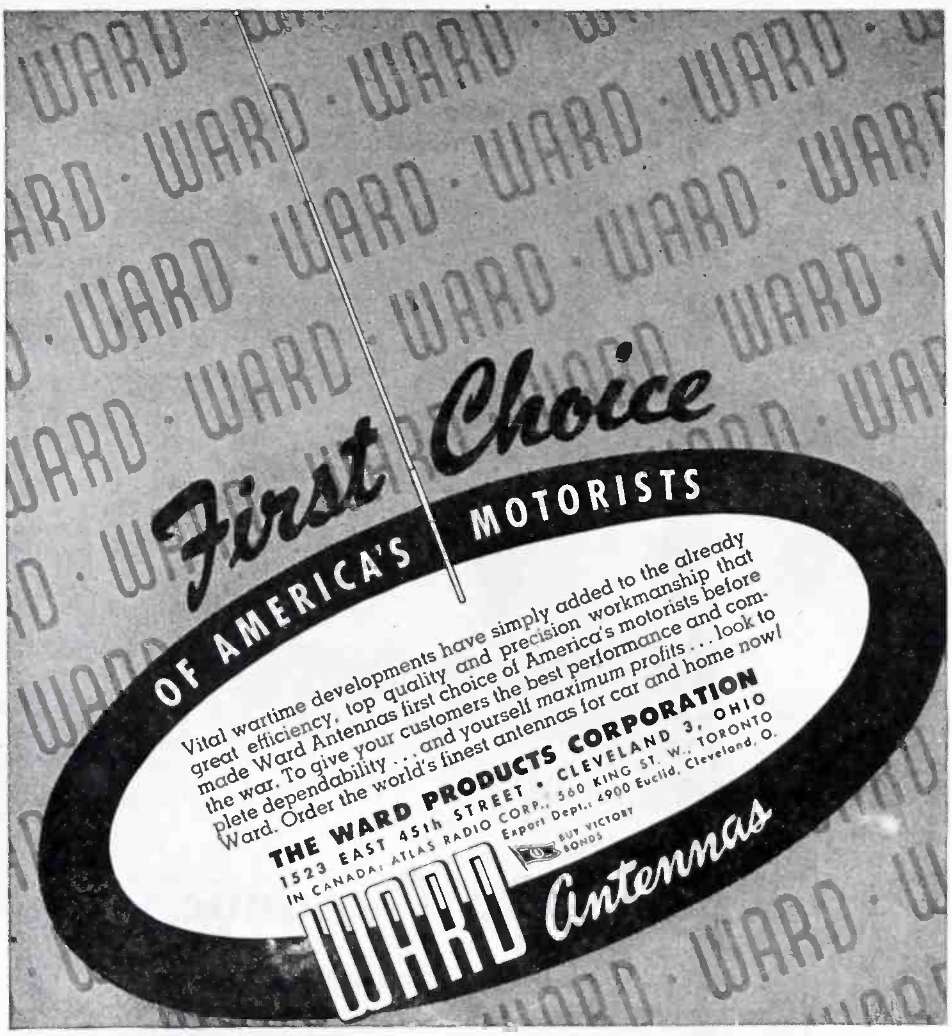
*TRADE MARK REG.

BUY WAR BONDS AND STAMPS TODAY

JACKSON

Fine Electrical Testing Instruments

JACKSON ELECTRICAL INSTRUMENT COMPANY, DAYTON, OHIO



NEWS

STUART NAMED RADEL S-M

R. B. Stuart has been appointed sales manager of the Radel Manufacturing Co., 6300 Euclid Avenue, Cleveland.

* * *

CORENTHAL RETURNS TO TERMINAL RADIO

First Lt. Robert Corenthal has returned to Terminal Radio Corp., 85 Cortlandt Street, New York City, to resume his post as advertising and sales manager, after three years as a pilot in the Army Air Forces.

Lt. Corenthal was awarded the Distinguished Flying Cross, Air Medal with three Oak Leaf Clusters, and Presidential Unit Citation.

* * *

PAUL ECKSTEIN BECOMES ECHOPHONE S-M

Paul H. Eckstein has been appointed sales manager of Echophone division of Hallicrafters.

Mr. Eckstein was formerly with Westinghouse Electric as assistant sales manager of the radio receiver division.

* * *

NEWARK ELECTRIC EXPANDS

The Newark Electric Company has enlarged its quarters at 323 West Madison Street, Chicago, by adding some 7,000 square feet of floor space.

Samuel Poncher is president of Newark Electric.

Samuel Poncher

* * *

INSULINE HOUSE ORGANS

House organs, *ICA-SCOPE*, written edited and produced by employees, are being published by the Insuline Corporation of America, Long Island City, New York.

* * *

PARTS SHOW TO BE HELD IN MAY, 1946

A radio parts and equipment show. sponsored by the parts division of the RMA, NEDA, Association of Electronic Parts and Equipment Manufacturers and the Sales Managers Club (Eastern Division), will be held on May 13, 14, 15 and 16, 1946, in the Hotel Stevens, Chicago.

* * *

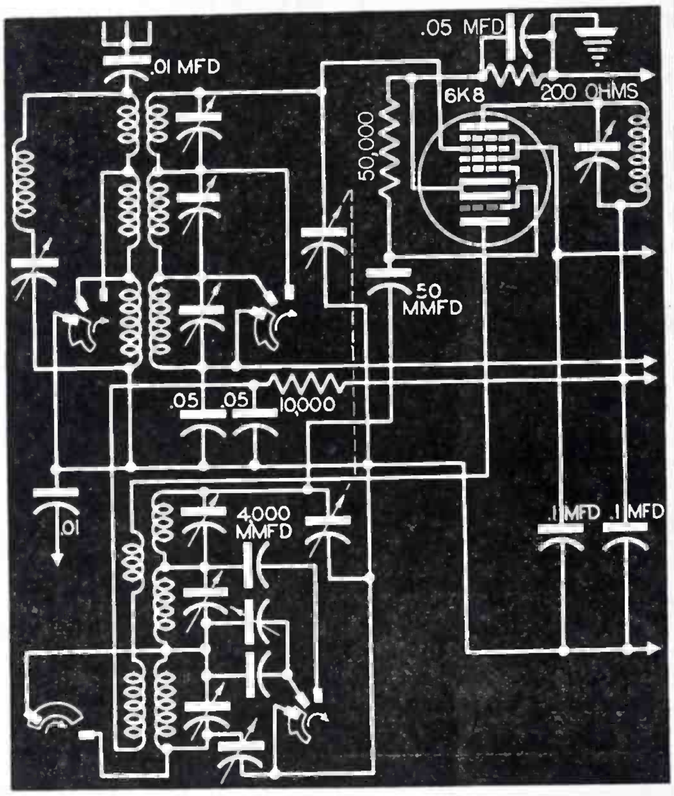
TED VON HAGEN JOINS DeMAMBRO

Ted Von Hagen, formerly of the Radio Service Laboratory, New Hampshire, is now with DeMambro Distributors, Inc., 1111 Commonwealth Avenue, Boston, Mass., as resident manager of northern New England.

SUPERHETERODYNE MIXERS

(*Continued from page 26*)

nd ground. The oscillator has a milar bandswitch with only two plate ckler coils used. An oscillator decoupling filter is also used. This consists of a 10,000-ohm and .05-mfd combination. It bypasses the oscillator voltage so that none of this voltage appears in the *B* supply circuit.



ig. 9. Allied E-0707. The use of a iode-hexode for ixing permits receiver operation at requencies up to 40 ic. The oscillator decoupling filter consisting of a .05-mfd apacitor and a 0,000-ohm resistor prevents the r-f developed by the oscillator from entering the *B* supply.

PEED UP REPAIRS WITH THESE G-C AIDS!

FREE STEEL CABINET

G-C Dial Belt Kits

Every Serviceman needs a G-C Dial Belt Kit. Save money—be ready for that repair job. Finest woven fabric replacements. Easy to install — no stretch — no adjustments. Supplied in kits of 25, 50, 100, 200 or 300 Belts in sturdy metal box with slide-in drawer. Free Belt Guide and measuring device.

G-C Dial Drive Cables

G-C has a complete line of Dial Drive replacement cables. Available by the spool for prompt servicing of all sets. Every Serviceman should have a complete assortment. Best quality—extra strength. Preferred by Radio Men everywhere.

G-C Radio Service Cement

The best Cement for Speaker and Radio Work. Especially suitable for cementing replacement cones and repairing rattling and torn cones. Also used on glass, to seal adjustments, hold wires in place, etc. Dependable, vibration proof, waterproof and fast drying.

Write for New G-C Catalog No. 146 and G-C Dial Belt and Service Book

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★ And that tells the story. For Clarostat is the name and guarantee of a better composition-element control such as is now found in the finest radio-electronic assemblies where trouble and failure just can't be tolerated.

The *stabilized* element, exclusive in Clarostat controls, sets new performance standards. Extreme immunity to humidity, temperature and other severe climatic conditions. Rated at 1 watt. Resistance values of 500 ohms to 5 megohms. With or without power switch.

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Ask for these Clarostat servicing aids . . . Composition-element Controls, Wire-Wound Controls, Greenohms (those tougher power resistors), Power rheostats, Ballasts, etc. Ask for catalog—or write us.

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THINK OF THE technical data you DO NOT have to wade through! And the time you can save! And the satisfaction for your customers, while you are making a nice profit and adding to your professional prestige!

ADAPTOL supplies the MISSING LINK

write QUICK for the WHOLE STORY

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260 Utica Avenue, Brooklyn 13, New York

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G. E. L-500 Series

Bad modulation hum: Found the trouble in the .05-mfd bypass capacitor in the avc circuit at the low end of the antenna-grid coil. This capacitor offers considerable reactance to the 60-cycle hum and builds up sufficient voltage to modulate the signal in the first tube.

Inserting any resistor, 50,000 ohms or higher, from the antenna to chassis removes this hum modulation with less than 5% signal attenuation.

On the underwriters approved models of this circuit it may be necessary to return the resistor to the common side of the a-c line.—*R. G. Chrouch.*

OLD TIMER'S CORNER

(*Continued from page* 57)

in many a year. I was still curious as to what Tommy had up his sleeve about the midgets, when Mr. O'Reilly suddenly asked, "Bring the sets with you, Tom?"

"Sure thing."

"Well let's get out into the barn and set them up."

So that was it! Seems like Tommy

(*Continued on page* 61)

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Long Scale, Wide Range Volt-Ohm-Milliammeter

DOUBLE SENSITIVITY D.C. VOLT RANGES

0-1.25-5-25-125-500-2500 Volts, at 20,000 ohms per volt for greater accuracy on Television and other high resistance D.C. circuits.

0-2.5-10-50-250-1000-5000 Volts, at 10,000 ohms per volt.

A.C. VOLT RANGES

0-2.5-10-50-250-1000-5000 Volts, at 10,000 ohms per volt.

OHM—MEGOHMS

0-400 ohms (60 ohms center scale)
0-50,000 ohms (300 ohms center scale)
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DIRECT READING OUTPUT LEVEL DECIBEL RANGES

—30 to +3, +15, +29, +43, +55, +69 DB

TEMPERATURE COMPENSATED CIRCUIT FOR ALL CURRENT RANGES D.C. MICRO-AMPERES

0-50 Microamperes, at 250 M.V.

D.C. MILLIAMPERES

0-1-10-100-1000 Milliamperes, at 250 M.V.

D.C. AMPERES

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OUTPUT READINGS

Condenser in series with A.C. Volts for output readings.

ATTRACTIVE COMPACT CASE

Size: 2½" x 5½". A readily portable, completely insulated, black, molded case, with strap handle. A suitable black, leather carrying case (No. 629) also available, with strap handle.

LONG 5" SCALE ARC

For greater reading accuracy on the Triplett RED DOT Lifetime Guaranteed meter.

SIMPLIFIED SWITCHING CIRCUIT

Greater Ease in changing ranges.

Write for descriptive folder giving full technical details.

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HERE'S THAT NEW TRIPLETT 625-N

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TUBES—PARTS

RADIO DEALERS—SERVICEMEN

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

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If your jobber does not have them, write for information.

RADIO EQUIPMENT CO. 1415 W. FRANKLIN AVE. MINNEAPOLIS 5, MINN.

OLD TIMER'S CORNER

(*Continued from page* 60)

ad found out that the cows liked music id might give a bit more milk or someing like that. Tommy had gone to e trouble to write the State College of griculture to verify and they had written m that while they couldn't be sure it ways worked, it was well-known that nimals were more docile under the tones music than without, and it certainly ould not do any harm.

So Tommy had canvassed the farms round the town and had sold the farmers ese old sets for a flat $10 each inalled. Since there was no reason to ne them, and since the cows were not o particular about the set's appearance was only necessary to find a set that ould received a station. With the flattened shaft they could be adjusted just enough to be tuned right on the nose.

The taking off of the tuning knobs prevented the farmers from tuning the sets to other stations which might not come in as well, and at the same time Tommy made it clear that the sets were supposed to be used with only one station.

We left Mr. O'Reilly's with $70.00 in our pockets, and seven sets sold and installed. Also Tommy stopped to fix their console which netted him another $7.50.

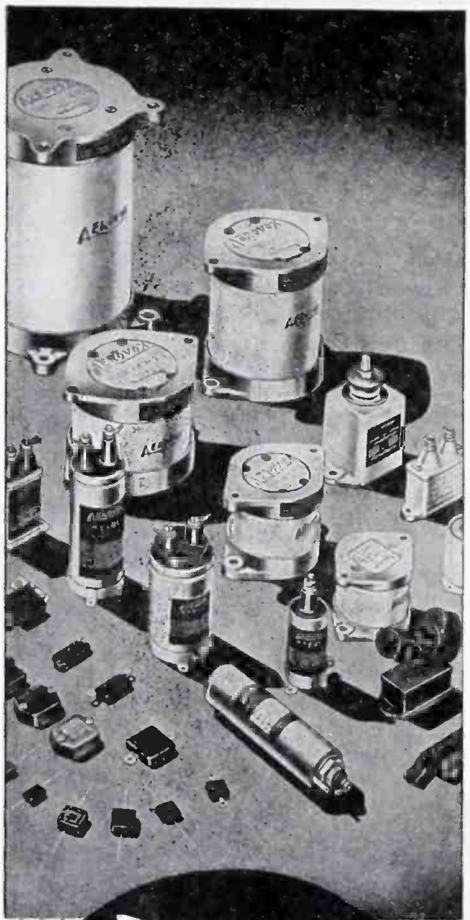
It was dark when we returned to the store. Every set had been sold. Tommy got out a sheet of paper and figured. We had taken in $500.00 for the sets, and a little over $97 in service work. Solemnly he handed me $100 for my day's efforts.

Nice work if you can get it!

C-R OSCILLOGRAPHS

(*Continued from page* 55)

high negative grid bias potential present across the terminals of the series grid resistor effectively suppresses the electron beam, and the luminous spot which writes the wave pattern on the tube screen disappears for the duration of the existence of this voltage. The electron beam is suppressed in *synchronism* with the relaxations of the linear time-base timing capacitor charge, and the visible trace written by the beam ceases during the period in which each relaxation occurs; it is not visible in the complete wave pattern which the beam writes on the screen.



Post-war Parade

● Hats off to these veterans! They have served with rare distinction on many battle fronts — on land, on sea, and in the air. And now that the needs of our fighting men have been fully met and the victory clinched, these heavy-duty mica, oil-filled, paper and electrolytic capacitators are once more becoming generally available. Because of their outstanding wartime service, they will be still better prepared to meet those heavy-duty service requirements of post-war radio and electronics. ● Consult our local jobber. Or write us.

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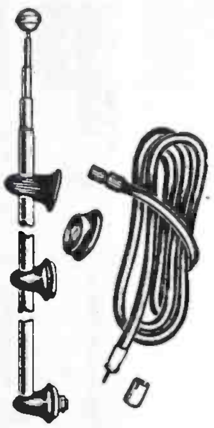
NEW PRODUCTS

RADIART ANTENNAS

Antennas, *DeLuxe CF,* featuring two short, one long and one wedge type, adapter insulators to fit curved or straight cowls and fenders, with a 50″ lead, have been announced by The Radiart Corp., Cleveland, Ohio. The rod assembly has a top rod of stainless steel. Tubular sections are of antimonial admiralty brass which is said to resist salt air and spray corrosion.

Leads are of *Plasti-Loom,* which is said to be impervious to moisture. The inner conductor is covered by polyethelene tubing which is then tape wrapped and covered with a closely woven copper shield, and the whole loom is then coated with an extrusion of abrasion resistant vinlyte.

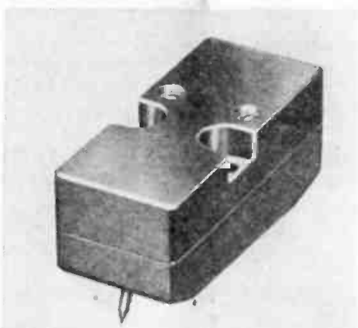
Mounting insulators are of Durez. Other features are: static muffler ball, phosphor bronze anti-rattler and single-pin connector with bayonet adapter.



* * *

CALTRON MAGNETIC PHONO PICKUPS

A high-fidelity magnetic phonograph pickup with no bearings, pivots or needle chuck has been produced by the Caltron Company, 11746 West Pico Boulevard, Los Angeles 34, California. It is stated the unit will track fully modulated pressings with 15 grams needle pressure.



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A tube tester, model 2143, featuring a flexible test circuit for *tube-values.* short and open-element tests, and a trans-

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Sound equipment by NEWCOMB

Our newest amplifiers offer greater excellence in sound reproduction than ever before available to the public address field. Designed by an organization devoted exclusively for seven years to the perfection of sound equipment, they embody all the benefits of today's most advanced electronic achievements.

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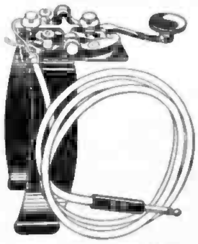


AIRPLANE CODE KEY $2.25

Knee type. Strong spring holds securely. Black enamel and brass finish. Complete with plug and cord. Limited supply. Order now. Only—$2.25.

DESK TYPE KEY—$1.69

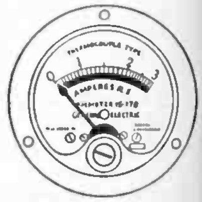
Cadmium plated. A good practice key for amateurs.

PL-55 PLUG—34¢

A high grade, dependable plug.

G. E. AMMETER

General Electric Thermocouple R.F. type — only $4.95.



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SHOCK-PROOF
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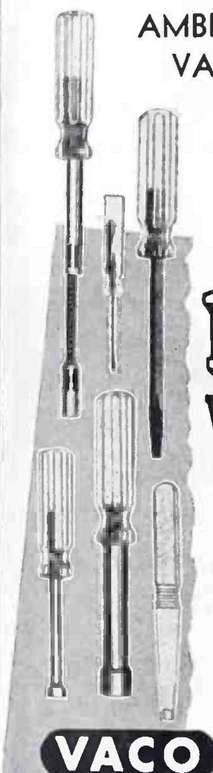
VACO DRIVER
OR
SMALL TOOL
TO
HELP YOU



173
VACO TYPES

Yes. Vaco has created more than just a variety of screw drivers. Vaco has built the exact type of screw driver to do the particular job that can be tedious and troublesome when an ordinary driver is used. No wonder mechanics who do precision work say Vacos are "tops" among all drivers. Vacos, with gleaming Amberyl handles, are shock-proof and break-proof. Write for catalog.

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THIS IS THE ANSWER TO YOUR RADIO REPAIR TROUBLES!

Just SEND us the SET via Railway Express. We REPAIR and RETURN. You ADD MARK-UP AND DELIVER. That's all there is to it.

- Complete Stocks—We can fix 'em all
- 90 day guarantee
- Prompt service
- OUR LOW PRICES mean more Markup for you.

Send that set to

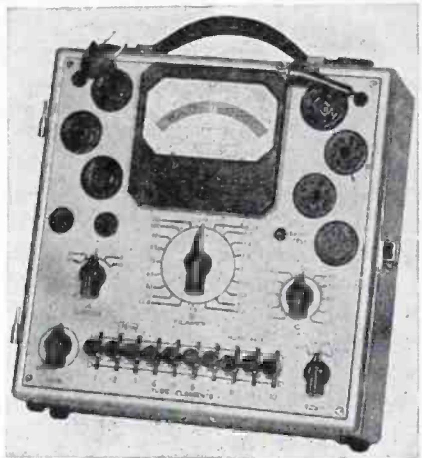
SHEFFIELD RADIO CO.

917 Belmont Ave., Chicago 14, Ill.

conductance comparison check for matching tubes, has been produced by The Triplett Electrical Instrument Co., Bluffton, Ohio.

Has three-position lever switching and multi-color scale to determine tube condition.

Size, 10" x 10" x 5¾".



* * *

GENERAL TRANSFORMER PORTABLE POWER SUPPLY

A portable power supply for 4-, 5-, or 6-tube, 1½-volt battery farm or portable radios, operating off 105-125 volt, 50-60 cycle lines has been announced by General Transformer Corporation, 1250 West Van Buren St., Chicago 7, Ill.

Provides *A*; 1.5 v at 200 ma, 1.35 v at 250 ma, 1.55 v at 300 ma, 1.35 v at 350 ma; *B*: 90 v at 13 ma, and 101 v at 8.5 ma.

Two section *A* filter is composed of three high-capacity capacitors, and two oversized iron core chokes; *B* has two high-capacity capacitors and oversized choke.

Universal sockets for battery plugs.

Weighs 4½ pounds. Size, 2⅛" x 4½" x 6¾".

* * *

INSULINE AUTO ANTENNAS

Several new auto antenna models have been announced by Insuline Corporation of America, Long Island City, N. Y.

One model, the *Rocker*, is a variable-angle job that can be swiveled into any position. Another, the *Topper*, has been designed for fender-top mounting while other models are designed primarily for cowl-mounting. A fourth model, *the Uni-Mount*, can be mounted without drilling of holes.

SUPPORT THE NATIONAL WAR FUND!

LAKE *has* **RADIO PARTS, CABINETS, EQUIPMENT**

for you Mister SERVICEMAN!

Portable Phonograph Case of sturdy durable plywood, in handsome brown leatherette finish. Inside dimensions 16½" long, 14" wide, 9½" high. Has blank motor board. As illustrated above, specially priced at **$6.95**

Portable Phonograph Case in brown leatherette covering. Inside dimensions 17½" long, 13" wide, 7½" high. Has blank motor board and opening for speaker. As illustrated at left, specially priced at **$7.95**

SOUND EQUIPMENT

Complete line of amplifiers, microphones, and sound accessories. Write today!

Also blank table cabinets of walnut veneer in the following sizes, with speaker opening on left front side:

(Note: *7 has center speaker grill.)

#1 — 8¼" L	x 5½" H	x 4" D	$1.95
#2 —10¼" L	x 6⅜" H	x 5" D	$2.75
#3 —13½" L	x 7⅝" H	x 6¼" D	$3.25
#7*—10¾" L	x 7" H	x 5½" D	$2.50
#8 —17" L	x 9" H	x 9¾" D	$4.50
#9 —21" L	x 9¼" H	x 10½" D	$5.50

*Speaker Opening in center of front side. Cabinets available in ivory color and Swedish Modern. Write for prices.

POWER TRANSFORMERS

4, 5, or 6 Tube—6.3 V at 2 amp 50 Mill Power Transformer...... **$2.45**

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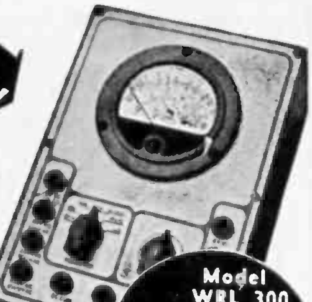

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Handles AC and DC Voltmeter, DC Milliammeter, High and Low range Ohmmeter. Size 5½x8x3¼. 3" meter with sturdy D'Arsonval movement.

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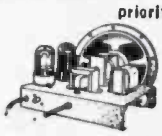
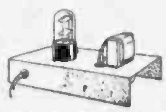


Phono Amplifier Kits
Complete with tubes, instructions
No. 1059... **$9.50**



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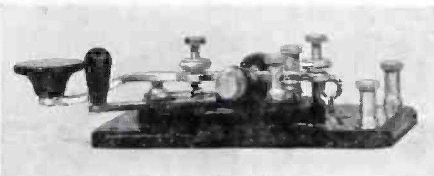
Sincerely,
Leo I. Meyerson
W9GFQ

Wholesale RADIO LABORATORIES

JOTS AND FLASHES

THE Muter Company, 1255 South Michigan Avenue, Chicago, has purchased the Rola Company, Inc., Cleveland. Larry King, formerly with Operadio, has been named president and general manager of Rola. Ben Engholm, former president of Rola, will act as a consultant for Rola. . . . Simplex Radio Corporation, Sandusky, Ohio, will hereafter be known as the Philco Corporation of Ohio. . . . H. B. Fisher has become president of a new distributing unit, the Northwest Distributing Company of Minneapolis, 1012 LaSalle Avenue. Mr. Fisher was formerly with the O'Donnel Motor Co. L. G. Miner will be sales manager. . . . Jack T. Dalton has been named manager of distribution of Bendix home radios. W. H. Autenreith succeeds Mr. Dalton as district manager for the metropolitan New York area, including Newark and Newburgh. . . . Chambers Radio Supply Company, 1104 Broadway, Cincinnati, will distribute Lear home receivers in the Cincinnati area. E. L. Chambers is owner of the supply company. . . . An "E" has been awarded to the Eastern Amplifier Corporation.

SIGNAL CORPS TELEGRAPH KEY



Genuine U. S. Signal Corps key with switch to close contacts, polished durable enameled metal base mounted on a bakelite base, key lever is nickel-plated brass-silver contacts; packed in new, original boxes. Shipping weight 1 lb. 10 for $11.00 **$1.29** ea.

ARMY-NAVY TYPE HEADPHONES

Type HS-33

Moisture-proof, sensitive and durable. Extra heavy-duty bakelite cap. Soft rubber cushions included. bi-polar magnet. 800 ohms. Furnished with cord and plug, leather headband. Shipping weight, 2 lbs.

$3.95 ea.

Order from your jobber or direct
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SERVICE INDEX—OCTOBER, 1945

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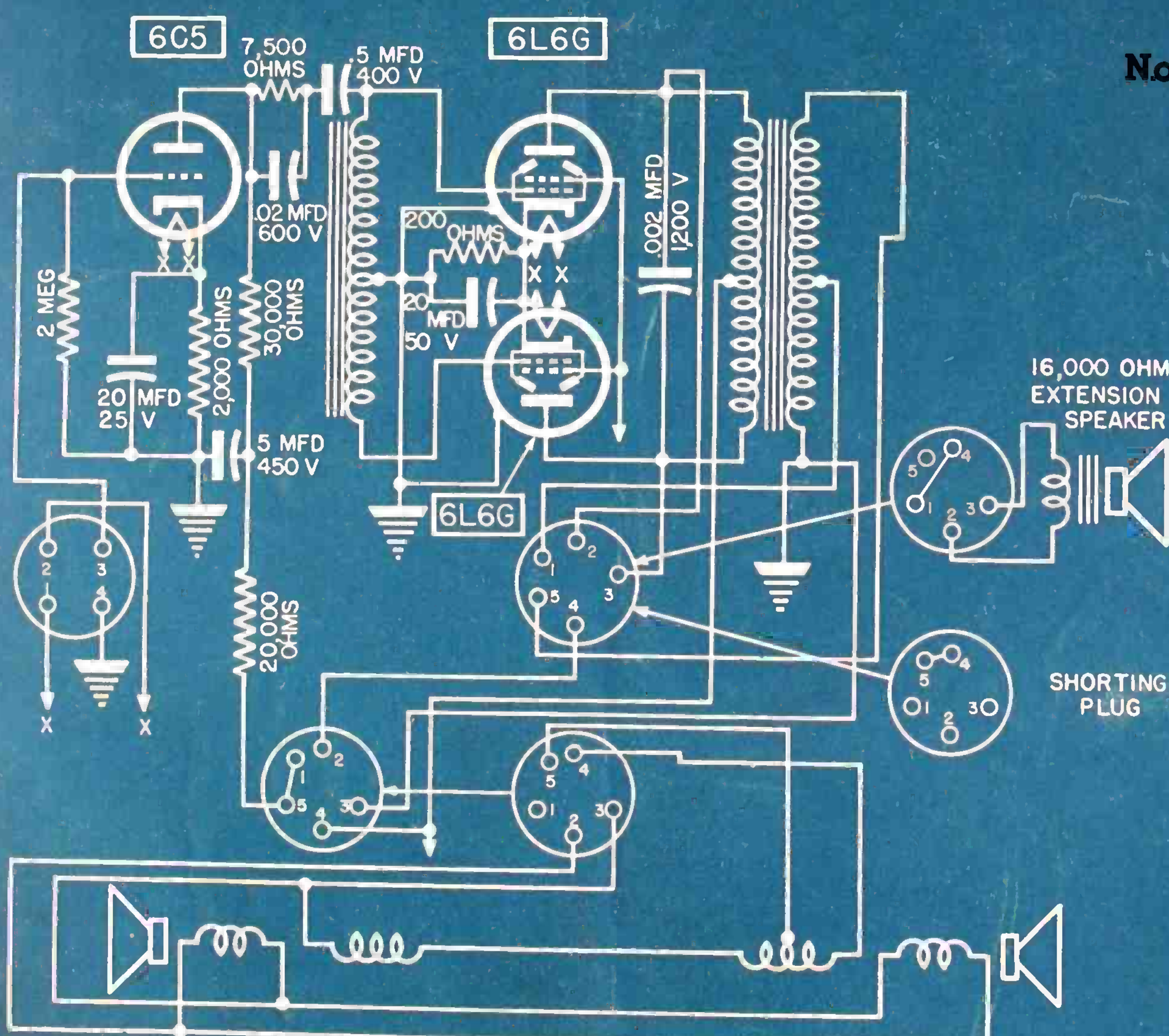
November
1945



High-fidelity 25-watt amplifier featuring bass-reducing control and provision for dual speaker operation. *(See pages 46 and 47.)*

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He reads the "C-D Capacitor" and gets a chance to look around

He's not a stunt man. Just a regular radio guy like you and all the others. The reason he rides so easy is that he gets a good head start . . . keeps his nose to the ground, but has his eyes wide open. Every month he pinches a couple of minutes off his working time to read the C-D Capacitor and get the tip-off on short cuts in servicing.

Imagine! A whole month's worth of service helps that you can swallow at one sitting! Nothing for you to do . . . not a penny to send; just write us and "The Capacitor" will come to you by mail regularly. Twelve times a year we'll send you this helpful, pocket-sized magazine. Write to: "The Capacitor", Cornell - Dubilier Electric Corporation, South Plainfield, N.J.

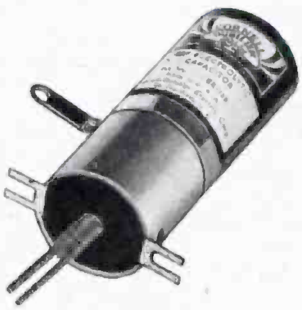
A TIMELY POSTER FOR YOU!

An attractive blue and yellow display card for your window or wall that reads "we use no war-weary surplus". It conveys to your customers that you use only genuine and original C-D Capacitors in all service jobs. Ask your local jobber for this poster today!

HAVE YOU SEEN THIS CATALOG?

Quick, easy, condensed reference that gives you a comprehensive listing of the most complete line of capacitors made. Remember Cornell-Dubilier for all your servicing needs Send for Catalog #195.

PRACTICAL E Z's!



Here's one of several types of capacitors that wins the serviceman's award for "all-around replacement." Adaptable for upright or under-chassis mounting, E Z's incorporate C-D's famous etched foil features in design and construction.

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KEN-RAD

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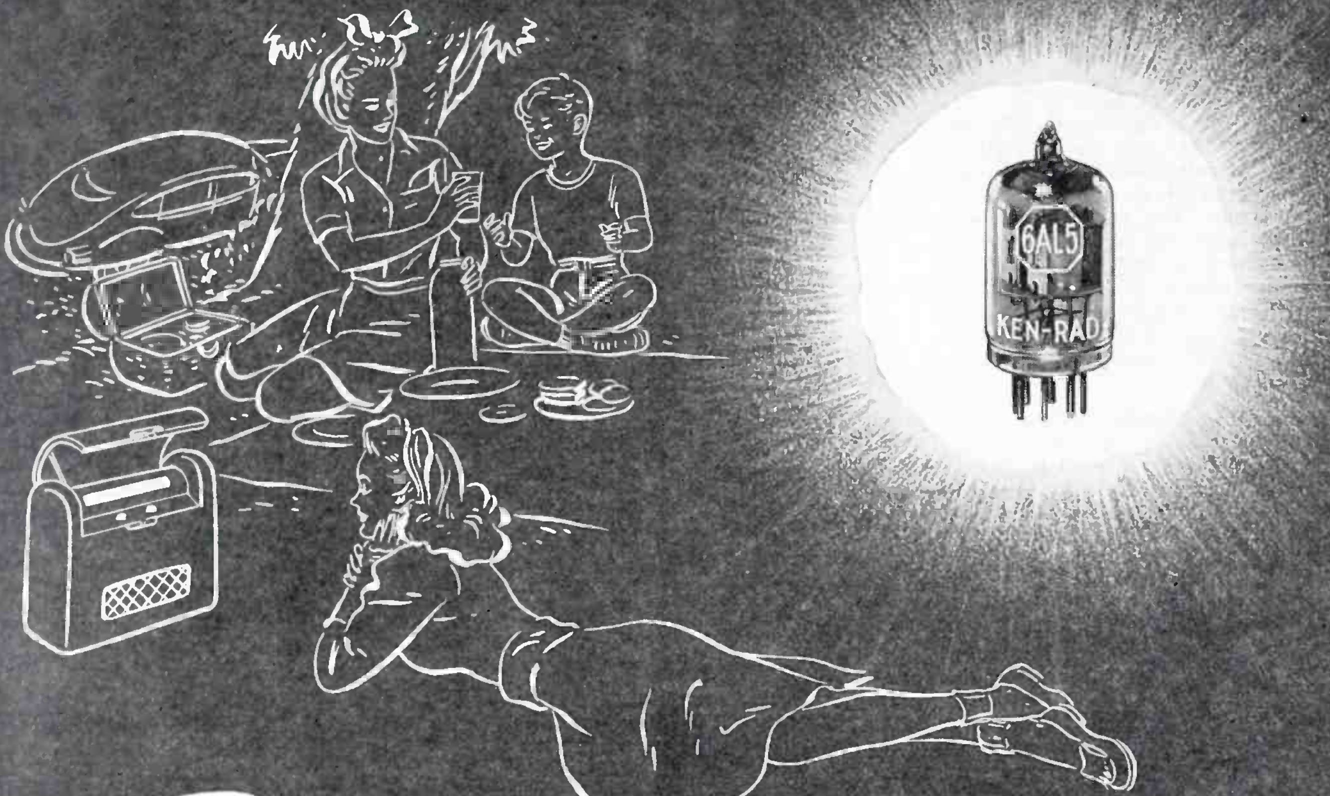

Better than ever

● Power-packed Ken-Rad Miniature Tubes have helped to popularize the friendly companionship of portable radios . . . Now still finer tube performance is assured by Ken-Rad's association with new, large research and engineering facilities . . . The ever-growing consumer demand for Ken-Rad *quality* means increased *profits* for Ken-Rad Tube 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

179-313-8850

EDITORIAL

THE intensive postwar expansion plans of the aircraft industry, indicating a production of around 50,000 planes for civilian travel, projects many unusual opportunities for the Service Man. For this large program will require wide-scale installation, servicing, and maintenance facilities for the planes' receivers and transmitters . . . a program that will tax the present facilities.

Servicing of this equipment will, of course, demand not only a specialized knowledge of aircraft units, but the acquiring of either of two licenses; a first-class commercial license for transmitter tests and a CAA license to permit testing of equipment, as well as installation, or any necessary plane alteration to accommodate equipment changes. While these license examinations will require schooling and hours of study, the results should prove quite profitable.

The hundreds of airports scheduled for construction will demand one or more shops on the field for radio equipment servicing. Such servicing will call for quite a profitable rate structure, commensurate with the specialized training needed for the aircraft activities. In most instances, it will be possible to arrange for a weekly maintenance and service fee, since some equipment will require checkups quite often.

Components, accessories and battery sales will also be a profitable feature of aircraft service shops. Battery sales alone will be substantial, since all planes will use battery-operated units, dry and wet. The wet-cell batteries will require charging, another medium of income.

The CAA has published a list of current airports and will soon publish a list of those airports to be constructed. You can secure such listings from the CAA department of information.

Aircraft radio servicing offers many advantages. Study its possibilities in your community now.

THE postwar f-m receivers covering the new bands are scheduled to feature an unusual tuning-dial numbering system. The first frequency (88.1 mc) will be designated as 201. The second assignment (88.3 mc) will be known as 202. This will continue up to 300. It had been planned to begin with *1* for the first channel, but the FCC said that the bands may be extended up or below the new assignments and thus provision should be made for such extensions.

This is a standard that will undoubtedly be adopted by all manufacturers to simplify f-m tuning. A wise move!

SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office

Vol. 14, No. 11 November, 194

LEWIS WINNER
Editor

ALFRED A. GHIRARDI
Advisory Editor

F. WALEN
Managing Edito

Pag

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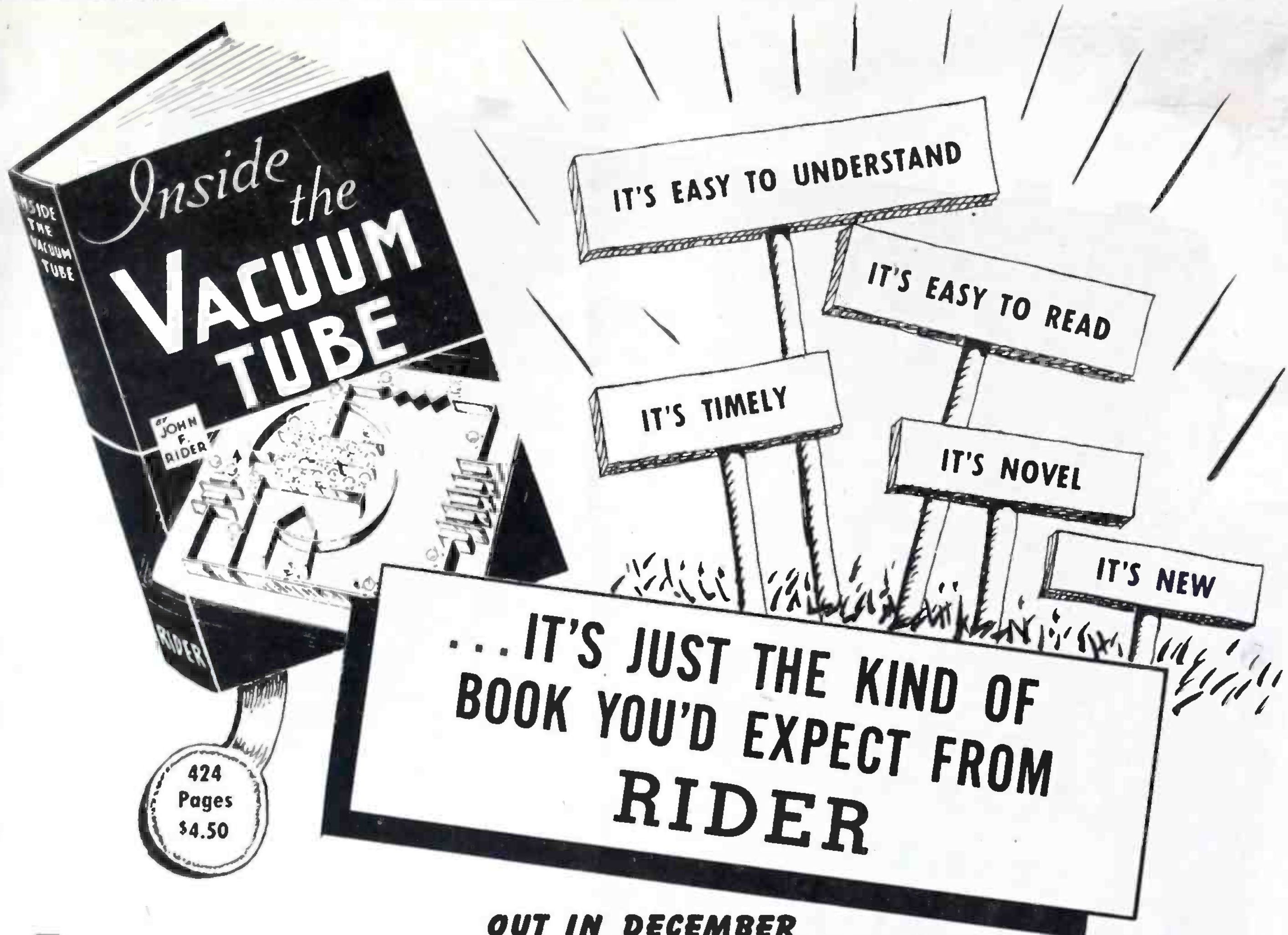

OUT IN DECEMBER

This is not just another book on the vacuum tube, but a typical Rider Book, offering a new approach to the subject—presented with a technique that makes its message clear and easy to understand. Here is a solid, elementary concept of the theory and operation of the basic types of vacuum tubes upon which can be built more advanced knowledge.

After explaining the electron theory, the text presents a discussion on electrostatic fields, on the theory that the reader's understanding of the distribution and behavior of the fields within a tube will give him a better picture of why amplification is accomplished within a tube and how the grids and plates are interrelated.

To give a clear physical picture of its subject, the book employs novel physical devices. For example, certain diagrams and graphs are repeated, to reduce to a minimum the bother of turning pages back and forth to read text and drawings. Another innovation is the use of anaglyphs, "three-dimensional" pictures of phenomena heretofore seen only in two dimensions. Viewed through glasses supplied with the book, they are invaluable aids toward the rapid understanding of the text.

Although this is an elementary book on a fundamental subject, therefore a goldmine for the student; developments in radio and the new fields of television and microwaves make it a must for the libraries of servicemen, amateurs and engineers. Place your order today.

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Volumes XIV to VII . . $12.50 each volume
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Frequency Modulation
Gives principles of FM radio . . . $2.00
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Basic Method of radio servicing . . 4.00
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An elementary text on meters . . . 2.00
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How to use, test and repair 2.50
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Automatic Frequency Control Systems
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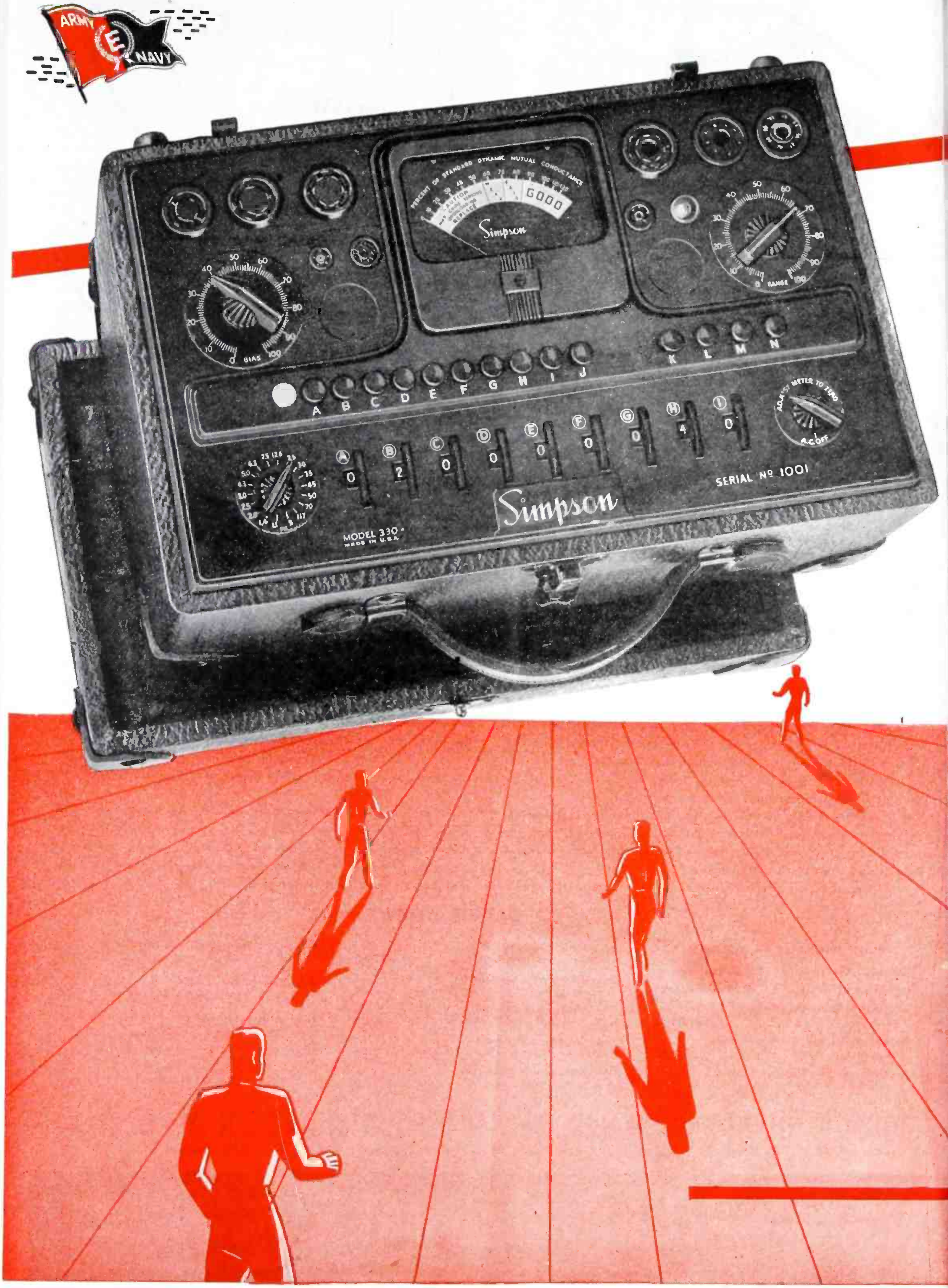
—and Don't Forget **RIDER MANUALS** are Now Complete in 14 Volumes

They Provide Schematics and Essential Servicing Data on American Made Radio Receivers.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GOOD
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MODEL 330
MADE IN U.S.A.

With this instrument a new era in tube testing begins

... Remember ...

As you read below the many other features of this pioneering instrument, remember this: It is a Simpson instrument, with all that implies in creative engineering research, in controlled testing and manufacture. Simpson products are not "assembled", they are engineered and built in the Simpson plant. Practically every component part, from the dial and movement to the beautifully designed panels and the bakelite cases and panels, is made by Simpson. It is this that makes Simpson's the "instruments that *stay* accurate" with ideas that *stay* ahead.

SIMPSON MODEL 330 MUTUAL CONDUCTANCE TUBE TESTER

1. Size—15½" x 9½" x 6½".
2. Case—Sturdy plywood construction, with heavy fabricoid covering, corners trimmed in leather, rustproof hardware—removable cover with slip type hinges.
3. Panel—Heavy molded bakelite, beautiful satin grained finish. All characters, numerals, and dial divisions are engraved and filled in white, insuring long wearing qualities.
4. Meter—4½" rectangular of modern design with artistic four-colored dial indicating good, fair, doubtful, and bad—also "Percentage of Mutual Conductance" scale.
5. Sockets provided for all types of tubes with two spare socket positions.
6. Neon glow tube incorporated to indicate shorted tubes.
7. New simplified revolutionary switching arrangement (see description above).
8. The tube chart provided is arranged for quickly identifying the tube and setting the controls.
9. Tests tubes with voltage applied automatically over the entire operating range and under conditions approximating actual operation in a radio set.

Ask Your Jobber

The New Simpson Mutual Conductance Tube Tester Brings To Radio Servicemen and Dealers An Entirely New Method of Testing Tubes And A Revolutionary New Switching Arrangement!

Tube manufacturers consider that a radio tube has reached the end of its usable life when it falls to 70% of its rated value. Until now there has never been an instrument to test tubes in percentage terms.

But now here *is* such an instrument. The new Simpson Model 330 tests tubes in terms of percentage of rated dynamic mutual conductance—a comparison of the tube under test against the standard rated micromho value of that tube. The colored zones on the dial coincide with the micromho rating or the percent of mutual conductance, indicating that the tube is good, fair, doubtful or definitely bad. Thus, at a glance, you can check the tube against manufacturers' ratings. If, for any reason, it becomes desirable to know the actual value in micromhos, the percentage reading may be easily converted.

This is the way tubes should be tested—the way testers always should have worked—but Simpson is first again in bringing this needed development. It tests tubes with voltage applied automatically over the entire operating range, reproducing more completely than ever before the actual conditions under which a tube functions in a radio set. No instrument, not even delicately adjusted laboratory devices, can do this 100%. But this new Simpson Mutual Conductance Tester approaches perfection as never before.

Besides this revolutionary new method, Simpson offers you an equally revolutionary switching arrangement. The circuit is so arranged that, even though there are numerous combinations possible, very few switches require moving to test any one tube. Many of the popular tubes are tested in the "normal" position without moving any of the nine tube circuit switches.

Ten push button switches and nine rotating switches of six positions each provide infinite combinations in tube element and circuit selection. Only a few settings are necessary for the most complicated tube. The tube chart provided is arranged for quickly identifying the tube and setting the controls.

When you have finished a tube test, the Automatic Reset takes over to speed and simplify the next test. Just press the reset button and instantly all switches, both push button and rotary, return to normal automatically!

Here is the test instrument you have had a right to expect from Simpson. With greater flexibility in its circuit and switching arrangement than any other tester can provide, it gives maximum provision against obsolescence. It's the tester of a new era.

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5216 W. KINZIE ST., CHICAGO 44, ILLINOIS

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INSTRUMENTS THAT STAY ACCURATE

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

THE IDEAL REPLACEMENTS FOR ALL DRY ELECTROLYTIC CAPACITOR TYPI

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SELL OR TRADE—500 tubes. Want 0-500v d-c panel meter and other individual range types. Walter F. Kapinos, 304 Front St., Chicopee, Mass.

WANTED—Complete recording set. M. Taonouchi, 6713 A. Siskya Ave., Newell, Calif.

SELL OR TRADE—Hammarlund variable condensers and several sets of plug-in coils for Comet Pro. What have you? D. Pommiss, 401 Schenectady Ave., Brooklyn, N. Y.

WANTED—Recorder for amplifier. Describe fully. Oliver Berliner, 1007 N. Roxbury Drive, Beverly Hills, Calif.

FOR SALE—Four 4' morning glory horns; 4' flat horn for car; 4 Fox driver units with 1000 ohm fields; 1 Fox driver unit with 6 volt field; 4 Rola G-12 6 volt heavy duty field speakers; $150 for lot. Also 6 volt 20-watt amplifier and 30-watt electric, $50 ea.; G-E portable recorder and record player; Federal symphonic 16 complete and large supply recording disc. Loren Beatty, 2408 Queen Ave., Middletown, Ohio.

WILL TRADE—Triplett portable lab model 1181; multimeter and signal generator. Want 12" P.M. speakers or a condenser analyzer. A. T. Zintner, 3152 Agate St., Phila., 34, Pa.

SELL OR TRADE—SW-3 with coils and power pack. Want camera or record player. Walt Woestman, 2310 Midlothian Drive, Altadena, Calif.

WANTED—RCA #816K chassis, less tubes and speaker. State condition and price. Kuehne Radio, Bryan, Ohio.

WILL TRADE—Ihagee revolving back camera with Carl Zeiss Tesser f4.5 lens focal plane shutter 1/15 to 1/1000 sec. filters and accessories. Want medium power transmitter or good communications receiver. John T. Craig, 611 S. Silver, Deming, New Mex.

WILL TRADE—Wells-Gardner Model 6F. 16 tube. Want ultra stratosphere "10" or other long-wave radio. R. F. Teisinger, 1256 Walker St., Waterloo, Iowa.

FOR SALE—Tubes and parts at bargain prices. Send for list. Want to rent code tape machine and tapes. Fred Humphrey, 117 N. 20th St., Philadelphia 3, Pa.

WANTED—Riders #6, 7, 8 and 10. Elliott Reames, 1149 Washington Ave., Muskegon, Mich.

FOR SALE—Triplett #1212 tube tester, complete with instructions and wiring diagram; A-1 condition $18 postpaid. F. S. Tourtellatte, 11 Lauren Park, Norwich, Conn.

SELL OR TRADE—Dumot 5" scope model #148. Want communications receiver, test equipment or camera. Ben L. Sandberg, 36 Washington Village, Asbury Park, N. J.

WANTED—Echophone model EC-1 or Hallicrafters model S-36. Joseph C. Baker, Weedsport, New York, R.F.D. #2.

FOR SALE—New tubes at list; Meissner ac-dc kits, 2-tube, $7; 3-tube, $8 plus 20c. postage per kit. Need test instruments. Edward Howell, Route 2, Dillon, S. Carolina.

WANTED—Multitester, signal generator, tube tester and set tester in good condition. Write, stating full description and price. Wm. H. Womack, Box 589, Mayfield, Ky.

FOR SALE—Teco tube tester T-10, almost new; Philco auto radio and one home radio; also meters, parts, etc. Write for list. Harold Mueller, Box 323, Rugby, N. Dak.

URGENTLY NEEDED—Communications receiver with or without tubes; any condition. Will pay cash or trade broadcast receivers, radio parts and test equipment. Wm. Briton, 4 O'Brien St., Norwalk, Conn.

FOR SALE—12" beam power radio tube SC1632, $1 ea. Lewis, Room 702, Boyce Bldg., Chicago 10, Ill.

FOR SALE—Western Electric 5" oscilloscopes with 5 BP4 white television tube. Extra heavy duty transformers, chokes, condensers, etc., complete with 12 tubes and carrying case. Tested and demonstrated, $50. Island Instrument Co., 368 Willis Ave., Mineola, N. Y.

WANTED—Rider's Manuals, late model tube checker, signal tracer or vacuum tube voltmeter. Bill's Radio Service, 11 Halsey St., Providence 6, R. I.

FOR SALE—Green Flyer dual speed phono motor, type 3DG4, complete with turntable and speed dials, $12. A. P. Bonfigli, 509 Hancock St., Wollaston 70, Mass.

WANTED—Majestic model 60 or 160 tuning meter; Majestic 60 chassis and speaker G5. Reasonable. Will sell 4 years back Radio World Weekly. C. E. Peters, 2925 Apple St., Lincoln, Nebr.

FOR SALE—Over 2,000 tubes at O.P.A. list prices or less, many pre-war. M. E. Dominick, Chicago, Ill.

WANTED—National SW58 or Sargeant regenerative radio. Must be in good condition. J. W. King, 525 Meridian, Anderson, Ind.

FOR SALE—Two used Philco auto radios and used Arvin 8-tube radio, $25 ea.; also two ¼ h.p. motors, $14 ea., and one 25 Cabbes automatic, $15. Paul Capito, 637 W. 21st St., Erie, Pa.

SELL OR TRADE—Martin handcraft cornet and case, cost $150. Want signal generator, multimeter and Rider's Manuals. Francis E. Manigold, Box 3003 Sta. A, El Paso, Texas.

FOR SALE—Crosley car radio, single unit, with lead-in, $12; other radios; small assortment volume controls, resistors, PM and dynamic speakers; earphones; condensers; coils; power and audio transformers, and some tubes. Also 28 back issues Radio Craft; 20 of Radio News, and 13 of Radio. Hal Bundy, 119 Chippewa Ave., Manistique, Mich.

FOR SALE—Sensitive d-c relays, coil resistance, 8,000 ohms, contacts; single pole, double throw, rated 2 amps. at 115v a-c, $1 ea. Mack, P. O. Box 123, New Hyde Park, N. Y.

WANTED—Rider's Manuals 1 to 14. Write, giving number, condition and price. Melvin Kelch, 1625 Natura Road, Towson 4, Md.

SELL OR TRADE—Pilot Super Wasp, also SW5, both with coils, tubes and speakers; also two short-wave radios, 3 and 4 tubes, plug-in coils in panel, built-in power supply. G. H. Gerhold, 9307 114th St., Richmond Hill, Long Island, N. Y.

WANTED—Receiver, 550 kc to 40 or 42 mc. Will pay cash. J. Kalenak, 30 Joralemon St., Brooklyn 2, N. Y.

FOR SALE—Used radios and tubes. Will buy good used radios and tube tester. Glenn E. Cruzan, Osgood, Ind.

WILL TRADE—Hockey type shoe skates, size 8, almost new. Want Ghirardi Radio Physics course. George E. Aldrich, 150 W. 98th St., Apt. 31-W, New York 25, N. Y.

FOR SALE—Superior signal generator, 100-105 mc; 955 type tubes, $1.95 ea.; 1,000 nu 2½ meter chokes, 5c. ea.; Isalanitite 1⅞" x ¼" diameter forms, threaded 2½ meter work, 5c. ea., and point stand off insulators, 2⅛ meter, ea. H. Arras, 277 E. 1st St., Mansfi Ohio.

SELL OR TRADE—Radio Physics Cou Radio Troubleshooters Handbook 3rd vised 1943, by A. A. Ghirardi, Mathematics for Electrician and Ra men, by Cooke. Want 8" rim-drive tu table top, 1-117Z6, 1-35Z3, 1-25Z5, tubes. William C. Stadtler, 49 Mi Ave., Brooklyn 7, N. Y.

FOR SALE—New R.C.P. #804 tube set tester, $87. Triplett new #1213 t tester, $30. I. J. Lubin, 2049 McG Ave., New York 62, N. Y.

WANTED—Transmitter plate transfor (1500, 1750 or 2000 volt); also, 200 300 m.a. swinging and smoothing chol Louis C. Sciez, 357 S. 1st St., Ishpemi Mich.

FOR SALE—Vacuum tube voltmeter re grid bias; AVC voltage, oscillator volt without affecting receiver operation. Re to 600v d-c in four ranges; also a-c; co plete with tubes. Used, but perf $19.50. John S. Jackson, 166 North Sie Bonita, Pasadena 4, Calif.

SELL OR TRADE—G.E. unimeter UM Readrite tube tester #432-A; and S perior signal generator #1230. John Grunigen, Jr., 1113 Hudson St., Harr burg, Pa.

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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.

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Dept. S-115, SPRAGUE PRODUCTS CO., North Adams, Mass.

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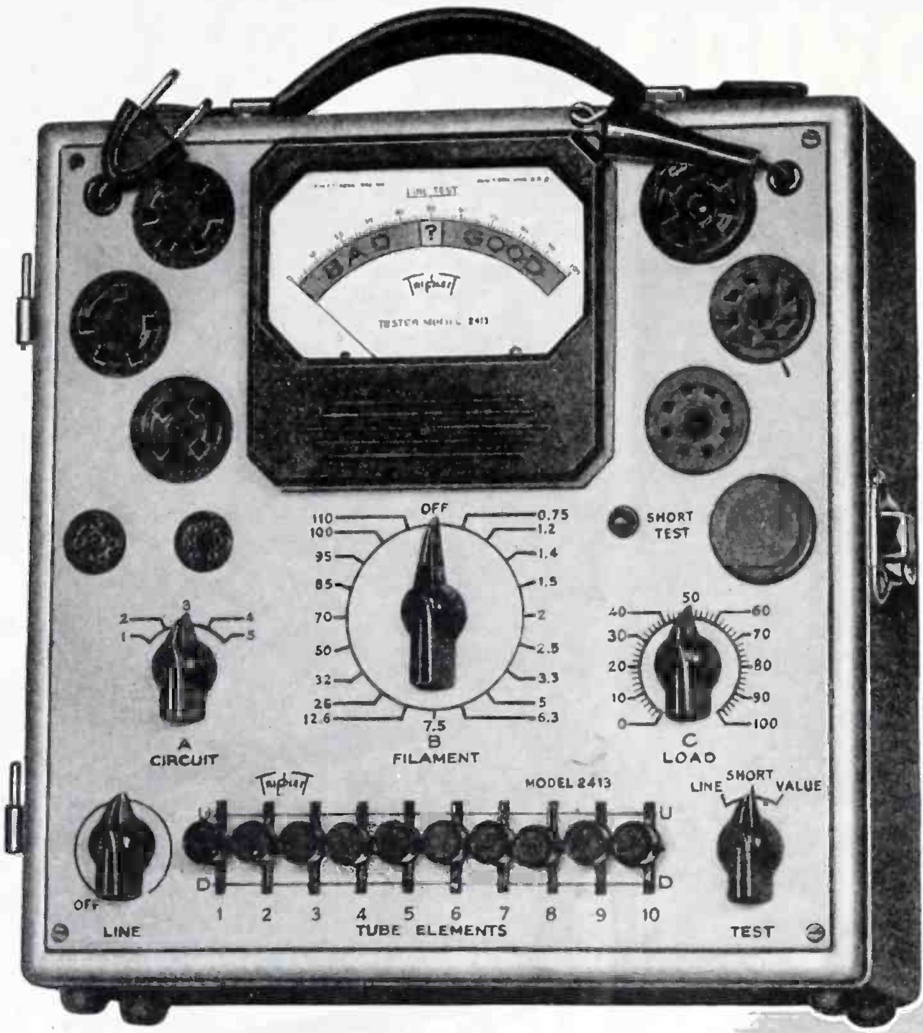

MODEL
2413

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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.

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- Line voltage adjustment control.
- Filament Voltages, 0.75 to 110 volts, through 19 steps.
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- Distinctive appearance with 4" meter makes impressive counter tester — also suitable for portable use.

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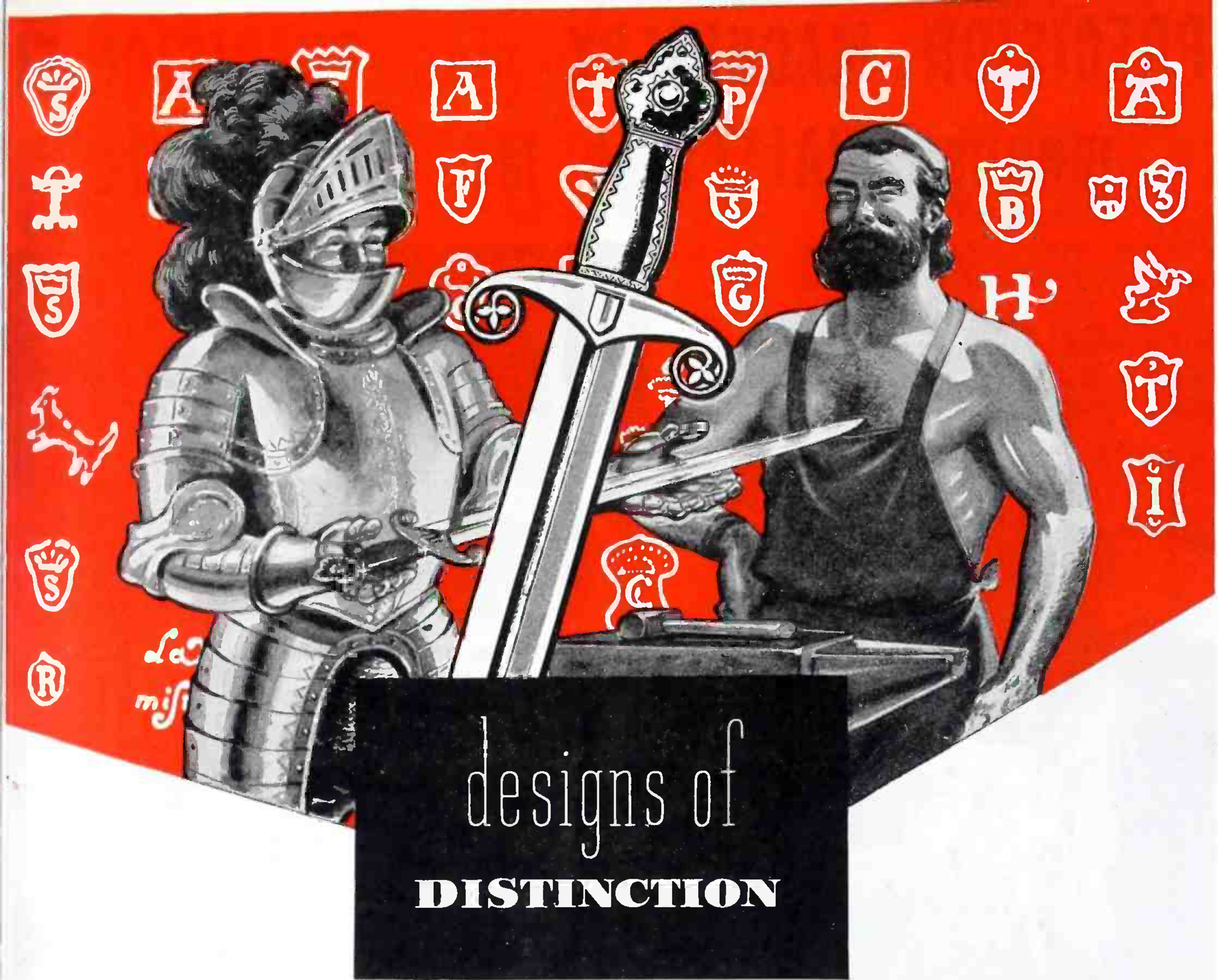

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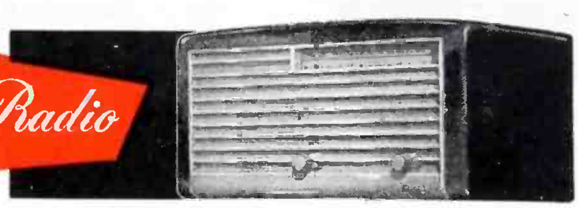
A few firms today still preserve that spirit of craftsmanship. You find it in the plants of Detrola Radio. That is why the "guild mark" of Detrola Radio on a radio receiver, record changer or other electronic instrument is a guarantee of production quality. The world's finest merchants, and their customers recognize the value of this mark.

DIVISION OF INTERNATIONAL DETROLA CORPORATION DETROIT 9, MICHIGAN

Detrola Radio

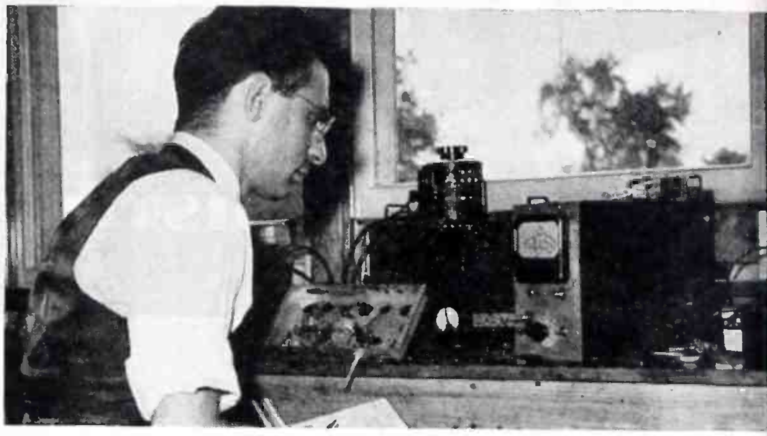


PRECISION MACHINERY plus PRECISION-EL means QUALITY in Mt. Carmel, Ill.

Precision machinery is part of Meissner's famed "precision-el" corps, too, and the men and women who build Meissner quality electronic equipment are the first to share the credit with their bench and tool-room friends. The photographs on this page show typical precision-el "teams" at work.

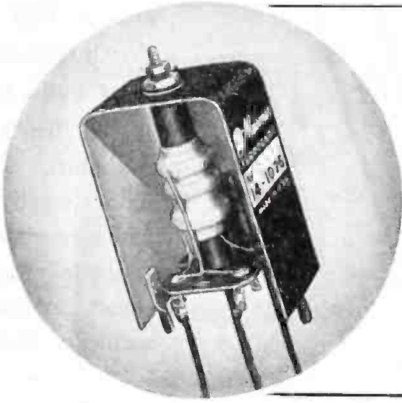
Here's another winning combination. Even the smallest parts warrant careful machining at Meissner. It's another reason for precision performance by Meissner products.

Here's a man who smiles proudly as his "helper"—a precision lathe—does a good job of holding extremely close tolerances.



This is the proof of the pudding. "Rejects" are surprisingly few, even under the sharp eye of the sensitive testing instruments used by this member of Meissner's *precision-el.*

His "partner" receives a delicate adjustment with all the skill he can command. This care of equipment by Meissner *precision-el* has meant higher quality and fewer shut-downs for repairs on a big war job.



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The New Model CA-11

SIGNAL TRACER

Simple to operate . . . because it has only ONE connecting cable— NO tuning controls!

INTRODUCED in 1939-1940 Signal Tracing, the "short-cut" method of Radio Servicing quickly became established as the accepted method of localizing the cause of trouble in defective radio receivers. Most of the pre-war testers (including ours) were bulky requiring a number of connections before the unit was "set for operation" and included a tuned amplifier which had to be "retuned" to compensate for signal shift.

The new model CA-11 affords all the advantages offered by the pre-war models and only weighs 5 lbs. and measures 5"x6"x7". Always ready for immediate use without the necessity of connecting cables, this amazingly versatile unit has NO TUNING CONTROLS.

Essentially "Signal Tracing" means following the signal in a radio receiver and using the signal itself as a basis of measurement and as a means of locating the cause of trouble. In the CA-11 the Detector Probe is used to follow the signal from the antenna to the speaker—with relative signal intensity readings available on the scale of the meter which is calibrated to permit constant comparison of signal intensity as the probe is moved to follow the signal through the various stages.

Features

- ★ **SIMPLE TO OPERATE** — only 1 connecting cable — NO TUNING CONTROLS.
- ★ **HIGHLY SENSITIVE** — uses an improved Vacuum Tube Voltmeter circuit. Tube and resister-capacity network are built into the Detector Probe.
- ★ **COMPLETELY PORTABLE** — weighs 5 lbs. and measures 5"x6"x7".
- ★ Comparative Signal Intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.
- ★ Provision is made for insertion of phones.

ease place your order with your regular radio parts jobber. If your local jobber cannot supply u kindly write for a list of jobbers in your state who do distribute our instruments or send ur order directly to us.

ne Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. omplete with Probe, test leads and instructions. **NET PRICE**

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SYLVANIA NEWS
RADIO SERVICE EDITION

NOV. *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 19

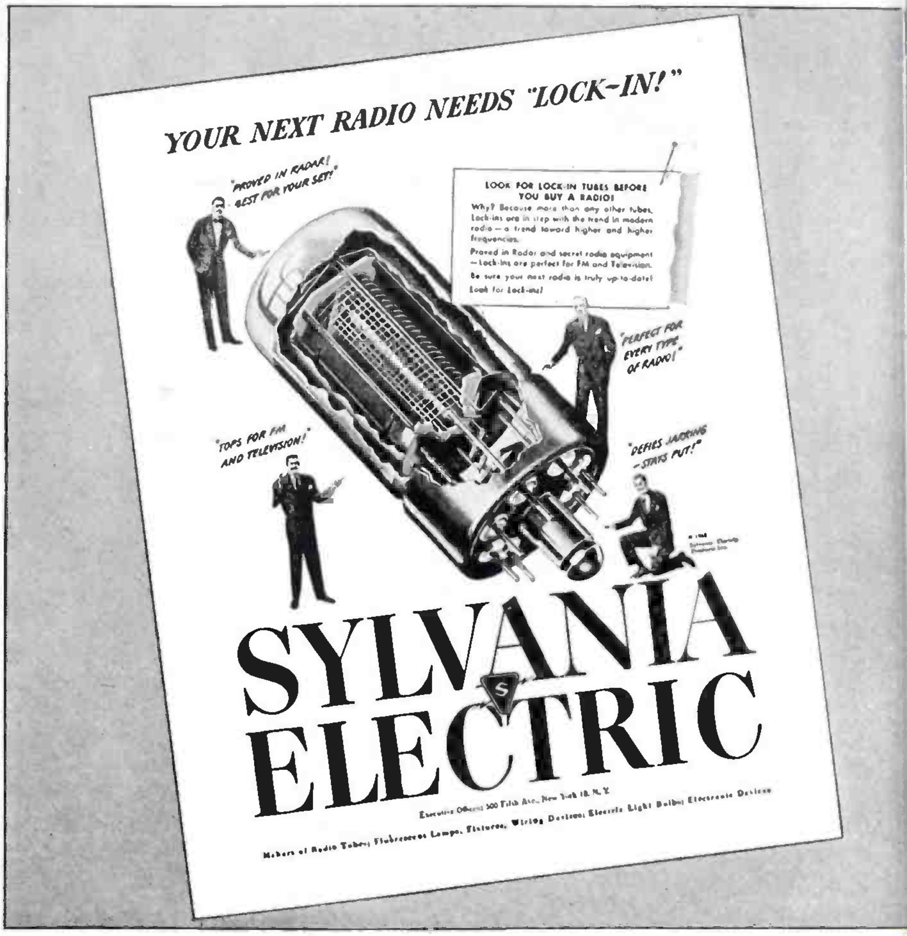
SYLVANIA "LOCK-IN" ADVERTISEMENTS SEL THIS SUPERIOR TUBE TO NATION'S MILLION

A large, attractive, three-color display banner featuring the phrase "Complete Radio Service" is now ready for distribution to servicemen by Sylvania.

The banner measures 46 by 28 inches, is printed in black, green and white on special weather-proofed "duckine" material, making it suitable for use either inside or outside of the store. It has six metal grommets to provide extra reinforcement.

This useful, durable and attractive display banner may be obtained for only $.40—or three for a dollar—from your local Sylvania distributor, or by writing to me at Sylvania Electric Products Inc., Emporium, Pa.

This banner is only one of the items on an extensive list of Sylvania promotional material designed to help servicemen merchandise both their own service and Sylvania radio tubes.



Servicemen will find even more people asking about the war-famed Sylvania Lock-In Tube—because of big, full-page Lock-In advertisements appearing in eight national magazines. These ads are telling over ten million people that Lock-Ins have advantages possessed by no other radio tube.

Lock-Ins are noted for their electrical efficiency and rugged durability. Element leads are brought directly through a low-loss glass header to become sturdy socket pins—effecting a much desir reduction in lead inductance and inte element capacitance. Support rods a stronger and thicker. There are few welded joints and no soldered joint

These remarkable tubes are design and built to handle the high and ultr high frequencies of FM and Televisi —as well as the lower frequencies. T day, set-manufacturers are looking the Lock-In Tube as the perfect ele tronic unit for all new radios.

SYLVANIA ELECTRIC

Emporium, Pa.

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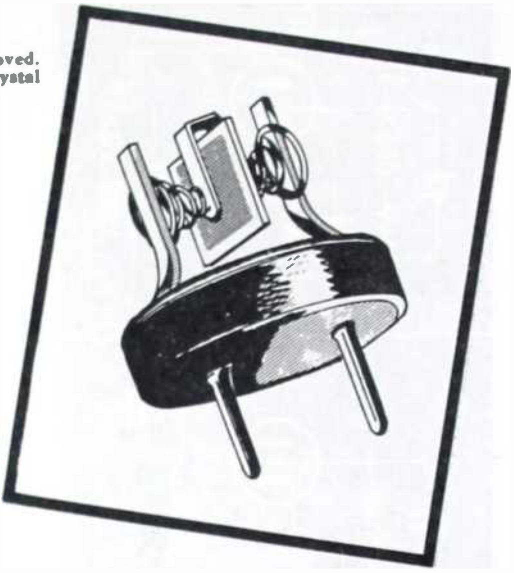
SERVICE
A Monthly Digest of Radio and Allied Maintenance

Fig. 1 (right). A crystal unit in its holder, with the cover removed. The two springs serve to hold the electrodes against the crystal surface. (*Courtesy Crystal Research Laboratories*)



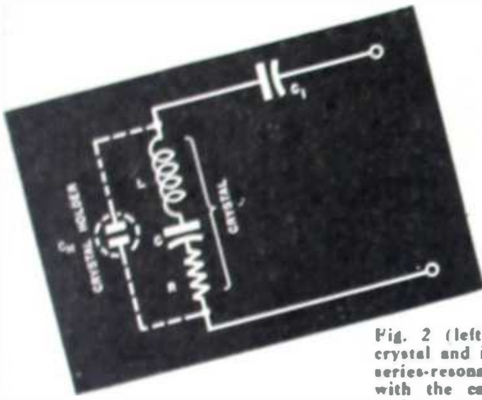


Fig. 2 (left). The electrical equivalent of the crystal and its holder. In effect, the crystal is a series-resonant circuit, consisting of *L*, *C*, and *R*, with the capacitance of the holder across the entire system. C_1 represents the series capacitance between the crystal proper, and the electrodes.

CRYSTAL-CONTROLLED OSCILLATORS

by J. GEORGE STEWART

IN many types of postwar receivers crystal-controlled oscillators will be quite an important feature. The extensive use of these oscillators in Army-Navy equipment has developed crystal manufacture to the point where they are economically feasible for mass production. At the winter IRE meeting last January, we were shown a receiver which tuned the entire b-c band through the use of push-button crystal oscillators.

Most of the new f-m receivers will use crystal-controlled oscillators. Stability requirements in the newly assigned v-h-f band will create a need for double superheterodyning, in which one of the fixed oscillators will probably be crystal controlled.

In the past most Service Men have had little opportunity to work with crystal controlled oscillators, since their use has been restricted to transmitters and fixed frequency receivers.

Physical Properties of Crystals

Physically, the quartz crystal is less than an inch square and only several thousandths of an inch thick. This crystal is *sandwiched* between two small, flat squares of metal, called electrodes, which serve as surface contacts. Spring pressure is usually applied to these metal squares to hold them firmly in place, and leads are brought out from these electrodes to external pins or contacts. The entire assembly is housed in a unit called the crystal holder. This has been the practice in the past. However, cost economy factors in receiver design may change the form of crystal holder, so that a simpler device embodying the same principles may be used.

Electrical Crystal Properties

The crystal may be likened to a two-plate condenser, with the crystal acting as the dielectric, Fig. 1.

Electrically, the crystal is equivalent to a high *Q*, parallel resonant-tuned circuit, whose frequency is largely determined by the physical dimensions of the quartz crystal. Its electrical equivalent is shown in Fig. 2, where *L*, *C* and *R* are the series electrical constants of the crystal unit, and C_H represents the capacitance between the metal electrodes, with the crystal acting as the dielectric. C_1 represents the series capacitance between the crystal proper, and the electrodes.

Crystal Operation

When an electrical current of approximately resonant frequency is applied across the crystal, sympathetic vibrations are set up in the crystal structure. This vibration, in turn, causes large voltages to appear between the electrodes. For this reason, the crystal may be used in place of an *LC* element in the grid circuit of an oscillator to supply the necessary grid driving voltage. Since the physical dimensions of the crystal are constant, and do not expand appreciably with heat, and since these same dimensions determine the frequency of operation, in the same way that the dimensions of a tuning fork determine its audible frequency, it can be seen that a high degree of frequency stability is thus obtained.

Grid Circuit Activity

When installed in the grid circuit of an oscillator, the value of C_H is further increased by the input capacitance of the tube, and the capacitance of the associated wiring. The resul-

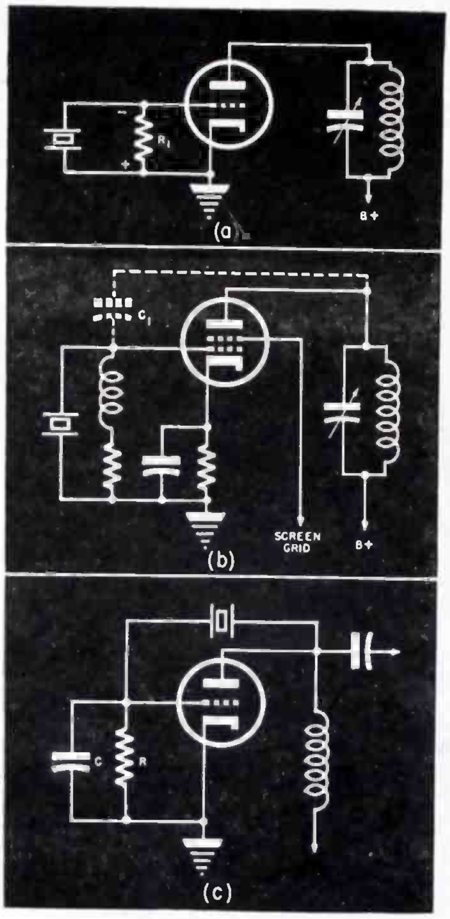


Fig. 3. Three circuits employing crystals for frequency control. In *a*, a triode circuit in its simplest form is shown. In *b*, we have a pentode circuit, while *c* shows the Pierce oscillator, which does not require a resonant circuit in the plate.

tant influence on the crystal frequency is quite small, and insofar as related to receivers, may be considered negligible.

Crystal Outputs

Crystal units are capable of delivering large values of r-f voltage, depending on the tube used, and the circuit voltages. However, in receiver applications, the amount of power required is small, and the circuit components reflect this in their size.

Any of several standard circuits may be employed using a crystal as the frequency-controlling element. Three typical circuits are shown in Fig. 3*a*, *b*, and *c*.

Triode-Crystal Oscillators

In Fig. 3*a* is shown a triode-crystal oscillator in its simplest form. This circuit is essentially a tuned-plate tuned-grid oscillator, with the feedback supplied by the grid-plate capacitance of the tube. Since the crystal itself is a discontinuous d-c circuit, the grid of the tube is returned to ground through the resistor R_1. This resistor serves a second purpose, since it also limits the r-f current in the grid circuit. This grid current limitation is important, since the permissible current through the crystal must be kept below the crystal rating, else the crystal may be punctured and rendered inoperative. Expressed another way, the activity of the crystal is a function of the r-f voltage across it. If this voltage exceeds the limits of the crystal, the overactivity will shatter the crystal. Therefore, decreasing the value of the grid resistor reduces the current through the crystal. In Fig. 3*a* the cathode has been returned to ground, so that the grid bias is a function of the grid current which creates the bias across the grid resistor.

Pentode Circuit

In Fig. 3*b* a pentode has been substituted for the triode. Since the gain of a pentode is higher than that of a triode, less grid excitation is needed. The feedback from the plate to the grid has been reduced by the lower g-p capacitance inherent in the pentode structure. If this capacitance is too low, an external coupling capacitor represented by C_1 is added, so that sufficient feedback is available. The size of the grid resistor for pentode crystal oscillators is usually 20,000 ohms or less. Since the lower value of resistor may shunt the crystal too effectively, and prevent oscillation, a r-f choke is usually added in series with the resistor. The choke supplies the necessary a-c impedance to reduce the shunting effect of the resistor, at the same time introducing a negligible amount of d-c resistance. Where cathode bias is used, the size of the grid resistor is reduced.

Crystal Excitation

The crystal excitation is a direct function of the plate and screen voltages used, and they must be watched carefully to make sure that they are not excessive. Since power is not important in a receiver, high value grid resistors, and low grid and plate voltages may be used.

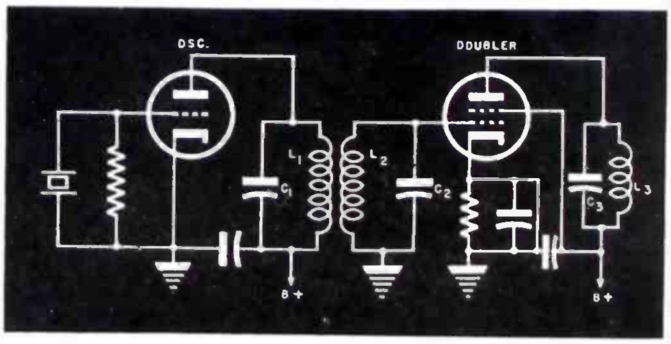
Pierce Oscillators

Fig. 3*c* shows a third method of crystal control for frequency stability, the Pierce oscillator circuit. A triode is used, although a pentode may be used too. Here, the crystal is used as the coupling element between the plate and grid circuits. Note that the plate circuit is untuned. Its use in a circuit of this type is similar to a crystal filter, in which only resonant voltages are passed by the crystal, the crystal performing as a series resonant circuit. For all other frequencies, the crystal acts as a pure capacitor. C_1 and the crystal may be considered as a load across the output of the tube. Therefore increasing the value of C_1 increases the load across the output circuit and the resultant grid current. Because of its position in the circuit the crystal is subject to high voltage strains. Therefore the plate voltage of Pierce oscillators is usually lower than for other crystal circuits.

Harmonic Oscillators

Fundamental frequency operation of crystal oscillators is limited by crystal size to about 15 mc. Crystals for frequencies above 6 or 7 mc are very expensive. To overcome this condition, the crystal may be cut to operate on a mechanical harmonic of its fundamental frequency, or may be employed in a circuit where some harmonic of the fundamental frequency of the crystal is amplified. When the crystal is operated on a mechanical harmonic of its fundamental frequency, the resonant circuit in the plate of the oscillator is tuned to the desired harmonic. The crystal then behaves as though it were oscillating fundamentally at the harmonic frequency. When the crystal is used to drive the frequency multiplier,

Fig. 4. A method for doubling the frequency of the crystal circuit. The first r-f transformer is tuned to the crystal frequency, while L_3C_3 is tuned to twice the crystal frequency.



he crystal first oscillates at its fundamental frequency. This fundamental requency is then used to drive the multiplier stage. Sometimes, where he desired frequency is quite high, both methods are used concurrently.

Frequency Multiplier

Fig. 4 shows a typical crystal oscillator and frequency multiplier. In this circuit, L_1C_1 and L_2C_2 are tuned to he crystal frequency. L_3C_3 is tuned o twice the crystal frequency. Thus, he output of the doubler stage is twice he fundamental or crystal frequency.

Tri-tet Circuits

This same principle may be so used hat only one tube is necessary for both operations. For example, the crystal oscillator may be one-half of a twin triode, and the doubler may be he other half. Or, a pentode may be used, as shown in Fig. 5. This circuit s known as the *tri-tet*. Here, the control grid, cathode, and screen grid perform as a triode-crystal oscillator. The screen grid serves as the plate of he triode. The plate of the tube is then used as the multiplier, with L_2C_2 uned to the desired harmonic. This circuit is usually used where even multiples of the fundamental frequency are desired. The circuit of Fig. 6 is used where odd multiples of the fundamental frequency are desired. This circuit is known as the *grid-plate* oscillator. The essential difference between the two circuits is that in Fig. 5 the crystal is returned to ground hrough the resonant circuit L_1C_1, whereas in Fig. 6 the crystal is returned to ground directly.

Resonant Circuit and Cathode Return

Actually, the circuit of Fig. 6 is a Pierce oscillator, since the screen grid, which is being used as the plate of a triode oscillator, and the crystal return, are connected together through heir common ground terminals. Since the cathode of a tube may be considered as a continuation of the plate circuit, the placing of the resonant circuit in the cathode return does not change the relationship, other than placing the actual plate of the tube at r-f ground.

Oscillator Tuning

All crystal oscillators are tuned in essentially the same way. Fig. 7 shows a typical plate-current characteristic

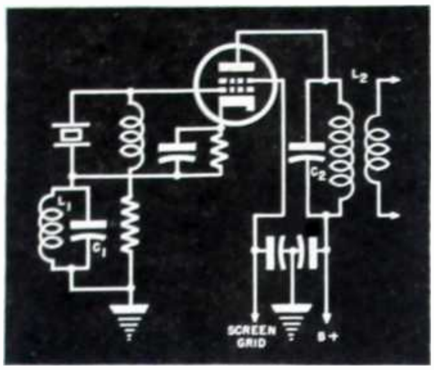


Fig. 5. A crystal frequency multiplier using one tube. L_1C_1 is tuned to the crystal frequency, while L_2C_2 is tuned to a multiple of this frequency. This circuit is used where even multiples of the crystal frequency are desired.

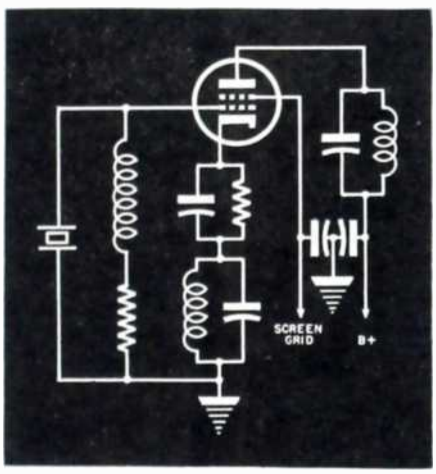


Fig. 6. This multiplier circuit is used where odd multiples of the crystal frequency are desired. The crystal portion of the circuit is essentially a Pierce oscillator, with the screen grid acting as the plate of a triode oscillator.

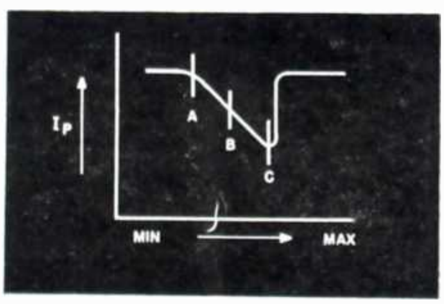


Fig. 7. Plate current characteristic of a crystal oscillator. For stability requirements, the circuit is tuned so that the current is in the vicinity of point *B*. This also prolongs the life of the crystal.

for a crystal oscillator. When the oscillator is in the non-oscillating stage, the plate current will be found to be at some high level. As the plate-tank tuning capacitor is tuned from minimum capacitance, the plate current will dip as shown in Fig. 7; the current decreases slowly until it reaches some minimum value, and then rises sharply. The maximum oscillation will take place at the point of minimum plate current. However, for stability purposes, it is best to operate the crystal oscillator at some point about halfway between maximum and minimum plate current. This point of operation also limits the amount of r-f current in the crystal, and will help prolong its useful life.

Causes of Non-Oscillation

If the crystal oscillator stops oscillating, the cause may be traced to physical and electrical problems.

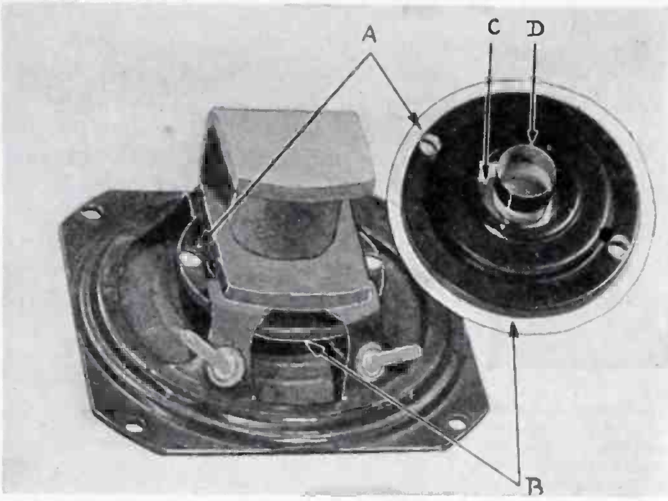
For instance, dirt on the crystal faces will interfere with oscillation. To clean crystals, carbon tetrachloride should be used. The faces of the crystal should be immersed in the liquid and then carefully dried on some lint-free cloth. The faces of the crystal should never be touched with the fingers, since a light film of grease is thus deposited on the crystal impairing its performance. The crystal should always be picked up by its edges, and care should be exercised not to chip the edges. The electrodes should receive similar care, since dirt or grease on their faces will produce the same effects as they would on the crystal.

Tight Coupling

If the crystal oscillator is coupled too tightly to the load, oscillations will cease. This condition will be rare in receivers, but is mentioned here in case some variable coupling method is used.

Other Sources of Trouble

Detuning of the plate tank circuit is another source of trouble. The cure is obvious. All bypasses and coupling capacitors should be checked if some unusual condition appears. For example, an open g-p coupling capacitor, or if a variable coupling capacitor is used, a low value of coupling capacitance will prevent oscillations from starting. An open screen-grid bypass, or a reduction in its value, may cause excessive excitation of the crystal. Another cause of excessive excitation is high bias. This should be checked with a v-t voltmeter in the grid circuit. For other troubles, the crystal-controlled oscillator may be treated in the same manner as any oscillator.



Construction of the Adjust-A-Cone assembly; the spider is kep in position with a pressure or clamping ring, which in turn is hel down by two machine screws. In insert view, we have a closeu of pressure ring, which is underneath at B. At C is the spider; D shows the voice coil.

SERVICING HELPS

RECENTERING LOUDSPEAKER CONES WITH QUAM-NICHOLS ADJUST-A-CONE

by FRANK C. KEENE

THE loudspeaker is a device for the conversion of electrical energy into sound. It is composed of electrical and mechanical parts which acting in conjunction with each other make the conversion possible. Thus the electrical components control the mechanical ones, and the electrical impulses to which the loudspeaker is subjected are converted into mechanical action which creates the sound waves.

Analysis of Two Types

In this discussion we will consider only two types of loudspeakers (though there are at least three others). The most commonly used, namely, the electro-dynamic and the permanent magnet type will be discussed. Both of these function exactly alike, the sole difference lying in the method employed to obtain the magnetic flux in the field in which the voice coil moves. In the former, it is created by an electromagnet and in the latter by a permanent magnet.

The electrical parts of the loudspeaker are the magnet, pot assembly, and the voice coil; while the mechanical parts are the housing and the cone or diaphragm. The voice coil assembly, known as the driver mechanism, is rigidly attached to the cone so that whatever movement is electrically caused in the driver is transmitted directly to the cone. The movement of the cone against the air in contact with it causes the radiation of air waves, or sound.[1]

In order for the voice coil to function, it must be concentrically located around the end of the magnetic pole-piece of the loudspeaker with a clearance between it and the pole-piece. The clearance between the pole-piece and the pot is very close so that the air gap energy is held at a maximum. It is the action of the audio currents through the voice coil while it is in the direct-current magnetic field that causes the voice coil to move in and out.[2] This movement, when transmitted to the cone to which the voice coil has been rigidly attached, causes the propogation of sound waves and hence sound.[3]

Clearances

Clearances must be close for optimum results, but it is imperative that the voice coil ride free within the space between the pole-piece and the pot which is termed the gap. If, for instance, grit or dust gets into the gap, the efficiency and work of the voice coil is thereby impeded. Similarly, the voice coil cannot rub either against the pole-piece or against the pot and give good reproduction.

To center the voice coil within the gap, a membrane, called a spider is built into the loudspeaker assembly. This supports the voice coil at the pole-piece, while the housing (or basket, as it is termed) supports the outer edge of the cone. The spider normally permits movement of the voice coil parallel with the side of the pole-piece, but restricts all side-way movements. If the spider itself gets off center, then the voice coil is no longer concentrically located over the end of the pole-piece and a rubbing voice coil results. The same would occur if the voice coil itself were bent at its junction with the spider.

Rubbing Voice Coils

A rubbing voice coil not only causes losses in power because of the friction developed between the voice coil and the pole-piece or the pot, as the case may be, but it also introduces distortion.[4] Such off-center operation is apparent in the reproduction in the sound by rasps and rattles and by highly distorted frequency responses. This widely divergent output response from that of a normal speaker cannot be reconciled by the human ear which, while not intolerant of small aberations and distortions,[5] does and can register those of this magnitude.

The result is that the user of a loudspeaker with an off-center or rubbing voice coil usually calls in the Service-Man to restore the quality which has

(*Continued on page* 51)

[1]Terman, *Radio Engineering*, page 767.
[2]Terman, *Radio Engineering*, page 765.
[3]Olson-Massa, *Allied Acoustics*; Massa, *Electronics*, Feb. 1936; Seabert, *Electrodynamic Speaker Design Considerations*, Proc. IRE, June 1934.
[4]Knowles, *Electronics*, Sept. 1933; Terman, *Radio Engineering*, page 774.
[5]Terman, *Radio Engineering*, page 763.

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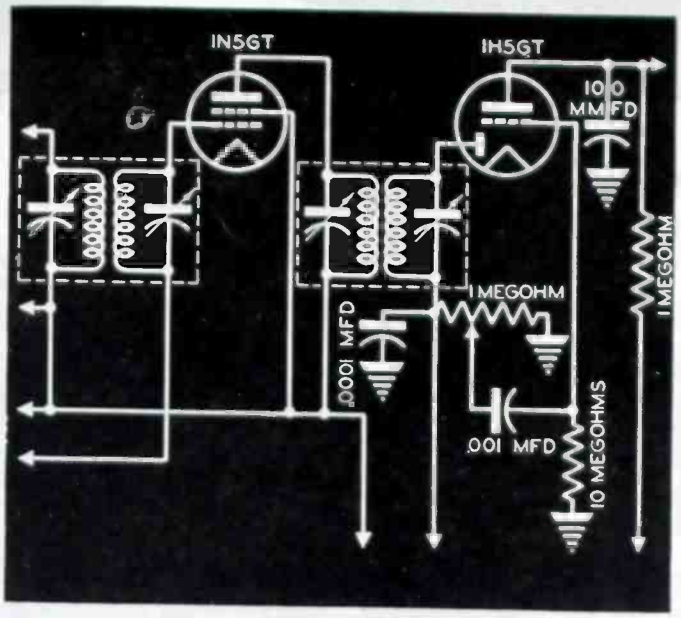


Fig. 1. The i-f system of the Westinghouse WR-678. The sensitivity of portable-receivers is about 30 μv for an output of 50 mw. Most of this gain is supplied by the high gain i-f stage.

by L. E. EDWARDS

I-F AMPLIFIERS

DURING the past few months we have been discussing some of the important circuit systems that constitute the modern receiver. Thus far we have covered inputs. (Martin W. Elliott's analysis of mixers appeared last month and continues in this issue on page 32.) In the i-f amplifier we have another vital element of receivers. For this section provides both sensitivity and selectivity.

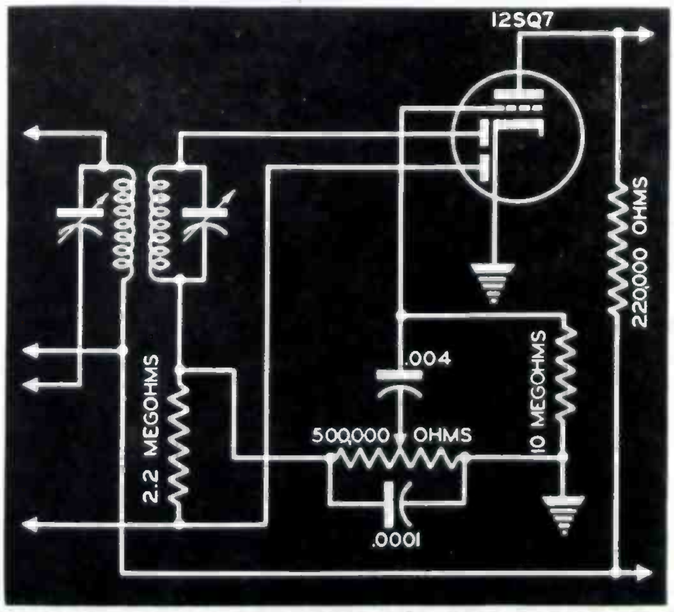
High-gain remote cut-off pentodes are the most suitable amplifier tubes, allowing a wide range of avc control without detuning, and have thus been used in most i-f amplifiers.

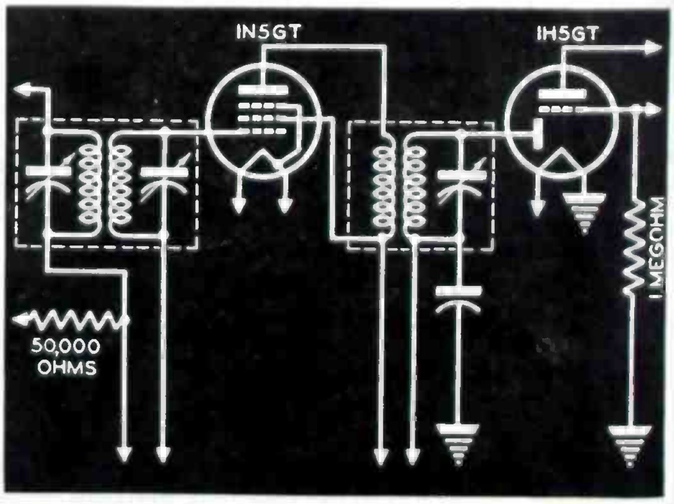
I-F Transformers

I-f transformers may be divided into two classes based upon their inductance; high-inductance coils of 2.0 to 2.5 mh and low-inductance coils of 1.0 mh or less. The former are tuned to 455 kc by low-capacity trimmers of 50 to 100 mmfd, giving a high *L/C* ratio and a high anti-resonant impedance which presents a good match to the pentode plate resistance. However, this arrangement is extremely critical to adjust to resonance and still harder to keep there because the trimmer is subject to change with temperature and age. Mechanical fatigue and warping are also annoying. Therefore, the attainable gain is not usually obtained for very long. On the other hand, low *L* transformers can use larger tuning capacitors, 150 mmfd and up, which are less subject to mistuning or detuning because they are not so critical. Small changes in capacity cause less change in resonant frequency.

Personal receivers using only 45 or 67 volts *B* must use very high quality, high *Q* transformers of the order of *80* to *100*, to obtain sufficient overall gain. Some of these types are potted, forming a closed magnetic circuit like two *E* laminations, or shell type which greatly reduces absorption in the shield, or even eliminates the shield in some instances.

I-f coils of the low-priced a-c/d-c receivers are wound with No. 37 or 38 solid copper, while the higher-priced receiver i-f's use 3 to 5 strand Litz for the input and either solid or Litz for the output, or second detector transformer. The i-f's of the very high





Figs. 2 (left) and 3 (above). Fig. 2 shows the i-f section of the Spiegel 1-40. No i-f tube is used, the gain of the single i-f transformer being enhanced by a small amount of regeneration. Fig. 3. I-f section of the Allied D-366. Primary of the second i-f transformer is untuned. The elimination of this tuned stage reduces both the gain and the selectivity of the receiver.

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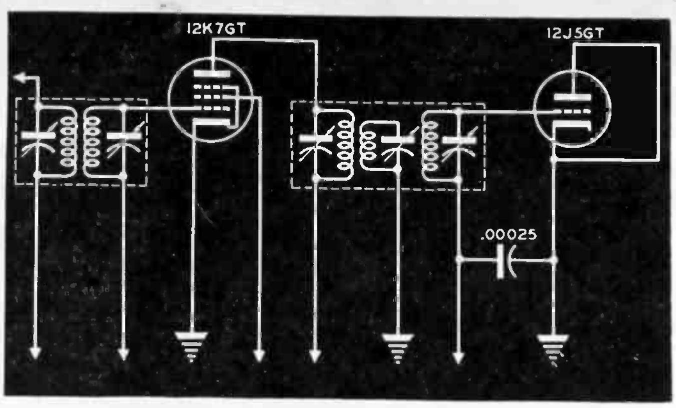

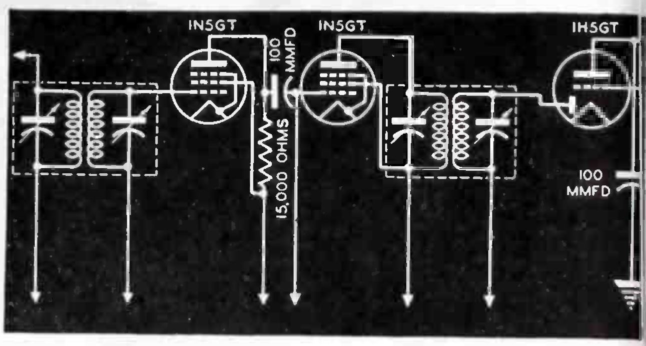

quality receivers have been wound with 7 to 10 strand Litz on larger coils, and often are triple-tuned or iron-cored, and encased in cans. For improved stability, the tuning capacity is often divided between a fixed silver mica capacitor and a small trimmer, any variation in the latter representing only a small part of the total.

Westinghouse WR-679

In Fig. 1 we have a conventional i-f amplifier of a portable, Westinghouse WR-679, using a 1N5GT with standard dual air-core transformers. Portables of this type have a sensitivity of about 30 microvolts from converter grid to speaker for an output of 50 milliwatts, the principal part of the gain coming from the i-f. For comparison, a typical a-c/d-c job has a sensitivity of about 180 microvolts.

The detector transformer is loaded by a 1H5 diode and its load resistance, a 1-megohm volume control. It is important that the second detector be well grounded to the chassis to prevent coupling to the loop antenna. Sometimes eddy currents are formed in the chassis which act as coupling loops. This condition is worse where the loops are poorly designed, since this prompts broad tuning because the i-f frequency

Figs. 4, (above left) and 5 (above right). In Fig. 4 appears the i-f system of the Air-King 4034. Triple tuning in the second i-f transformer provides good gain. At the same time the bandpass characteristic is improved, resulting in high fidelity reception. Fig. 5. Resistance coupling in an i-f stage in the Ward O4WG-2672. This is an inexpensive way of increasing the gain of a receiver with very few parts. The increase in gain is of the order of 12-20.

of 455 kc is quite close to the 540-kc setting at the low end of the band.

Spiegel 1-40

The i-f section of a midget 3-tube and rectifier superhet without an i-f amplifier tube is shown in Fig. 2. In this receiver, Spiegel 1-40, a 12SA7 modulator feeds a 12SQ7 second detector through the single i-f transformer. Sensitivity and selectivity are both enhanced by regeneration by returning the primary tuning capacitor to an *RC*-feedback element in the cathode circuit. One diode is used as detector, the other as a gate on the avc system.

Allied D-367

In Fig. 3, we have another portable receiver, Allied D-367, which contains a conventional i-f input transformer but uses a single-tuned detector transformer. This transformer is a cart wheel type, wound on a single ceramic base, with the windings very clos coupled. This type of unit hasn't m selectivity.

Air-King 4034

In Fig. 4 appears the i-f system the Air-King model 4034. In this sy tem we have a triple-tuned second d tector transformer which provides go gain and, at the same time, bandp characteristics for passing a wide ba for high fidelity. This may be acco plished by staggering the tuning of t three circuits so they resonate at thr equally separated frequencies. T added tank circuit is grounded to pr vent electrostatic coupling. The d tector is a 12J5 used as a diode with ½-megohm load resistance. The inp i-f transformer is standard.

Ward 04WG-2672

A Ward portable, model O4W(2672, with a resistance-coupled secor i-f stage, is shown in Fig. 5. Th method is ideal for portables, since provides an additional gain of 12-2 with but one extra tube, two resisto and a coupling capacitor. Its use generally limited to applications i which selectivity is not a problen There is a further disadvantage in th reduction of the signal/noise rati With the additional i-f gain in this typ of receiver, the circuits are pretty *ho* compared to the standard single i-f cir cuits; hence, such items of stability a bypass capacitors must be watche carefully. Replacement units must b of good quality and adequate capacity

The first i-f plate load consists o 15,000 ohms. Some designers hav used up to 75,000 ohms. The coupling capacitor is 100 mmfd.

G. E. L-643, 653, 663, 673

In Fig. 6 (G. E. L-643, 653, 663 673), we have an iron-core i-f inpu system, with a large air-core unit fo the second detector, the pair providing exceptionally good i-f gain without th use of high-inductance coils. In som receivers the cores are sometimes mad

(*Continued on page* 48)

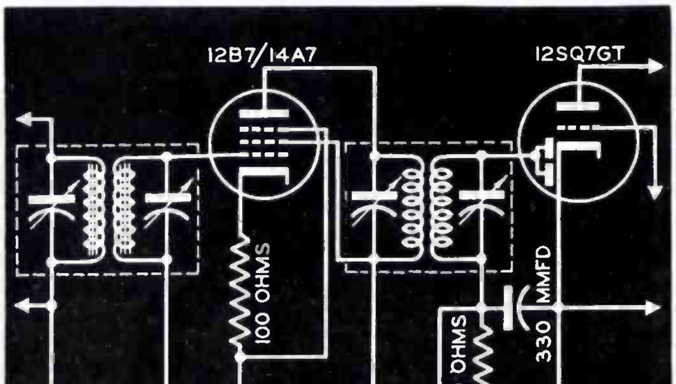

Fig. 6. The G.E. L-243 i-f system. Iron core coils are used to improve the *Q* of the i-f system. In some receivers, the cores are made adjustable, permitting the use of stable, fixed capacitors.

Portrait of Randolph C. Walker by John Carlton

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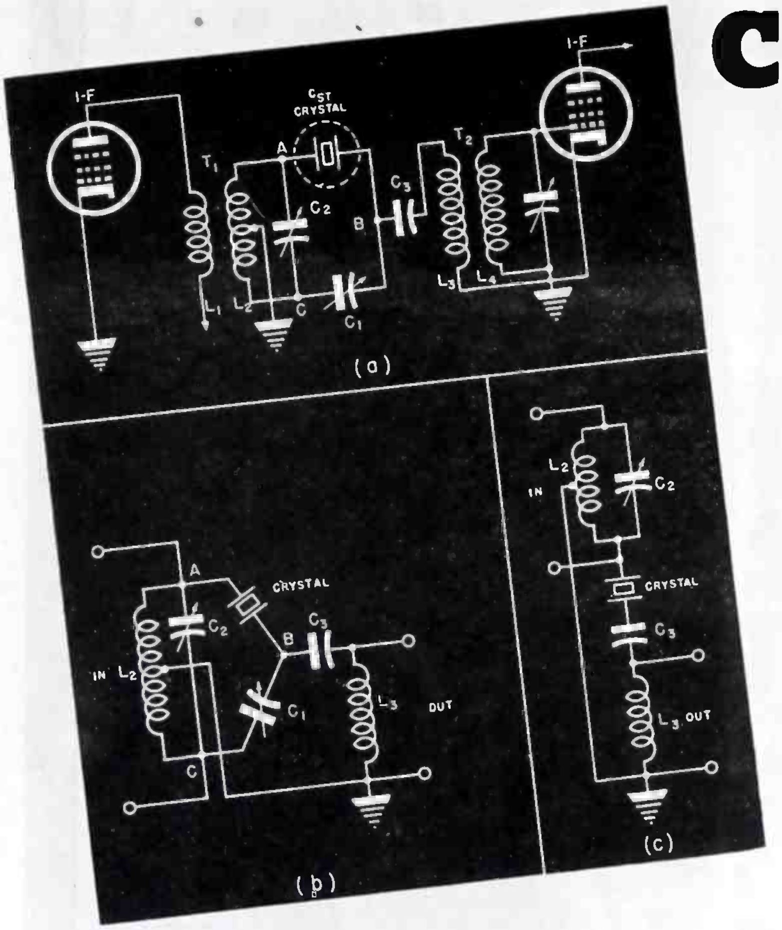

CRYSTAL

by THOMAS T. DONALD

Fig. 1. A typical crystal filter i-f network. In *a*, the crystal filter circuit is shown; *b* shows its close relationship to a balanced-bridge type network; *c* shows how the series resonant characteristic of the crystal is used to provide extreme selectivity.

Many types of communications receivers feature single-signal circuit design for c-w or code reception.

In c-w (continuous waves) we have the transmission of an r-f carrier only, with no audio modulation. The carrier is then broken up into short and long dashes, or coded. Since there is no audio modulation, the only means of detecting the signal, is through the use of a beat-frequency oscillator or b-f-o which was analyzed in last month's article. However, in the bands used for this type of communication, two adjacent signals may be no more than a few cycles apart, since the volume of air traffic is quite heavy. Therefore, the selectivity of a broadcast type receiver, and its band acceptance of ten kc required to accommodate the side band transmissions necessary for true fidelity of music and voice, would be unacceptable for c-w work. It therefore becomes necessary to improve the selectivity of the receiver to a point where the band acceptance is 100 cycles or less. The best method for accomplishing this is through the use of a crystal filter. In addition, a narrow band acceptance helps to reduce static as well as other types of interference. Many Service Men may have noted that when European pickups are retransmitted in this country c-w signals are heard in the background. With a sharp crystal filter, it is possible to receive the code signal, and almost completely obliterate the broadcast signal.

Crystal Filter Positions

Crystal filters are usually installed between the first detector of a superheterodyne receiver, and the following i-f stage, or between i-f stages. A typical crystal filter i-f network is shown in Fig. 1*a*. It is redrawn in Fig. 1*b* to show its close relationship to a bridge type, or balanced network. In this figure C_1 is the *phasing* control. If the crystal could be installed in the circuit without the accompanying capacitance introduced by the crystal holder and associated wiring, C_1 as well as the balanced type circuit, would be unnecessary. However, due to the introduction of this stray capacitance, represented by C_{ST} in Fig. 1*a*, it is necessary to balance out its effect. This is accomplished with C_1, the phasing control. If this were not done, the circuit enclosed by the dotted line in Fig. 1*a*, would act as a coupling capacitor, with the crystal assuming the role of a dielectric, serving to link T_1 and T_2, and permitting the passage of all r-f signals present in T_1. However, when C_1 is adjusted so that it is equal in value to C_{ST}, any non-crystal-resonant voltage developed between points *A* and *B*, is cancelled out by a like voltage between points *C* and *B*. A study of Fig. 2*b* shows how the balanced-type circuit accomplishes this. For crystal resonant voltages, the crystal acts as a series resonant circuit, thereby providing a coupling path between T_1 and T_2.

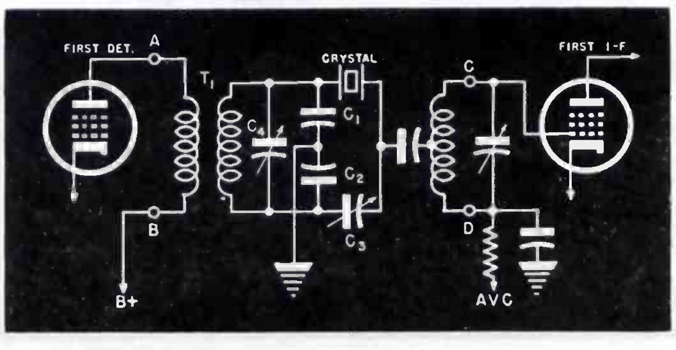

Fig. 2. The crystal filter network of the National NC 100 XAB. C_1 and C_2 split the secondary of the first i-f transformer capacitively. C_3 is the phasing control. This is a plug-in type stage, *A*, *B*, *C*, and *D* representing the four prongs of the plug.

Phasing Controls

The phasing control, C_1, also performs another function. Since it is a

FILTERS USED IN COMMUNICATIONS RECEIVERS

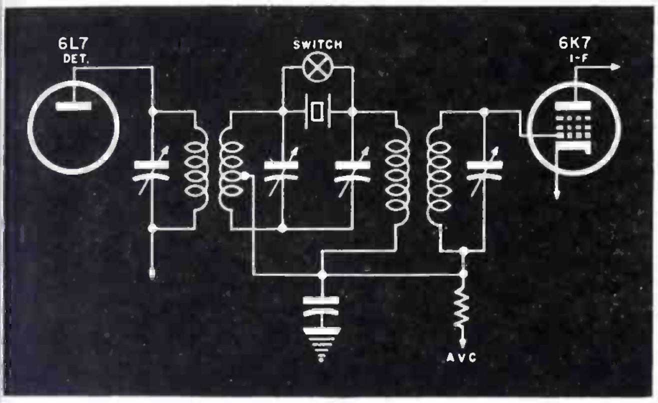

Fig. 3 (above). Crystal filter of the Hallicrafters SX 18. Here, the transformer is split inductively. A panel switch is provided to cut out the crystal for voice reception.

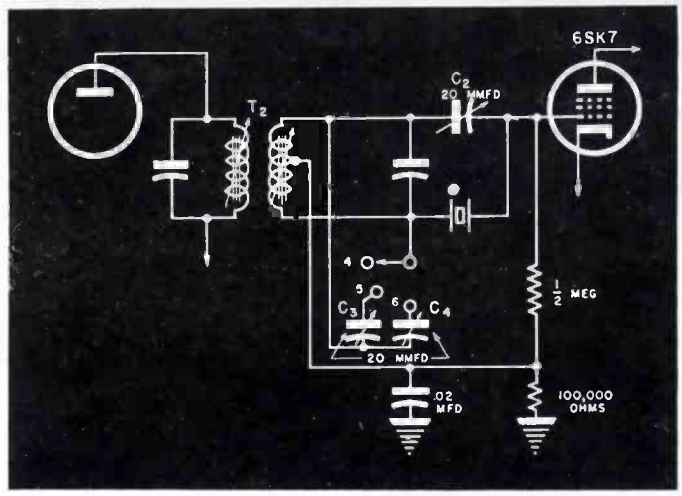

Fig. 4. The variable-selectivity system used in the Hallicrafters SX 28. Capacitors C_3 and C_4 detune the secondary of T_2, thereby increasing the effectiveness of the crystal and improving the selectivity of the system.

ancelling agent, any partial concellaion of the distributed capacity in the rystal circuit would tend to decrease ts selectivity. Therefore, the phasing ontrol may also be used to control the electivity of the crystal filter.

Selectivity Control

The adjustment of C_2, which tunes $_1$, may also be used as a selectivity ontrol. When C_2L_2 is tuned to the esonant frequency of the crystal, it laces a high resistance in series with he crystal, since, at resonance, a parllel tuned circuit offers the greatest mpedance, or resistance. (The ciruit is shown in Fig. 1*c*.) Therefore he effectiveness of the crystal *Q* is educed, since it only represents a mall portion of the entire resistive etwork represented by L_2C_2, the rystal, C_3, and L_3. However, if L_2C_2 s detuned, the resistance of this porion of the network is reduced to the eactance of either L_2 or C_2, whichver is smaller, and the effectiveness f the crystal is increased. Thus, the electivity of the circuit is increased.

Basic Designs

The three points previously disussed are important since they are ot only the basis of most of the rystal-filter network communications receiver designs, but a major factor in servicing and alignment.

National NC 100 XAB

Figs. 2 to 6 show the crystal-filter networks used in typical communications receivers.

Fig. 2 is the crystal-filter circuit of the National NC 100 XAB. C_1 and C_2 are used to split the secondary of T_1 to obtain a balanced circuit. C_3 and C_4 are the phasing and selectivity controls, respectively. This particular model is so arranged that a standard i-f transformer of the plug-in type may be used instead of the crystal-filter unit, which is also a plug-in type. The plug-in points are represented by *A*, *B*, *C*, and *D*. The selectivity of the crystal unit is preset, before insertion.

Hallicrafters SX 18

Fig. 3 shows the crystal system used in the Hallicrafters SX 18. Here, the primary of the first i-f transformer is tuned, and its secondary split inductively. A panel switch is provided to cut out the crystal when the set is used for b-c reception. Note the similarity of this circuit to Fig. 1*a*.

Variable Selectivity Filters

The circuits shown previously have been simple versions of crystal filters. More expensive types of communications receivers feature a variable selectivity i-f system, with and without crystal filters.

All variable selectivity crystal-filter systems revolve around some method of decreasing the *Q*, or band acceptance, of the crystal. This is necessary, since it permits easier tuning of c-w signals when noise conditions are not restrictive. It can be appreciated that when dialing for a signal with an i-f channel that is only 100-cycles wide, the slightest movement of the dial would pass over the signal. Figures 4 to 6 show three such systems.

Hallicrafters SX 28

Fig. 4 shows the variable selectivity system used in the Hallicrafters SX 28. Three positions, *4*, *5* and *6*, are provided for crystal *broad*, *medium*, and *sharp*. In position *4*, T_2 is tuned accurately to the crystal frequency. This causes broad-band acceptance, as explained in Figure 1*c*. Position *5* adds trimmer C_3, which detunes T_2 slightly, thereby increasing the effectiveness of the crystal filter. Position *6* further

(*Continued on page* 50)

ELECTRONIC ALARM SYSTEMS

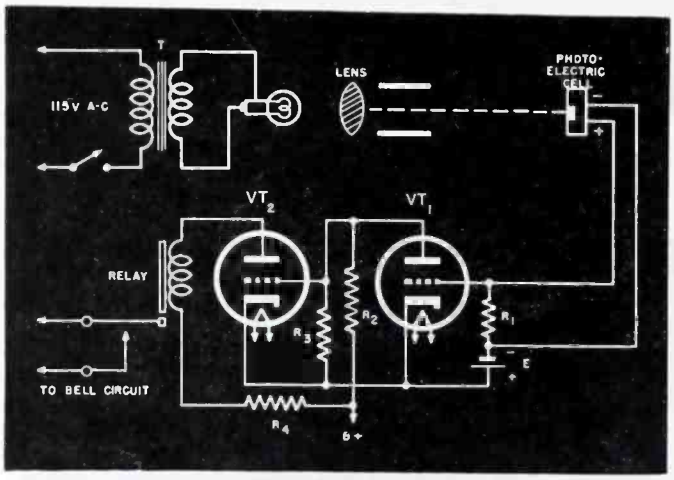

Fig. 1. An elementary photoelectric alarm system. Interruption of the light source reduces the voltage across R_1, which is bucking the bias voltage. This reduces the plate current, and thereby actuates the bell system.

by WILLARD MOODY

ELECTRONIC circuit developments have introduced many unusual tube applications, such as the electronic alarm. During the war electronic alarms were used in a variety of installations. The postwar era will see an extensive use of these alarms in industry and the home.

Types of Alarm Systems

There are several types of electronic alarm systems. In Fig. 1 we have one where light from an auto type bulb is directed through a lens and barrel-like tube to a photoelectric cell which may be four or five feet away. In some cases a filter is used in front of the barrel for passing invisible infra-red days only. In other cases, ordinary white light is used. In operation, the light strikes the photocell which develops a potential across the cell terminals. This voltage is applied to the grid of the first tube and is bucked out by a bias voltage. When light no longer strikes the cell, the voltage is zero and the grid bias potential causes a decrease in the plate current, since the bias is more negative.

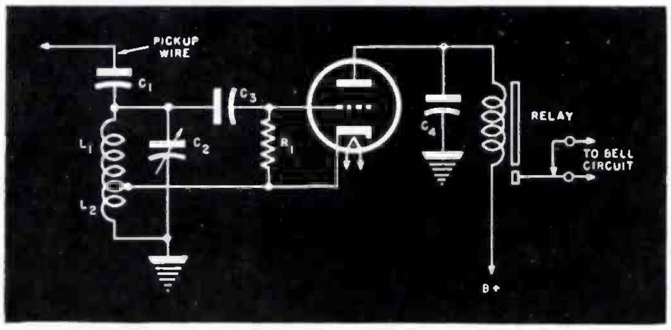

Fig. 2. A circuit typical of r-f types of alarm systems. Variation in the capacity across the grid circuit of the oscillator causes a decrease in plate current, which in turn closes or opens a relay.

Relay Activity

The interruption of the light beam thus actuates the alarm system. That is, the drop in plate current, with an increased negative grid potential, causes less current flow in R_2 and a decreased voltage drop across R_2. Then, the increased positive potential on the grid of the second tube causes a rise in plate current and the relay closes. A latching or lock-in arrangement may be used on the relay, so that

(*Continued on page* 38)

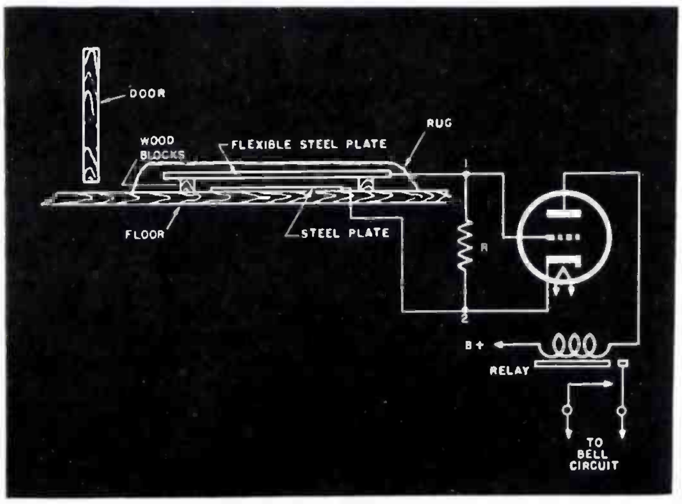

Fig. 3. A step-operated type of alarm system. Resistor *R* is usually of the order of 10 to 15 megohms. Shorting of the flexible steel plates by stepping on them shorts out the grid resistor, causes the plate current to rise, and actuates the relay.

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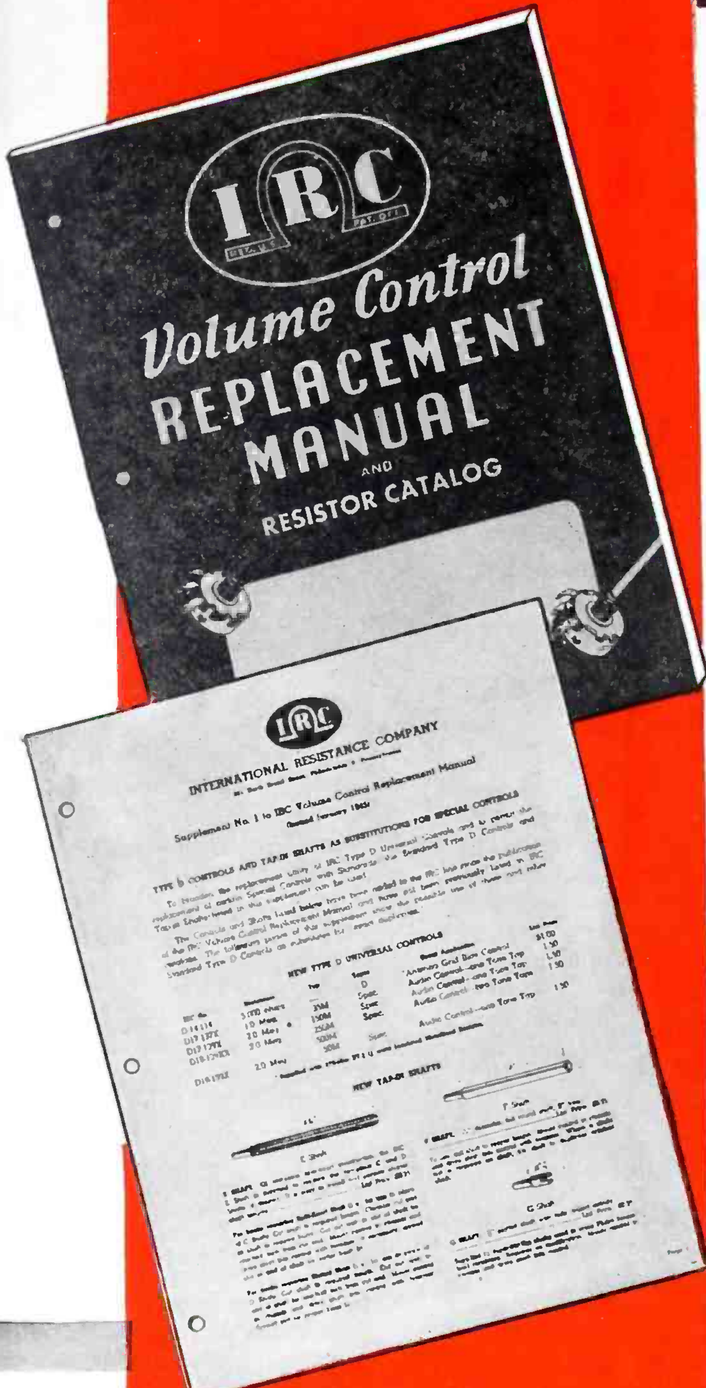

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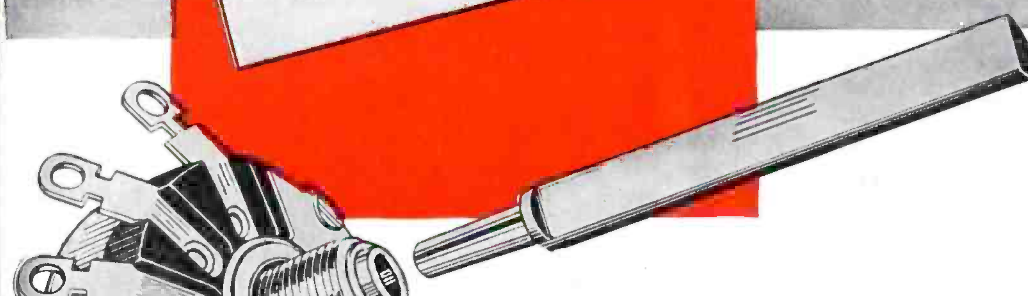

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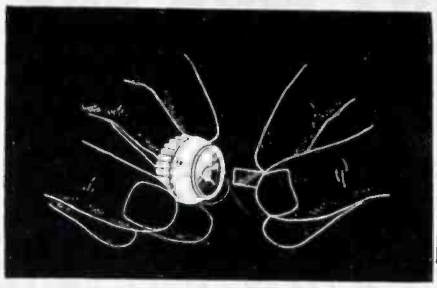
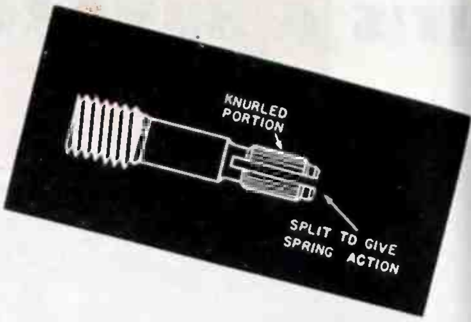


Figs. 1 (left) and 2 (right). Fig. 1. How the metal spacer is inserted in the knob against the flat spring in push-on type knobs requiring only a 1/32" flat. (*Courtesy P. R. Mallory & Co., Inc.*) Fig. 2. Split-knurl type shaft that makes a set screw or spring in the control knob unnecessary.



VOLUME AND TONE CONTROL RESISTORS

Part Nine of a Series on Receiver Components

by ALFRED A. GHIRARDI
Advisory Editor

VOLUME and tone controls have, in part, reached standardization of certain mechanical dimensions. In general, the tendency has been toward a reduction in overall size, particularly for automobile and midget receiver applications. Perhaps the greatest variance in the controls used as original equipment concerns the length of shaft and the method of fastening the control knob to the shaft.

Control Shafts and Knobs

The knobs used on most of the home and portable receivers have been of two general designs, the *set-screw* type and the *push-on* type knob. The shaft diameter has (practically from the start) been ¼" in diameter and the bushing ⅜" in diameter, so from the replacement-control angle, the main problem involves the providing of a universal means which will allow the use of either the screw type or the push-on type of knob.

Provision of a *flat* on the shaft accommodates the screw type; it provides a secure mounting. The *push-on* type also utilizes a flat on the shaft, but in the design of such knobs two sizes have been developed, one which uses a shaft milled down 3/32" and one which uses a 1/32" milling. The former was extensively used in earlier receivers. The problem of making a universal line of home receiver controls has been met by one manufacturer by milling all shafts to 3/32". This covers the majority of *push-on* type knobs and also accommodates the *screw* type. Then, for those cases which require a 1/32" milling, a small 1/16" metal insert or spacer is used on the deeper milling to bring it up to 1/32". This spacer is inserted in the knob, resting it on the flat spring member (as illustrated in Fig. 1) before assembling the knob to the shaft. When this assembly is pushed on the shaft, it provides a secure and simple method of application. The milled side of the shaft is turned to the downward position allowing the insert to remain in the proper location in the knob during assembly.

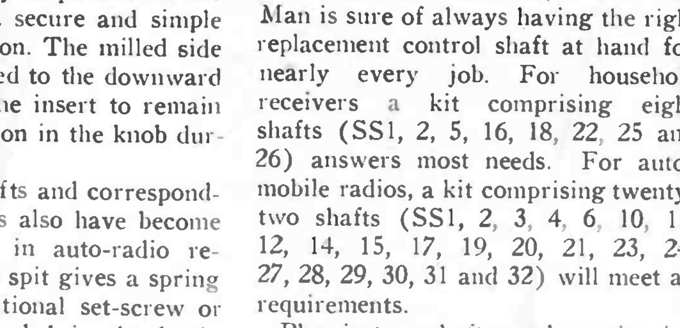
Split-knurled shafts and correspondingly knurled knobs also have become popular, especially in auto-radio receivers, because the spit gives a spring action and no additional set-screw or spring insert is needed in the knob. Furthermore, the knob can be pushed on the shaft in any relation to the sliding contact arm of the control. A split-knurled shaft is illustrated in Fig. 2. The knobs for split-knurled shafts will not fit the conventional flattened shaft.

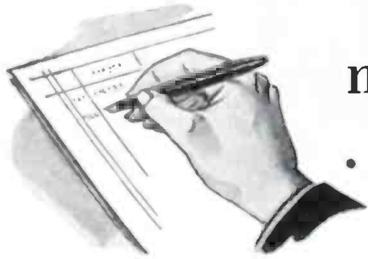
Plug-in Shafts

The *plug-in* type shaft is a recent innovation in universal shaft design. Such shafts are made in plug-in form to fit a special line of controls made by the particular manufacturer. The shaft is easily attached or detached to a special fitting in the bushing, and is held rigid. A recent shaft design employing a tapered plug-in portion is illustrated in Fig. 3; a complete line of plug-in shafts is illustrated in Fig. 4. With this entire set, the Service Man is sure of always having the right replacement control shaft at hand for nearly every job. For household receivers a kit comprising eight shafts (SS1, 2, 5, 16, 18, 22, 25 and 26) answers most needs. For automobile radios, a kit comprising twenty-two shafts (SS1, 2, 3, 4, 6, 10, 11, 12, 14, 15, 17, 19, 20, 21, 23, 24, 27, 28, 29, 30, 31 and 32) will meet all requirements.

Plug-in type shafts are becoming increasingly popular for the following reasons: (*1*)—They result in a tremendous increase in the flexibility of control applications, for only a few types of controls are required to service the large majority of receivers. Hence they reduce the stocking and inventory problem. (*2*)—They either replace the original shaft exactly, or they can be made into exact replicas by simply cutting to the required length.

Fig. 3. A recent design of tap-in (plug-in) shaft. (*Courtesy IRC*)





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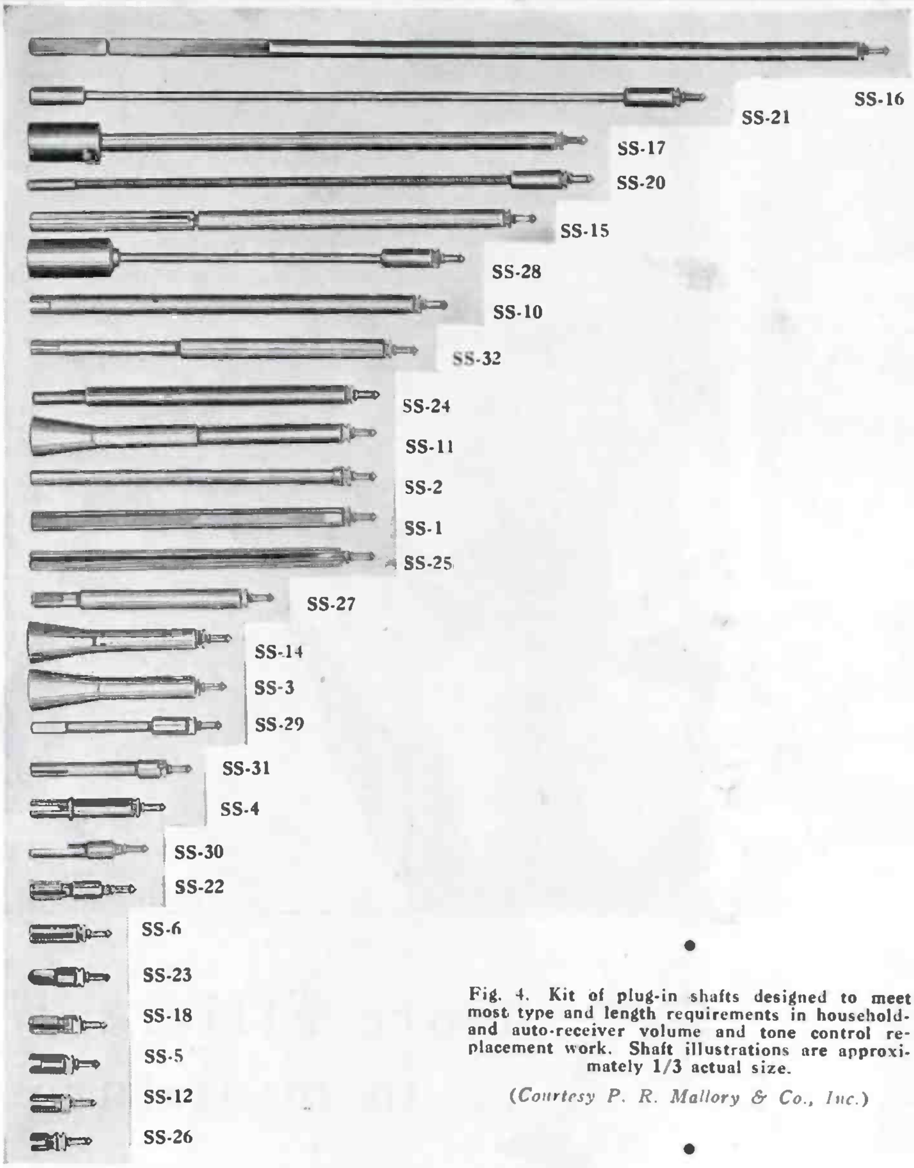
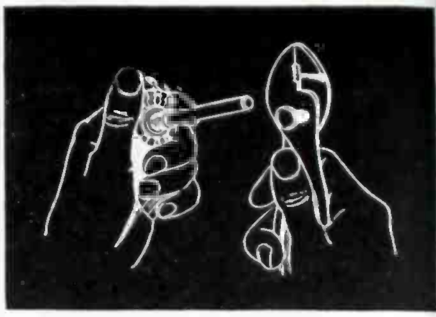


Fig. 4. Kit of plug-in shafts designed to meet most type and length requirements in household- and auto-receiver volume and tone control replacement work. Shaft illustrations are approximately 1/3 actual size.

(Courtesy P. R. Mallory & Co., Inc.)



A sharp tap is all that is necessary to drive the shaft into the control.

(3)—They speed up volume and tone control replacement in the many receivers in which other components are crowded against the back of the control. In such cases, the replacement control may be inserted in place *before* attaching the shaft, thus eliminating the necessity of first having to disconnect and remove nearby components from behind the control to provide sufficient space in which to work. (In such cases, if the defective control that is to be replaced is constructed so its shaft is not removable, it may be slipped out from a crowded place by first cutting off its shaft as close to the panel as possible by means of a hacksaw).

The length of shaft used on controls in receivers is a variable. It depends on the chassis mounting, thickness of the receiver panel, etc. This dimension varies from ½" to 6" or more, with the majority of controls having shaft lengths of 1" to 1½". To adapt a line of fixed-shaft replacement controls to all receivers, the shaft usually is made 3" or 4" in length. For the few receivers having longer shaft controls, extension shafts are obtainable. For shorter shaft controls the ordinary shaft (which usually is made from a special grade of aluminum or other fairly soft alloy) can be notched at the required length by means of a file or knife, as shown in Fig. 5, after which it can be easily broken, as shown.

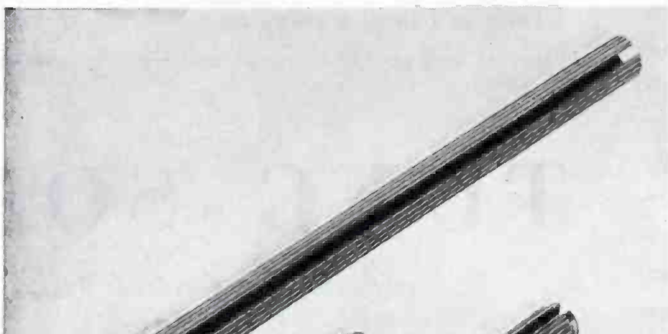
A set of knurled, plug-in shafts of three different lengths up to 4", illustrated in Fig. 6, provide a flexible kit for plug-in shaft type replacement controls where a simple type of shaft is required. These may be cut to the required dimensions to make plug-in shafts of any desired shorter lengths.

Clutch Type Controls

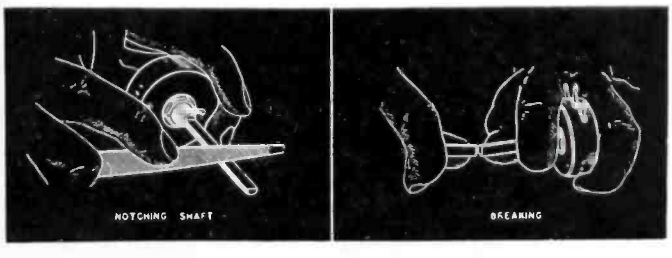
A large number of auto-radio receivers have been constructed with the *on-off* switch that is in or upon the control head located on the car instrument panel, instead of being attached to the volume control in the receiver, Fig. 7.

This arrangement requires a special type of control known as the friction *clutch type* because it contains a friction clutch which permits the shaft to

(Continued on page 30)



Figs. 5 (below) and 6 (left). Fig. 5 Shortening a long shaft to the correct length. Fig. 6. Knurled plug-in shafts in three sizes up to 4". *(Courtesy P. R. Mallory & Co., Inc.)*



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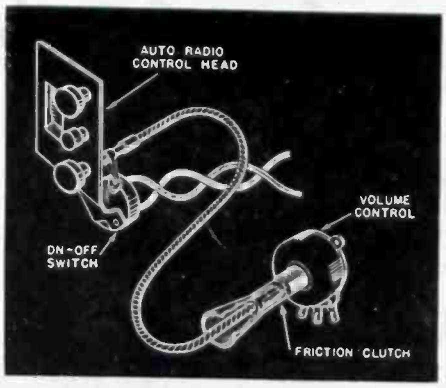
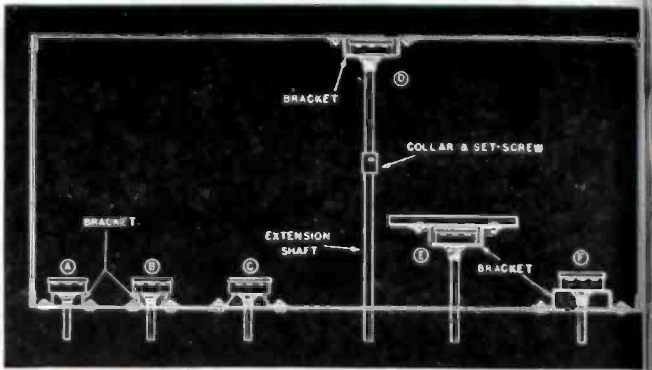


Figs. 7 (left) and 8 (right). Fig. 7. Application of special type controls having a friction clutch-drive arm which permits the shaft to slip. Used in auto sets. Fig. 8 illustrates the use of brackets for mounting volume and tone controls to front panel and sub panels; also the use of an extension shaft where an extra long shaft is required.
(P. R. Mallory & Co., Inc.)



slip in order to allow alignment of the contact arm of the control with the knob indicator on the tuning head so that the *on-off* switch operates at the correct postion. When installing a repaired or replacement control of this type, we must first install the control and insert the driving shaft; then the control knob is turned through its full rotation in both directions. The result is the proper alignment of the contact arm of the control with the driving knob so that the switch operates at the correct position.

Controls having this clutch feature are usually provided with a plain cover, but with a proper portion of the resistance shorted out, so the volume control does not begin to function until the switch has been operated.

Several clutch-type control shaft assemblies of the plug-in type and in different lengths for various models of auto-radio receivers are illustrated at SS-3, SS-14 and SS-11 in Fig. 4.

Mounting Brackets, Extension Shafts and Bushings

Metal mounting brackets with slotted mounting holes are available to enable the Service Man to accommodate available replacement controls to most of the special methods of control mounting which are found in some radio chassis, or for attaching the controls to special mounting brackets provided on the receiver chassis. Fig. 8 illustrates several ways of using such brackets.

A narrow bracket may be used, as shown at *A*, *B*, and *C*, where the control is to be fastened to the panel by means of two screws instead of by its bushing. In arrangements *B* and *C* the bracket is simply bent so that the spacing between the centers of its mounting-screw holes will be the same as that of the holes already in the receiver panel.

Illustration *D* shows the use of a longer mounting bracket, and an extension shaft with its collar and setscrew, when the control is to be mounted to a panel behind the front panel of the receiver. Notice the inverted position of this longer bracket.

In *E* we see the same type of mounting where however the shaft of the control is long enough to make the use of an extension shaft unnecessary. The mounting bracket can be used in the same way as in illustration *F*, if more convenient.

In some types of receivers, particularly auto-radio and communications-type receivers, many parts are mounted by means of such brackets, so some should be included in the Service Man's kit as a matter of convenience and to promote rapid replacement work.

Most controls employed as original equipment on receivers use a standard bushing ⅜″ long. This has been adopted as standard by the RMA standards committee. Accordingly, a standard ⅜-32 bushing, ⅜″ long is supplied on most commercial replacement controls.

In a few cases it is necessary to mount replacement controls on extr thick panels. To accomplish this at minimum cost, hex-type shoulder nu are available as accessories to the co trol and are sold separately. In usi these hex-type shoulder nuts, it necessary to enlarge the hole in t panel slightly by reaming it. Th these nuts are screwed on over t standard bushing; the regular flat n supplied with all controls is not use

Wire-Wound/Composition-Element Control Applications

Two broad types of volume contr are in general use . . . the compo tion-element or so-called *carbon* typ and the *wire-wound* type[1]. The forme ly popular applications of volume co trols in cathode and voltage-supply ci cuits required controls having fair low resistance but a definite curren carrying capacity. Thus wire-wour controls were mostly employed in su circuits. However, the increasing popular practice of using a volun control that controls the audio circui in avc receivers, calls for a high-r sistance type control which is not r quired to dissipate much power.

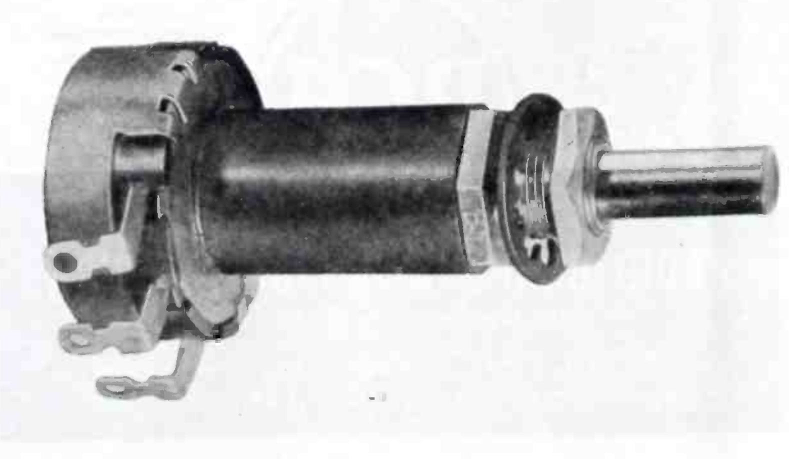
Because it is possible to manufactu the carbon-type control in a great resistance range and flexibility in tl matter of resistance taper[2], it is th type most used for such control ci cuits today, especially when intrica resistance tapers are required.

It is obvious that both types hav a definite receiver application. It ca not be said that either one type c another is best for all purposes, fo each has distinct advantages and dis advantages. Consequently, each typ of control is limited in its applicatio to the circuits or conditions requirin the particular advantages of its typ

Substituting Controls

Although volume- and tone-contr manufacturers offer both types of con

(Continued on page 61)



High-voltage insulating coupler applied to control that must be used in high-voltage circuits such as in television, c-r oscillographs, etc.
(Courtesy Clarostat Mfg. Co., Inc.) [Additional data on these couplers will appear in next month's installment.]

[1]See *Part 6* of this series, August 194 SERVICE.

[2]See *Part 7* of this series, September 194 SERVICE.

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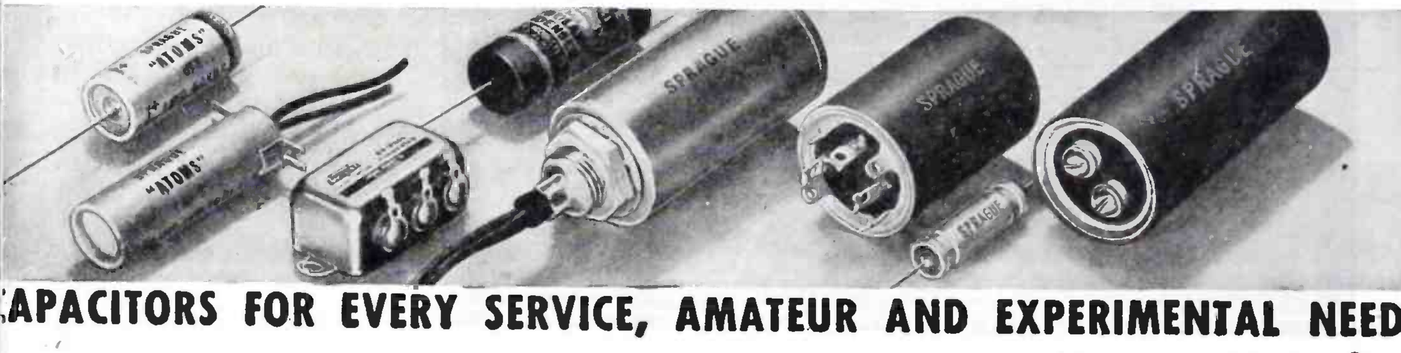

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SUPERHETERODYNE MIXERS

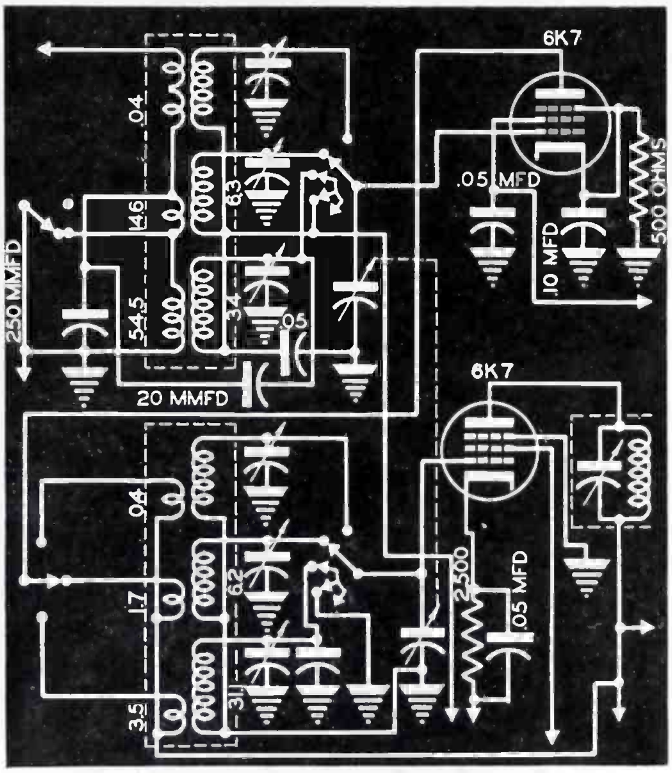
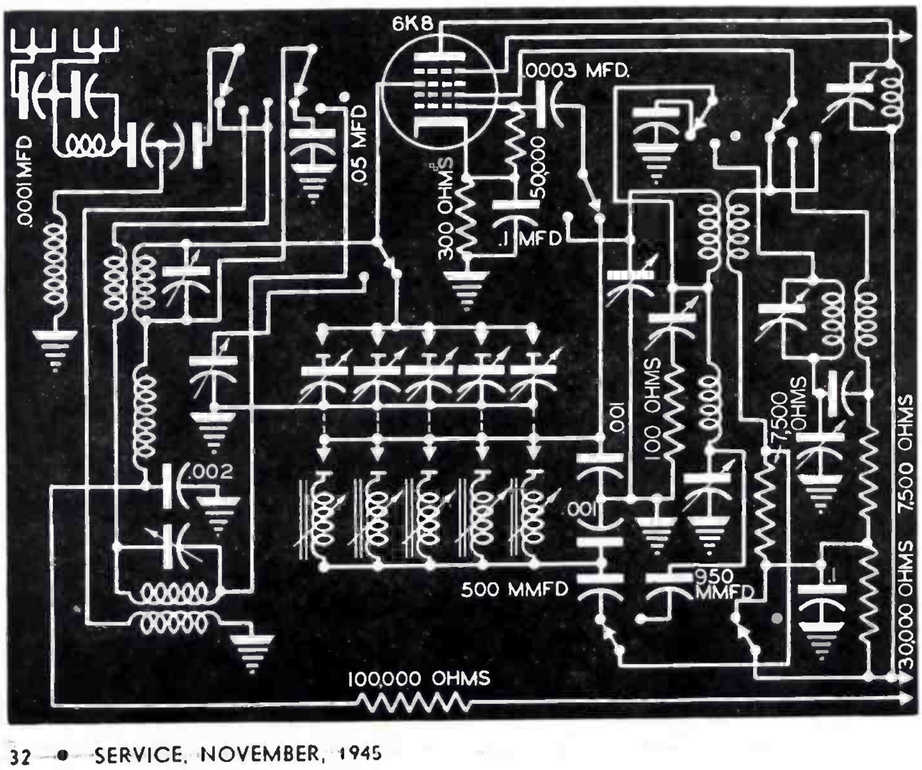


Fig. 11. Mixer circuit of the Ward 62-262. Here, a separate oscillator, not shown, is used. Coupling to the mixer tube is accomplished by tying the oscillator plate to the mixer screen grid.

by MARTIN W. ELLIOTT

[Part Two]

Fig. 10 (below). Mixer circuit of the Lafayette C-37. A Colpitts-type oscillator is used to simplify the wiring, since only two terminals are required. Note the d-p-d-t switch used to change from manual to automatic tuning.



THE mixer of a 3-band receiv Lafayette C-37, using a 6K8, shown in Fig. 10. Provision made for long and short antennas, 456-kc i-f wavetrap, a shunt r-f cho isolated by two capacitors and pus button automatic tuning with capacit tuning for the signal frequency, a permeability tuning for the oscillat frequency. A 300-ohm cathode resis and 50,000-ohm grid leak provide t biasing. A Colpitts oscillator circu with the grid at one end of the coil a the plate at the other end, and t cathode at the potential of the cent of the coil by virtue of two .001-m capacitors affords a convenient ty circuit because only two coil termina are required. The grid is connect through a large .0003-mfd grid cap citor, while the plate is connect through a .0005-mfd capacitor. Th is called a shunt-feed system. A 50 000-ohm leak is connected between t grid and cathode. Manual to au matic tuning is controlled by a d-p-d switch.

Capacitor-Tuned Oscillator Contro

The capacitor-tuned oscillator us in the manual position is also unco ventional. On the s-w position show the grid is connected to the top of t oscillator-tuned circuit. The plate connected through a tickler coil and .00075-mfd capacitor to the opposi end of the tuned circuit. The junctio of the two coils in the tuned circu is connected to ground through trimmer and 100 ohms, also through switch to ground through a .0065-m capacitor, virtually shorting the low coil. On the police band the low coil is shunted by a grid coil of second oscillation transformer. Th

(Continued on page 39)

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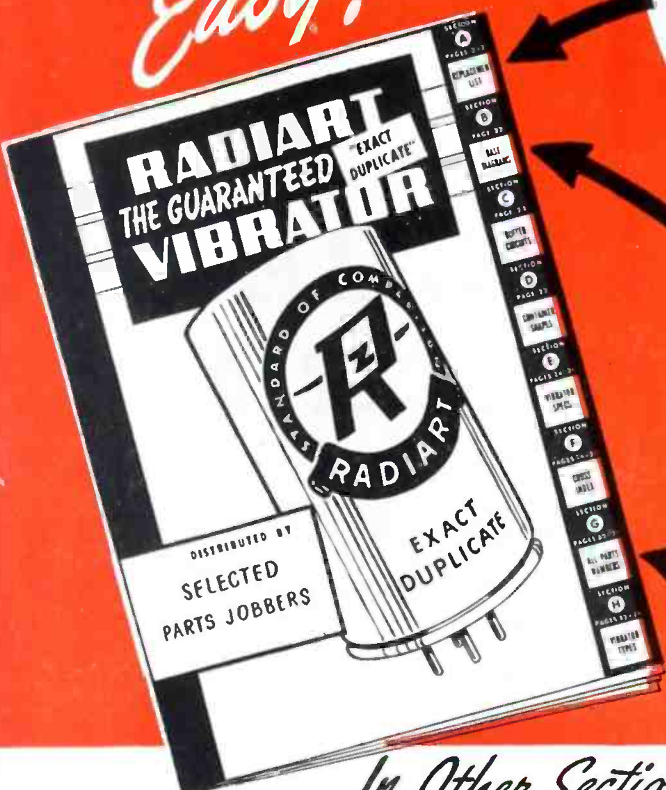

CAR MAKER · SERIES NO. SET MFR. YEAR MADE · MFRS. PART NO. · RADIART NO. · LIST PRICE · BASE DIA. · BUFFER COND.

Section A ...Vibrator

Name, Model No.	Mfrs. Part Number	Radiart Number	List Price	Base Dia.	Buffer Condenser
CHRYSLER					
C1808 (Elec. P. B.) (Philco—1941)....	83-0027	5326P	3.00	A	.005
25C6 (Wells-Gardner—1938)...	19A32	5437	5.95	AB	.018
600 (Mech. P.B.) (Colonial—1941)...	43697	5301	3.55	A	.004
601 (Colonial—1942).	911545	5301	3.55	A	.004
800 (Philco—1941)....	83-0027	5326P	3.00	A	.005

Every model listed includes all available data. The correct Radiart Replacement number and other essential information is determined instantly.

SECTION "B"—Cross

Diagram	Number	Shape	Voltage	Diam.	Ht.	Freq.	Identifying Characteristics	Max. Load Amps
B	3417	2	6	1 1/16	4½	105		6
	3815	9	6	1 1/16	4½	105	Spec. Cup	6
C	5309	1	6	1½	2⅜	105		6
	5331	1	6	1½	3⅛	105		6
D	4256	1	6	1½	3⅛	105		10
	4256-12	1	12	1½	3⅛	105		6

In addition to conventional base diagram drawings this section is unique in that it groups all similar base types together indicating readily the differences between vibrators with the same base wiring. All characteristics are shown, including frequency and maximum load limit of each type.

SECTION "G"—C

Radiart and Original Equ

Original Equipment Part Nos.	Radiart Nos.	Original Equipment Part Nos.	Radiart Nos.	Original Equipment Part Nos.
75	3283	1974	5301	8539
80-161	5421	2080	3417	8540
82B	5341M	2110	3417	8541
83-0017	5326P	2269	5413	8542
83-0025	5326P	2404	5340M	8601
83-0026	5326P	2501	5411	8602

Another Radiart Vibrator Guide EXCLUSIVE feature. When called upon to duplicate a vibrator and no information is available except the number on the old one, use this cross-index which shows the original manufacturer's number (as stamped on vibrator) and the CORRECT Radiart Replacement.

In Other Sections..

Section "C"—Buffer Condenser Values and Circuits.

Section "D"—Container Shapes permitting an easy method of "visual" identification.

Section "E"—Complete Vibrator Specifications arranged numerically by number. Contains necessary data not published in any other replacement guide.

Section "F"—Long a favorite with users of this guide. The only cross-index of all other manufacturers or merchandisers of vibrators, converting their type numbers to the Correct Radiart Replacement.

Section "H"—Numerical Listing of Radiart Vibrators. Furnishes complete information as to all models serviced by each unit. Also advises year each type was originated.

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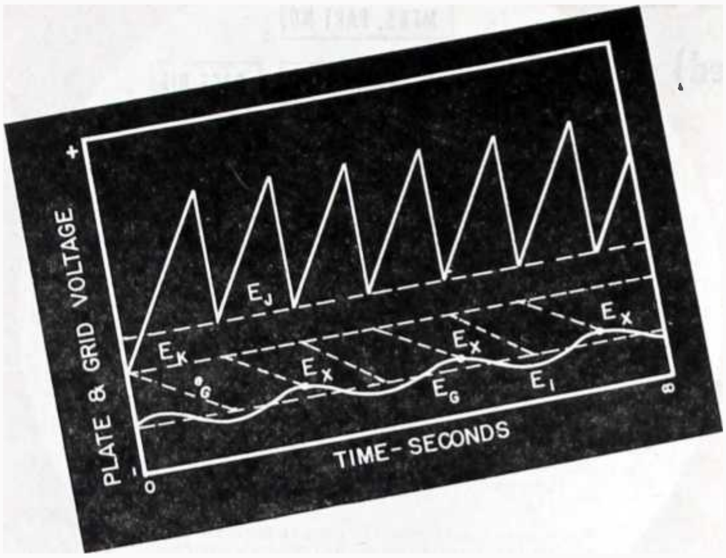

Fig. 1. Graphical synchronization of the linear time-base oscillato system. The critical grid voltage C_g, at which the thyratron con ducts, is proportional to the plate-to-cathode voltage E_p. Thus when the timing capacitor voltage, which is the thyratron plat voltage, is near a maximum value, the signal voltage component E exceeds the critical grid-to-cathode voltage level. This conditio occurs at the critical grid voltage level E_x, and the thyratro relaxes the capacitor charge synchronously with the arrival of th maximum positive potential level of the signal voltage.

C-R OSCILLOGRAPHS

SERVICING . . . APPLICATIONS . . .

[Part Five of a Series]

by S. J. MURCEK

WHERE the oscillograph is utilized to provide a visual analysis of voltage variations, under the condition that the linear time-base oscillation system is not synchronized to oscillate in phase with the frequency of the variation under observation, the image appearing on the screen appears to be in continuous motion. This condition results from the existence of the heterodyne or beat frequency which is developed between the frequency of the voltage under analysis and that of the linear time-base system output.

In order that the waveform appearing on the screen be stationary, it is imperative that the frequencies of the incoming signal voltage and of the linear time-base oscillator synchronize perfectly. Thus, if the image or waveform which is written on the screen varies in exactly the same pattern with each positive motion or sweep of the electron beam, the image of the waveform is written on the screen in exactly the same manner with each succeeding sweep. If, however, the subject waveform occurs earlier in each of the succeeding sweeps of the electron beam, the waveform written on the screen is altered in position with each sweep. Moreover, since the waveform is recurrent earlier in each charging of the linear time-base timing capacitor, the resulting image of the waveform on the electron screen appears to *move* to the *left*. Again, if the waveform should occur later in each positive motion of the electron beam, a similar alteration of the wave image position obtains, and the image appears to move to the *right*.

As a direct consequence of the definite motion which is imparted to the wave image written on the screen by the beat which is present between the two frequencies, it becomes possible to determine accurately the frequency of the voltage variation which is under visual analysis. This, if the motion of the written image is in a left hand direction, the frequency of the signal voltage is greater than that of the linear time-base oscillator. Conversely, if the image motion is in a right hand direction the signal voltage frequency is less than that of the linear time-base oscillator. Zero beat, or synchronization of the two frequencies, occurs when the image is stationary.

For wave- or voltage-variation analysis, it is essential that the image remain stationary. This, in turn, requires that the oscillation of the linear time-base oscillator occur in exact synchronism with the voltage variation which is under analysis. Commercial oscillographs are, therefore, provided with suitable means for the necessary synchronization of the linear time-base system and the signal voltage frequencies. In all of these oscillographs, the synchronization is usually effected through the modulation of the linear time-base relaxation tube grid bias potential by a portion of the voltage variation.

The synchronizing system utilized in the du Mont 164E oscillograph is shown in the circuit diagram, Fig. 2. Here, the voltage which is under observation is impressed across the synchronization system input terminals *H* and *G*. Since the capacitance of the dynamic coupling capacitor C_{12} is large, and the resistance of the *synchronization* potentiometer R_8 is high, the voltage variation impressed across the input terminals *EXT* and *G* appears, in the greatest part, across the resistance element of the synchronization control potentiometer. Further, since a portion of this potential appears between the slider arm and the grounded terminal of the synchronization control potentiometer, and is thus directly in series with the control grid of the *2B4* thyratron, together with the grid current limiting resistor R_{25}, a part of the signal voltage variation is effectively in series with the thyratron control grid-to-cathode bias potential, the latter maintaining the thyratron control-grid negative. Hence, each positive alternation of the signal voltage effects a reduction of the negative grid-bias voltage present between these electrodes.

The effects of the signal-voltage modulation of the *2B4* grid-to-cathode potential are evident from the graphical illustration of Fig. 1. Here the

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tors, ranges, electric irons, and other home
appliances.

● YOU can profit from this big, hungry
market by selling G-E radio tubes. Arrange
now for a sharp increase in your tube busi-
ness in the months ahead. Write for infor-
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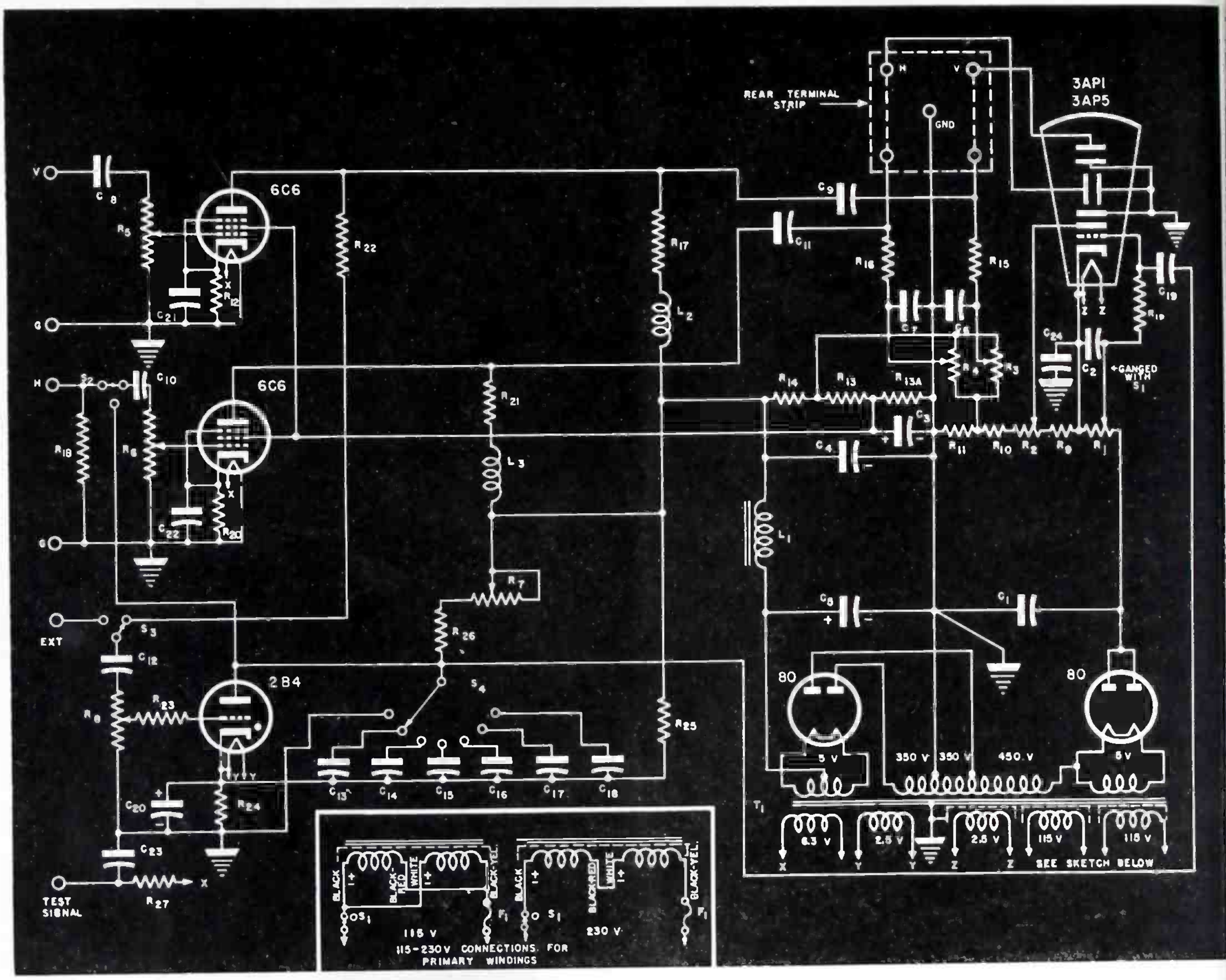

Fig. 2. Circuit of Du Mont 164 E oscillograph.

relations of the various voltage variations occurring in the synchronized linear time-base oscillator operation are plotted with respect to the *2B4* cathode potential level E_k. The d-c component of E_c, which is negative, is shown to be modulated by a portion of the signal voltage variation E_1. Since the critical grid potential E_g is increasingly negative with each increase of the plate-to-cathode potential, E_p, and the latter increases directly in proportion with the charge on the timing capacitor, the positive variations of the grid-to-cathode control voltage eventually exceed the critical voltage E_x. Thus the control grid of the thyratron is effectively positive and becomes conductive, at which instant the tube relaxes the charge on the timing capacitor. Therefore, when the linear time-base oscillation circuit is so adjusted that the frequency of the relaxations is near that of the signal voltage, as we see in Fig. 1, each relaxation must occur in synchronism with each positive alternation or peak of the signal voltage.

Further study of Fig. 1 indicates that thyratron breakdown and the relaxation of the charge on the timing capacitor occur when the signal voltage attains its maximum positive crest, under the condition that the signal voltage wave is of sine wave form. Since the maximum positive voltage level in any sine wave alternation occurs 90° after the inception of the cycle, the relaxations of the linear time-base capacitor charge occur 90° out of phase with the signal voltage variation. The wave image written on the screen is consequently initiated at the maximum positive potential level in its pattern.

Studying the circuit of Fig. 2, we note that the signal voltage variation required for the synchronization of the linear time-base oscillations is obtained either from the plate circuit of the vertical amplifier, or from the external signal synchronizing voltage source, available through the input terminals *EXT* and *G*. A convenient switch, S_3, is provided to connect the ungrounded terminal of the synchronization control potentiometer, R_8, to either voltage source. The series resistor, R_{22}, connected between the *INT* contact of the switch S_3 and the plate of the vertical amplifier pentode prevents excessive loading of the vertical amplifier plate circuit by the linear time-base synchronizing input circuit. Only a very small portion of the vertical amplifier output voltage is necessary to effect satisfactory synchronization of the two frequencies.

In general, modern electronic apparatus is designed for synchronous operation from low-frequency commercial power sources. Hence, synchronization of the horizontal sweep frequency in the oscillograph with that of the voltage variations usually encountered in industrial electronic apparatus, is most effectively accomplished through a linear time-base synchronization circuit connected directly to a voltage source of the same frequency. This type of operation is especially important where the phase relation of the voltage variation under observation to that of the source voltage wave must be ascertained, inasmuch as such phase relationships are not evident when the synchronizing system is activated by the plate circuit of the vertical amplifier.

Where the synchronization of the

linear time-base frequency to that of the voltage under study is accomplished by exciting the plate circuit of the vertical-amplifier pentode, relaxation of the timing capacitor charge must always occur at the maximum positive voltage level attained by the amplified signal voltage.

Thus, if the maximum positive voltage crest occurs when the vertical-amplifier output voltage is completely out of phase with that of the voltage source wave, the linear time-base capacitor relaxations occur at the maximum positive peak of the *amplifier output voltage* and are, therefore, completely out of phase with relation to the source voltage wave. Further, if the phase position of the amplifier positive peak voltage swing varies with relation to its initial position, the linear-time base capacitor relaxations must also vary in phase position, and the wave image written on the screen shows no resultant motion. This factor is of great importance where the signal voltage is, for example, the a-c component of a phase-controlled rectifier grid-to-cathode control potential, where the phase position of the a-c component must be shown to vary directly with the operation of the phase-control potentiometer.

When it is necessary to synchronize the oscillograph horizontal sweep voltage with that of the line frequency, or that of the source, it is only necessary to connect the terminal, *test signal,* to that marked *EXT,* and to operate the switch, S_3, to the *EXT* position. Then the horizontal sweep voltage will be synchronized with the a-c or source voltage frequency, at a 90° phase lead angle. When the oscillograph is operated with this form of horizontal frequency synchronization, application of the input voltage results in the development of a wave image which is initiated at the *positive* zero voltage inflection of the sine voltage wave. The maximum positive crest of the signal potential is shown clearly as a positive peak or cusp in the screen image. Moreover, if the phase position of the signal voltage wave with relation to that of the source voltage wave is varied, the extent of the variation is clearly visible in the motion of the screen image.

Where the oscillograph is operated from a stable voltage source, the voltage present across the phase-shifting capacitor, C_{23}, may be readily utilized to calibrate the vertical deflection system. The calibration is accomplished through connection of the capacitor terminal, *test signal,* to the vertical amplifier input terminal, *V,* and the subsequent adjustment of the vertical gain control to such a position that the height of the vertical motion of the luminous spot on screen is twice the division number.

The horizontal voltage sweep-frequency range is arranged for operation over a frequency range extending from a low frequency limit of approximately 12 cps to a high-frequency limit approaching 50 kc. Since this extended range cannot be practicably arranged in a circuit comprising a single capacitor and a single variable resistor or potentiometer, a multiplicity of capacitors, $C_{13-14-15-16-17-18}$, of various capacities are used, together with a *vernier frequency* control potentiometer, R_{20}, and range selector switch, S_4. Each of these capacitors is so selected that the frequency ranges covered appreciably overlaps the ranges covered by the capacitors adjacent to the former. It should be observed here that the shield terminal of each capacitor is common with the cathode of the relaxation thyratron, and that the maximum potential which is developed across these capacitors is relatively low in level. Further, because of the low-capacitor operational potential, the charge stored is correspondingly low, necessitating the application of high capacitances in the lower-frequency ranges.

It is the horizontal deflection system, together with the linear time-base oscillator, which must be generally depended upon to effect the writing of recognizable waveforms on the screen. Where the signal input or dynamic voltage variation applied to the input terminals of the vertical deflection amplifier is subject to sporadic disturbances or interruptions, the continuous horizontal motion of the beam, effected by the linear time-base oscillator and the horizontal deflection amplifier, prevents accidental damage to the screen which would result with a stationary luminous spot. Hence, before any cathode-ray oscillograph is placed into actual operation, it is prudent to be sure that the beam will be in motion when the cathode of the tube reaches operating temperature.

In the du Mont unit of Fig. 2 the *intensity* or beam control is ganged with the primary or power input control switch, S_1. Thus, when the unit is placed into operation, it is only necessary to partially turn the intensity control to the a-c line control switch, S_1 to the *on* position. The slider arm is then placed so that the grid is maintained quite negative. This prevents further development of an electron beam during the period in which the tube heaters rise to operating temperature. Then, it is necessary to see that the horizontal amplifier input control switch, S_2, which is usually ganged with the linear time-base *coarse-frequency* control switch, S_4, is in the linear sweep position, if no other form of horizontal deflection potential input is to be used. In this way we can be sure that the beam will be in motion when the beam is permitted to strike the screen.

Since the first plate, or accelerating electrode, is effective in the development of the beam, it is necessary to turn the *focus* control potentiometer knob a complete half-turn in a clockwise direction. The *vertical* and *horizontal* positioning controls determine the normal or *idle* position of the electron screen pattern.

The length of the horizontal sweep pattern is governed by the amplification level at which the horizontal amplifier operates. Inasmuch as no actual deflection of the electron beam occurs if this control is left in the minimum or zero position, it is advisable to advance the horizontal or *X* axis amplifier gain control, in a clockwise direction, at least to the 50% dial position. At this time, the intensity control may be advanced in a clockwise direction until a visible green trace is written on the screen. The intensity of the luminous trace is then carefully adjusted to the desired level or brightness, and focussed to the desired clarity, by manipulation of both the intensity and the focus control potentiometers. Here, it may be found that the horizontal sweep voltage causes the written trace to extend beyond the edges of the electron screen area, causing a visible parasitic glow at either of its extremities. This condition is corrected by appropriate reduction of the horizontal amplifier gain. The final position of the trace may be brought to the geometric center of the screen by the proper manipulation of the vertical and horizontal positioning controls. In the instance of the vertical control, the screen pattern moves *upward* when the vertical control is turned in a clockwise direction, and, in the instance of the horizontal control potentiometer, the pattern moves to the *right* when the control is turned in a clockwise direction.

Under the condition that the controls are in the position just described, the pattern written on the screen will be a short, straight line. If, at this time, an a-c potential is applied to the input terminals *V* and *G* of the vertical amplifier, and the vertical gain control is advanced slightly, the beam will be subjected to deflection voltages which operate at a right angle with respect to each other. Briefly, the vertical deflection is perpendicular to the horizontal deflection. The pattern written on the screen is reformed into rectangular coordinates, the actual

(Continued on page 52)

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ELECTRONIC ALARMS

(Continued from page 24)

once it is tripped it remains closed until opened manually. R_4 limits the plate voltage on tube *2*, so that the plate current will not be too high for the positive grid condition of operation.

Although circuits of this kind can be developed experimentally, it usually is better to purchase commercially manufactured products which have had the kinks removed.

Another type of alarm control is shown in Fig. 2.* The operation is very simple. The oscillator may be tuned to a fairly high frequency, perhaps 7000 kc. If a small change in capacity occurs in the grid circuit, the oscillator plate current will change. Adding capacity to the grid circuit causes a decrease in the operating frequency, which, in turn, causes the oscillator plate current to rise. This increase in current may be sufficient to cause the closing of a sensitive relay in the plate circuit of the oscillator tube. When the relay contacts close, an external bell system circuit is set in operation, giving the alarm.

In this circuit, C_1 is a small capacitance to limit the detuning effect. L_1 and L_2 represent the oscillator coil, the lower section L_2 serving to provide inductive coupling between grid and plate circuits and develop oscillations. C_2 the tuning capacitor to set the frequency of operation. C_3 and R_1 are the usual gridleak and capacitor, and C_4 is a plate circuit r-f bypass capacitor which keeps the plate-circuit impedance low in value, and aids oscillation.

In a typical installation the pickup wire would be connected to the object to be protected. If the object were a safe, it would be insulated from the ground by rubber pads and serve as the pickup wire. Anyone coming near the safe would upset the capacity of the circuit and detune the oscillator, setting off the alarm. Anyone approaching a door or window where the pickup would be located would also cause the alarm to be set off.

Another type of alarm is shown in Fig. 3. Two metal plate electrodes are used. Normally, they are separated, but when anyone exerts pressure on them the plates touch and the alarm is set off. Once the alarm is set, the relay stays closed, due to a locking arrangement, until turned off manually. Normally, with the plates not touching, the grid circuit of the tube is open, since *R* may have a value of 10 or 15 megohms. Closing the grid circuit causes the plate current of the tube to rise and the relay swings into operation, causing the alarm to go off.

Thin steel plates are probably the best to use, for they are quite tough and flexible.

Electrically, the steel is not very conductive, but since the resistance can be fairly high and still permit efficient operation of the tube this is no particular disadvantage.

Alarm circuits may also be devised to actuate cameras. The cameras may be concealed in the walls. The relay contacts are simply connected in series with a flashbulb circuit using a couple of dry cells to set off the bulb. The shutter on the camera can be left open. The speed of the flash explosion is sufficient to catch the action without using intricate timing arrangements.

*Some of these circuits are covered by patents and cannot be duplicated for sale to others.

MIXERS

(*Continued from page* 32)

plate is switched to the tickler of the second transformer. On b-c both the coils of the first transformer are used in series. The plate voltage is increased for automatic tuning by shorting a 30,000-ohm series resistor in the *B* supply.

Ward 62-262

A complex mixer system with a tuned r-f stage, 3-gang capacitor and a separate 6C5 triode oscillator, Ward 62-262, is shown in Fig. 11. This model uses 6K7s for both r-f amplifier and mixer. Three bands are covered; 148 to 380 kc. b-c and s-w. The antenna transformer has three primary coils in series with a shorting switch for the l-f and b-c primaries, as well as a .00025-mfd capacitor across them. A 20-mmfd coupling capacitor links the b-c primary and the l-f secondary for additional l-f coupling. A separate secondary is used for each band with a combination selector and shorting switch for wavechanging. The interstage transformer is similar except that the r-f amplifier plate is switched to individual primaries.

The oscillator transformer uses separate cathode ticklers for l-f and b-c and a combination of cathode-tapped Hartley and plate tickler for s-w. The mixer tube is excited by cathode-to-cathode coupling through a bias resistor of 2500 ohms and its .05-mfd bypass. The oscillator plate is also directly connected to the mixer screen. The plate is at ground potential at l-f and b-c but is *hot* on the short-wave band because of the plate tickler. Therefore, this tie to the screen constitutes an additional source of excitation. In some receivers with a separate oscillator, supplementary short-wave coupling is supplied to the signal grid. Still other sets use magnetic coupling between oscillator and converter by winding the coils on the same coil form.

•

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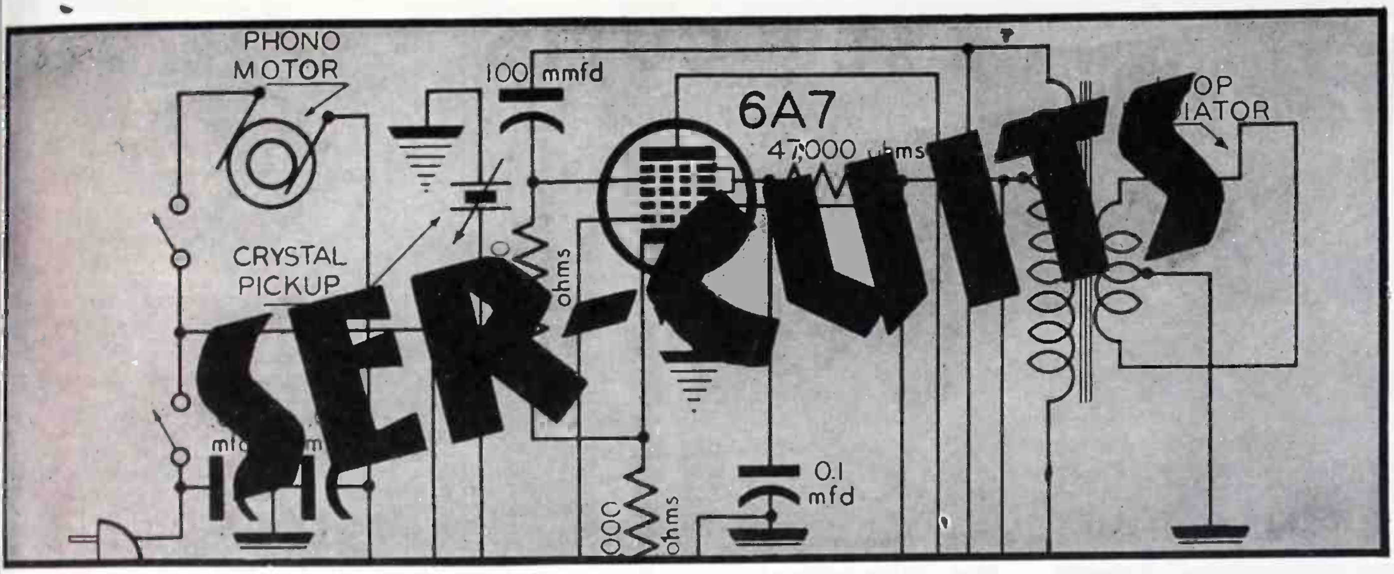


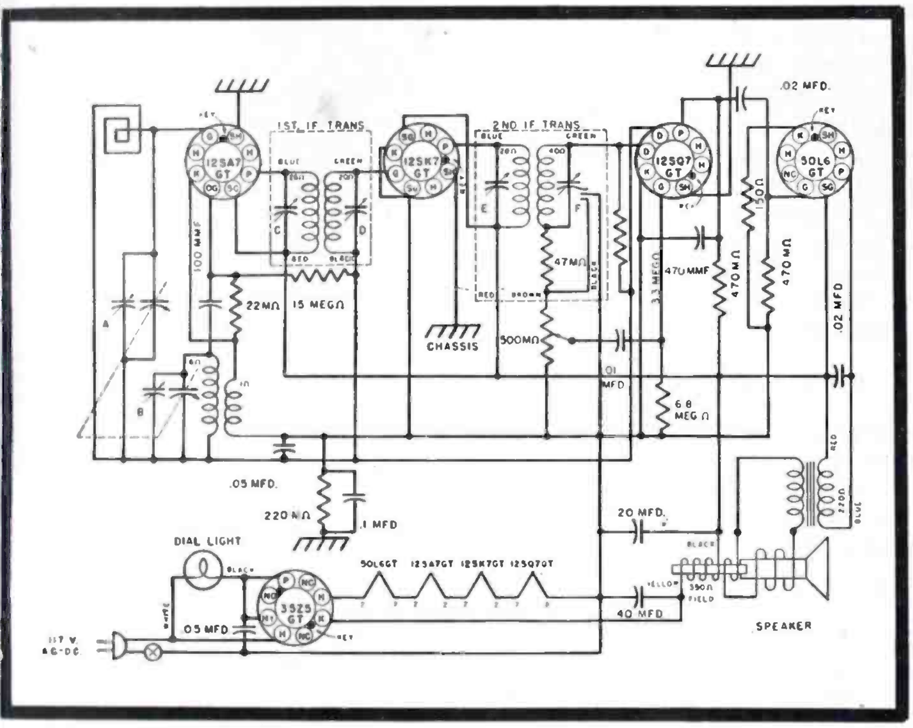
SER-CUITS

by HENRY HOWARD

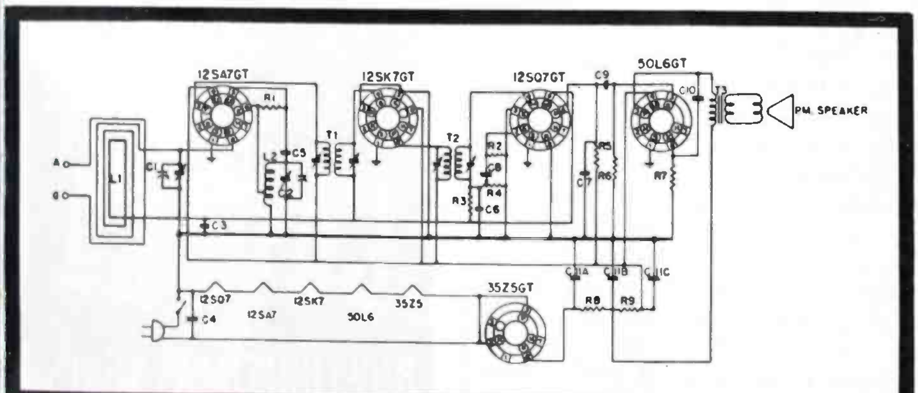
THE postwar receivers, long anticipated, have now begun to come off the production line. From the circuits of several of the models, just received, we find that quite a few interesting features have been included.

In Fig. 1 we have a Detrola postwar a-c/d-c 4-tube and rectifier unit, model 571. One of the features of this model is a fixed bias for the avc bus. This may be considered delayed avc and is obtained from the rectified grid voltage developed by a 12SA7 oscillator across a 22,000-ohm grid leak. Since this voltage is usually of the order of 5 volts, it is necessary to reduce it considerably. This is done by a 15-meg-ohm resistor. This resistor also serves as a filter in cooperation with a .05-mfd bypass capacitor. The filter is required to keep oscillator r-f out of the avc system.

The oscillator uses a cathode-type tickler circuit. Chassis is connected to the *B*-supply through a 0.1-mfd capacitor and 0.22-megohm resistor in parallel. A 350-ohm series field speaker supplies the only series filter element; no resistors are used in the power supply.



Figs. 1 (above) and 2 (below). Fig. 1. Detrola 571. Fig. 2. Meck Industries RC-5C5. List of parts at right.



Meck RC-5C5

In Fig. 2 appears a Meck Industries postwar loop receiver, model RC-5C5. Provision for an external antenna is also provided in this model. The oscillator is a grounded-plate hot-cathode type Hartley. To afford a negative bias one of the 12SQ7 diodes is directly connected to the avc bus. The 150-ohm bias resistor of the 50L6 power tube is not bypassed.

A p-m speaker is used, necessitating a two-section resistance filter consisting of 200 ohms and 1,000 ohms, the

(*Continued on page* 42)

Circuit Symbol	Description	Model
C1,C2	Condenser-Variable, with pulley	RC-5C5
C1,C2	Condenser-Variable, with pulley	RC-5C5-A
C1,C2	Condenser-Variable, with pulley	RC-5C5-B
C1,C2	Condenser-Variable, with pulley	RC-5C5-C
C3,C4,C10	Condenser-Paper, 0.05mfd. 400V	All
C5	Condenser-Mica, 0.00005mfd.	All
C6,C7	Condenser-Mica, 0.00025mfd.	All
C8,C9	Condenser-Paper, 0.01mfd. 400V	All
C11A,C11B,C11C	Condenser-Electrolytic 20/20/20 mfd 150V	All
R1	Resistor-Carbon, 20,000 ohms ½watt	All
R2	Resistor-Carbon, 10 megohms ½watt	All
R3	Resistor-Carbon, 2 megohms ½watt	All
R4	Control-Volume, with switch, 1 megohm	All
R5	Resistor-Carbon, 250,000 ohms ½watt	All
R6	Resistor-Carbon, 500,000 ohms ½watt	All
R7	Resistor-Carbon, 150 ohms ½watt	All
R8	Resistor-Carbon, 200 ohms ½watt	All
R9	Resistor-Carbon, 1000 ohms ½watt	All
L1	Antenna-Loop,	RC-5C5, A,B,
L1	Antenna-Loop	RC-5C5-C
L2	Coil-Oscillator	RC-5C5, A,B,
L2	Coil-Oscillator	RC-5C5-C
T1	Transformer-1st I.F.	All
T2	Transformer-2nd I.F.	All
T3	Transformer-Output	All
SPKR	Speaker-P.M. 6" round, less T3	All
SPKR	Speaker-P.M. 6" round, with T3	All

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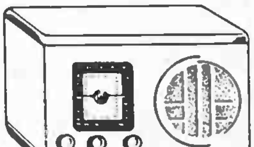

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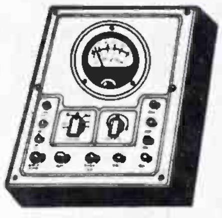

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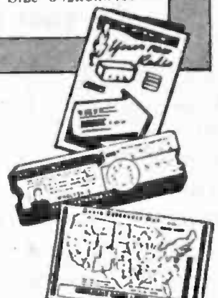

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SER-CUITS

(*Continued from page* 41)

electrolytic being a triple 20-mfd capacitor.

Detrola 568

A postwar a-c/dc 2-band receiver, Detrola, model 568, is shown in Fig. 3 (page 44). This model has an unusual bandswitch system. The signal grid of a 12SA7 is switched to either the short-wave or broadcast transformer. A supplementary 2.2-mmfd capacitor acts as a capacity coupling from antenna to grid, boosting the high-frequency end. In the circuit diagram the switch is shown in short-wave position. Here the antenna is connected to the short-wave primary through a .002-mfd capacitor, the primary circuit being completed through the bandswitch to *B*–. The same switch member also shorts the unused broadcast oscillator coil, completing the short-wave osciliator circuit to *B*–. A third section of the switch connects the 12SA7 cathode to a tap on the short-wave oscillator coil, or to the cathode tickler of the broadcast coil.

A 150-ohm resistor is connected in series with a 100-mmfd grid capacitor. A 5100-mmfd padder is in series with the oscillator coils. Bias for the 50L6 is supplied by an unbypassed 150-ohm resistor. The chassis is connected to *B*- through a 0.1-mfd capacitor and 220,000 ohms, in parallel.

Garod High-Fidelity Receiver

A prewar high-fidelity a-m receiver with several interesting design features is shown in Fig. 4 (page 44). This model has a variable bandwidth and separate low and high-frequency p-m speakers. The tuner and power amplifier are built on separate chasses, each with its own power supply. A 2-section 10-kc low-pass filter has been included. This may be switched into the audio amplifier between the tuner and power amplifier to minimize interference in the high-frequency audio range, including the 10-kc beat between adjacent channel carriers.

In the input is an iron-core antenna transformer, designed for a short antenna or a long antenna, in series with a .0001-mfd capacitor. A .006-mfd blocking capacitor prevents grounding the antenna. In the tuned secondary circuit is a 150-ohm series resistor. There is a similar 50-ohm unit in the tuned first detector circuit to broaden the response of these circuits for acceptance of an extended treble range.

A 6SA7 converter employs a 300-

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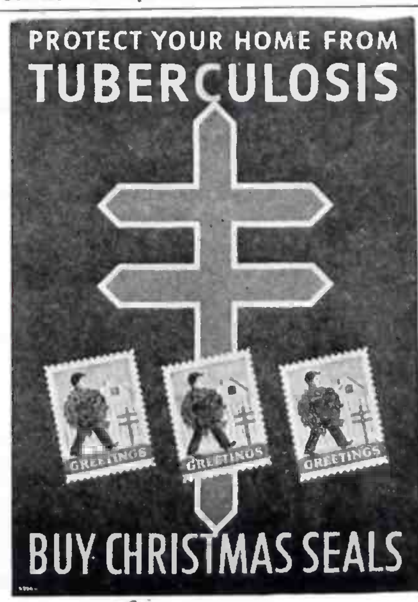
Before me, a Notary Public, in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of SERVICE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 52 Vanderbilt Avenue, New York 17, N. Y.; Editor, Lewis Winner, New York, N. Y.; Managing Editor, F. Walen, Union City, N. J.; Business Manager, B. S. Davis, Ghent, N. Y., 2. That the owners are: Bryan Davis Publishing Co., Inc., 52 Vanderbilt Avenue, New York 17, N. Y.; B. S. Davis, Ghent, N. Y.; J. C. Munn, Union City, Pa.; A. B. Goodenough, Port Chester, N. Y.; P. S. Weil, Great Neck, N. Y.; F. Walen, Union City, N. J.; G. Weil, Great Neck, N. Y.; L. Winner, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities, are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock, and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) B. S. DAVIS, Business Manager.

Sworn to and subscribed before me, this 27th day of September, 1945.

(Seal) FRANKLIN B. GOOLD, Notary Public. Commission expires March, 1948.



hm bias resistor without bypass and ı decoupling filter of 5,000 ohms and).1 mfd.

Two 6SK7 i-f stages are coupled by special variable-selectivity transformers having a third winding, tapped to provide regeneration or degeneration. This is accomplished by connecting the tertiary to the secondary in a series-aiding or series-opposing manner. Series resistors of 25 or 39 ohms are also involved in obtaining the correct amount of selectivity in both transformers. The third i-f transformer is more conventional, although a tap is provided for the diodes. This would be expected to sharpen the tuning and thus be inconsistent with the rest of the amplifier. However, considerable damping is provided by parallel diodes which allows the passage of a wide band.

The r-f, converter and two i-f screens are tied to a common supply. The first three stages are supplied with avc bias. The r-f detection components are filtered out by a low-pass filter consisting of 50 mmfd, 100,000 ohms and another 50 mmfd. A ¼-megohm resistor is connected in series with the volume control to prevent overloading of the detector with the consequent distortion. The treble tone control is connected in parallel with the volume control. When the grounded arm is at the lower end of the control, a .001-mfd capacitor is connected in shunt with the volume control, cutting the highs. When the arm is at the top, the .001-mfd unit is in series with a ½-megohm resistor making the shunting ineffective. However a .05-mfd capacitor is connected across a 2,000-ohm cathode bias resistor which causes an increase in highs. This action may be called selective degeneration because the bypassing action of the .05-mfd unit is confined to the treble only, increasing the gain in proportion to the frequency. Low frequencies are not bypassed, so the full amount of degeneration is present.

The 6J5 first audio has a grid leak of only 150,000 ohms. A 6C8G is used for the second and third a-f stages, the gain being limited by inverse feedback from the second audio plate to the first audio cathode and by a 1,000-ohm second a-f bias resistor without bypass. There is also some attenuation in the bass tone control and the associated 15,000-ohm grid leak in the third a-f stage. This control consists of a 2-megohm potentiometer which acts as a variable shunt to a .001-mfd audio-coupling capacitor. The capacitor is so small

(*Continued on page* 44)

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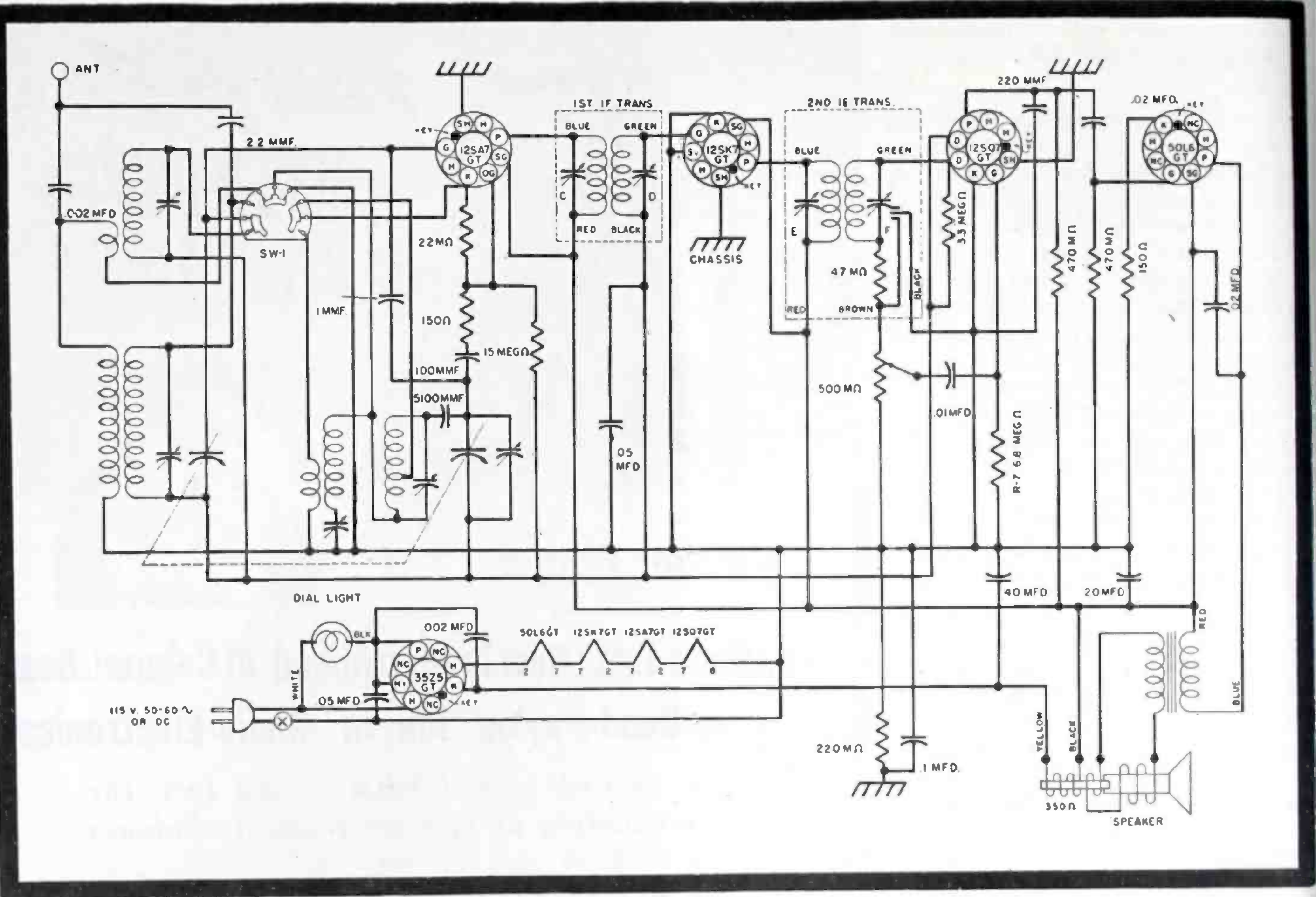
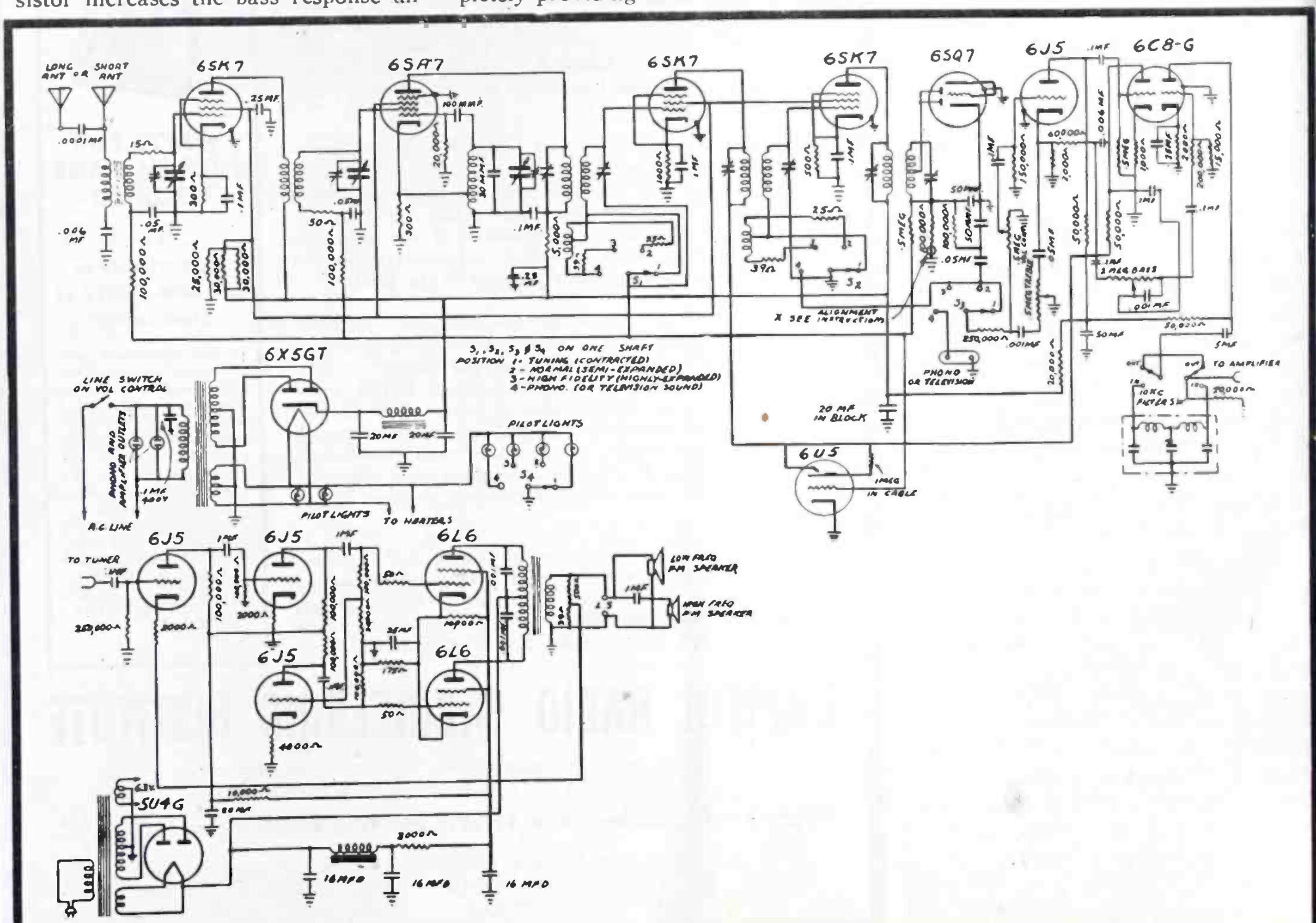


that only the treble is passed without attenuation. Thus, shunting the resistor increases the bass response until the capacitor is completely shorted, when the resistance is cut out, completely providing maximum bass.

Figs. 3 (above) and 4 (below). Fig. 3. Detrola 568. Fig. 4. Garod high-fidelity receiver.



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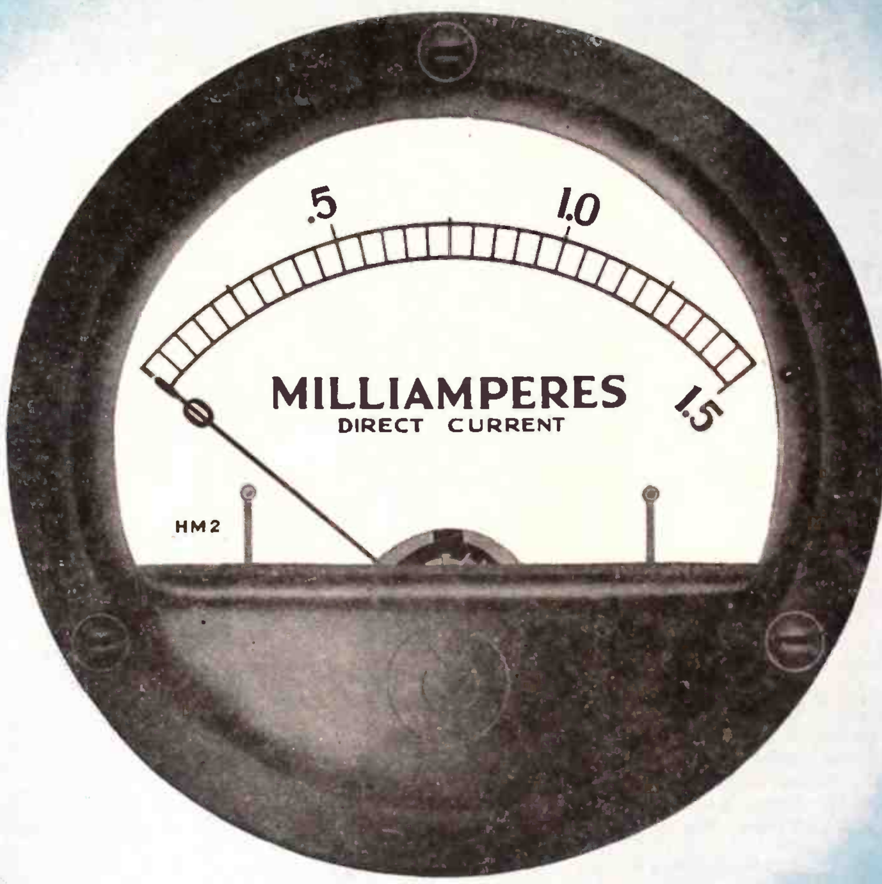

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HIGH FIDELITY AMPLIFIER

(See Front Cover)

A 25-WATT high-fidelity phono amplifier system, Magnavox A-3001C, has been diagrammed on this month's cover.

Pickup-to-Input Circuit

To effect a complete trace of the circuit, the pickup to the first-audio input plug part of the system appears in a separate diagram, Fig. 1. A high-impedance pickup terminates in a 2-pin plug for easy servicing. An equalizer consisting of a .003-mfd capacitor in series with a ¼-megohm resistor is connected directly across the pickup and a 1-megohm volume control. A 50,000-ohm resistor and bass tone control are located between the control arm and the plug feeding the input grid.

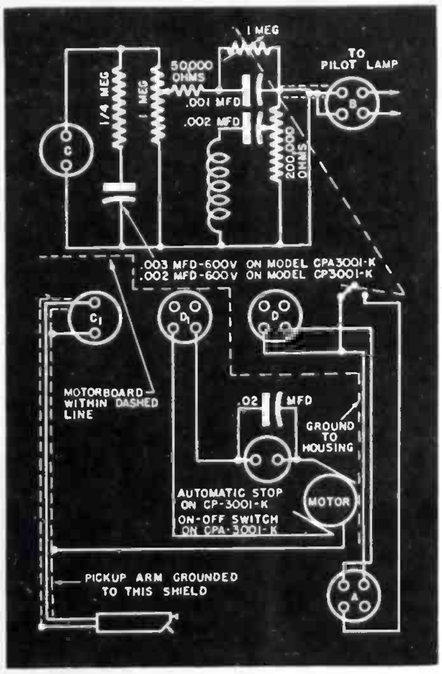

Fig. 1. Input plug system of amplifier, showing pickup and equalizer circuit.

Tone Control Use

This tone control, which is attached to the *on-off* switch operates a .001-mfd audio coupling capacitor which favors the high frequencies. This is shunted by a 1-megohm control which brings up the bass notes as the resistance is decreased.

Reactance Ratios

Analyzing the actual capacitor-reactance ratios and their effect on bass control we find that a 1-mfd capacitor has a reactance of about 2,600 ohms at 60 cycles and 1,300 ohms at about 120 cycles, which is usually in the vicinity of the lowest bass note reproduced. So a .001-mfd capacitor has a reactance of about 1.3 megohms at 120 cycles and about 32,000 ohms at 4,800

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cles which is around the highest ›te normally reproduced, a difference 40 to 1. The 1-megohm shunt helps e bass along but it has little effect on e treble. As the resistance is de- eased, we note that the bass is in- eased considerably while the treble increased only slightly.

Treble Booster

A treble-boosting tone control is so included. More correctly, per- ıps, this control should be termed a ıss-reducing control as it shunts a ıoke coil across the line which by- sses the low frequencies but allows ost of the highs to go by unmolested. .002-mfd capacitor in series with e choke makes the control non- near, particularly near the resonant equency of the choke and capacitor.

Hum and Decoupling Filter

A 2-megohm grid leak establishes e input impedance of the amplifier 2 megohms for bass frequencies and bit less than 2 megohms for the eble. The 6C5 first audio is biased by 000 ohms and a 20-mfd capacitor. Here we also have a separate *R-C* um and decoupling filter. Coupling the power stage is completed by a 0,000-ohm plate resistor and a center- apped grid choke. An equalizer, .02- nfd and 7,500 ohms, is in series with he blocking capacitor.

External Speakers

Two output impedance taps, 1.12 and 2.25 ohms, and an extra plug is provided for an external speaker. The voice coils are arranged in parallel with the fields in series, excitation be- ng provided by the current in the 6L6 screens and 6C5 plate. A .002- mfd 1,200-volt bypass capacitor is connected from plate to plate in the output stage. The entire record player draws an average of 134 watts from the power line.

•

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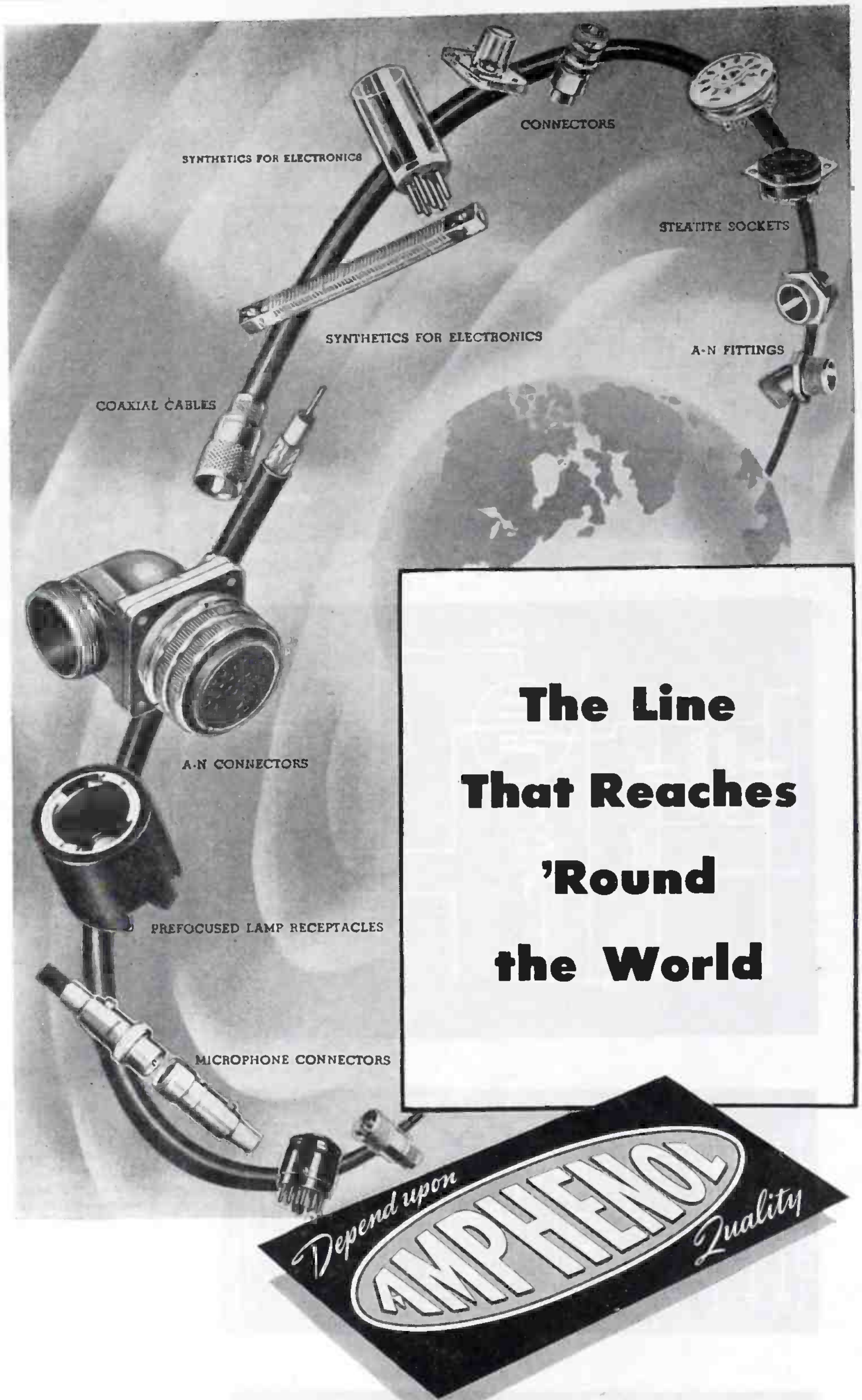

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I-F AMPLIFIERS

(Continued from page 20)

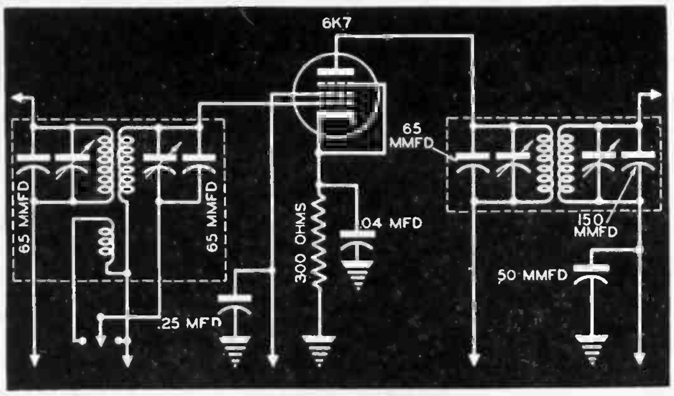

Fig. 7. The Wells-Gardner A-7 variable-width i-f transformer system. The tertiary winding provides tight coupling between primary and secondary, broadening the i-f response. The tertiary winding is shorted out for greater selectivity.

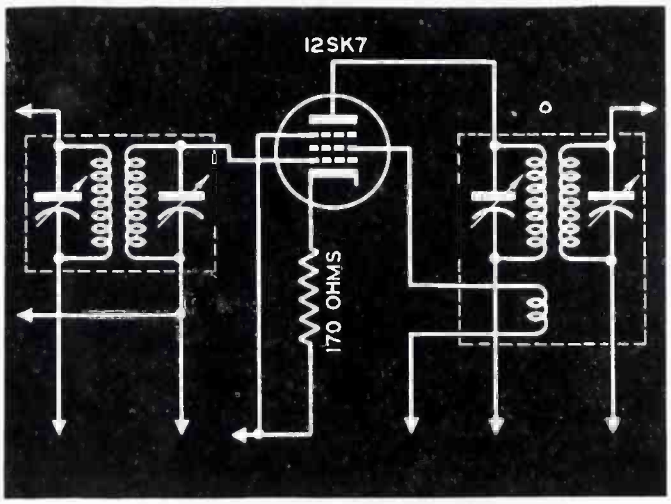

Fig. 8. I-f system of the Westinghouse M-104. The gain of this i-f system is increased by feedback, introduced into the circuit by coupling the screen grid of the i-f tube back into the detector transformer.

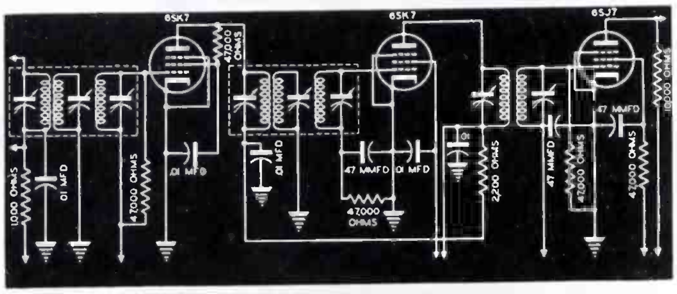

Fig. 9. The f-m i-f of the G.E. 60. Because of the high i-f frequency, and the broad-band response, the gain of the i-f stage is reduced considerably. For this reason two i-f stages are usually necessary.

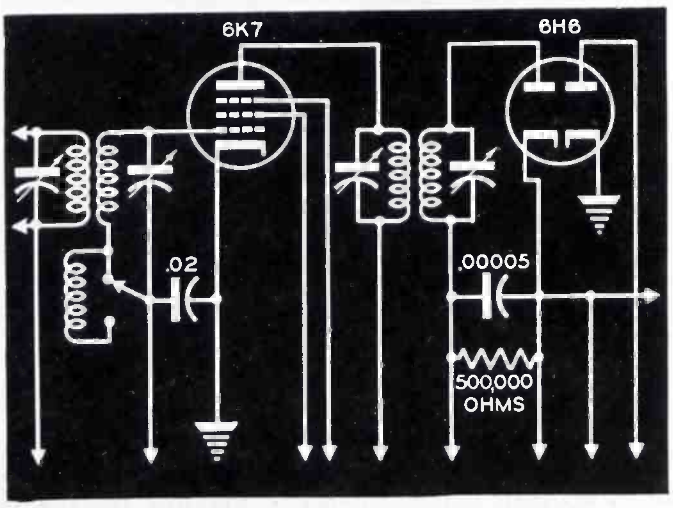

Fig. 10. The sharp-broad i-f system of the Ward 62-319. This circuit is similar to that shown in Fig. 7. A switch across a tertiary winding broadens or increases the frequency admittance of the i-f system.

adjustable, eliminating the need for trimmers. Silver mica fixed capacitors are used instead.

Wells-Gardner A-7

Fig. 7, from a Wells-Gardner model A7, introduces another type of i-f with variable selectivity transformers. The input transformer from a 6J7 first detector has a tertiary winding which is connected in series with the secondary for wide-band reception. It is cut out of the circuit for sharp tuning, the trimmers being adjusted for the sharp position. The band is widened by virtue of the tight coupling provided by the tertiary.

Other methods of selectivity control in i-f amplifiers have included the insertion of resistance in the tank circuit, shunting of the primary or secondary with resistance, moving the coils mechanically and coupling variation by means of a variometer. Combinations of these systems have also been used.

In this model fixed silver-mica tuning capacitors are used in both primary and secondary circuits of both i-f transformers, the first three having a value of 65 mmfd, the detector capacitor, 50 mmfd.

Westinghouse M-104, 204

It is often desirable to introduce regeneration into the i-f amplifier to increase gain or selectivity, or both. Westinghouse uses a method of screen-grid feedback in the detector transformer in models M-104 and 204, shown in Fig. 8. Improved performance is obtained without expensive transformers, but at the expense of critical tuning.

Other means of adding regeneration include removing the bypass from the screen grid and placing a small r-f choke in series with the screen. A 2 to 1 improvement in gain is often possible by such devices, enabling the Service Man to pep up a deficient receiver. If the amplifier tends to oscillate with the series choke, wire should be removed until stability returns.

G. E. 60, 80

The broad band i-f channels of f-m sets preclude the possibility of obtaining high gain per stage, hence at least two stages are required. Also, the gain is not as high at 4.3 mc as at 455 kc, all other factors being equal. The high i-f is necessary, of course, to obtain a wide band simply. In Fig. 9 we have an f-m model of G. E., type 60/80, with a dual 6SK7 amplifier, the first two transformers being triple-tuned. The

(Continued on page 52)

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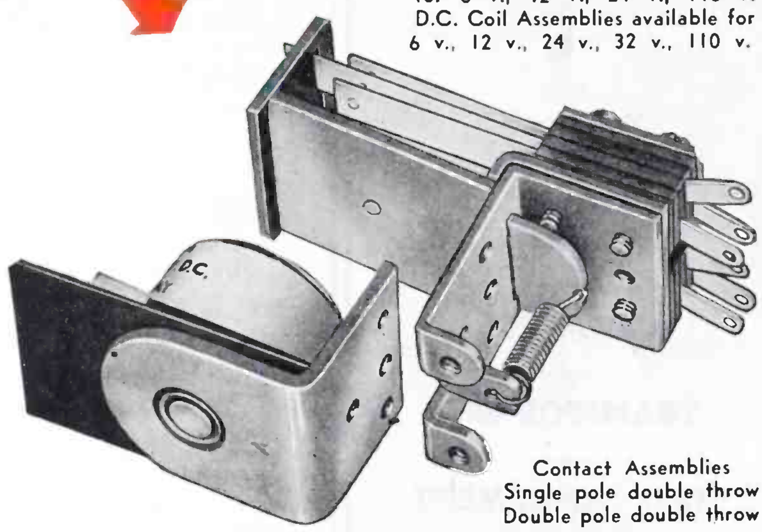

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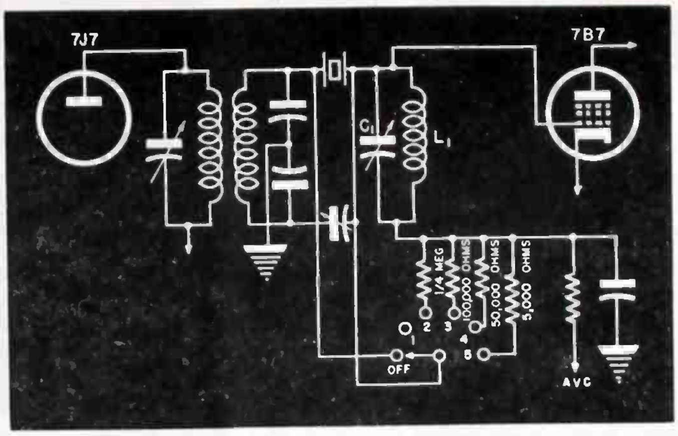
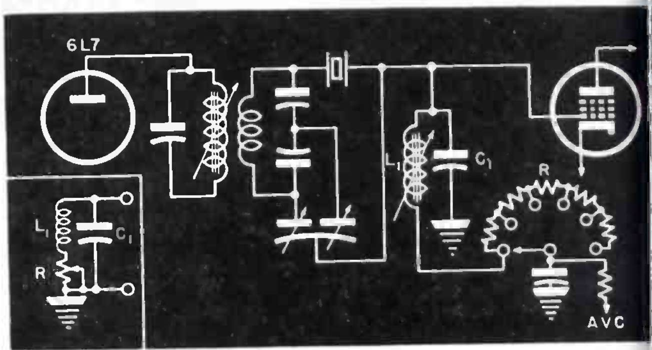


Fig. 5. The variable lectivity system of RME 41-43. Varia selectivity is acco plished by varying t size of the resis across L_1C_1, the lar the value of resistan the greater the sele tivity.

Fig. 6. Hammarlund Super-Pro variable selectivity system. Here, the selectivity is varied by inserting resistance in series with L_1C_1. Increasing the value of resistance improves the selectivity by increasing the effectiveness of the crystal.



detunes the circuit, and permits the crystal to exert its greatest influence on circuit Q, or sharpness of resonance.

RME 41-43

Fig. 5 shows the variable-selective circuit used in the RME model 41-43. The tuned circuit here is on the crystal output side instead of the input. The effective resistance of the tuned circuit represented by C_1 and L_1 in series with the crystal is varied by shunting it with various size resistors, in very much the same manner as is used to broaden the response of i-f transformers used in f-m receivers. The lower the value of the shunting resistor, the greater will be the effectiveness of the crystal and the resultant selectivi

Hammarlund Super-Pro

In Fig. 6 we have the method a plied in the Hammarlund Super-P Here again, resistance is used to d crease the effectiveness of a tuned c cuit in series with a crystal filt However, the resistance is used d ferently than for the circuit shown Fig. 5. The Q of a coil is a functi of its reactance over its resistance, $Q = X/R$. Since the resistance is troduced into the tuned circuit so t it is in series with L_1, and C_1 is acr both the resistance and the inductan the effective resistance of the circ as represented by L_1C_1R is reduc and C_1 then acts as a bypass capacit Thus the effectiveness of the crys is increased.

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CENTERING CONES

(*Continued from page* 16)

lost. Every effort is made by the facturer to build his loudspeaker so t will stand up not only for normal tion, but that it has a safety factor will permit some limited amount use or abnormal operation without ing the performance.

en confronted with a rubbing voice he Service-Man can do one of two . First, he can replace the whole er with a new one and second, he ry to repair the one that is dam- In these days when production he demand so much, there is little in trying to replace the unit when ances of getting a new speaker are indeed. Therefore, the Service usually tries to repair it.

new development, the *Adjust-A-* unit, developed by Quam-Nichols, an effective solution to the rub- oice-coil problem. In this unit, the , instead of being permanently or fastened to the housing, is kept sition with a pressure or clamping which is in turn held down by two ne screws. This construction is ated at A in Figure 1, the inset ng a closeup of the pressure ring, is underneath, at *B*, and the spider The voice coil is designated at *D*. sening the screws holding the pres- ring (*A* in the illustration) will a small amount of movement of ider in a lateral manner which will the voice-coil to be centered around le-piece and within the gap.

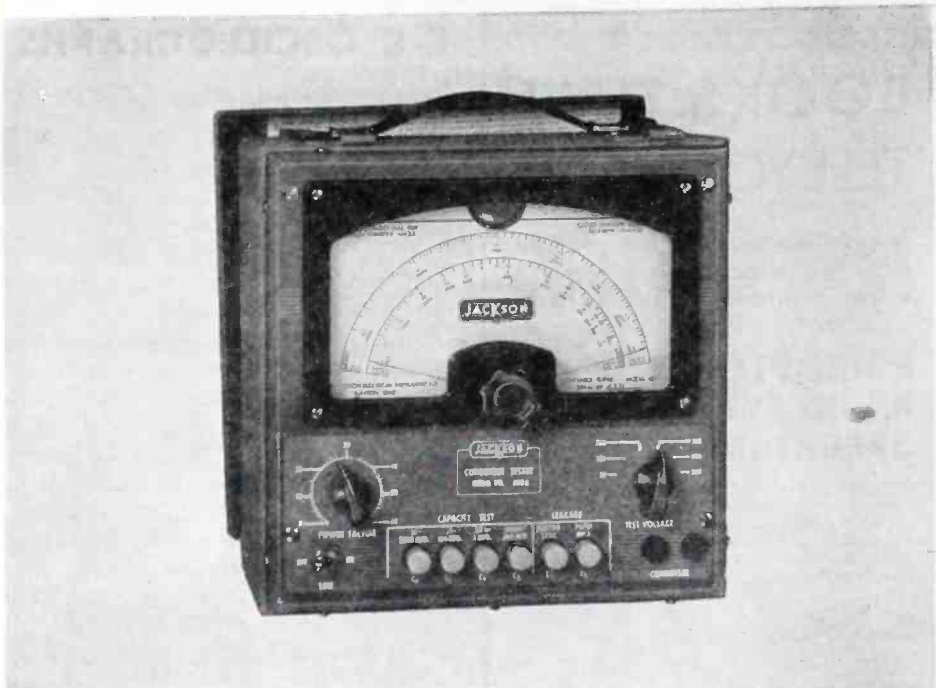
s to be noted that the screws hold- he clamping ring are so positioned t will be often unnecessary for the ce Man to remove the loudspeaker the cabinet to re-center the voice In conditions of severe rubbing coils, a better job can be done by ving the speaker from the cabinet; h in either instance, no audio sig- enerator is necessary, and only the radio (or public address system) or voice signals are required for g and maintenance.

e repair of a speaker with this new is quite simple. Before attempting -center the voice coil, one first de- nes on which side the voice coil is ng by pushing it up and down in ap. Then it is necessary to loosen amping ring screw nearest the point the rubbing is found. Using the s, the voice coil is gently pulled ds the loosened clamping screw. screw is then tightened and a check de to see if the voice coil now rides Caution should be used at this not to be too violent with the anism because of the possibility of bying the juncture of the voice coil r and the cone neck.

this operation does not correct the ng voice coil, another method will to be employed. One must first re- the felt dust cap over the voice by saturating it with lacquer or nt thinner, allowing it to soak a few ents before picking it off. Then strips of ordinary wrapping paper ximately 5/16" wide by 1½" long d be cut.

th clamping ring screws should be ned until the clamping ring is free, the wrapping paper shims are in-

(*Continued on page* 52)



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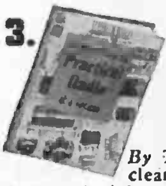

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C-R OSCILLOGRAPHS

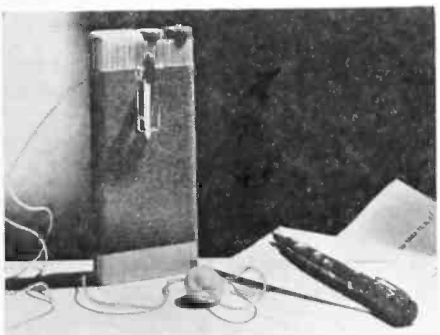
(Continued from page 37)

form depending on the settings of the linear time-base oscillator controls. In any event, the characteristic sine wave form of the a-c supply frequency waveform is evident in the pattern.

Manipulation of the linear time base *coarse* and *vernier sweep frequency* controls permits the reduction of the pattern written on the screen to either a single a-c wave pattern, or to a pattern containing a number of similar a-c cycle forms, whichever may be desired. In either case, the pattern will appear to be in motion, and complete synchronization of the sweep frequency with that of the a-c supply source will be found difficult. If, however, the *test signal* terminal is connected to the linear time-base synchronizing voltage input terminal *EXT*, synchronization control selector switch, S_3, turned to the *EXT* position, and the *synchronization* control potentiometer advanced slightly, the written wave pattern will stabilize completely. The wave pattern being written from the positive zero voltage inflection due to the phase-shift will be effected by the positioning capacitor C_{23}.

•

MINIATURE POCKET SETS



Five-tube pocket receivers produced by Belmont, using Raytheon sub-miniature tubes. Case is 3" wide, ¾" thick and 6¼" high. Weighs 10 ounces, including batteries. Circuit is superheterodyne. Cases will be supplied in solid gold, sterling silver, morocco, suede, etc.

RECENTERING CONES

(Continued from page 51)

serted between the voice coil and the pole-piece (the inside of the voice coil). The three strips are not used one on top of the other, but merely to assure that at least one thickness of the shim circumscribes the pole-piece entirely. the final step the clamping ring screws should be tightened a little at a time, tightening first one, then the other, gradually and alternately so as to bring the clamping action to bear on the ring evenly all around.

This should result in a perfectly centered voice coil. The wrapping paper shims can then be removed, and the dust cap glued back on with lacquer cement.

•

I-F AMPLIFIERS

(Continued from page 48)

third transformer which feeds the limiter stage is a conventional double tuned job.

Ward 62-319, 329, 409, 419

Another receiver using sharp-broad tuning (i-f of 465 kc) is shown in Fig. 10, Ward 62-319, 329, 409, 419. The input transformer has a switchable tertiary winding similar to that shown in Fig. 7. The output transformer feeding the 6H6 detector is standard

RADOLEK

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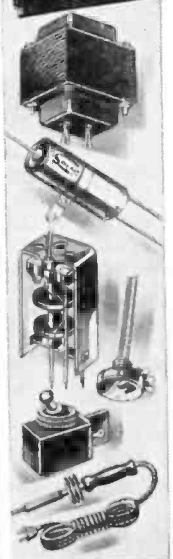

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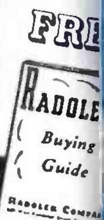

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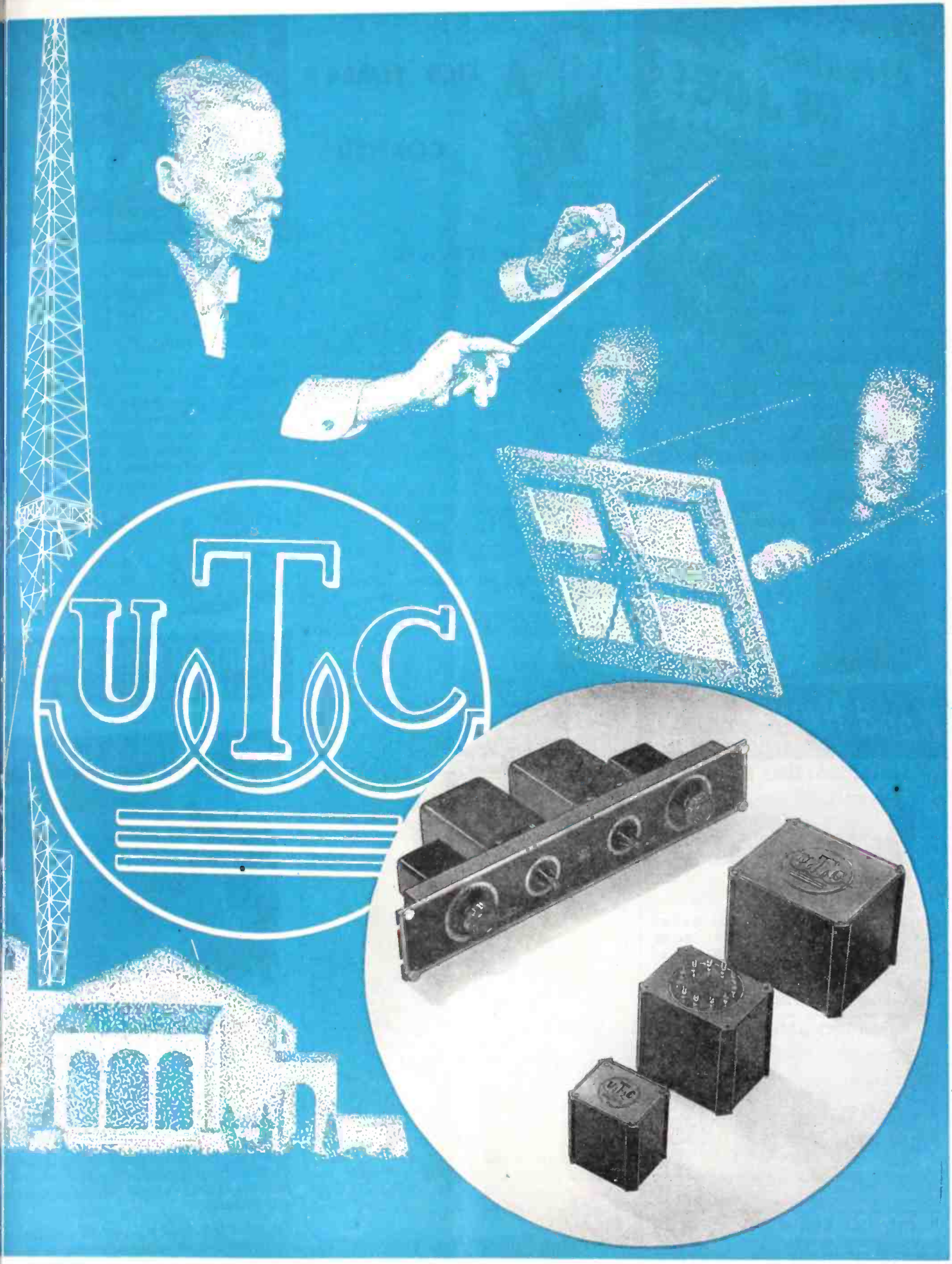

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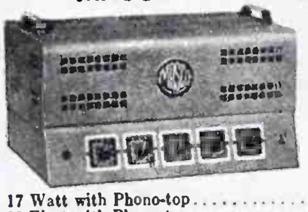
MASCO AMPLIFIERS



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OLD TIMER'S CORNER

by SERVICER

We had quite an unusual session at an end-of-the-day get-together some weeks ago, a session that provided many unusually interesting and useful facts.

It all began when Roy walked in quite pleased with himself.

"What's with you, Roy?" I asked. "You sure look spirited."

"Well, fellows," said Roy with a grin, "I have just made a swell contact."

"What kind?" we asked.

"With a manufacturer of capacitors," answered Roy. "With my plans I will be able to cut out everybody except the manufacturer. No more distributor, and no more company representative for me. I'll deal right with the capacitor maker, direct."

"What will that mean in dollars and cents?" we asked him.

"Well, I should be able to buy at better prices. Then deliveries will be faster, and also I'll have a wider choice than any of you have been able to get from John's Radio Company, the distributor up here. That in itself is worth the deal to me. But best of all I will be buying at rock-bottom, manufacturer's prices!"

"I think you're dead wrong, Roy," said Bill.

Bill's Opinion

We picked up our ears. Bill was one of the older crowd who usually did not have anything much to say. He and his type just went ahead year in and year out, not making a very big splash in the waters of radio servicing business, but at the same time syphoning off a fair share of profits and keeping themselves high in the opinions of the community. Bill was not only conservative, but he was also highly respected for his ethics, business acumen and community pride. He was no world-winner, but his hard-headedness and carefully thought out plans often wrung a lot of silent (and sometimes not so silent) acclaim from our gang.

So when Bill fired his opinion at Roy, we were quite surprised.

"You see, boys, Roy thinks that he has made a world-winning deal by cutting out the distributor! Well, instead he has just done himself a great disservice! Sure, this particular manufacturer probably now has almost everything in stock that Roy could want. And he's anxious to get it out. So he'll do almost anything to see that Roy gets what he wants. But wait until this man-

For Soldering in Tight Places . . .

DRAKE No. 400 Soldering Iron

Smallest Industrial Iron Ever Designed

60 Watts — 1/4 in. Tip
Only 9 in. long. Wt. only 8 oz.

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

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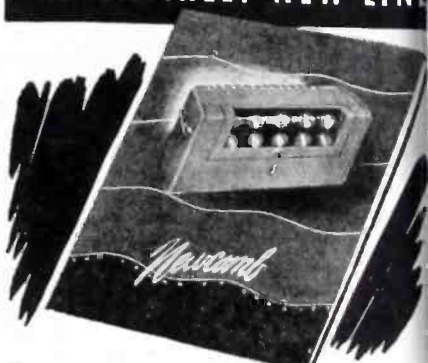
AN ENTIRELY NEW LINE



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LOS ANGELES 7, CALIFORNIA

rer—and I'm sure that he is not the old line men—gets going. He ave a big business some day. And e will recognize that it doesn't have Roy's orders lying for, say, en 25-mfd 25-volt electro's, and two dozen .05 mfd's and a couple en half mikes at 450 volts. He is to tell his production men to set der aside until he gets into those -runs for a set manufacturer. Thus of the capacitors Roy wants, will be ly run through with the manufac- lot. Now the .05 mfd's that are made for the set manufacturer are y different in size than the type rdered before, and so Roy gets the ze which may or may not fit. Also ice may be different each time, due hange in specifications.

Replacement Problems

d that isn't all. Suppose that Roy ed some faulty capacitors. Can ure immediate replacements? No, nnot, for at that very time the type rd is out of stock, and another size ng run through, a size of no use to So poor Roy will have to wait the manufacturer runs through of the kind Roy wants before he et his replacements. Now since as been dealing with the manufac- directly, he not only has lost con- with the local distributor, but he lso encouraged that worthy to dis- him. As a result, Roy can't get capacitors from the distributor . So he must go out and buy them or hope that one of you—or me l help him out for the time being. normally, we would be more than g to help out a fellow Service —especially Roy, because we all like But business is business, and we like to have the returned capaci- o be similar to those we gave Roy. are not interested in the few cents the capacitors cost. What we is some of Roy's units when his nent gets in. But Roy isn't going ceive the same standard parts we been using, even when his ship- arrives. And we are not sure of exactly he is going to get. So on't let him have any of ours, and will find himself in quite a spot!

Virtues of Distributors

ow, if Roy trades with the local butor he'll get what he needs right the distributor's stock. The dis- or pools all of his orders and sends in to his standard manufacturers e they make, taking in all the Serv- Men accounts of the distributor, and order and quite a run. If some- goes bad with the units, the manu- rer cannot afford to ignore the dis- or, and so he makes it good. The butor knows that and will replace tive units for Roy on sight. Then, the distributor is a local man. y time Roy buys from him and pays ill promptly, he establishes a better t. That may come in handy when ime rolls around and Roy needs a reference. Some of the boys just think much of references from out-of-the-state place where people know each other except via the ge stamp route.

"So if you want some sound advice, play ball with your local distributor. The prices may *seem* a bit higher than those a manufacturer selling direct may offer. But when the smoke clears away, you are getting so very much more for your dollar in the form of reputation, good will and fine service, that in reality the costs are cheaper."

No Sale

"I think you have something there, Bill," said Roy. And from the way he spoke, I guess that a certain manufacturer, who sells capacitors directly to the radio Service Man, had just lost a fairly nice account.

33 well overlapped ranges . . .

plus long-life dependability!

WESTON

(Model 665 Type 1)

VOLT-OHM-MILLIAMETER

Its compactness, versatility and rugged dependability make Model 665 the ideal instrument for use in the field, or in the shop . . . whether servicing communications equipment, testing electrical components in production, or research or maintenance work. Provides 33 AC and DC voltage, DC current, and resistance ranges . . . with simplified switching arrangement for rapid operation. Built to WESTON standards to assure dependable measurement accuracy throughout the years. Full details on request. Weston Electrical Instrument Corporation, 605 Frelinghuysen Avenue, Newark 5, N. J.

WESTON *Instruments*

POSTWAR RECEIVER

Receiver of the future shown at a recent postwar display by the Hallicrafters, Chicago.

Plug in

METAL TUBE RESISTORS

★ To facilitate the servicing of AC-DC sets equipped with plug-in metal-tube resistors, Clarostat offers 10 Universal Types which replace 90% or better of the original numbers.

The Clarostat Universal Type operates within voltage ranges specified on tube, regardless of what pilot current is drawn or of any pilot light combination. Operates regardless of burnt-out pilot lights, and well within the .3 ampere range required for tube filaments. Operates efficiently regardless of line-voltage variation.

★ **Ask Your Jobber . . .**

Ask for these Clarostat plug-in metal tube resistors, Type MT. Ask for other servicing aids—controls, resistors, attenuators, etc. Ask for latest catalog—or write us direct.

CLAROSTAT Controls and Resistors

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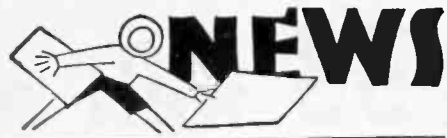

RAYTHEON BONDED SERVICE MAN PROGRAM

A *Bonded Electronic Technician Program* to improve standards of practice among Service Men and provide work guarantees, has been announced by the Raytheon Manufacturing Company. The program provides for the bonding of Service Men through the facilities of Raytheon distributors, Raytheon and a bonding group.

According to Arthur E. Akeroyd, distributor sales manager, the program will assist the Service Man in building a solid foundation for postwar activities.

It will offer deserving newcomers such as returning veterans, the opportunity to establish themselves in business, without being handicapped by the questionable practices of some widely publicized repairmen.

Mr. Akeroyd said that it was felt that the plan should be based on guarantees to the much maligned Service Man as well as the customer. Every radio shop is entitled to a legitimate profit, he said. Thus with widely divergent costs under different conditions and in different locations, any bonding program must not interfere with the established business policies of the ethical shop. By the same token, the program must also recognize the fact that the majority of Service Men are honest. The bond provided by this program will assure the public of the Service Man's honesty and integrity, said Mr. Akeroyd.

To qualify as a *Raytheon Bonded Electronic Technician*, a Service Man will have to meet certain qualifications of experience, reputation and ability, and also state that he has and will use adequate equipment to do skilled service work efficiently.

The Service Man's application will have to be approved by his Raytheon distributor, Raytheon and the bonding company. When accepted by all parties, he will become bonded for the period of one year by the Western National Indemnity Company of the Firemen's Fund Group. The bond states that the Service Man agrees to guarantee complete satisfaction

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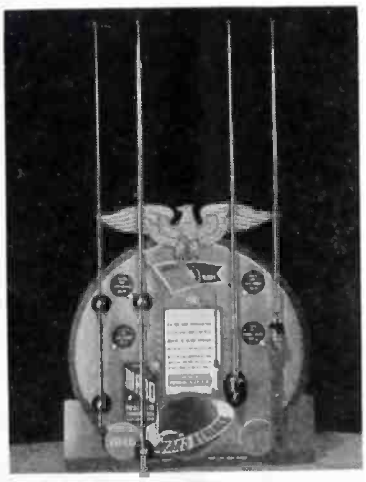
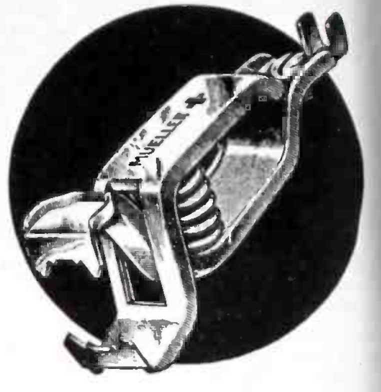
POSTWAR ANTENNAS



Ward store display featuring four postwar antennas. Highlights of the antennas are said to be H-Q low-loss detachable polyethylene lead with silver-to-silver contact; one man installation and fluid type anti-rattle construction.

MUELLER



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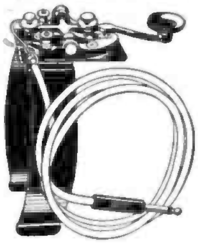

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Knee type. Strong spr holds securely. Black amel and brass fini Complete with plug cord. Limited supp Order now. Only—$2

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Cadmium plated. A good practice key for amateurs.

PL-55 PLUG—34¢

A high grade, dependa plug.

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ery radio repair job for 90 days, outlines a *code of ethics* that he ... to observe in the conduct of his ...ns.

Mr. Akeroyd said that the requirements ...tification have been drawn up so ...ey parallel the now generally ac...te practices and standards of the ...petent qualified Service Man. The re...rements do not represent the ideas of ... single group, but rather the sugges...ns and opinions of hundreds of Service ...n. Adequate provision is said to be ...vided to prevent the exclusion of any ...vice Men from this program, without ...d in the event that they feel rejec... as not justified.

A. E. Akeroyd

* * *

GRENBY BUYS CARDWELL

...h Grenby Mfg. Co., Plainville, Conn., ...quired full control of The Allen Cardwell Mfg. Corp., Brooklyn, N. Y. ...A. Gray, president of Grenby, has ...e chairman of the Cardwell board. ...o the sales and development engi...ring departments of Cardwell will ...tinue to operate from their present lo...ion at 81 Prospect St. The manufactur... division has been moved to Plain...e, Conn.

...h H. Soby, vice president and di...tor of Grenby, has been elected pres...t of Cardwell, following the retire...t of Mr. Cardwell. Joseph K. Fabel ...ontinue to serve as vice president ...sales manager of the Cardwell de...ment and engineering division. Ray ...rehouse will also continue as Card... sales manager.

C. A. Gray

* * *

CAPACITOR COLOR CODE CARDS

Color code charts and cards for small capacitors with RMA six-dot color and three-dot color code as well as Army-Navy standards, have been pre-

(*Continued on page* 58)

●

...S N.U. DISTRIBUTOR ON RANCH

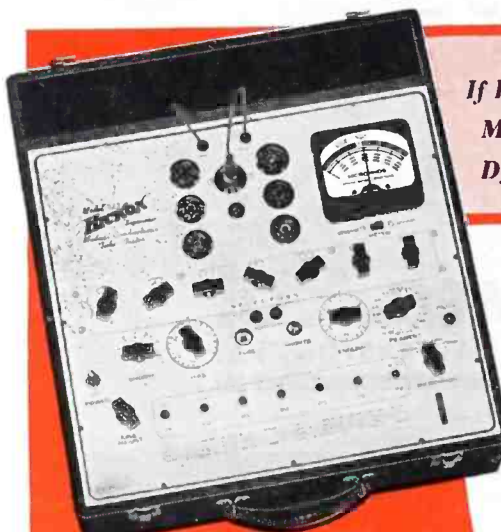
... Olsen, National Union distributor in ...ntonio, with Jack Clune, N.U. sales manager, on the Olsen ranch.

Wait for these new

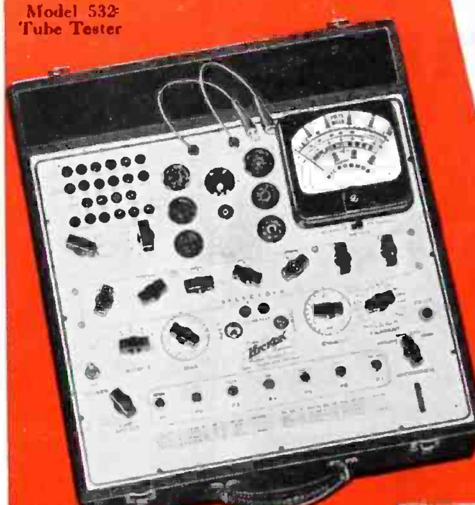
HICKOK

Radio Service Instruments

If It Isn't A Hickok Indicating Micromhos It's Not Dynamic Mutual Conductance ★



Model 532 Tube Tester



Model 534 All Purpose Tube and Set Tester

Your patience in waiting for these new 1946 HICKOK models will be richly rewarded for these new HICKOK tube and set testers make still closer tests, with finer accuracy, rejecting tubes that might get by with an ordinary tester.

Now you have 7 selector switches instead of 2. That aims to prevent obsolescence. Isn't that worth waiting for?

What's more, Dynamic Mutual Conductance, indicated in Micromhos, is a duplicate of the manufacturers' method of checking when he makes the tubes. Remember, if it isn't a HICKOK Indicating Micromhos, it isn't Dynamic Mutual Conductance.

The new Electronic Volt-Ohm-Capacity Milliammeter Model 203 reads as low as 1.0 mmf and up. It will measure at frequencies to over 10 mc with no frequency error and the ohm meter will measure up to 10,000 megohms.

Keep patiently in touch with your jobber and you will soon get the instruments that are held in highest esteem.

THE HICKOK ELECTRICAL INSTRUMENT CO.

●

10521 Dupont Avenue
Cleveland 8, Ohio

Model 203 Electronic Volt-Ohm Capacity Millimeter

NEW SOLDERING GUN

THE SPEED IRON*

Soldering Heat in 5 Seconds

Wherever you have a soldered joint in radio, electrical or electronic repair and service work, the Speed Iron will do the job faster and better

The transformer principle gives high heat—in 5 seconds—after you press the trigger switch. Convenient to hold with a pistol grip handle, the compact dimensions of this new soldering tool permit you to get close to the joint. The copper loop soldering tip permits working in tight spots. The heat is produced by the high current flowing through the soldering tip—permitting direct and fast transfer to the soldered connection.

If you want to save time on soldering jobs with a tool that is ready to use in 5 seconds, get a Speed Iron today. See your radio parts distributor or write direct.

*T.M. Reg. U. S. Pat. Off.

WELLER MFG. CO.

DEPT. S-1 • EASTON, PA.

UNIMETER

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

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

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

For details write: *Electronics Department, Specialty Division, General Electric, Syracuse, New York.*

Electronic Measuring Instruments

GENERAL ELECTRIC **UM-3**

NEWS

(*Continued from page 57*)

pared by Cornell-Dubilier Electric Co poration, New Bedford, Mass.

The basis of the code is the use of distinct color for every number fr zero to nine inclusive.

* * *

TECHNICAL APPLIANCE CONSOLI DATES PLANTS

Technical Appliance Corporation consolidated its wartime New York C and Flushing plants and will hereafter located at 41-06 DeLong Street, Flu ing, N. Y.

The postwar Taco line will inch antenna systems and kits for broadc reception and also for f-m and televis purposes.

* * *

RADIONIC EQUIPMENT CATALOG

A 32-page catalog listing compone test instruments, sound equipment and cessories, and technical books, has b released by the Radionic Equipment C pany, 170 Nassau Street, New York N. Y.

* * *

NEWS OF THE REPRESENTATIVE

John B. Tubergen, 1406 S. Grand A Los Angeles 15, and Joe W. Marsh, 1 West Pica Blvd., Los Angeles 15, h become members of the Los Ang chapter. Jerry W. Miller, 5917 S. M St., Los Angeles 3, Cal., has become associate member of the Los Ang chapter.

T. M. Graner, 600 Camelia St., B ley, is now a California chapter mem

O. N. Jones, 1085 The Arcade, Cl land 14, O., is now a member of Buckeye chapter.

At a recent meeting of the Wolv chapter, H. E. Walton was elected ident; J. C. P. Davenport, vice presid and Robert Milsk, secretary-treasur

The Hoosier chapter elected Leslie DeVoe president; Chuck Southern, president; Bruce McPherson, treasu and Bud M. W. Fisch, secretary.

Martin Friedman, a member of Mid-Lantic chapter has moved to Real Estate Trust Bldg., Philadelph Pa.

* * *

H. E. HARRIS PROMOTED BY BE SOUND

Harry E. Harris, formerly sales e neer of the Bell Sound Systems, Columbus, Ohio, has been appointed eral sales manager of the manufactu and jobbers sales division.

* * *

CANNON CONNECTOR BULLETI

A revised 64-page edition of the non Electric K bulletin on electric nectors has been released by Ca

•

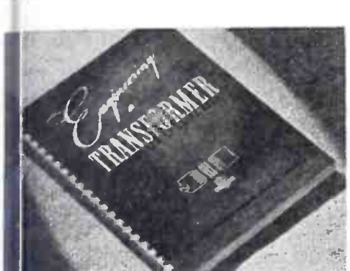
AT EASTERN AMPLIFIER "E" CEREMONIES

Left to right, Lt. Col. Harold L. Lister Comdr. William J. Warburton, Harry Friedl and Leonard Meyerson of Eastern Amp Corp., and Major Meredith J. Roberts ctr Development Company, 3209 ml dt St., Los Angeles 31, California. s ition contains data on receptacles, t ips, junction shells, stowage re-tacs for instruments, radio, motors, general electrical applications.

* * *

NOR TRANSFORMER BROCHURE

n 8-page brochure, *Engineering a nsformer*, covering lamination size, de gage and magnetic performance; e ze, type and gage; winding de-n; transformer-reactor physical and tr al aspects; electrical-mechanical si rations of core laminations; im-g ion, assembling and casing; and ti and sealing, has been released by n rd Transformer Corporation, Chi-o ll.



* * *

A ORY REPLACEMENT VIBRATOR GUIDE

-page replacement vibrator guide i eplacement listings for auto radio attery-operated household receiv-ffer circuit diagrams, installation e cross references of vibrators and l tions, buffer capacitor reference u l, and notes on an assortment of vibrators, has been published by P. R. Mallory & Co., Inc., Indianapolis 6, Indiana.

* * *

CAMBURN TO PRODUCE AUTO/FM/ TELEVISION ANTENNAS

A variety of antennas for auto sets, and f-m, television and marine receivers will be included in the postwar line of the Camburn Products Company, 490 Broome Street, New York 13, N. Y.

A new plant will be built on Long Island to produce the new postwar items. M. B. Bernstein is president of Camburn Products Co.

* * *

BROWNING JOINS NORMAN B. NEELY

Robert Browning has been appointed special field engineer for Norman B. Neely Enterprises, Hollywood, California.

Mr. Browning was formerly with Western Electric as a radar field engineer.

* * *

PLYTUBE F-M MAST KIT

A plytube antenna kit for f-m and television has been announced by the Plymold Corporation, Lawrence, Massachusetts.

The mast is supplied with fittings for attachment atop a roof or side of a building. Mast, antenna system, and all fittings are offered as a unit.

* * *

JACK BEEBE JOINS SWAIN NELSON

Jack Beebe has joined the transformer division of the Swain Nelson Company, Glenview, Illinois, and will be in charge of manufacturing and distributing of S-N-C transformers. Mr. Beebe was formerly general sales manager of the Thordarson Electric Manufacturing Company.

* * *

MUELLER INCREASES PLANT FACILITIES

A postwar plant expansion program has been announced by the Mueller Electric Co., Cleveland.

The first step in this program provides for the installation of new plating and finishing facilities.

* * *

BURGESS BATTERY REPLACEMENT GUIDE

A guide listing replacement batteries for approximately 1,000 models of portables and farm type receivers has been prepared by the Burgess Battery Company, Freeport, Ill. Included also are a list of private brand portables. Also

(*Continued on page 60*)

FREE TO YOU

COLOR CODE OHMS LAW CALCULATOR

reat Time Saver

Burstein-Applebee of Kansas City offers you this great convenience FREE. Easy to work. Solves many problems in a jiffy. FREE to Radio men, electronic engineers and others in the business. Attach coupon to your letterhead.

MAIL COUPON NOW

RSTEIN-APPLEBEE CO.
2 McGEE ST.
NSAS CITY 6, MO.
d me FREE Color Code and Ohms Law Cal-ator along with latest catalog.

n ______
STATE CONNECTION IN INDUSTRY
ME ______
DRESS ______
WN ______ STATE ______

● Now that V-J Day has come and gone, those heavy-duty metal-can electrolytics are once again becoming available for civilian use. Once again the Aerovox electrolytic line is providing that outstanding choice of types for the better jobs you are out to do, in this postwar radio and electronic world.

For your very best maintenance work where equipment must be kept going day in and day out: for those power packs that have to keep delivering properly filtered voltages hour after hour: for those radio sets that "must stay put"— you can depend on these Aerovox metal-can heavy-duty electrolytics.

• Ask Our Jobber...

Ask him about the Aerovox heavy-duty electrolytics that are now starting to come through for civilian use. Ask about the other types in the outstanding choice of Aerovox capacitors. Ask for a catalog—or write us direct.

AEROVOX Capacitors

INDIVIDUALLY TESTED

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

Adaptol

PHONO-RADIO
MATCHING UNIT

BOON FOR SERVICERS! A time-saver and moneymaker that just had to come . . . fruit of ADAPTOL initiative and research, supported by technical help from your own profession.

HOW SIMPLE! Without removing anything from either housing . . . without even breaking a circuit . . . you can install this long-wanted convenience wherever there is a radio to be utilized for reproducing record entertainment!

THINK OF THE technical data you DO NOT have to wade through! And the time you can save! And the satisfaction for your customers, while you are making a nice profit and adding to your professional prestige!

ANY RECORD PLAYER

ADAPTOL supplies the MISSING LINK

ANY RADIO

write QUICK for the WHOLE STORY

ADAPTOL COMPANY
260 Utica Avenue, Brooklyn 13, New York

Antennas

FIRST CHOICE... OF AMERICA'S RADIO DEALERS

Radio dealers, too, recognize the factors that long ago made Ward Antennas most popular with auto manufacturers and dealers. They see the top quality, precision workmanship, and now the new war-created designs that make Ward better than ever! The world's finest antennas for car and home were made, are made, and will continue to be made by Ward. Place your order for Ward Antennas now!

BUY VICTORY BONDS

THE WARD PRODUCTS CORPORATION
1523 EAST 45th STREET · CLEVELAND 3, OHIO

NEWS

(*Continued from page* 59)

presented is a numerical and alphabetic listing of all Burgess Battery products. Free copies of the guide are availab from department RG.

* * *

JENKINS JOINS FORSHAY

Victor E. Jenkins, formerly test equi ment sales manager for the Weston Ele trical Instrument Corp., has joined J M. Forshay, 27 Park Place, N. Y. N. Y., factory representative in Ne York City and New Jersey for Simp Electric Company and Industrial C denser Corporation.

* * *

COLEMAN NOW ASST. DIRECTOR RCA VICTOR ENGINEERING DIV.

J. B. Coleman has been named assis director of engineering for the RCA V tor division. M. C. Batsel has bec chief engineer of engineering products. Mr. Coleman will make his he quarters at the company's home office Camden, N. J.

Previous to his new assignment, Batsel was chief engineer at the R Victor plant in Indianapolis, Ind.

* * *

COMMUNICATIONS PARTS MOVES NEW PLANT

Communication Parts has moved 1101 North Paulina Street, Chicago.

•

POSTWAR RECEIVERS

Portable and phono-table postwar models Westinghouse. Unit, above, can be mounted wall or set up on flat surface. Combination, low, can be operated as a phono-receiver or with separate units, it being possible to re receiver and using as a straight table m

VOLUME AND TONE CONTROLS

(*Continued from page* 30)

in practically all the necessary ...ance values and tapers in the ...d range of resistance wherein ... type may be used, the Service ...should make it a policy, when ...nted with the replacing of con- ...of either type, to replace an ...al *wire-wound* control with a ...le *wire-wound* control, and an ...al *carbon type* control with a ...le *carbon type* control whenever ...ossible to do so. By adhering to ...policy, customer dissatisfaction ...e avoided in most cases.

...circuit design of many receivers ...ently includes special considera- ...which make it necessary for ...r operation to replace the volume ...ol with one of the same type. ...are many receivers (especially ...lder models) in which the use ...wire-wound control is definitely ...ited, and where the carbon type ...not give satisfactory service. ...-wound units are frequently used ...ntrol circuits which require a ...ratively high circuit-carrying ...ity. Compact, low-resistance ...of this type can be made to han- ...r greater currents than a carbon- ...control. They are also used in ...critical circuits where it is nec- ...y to have a higher degree of re- ...ce permanence, or much closer ...ance tolerance, than is possible ...the carbon type.

...ere are certain conditions where it might be desirable or even necessary to change the type of control; i. e., use a carbon control having the proper resistance value, taper and wattage rating to replace an original wire-wound control or vice versa. This is a matter of discretion for the Service Man. Unless it cannot be avoided, the exchange should not be made unless the advantages to be gained are *not* offset by the disadvantages of the particular type control. Quite often this can be correctly ascertained only by trial and error.

Midget Versus Large Size Controls

In some receivers, particularly in *off brand* or a few *trade name* receivers in which small midget-type volume controls are used in current-carrying circuits of the *antenna-bias* type, repeated volume-control trouble due to the overheating may be experienced. If the original midget control is damaged or burned out and a check reveals that the failure is due to excessive current in the control, the defective unit should be replaced with one of the larger type controls if there is space available.

On the other hand, a midget type may be used to replace a large type control in an *audio* type of control circuit whenever this procedure tends to simplify a crowded installation.

(To Be Continued)

NEW ...RODUCTS

NE-O-LITE TESTER

...est unit, *Ne-O-Lite Test-Lite,* for ...g a-c lines, checking polarity of ... d-c, and tracing ground lines, has ...announced by the Ne-O-Lite Mfg. ...Rockford, Illinois.

...ts voltage from 60 volts a-c to 550 ...a-c or d-c by variable light intensity. ...a neon lamp. Has a clear plastic ...d shell and insulated test points.

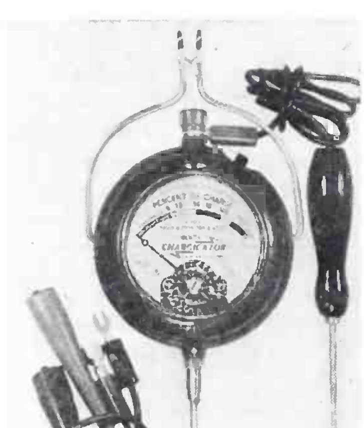
* * *

HICKOK CHARGICATOR

...*Chargicator* to indicate electrically ...quivalent gravity of any lead-acid ...ge battery, regardless of size or volt- ...has been developed by the Hickok ...rical Instrument Company, 10521 ...nt Avenue, Cleveland 8, Ohio.

Probe type, illustrated, gives instantaneous measurement of battery condition. It shows what charging rate to use, either for trickle charging or for an efficient, safe, high-rate charge. It indicates the percentage of charge and charging danger and warns of destructive overcharging.

Has a four-color scale dial. All models are sealed in molded acid-proof bakelite cases.



* * *

RADIART MIDGET VIBRATORS

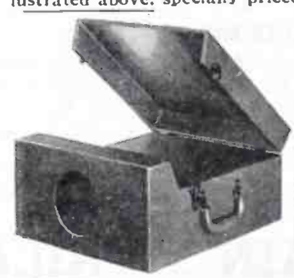
Midget vibrators, type VR-2, 2⅛" high x 1⅛" in diameter, have been announced

(*Continued on page* 62)

LAKE

has a better selection of RADIO Parts, Cabinets and Equipment!

Portable Phonograph Case of sturdy durable plywood, in handsome brown leatherette finish. Inside dimensions 16½" long, 14" wide, 9½" high. Has blank motor board. As illustrated above, specially priced at **$6.95**



Portable Phonograph Case in brown leatherette covering. Inside dimensions 17½" long, 13" wide, 7½" high. Has blank motor board and opening for speaker. As illustrated at left, specially priced at **$7.95**

SOUND EQUIPMENT

Complete line of amplifiers, microphones, speakers and sound accessories. WRITE TODAY!

Also blank table cabinets of walnut veneer in the following sizes, with speaker opening on left front side:

(Note: *7 has center speaker grill.)

#1	— 8¼"	L	x	5½"	H	x	4"	D	$1.95
#2	—10¼"	L	x	6⅜"	H	x	5"	D	$2.75
#3	—13½"	L	x	7⅝"	H	x	6¼"	D	$3.25
#7*	—10¾"	L	x	7"	H	x	5½"	D	$2.50
#8	—17"	L	x	9"	H	x	9¾"	D	$4.50
#9	—21"	L	x	9¼"	H	x	10½"	D	$5.50

*Speaker Opening in center of front side. Cabinets available in ivory color and Swedish Modern. Write for prices.

POWER TRANSFORMERS

4, 5, or 6 Tube—6.3 V at 2 amp 50 Mill Power Transformer...... $1.49

7, 8 or 9 Tube—6.3 V at 3 am 70 Mill Power Transformer....... $1.89

All types of radio cabinets, equipment and parts are available at Lake's lower prices. A large stock is listed in our catalog.

SERVICEMEN! Join our customer list today. *Write for Our Free New 12-page, elaborate, Illustrated Catalog!*

Order from Lake! You'll make no mistake! **Dept. D**

Lake Radio Sales Co.
615 W. Randolph Street
Chicago 6, Ill.

by the Radiart Corporation, 3571 W. 62nd St., Cleveland 2, Ohio. Designed for operation from a small 6-volt storage battery.

Vibrator frequency, 185 cps ±10%; input voltage (nominal), 6.0; input voltage range, 4.5 to 7.5; input current, 1.5 amperes maximum at 6.0 v; output voltage, 200 d-c maximum; and potential difference between primary reed and secondary reed, 25 v maximum.

* * *

INSULINE MIDGET JACKS

A series of midget-sized jacks has been developed by the Insuline Corporation of America, Long Island City, N. Y.

Models include single closed-circuit,

NEW PRODUCTS

(*Continued from page* 61)

single open-circuit, and three-way microphone types. Jacks have a tooled-brass body with phosphor-bronze spring members, nickel plated.

* * *

SHALLCROSS AXIAL LEAD RESISTORS

Fixed wirewound axial lead 1-megohm, 1-watt resistors have been announced by the Shallcross Manufacturing Co., Jackson & Pusey Avenues, Collingdale, Pa.

Known as Akra-Ohm type 188, the resistors are 1 3/16" long x ⅜" diameter. Axial leads, 3" long, of No. 20 tinned copper wire. Standard tolerance is said to be ±1%.

* * *

WESTON DIRECT-READING INSULATION TESTER

A direct-reading insulation measuring device, model 799, providing a single range for .1 to 10,000 megohms with the 10,000 mark at 8% of the scale length, has been announced by Weston Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

The circuit is said to have a test potential of less than 50 volts d-c. Its uses include checking leakage between windings in transformers, leakage of low-voltage paper and mica condensers, etc. Size 5⅜" x 3¼" x 4⅞".

* * *

REINER VACUUM-TUBE VOLTMETER

A vacuum-tube voltmeter, 451, a[nd] amplifier, 101, featuring 25 millivolts a[t] on the lowest range, 1,000 volts on [the] highest range, 10 cps to 700 mc frequen[cy] range, and 7 mmfd input capacity h[as] been announced by Reiner Electroni[cs] Co., Inc., 152 West 25th Street, Ne[w] York 1, N. Y.

Model 451 ranges are: *a-c volts*, 0-.02-.1-.25, (with amplifier)-2.5-10-25-100-25[0]-1,000; *d-c volts*, 0-2.5-10-25-100-25[0]-1,000; *d-c current*, 0-2.5-10-25-100-25[0]-1,000; ohms; 1 ohm to 1,000 megohm[s]

AGAIN AVAILABLE!

RADIO·TELEVISION·ELECTRONIC

SERVICE

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Please enter annual subscriptions (12 issues) for each of the above for which payment is enclosed at the rate of $1.00 each. (This rate applies only on 4 or more subscriptions when occupations are given.)

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State whether Employer is a Service Organization, Dealer, Jobber or Manufacturer ....

SERVICE, 52 Vanderbilt Ave., New York 17, N.Y.

-c *requency range,* 10 to 5,000 cps, w amplifier) 50 cps to 700 mc. D-c ol ohm and current accuracy is said) 2% on full scale. A-c volt accuracy al to be 2%, 50 cps to 50 mc; entire re ency range 5% accuracy. Weight, 20 u ls. Size, 10¾" x 9" x 8".

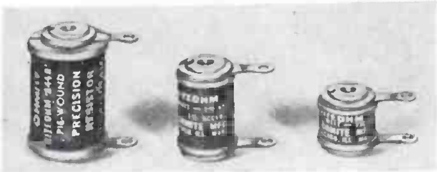
* * *

HMITE PIE-WOUND RESISTORS

series of pie-wound resistors, Rite- types 844A/844B/842A, that can be nted by means of a through-bolt, has e announced by the Ohmite Manufac- ig Company, 4835 Flournoy St., Chi- g 44, Ill.

ailable in 3 sizes: 9/16" diameter x ' long, 9/16" diameter by ⅞" long, and ¾" diameter x 1 3/16" long. The smallest is a 2 pie while the other two are 4-pie units. The minimum resistance is 1 ohm for the 2-pie unit and small 4-pie unit, and .10 ohm for the large 4-pie unit. The maximum resistance is 200,000 ohms for the 2-pie, 400,000 ohms for the small 4-pie, and 1.5 megohms for the large 4-pie unit.

Uses enameled alloy resistance wire non-inductively pie-wound on a non-hygroscopic ceramic bobbin.



* * *

CARTER MOTOR FREQUENCY-CONTROLLED D-C TO A-C CONVERTER

A frequency-controlled d-c to a-c rotary converter has been announced by Carter Motor Company, 1608 Milwaukee Avenue, Chicago, Illinois.

Designed with the frequency control in the base, including a vibration reed-type meter to visually indicate the frequency of the output.

In the 110-120 volt d-c to 117-volt a-c models, the output control is said to be within ± 10 volts at 60 cycles, over a ± 10-volt d-c fluctuation.

Models can be supplied with input voltages ranging from 6 through 64 volts for battery conversion and also 110-120 volts d-c for line conversion. Wattage ranges are from 40 through 250, continuous duty.

FREE CATALOG

Radio parts, test equipment, P.A. accessories, amateur supplies, technical books. Send today for your free copy to Dept. A-2.

RADIONIC EQUIPMENT CO.

"Chancellor Radio"

170 NASSAU STREET, NEW YORK 7, N. Y.

ADIO SERVICE—FLAT RATE SCHEDULES

implify pricing, eliminate losses, reduce arguments and make timating easier.

If your Jobber does not have them, write for information.

ADIO EQUIPMENT CO. 1415 W. FRANKLIN AVE. MINNEAPOLIS 5, MINN.

ATTENTION—SERVICEMEN

Send for our Latest FREE Catalogue of hard-to-get tubes and parts.

Immediate Delivery

ARAGON RADIO DISTRIBUTORS

35 LIBERTY STREET, DEPT. S., NEW YORK 6, N. Y.

Ted McElroy

World's Largest Manufacturer of Wireless Telegraphic Apparatus

COMPLETE CENTRAL OFFICE EQUIPMENT

McElroy Manufacturing Corp.

32 Brookline Avenue • Boston, Massachusetts

EFFECTIVE JANUARY ISSUE

TRIM SIZE OF SERVICE WILL BE INCREASED TO 8⅞" x 11¾"

BLEED PLATES SHOULD MEASURE 9" x 12"

PAID CIRCULATION OVER 10,000 ABC

Need Any Radio Tubes?

SEND US YOUR LIST

Insulated Resistor Kit—100 most pop. sized Deluxe Asst. ¼, ½, 1 Watt R.M.A. color coded .... per kit **$2.75**

Radio Knob Kit—50 Bakelite Set Screw for ¼" shaft Deluxe Asst. .... per kit **$3.69**

Hookup Wire—No. 20 Vinylite Covered. Solid Copper Core. 100 ft. indiv. boxed **69c**

By-Pass Condensers—600 v. fully guaranteed, all sizes up to .05 mfd. .... ea. **7c**—per hundred **$5.50**

Aerial Kits (Indiv. Boxed) **75c**

Write for Complete Catalog of Hard-to-Get Items

NATIONAL RADIO DISTRIBUTORS

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TUBES—PARTS

RADIO DEALERS—SERVICEMEN

Send for our list of available tubes and repair parts.

Sylvania, Tung-Sol, Ken-Rad.

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IMMEDIATE DELIVERY

ON TEST INSTRUMENTS !

SIMPSON 260 v.o.m. $33.25
TRIPLETT 625-N v.o.m. 37.50
TRIPLETT 666-H v.o.m. 16.00
TRIPLETT 2413 tube tester.... 45.00
SOLAR CE-1-60 cond. checker.. 44.90
SUPERIOR CA-11 sig. tracer.. 18.75
SUPERIOR 400 multimeter 52.50
RADIO CITY 704 sig. gen..... $46.50
RCP 805 tube & set tester..... 89.50
DUMONT 3" oscillograph..... 105.00
Also, many other types available.
Write to us on your needs.
25% deposit should accompany C.O.D. orders.

SCENIC RADIO & ELECTRONICS CO., 53a Park Pl., N. Y. 7

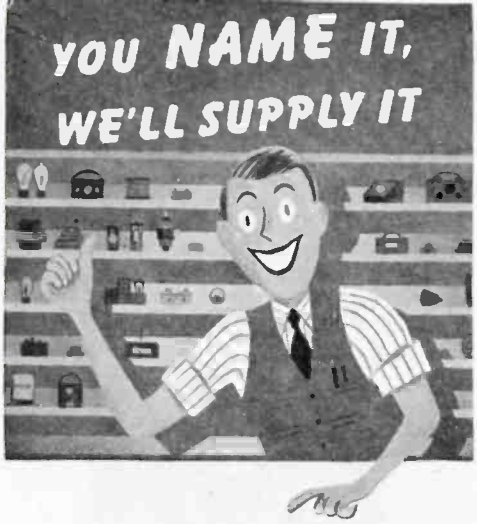
WARTIME RADIO SERVICE

1500 tested radio tube substitutions and other valuable information.

Keeps 'em Playing in spite of the tube shortage — only $3 postpaid. Order now.

CITY RADIO COMPANY

East Washington at 5th St. Phoenix, Ariz.



EVERYTHING IN RADIO AND ELECTRONICS

R. W. T., world's oldest and largest Radio Supply House is ready again with tremendous stocks of sets, parts and equipment. Yon can depend on our quarter-century reputation for quality, sound values and super-speed service. Orders shipped out same day received. All standard lines already here or on the way, including: National, Hammarlund, R. C. A., Hallicrafters, Bud, Cardwell, Bliley and all the others you know so well.

Originators and Marketers of the Famous *Lafayette Radio*

Radio Wire Television Inc.

100 Avenue of the Americas, New York 13
(Formerly Sixth Avenue)
Boston, Mass. • Newark, N. J.

"No supplier anywhere has a bigger stock of Radio and Electronic equipment, Test equipment, Public Address equipment, Communications equipment. If your engineering problem requires special equipment, we'll make it. Write today. Dept. F-K-5."

JOTS AND FLASHES

OVER 10,000,000 f-m sets will be sold during the next two or three years, according to Frank Mansfield, director of sales research of Sylvania, who based his data on a survey recently completed. . . . Irving P. Wolfe has become a distributor and opened a store at 224 Main Street, Poughkeepsie, New York. His company will be known as Chief Electronics. . . . Olson Radio Warehouse, 73 E. Mill Street, Akron, Ohio, have been appointed distributors for Philco. . . . John Meck Industries now have a Cessna T 50 plane for transportation of company personnel and special equipment. . . . Jack Kaufman, former president of Heintz and Kaufman, Ltd., has been named vice president of Aireon Manufacturing Corporation and manager of the San Francisco office of Aireon. . . . A one-story plant on a 7½-acre tract on Skokie Highway near Waukegan, Illinois, has been purchased by Belmont Radio. This will supplement the Belmont plant on Dickens Avenue, Chicago for receiver production. . . . Ray T. Schottenberg, jobber sales manager of Astatic Corporation, visited jobbers in the New England states recently. H. A. Chamberlin, Astatic New England rep., accompanied Mr. Schottenberg. . . . George Balsam has been named ad manager and director of sales promotion of Aerovox Corporation, New Bedford, Mass. . . . Westchester Electronic Supply Company, 333 Mamaroneck Avenue, White Plains, N. Y., was recently appointed distributor for RCA, IRC and Cornell-Dubilier. . . .T. R. McElroy, president of the McElroy Manufacturing Corporation, 62 Brookline Avenue, Boston, Mass., has rejointed the Merchant Marine as a radio operator, Lt. Senior Grade, and is now making the regular run between Europe and U. S. . . . Amphenol Phenolic Corporation, 1830 South 54th Avenue, Chicago, Ill., are expanding their plastics manufacturing facilities and building a three-story building next to their present plant. . . . V. Hutto has been named Georgia factory representative for Universal Microphone Company, Inglewood, Calif. . . . Radiart Industries, Cleveland, Ohio, has been bought by Maguire Industries, Inc., Leslie K. Wildberg and William H. Lamar of Radiart have sold all their common and preferred stock to Maguire. . . . James H. Hickey has been appointed general manager of the Zenith Radio Distributing Corporation.

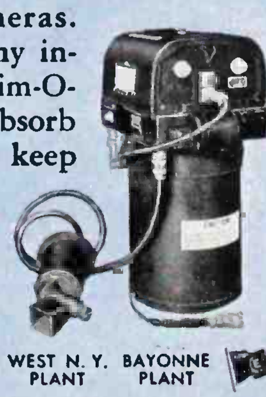
ADVERTISERS IN THIS ISSUE

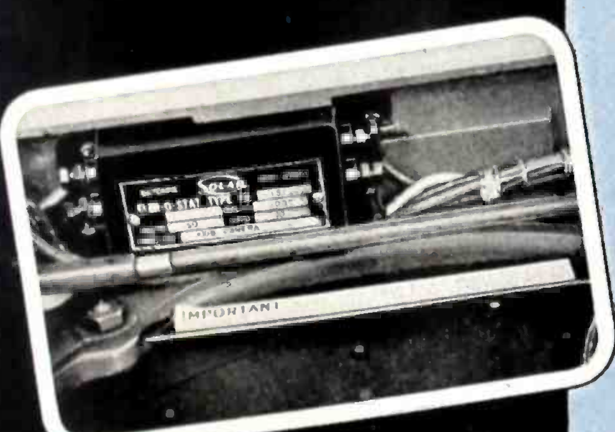
SERVICE INDEX—NOVEMBER, 1945

Quick as a wink the Fairchild Night Owl Camera records enemy movements intended to be hidden by darkness. Quick as a flash the radio of the photo-reconnaissance plane keeps touch with its base — and clearly — for Solar Elim-O-Stats are part of the electronic equipment of these highly perfected cameras.

This is but one of many instances where Solar Elim-O-Stats are being used to absorb local interference and keep speech channels free.

Let Solar advise you on radio-noise suppression.





BACK AGAIN!
Solar Elim-O-Stats for noise suppression in all Household Electrical Appliances. Order now from your Solar Distributor.

SOLAR

WEST N. Y. PLANT · BAYONNE PLANT

A TOTAL OF TEN ARMY-NAVY EXCELLENCE AWARDS

SOLAR MANUFACTURING CORP.
285 Madison Avenue • New York 17, N. Y.

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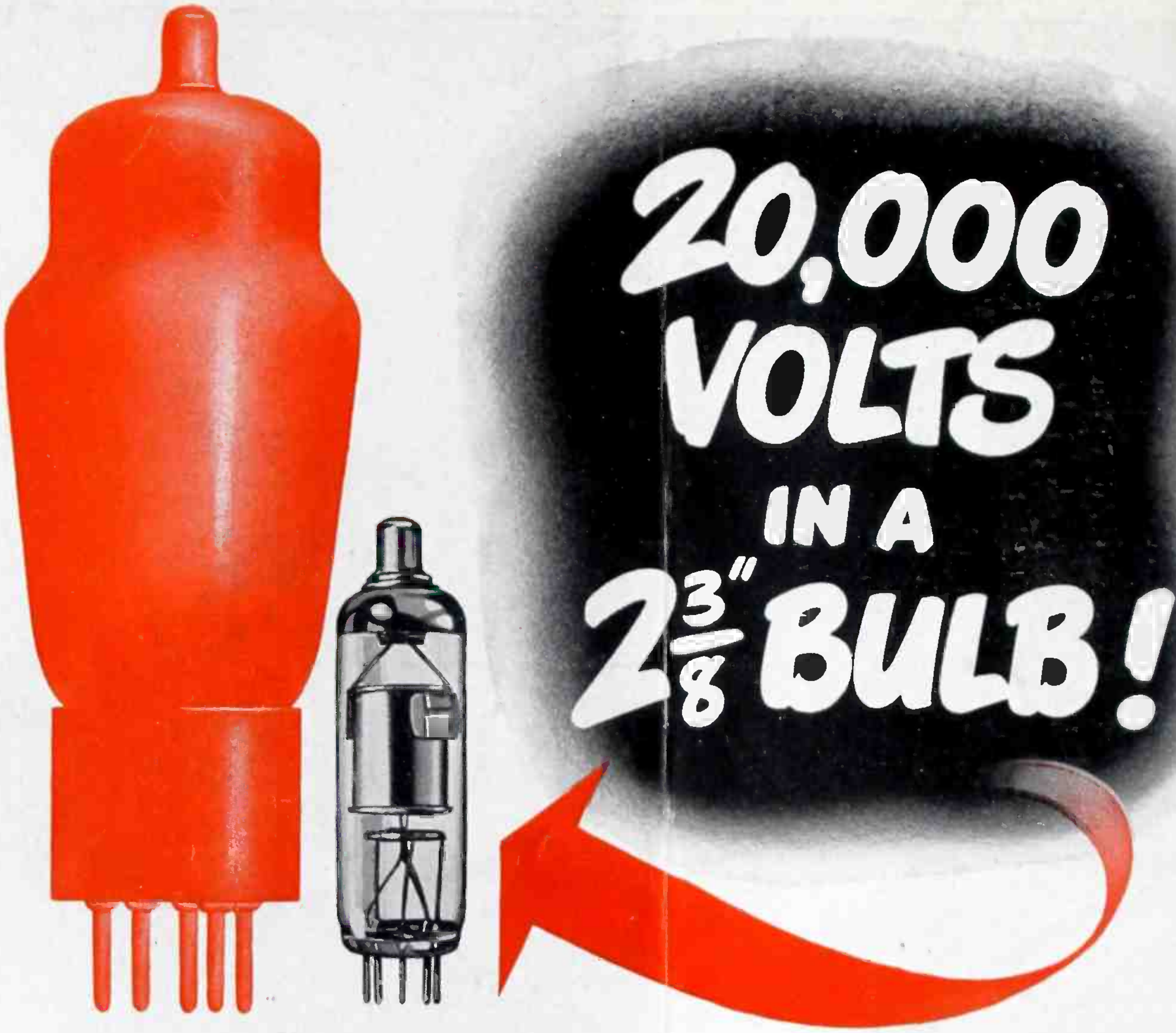

ANOTHER "FIRST" BY NATIONAL UNION RESEARCH LABORATORIES

AN example of how war-time research by National Union engineers is helping to lay the foundation for vastly improved post-war Television, FM and radio reception, is this new half wave high vacuum rectifier—the NU 1Z2.

Here is a miniature with the voltage handling capabilities heretofore possible only in full size tubes. For a high voltage rectified supply in the operation of radar and television equipment, the NU 1Z2 saves space—operates with increased efficiency—is exceptionally rugged. Its low filament power consumption suggests many new fields in circuit design and application, especially to the "ham" and experimenter.

For the distributor and service dealer, such original N. U. electron tube developments are creating new opportunities for profitable N. U. Tube replacement sales—today and in the future.

National Union 1Z2
High Voltage Rectifier

Inverse peak anode voltage-max.	20,000 volts
Peak anode Current	10 ma.
DC Output Current	2 ma.
Filament Voltage	1.5 volts
Filament Current	300 ma.

The NU 1Z2 is designed to withstand shocks in excess of 500 G's.

Maximum overall length	2.70"
Maximum seated height	2.37"
Maximum diameter	.75"
Bulb	T5½
Base Miniature Button	7 pin
Mounting position	Any

NATIONAL UNION
RADIO AND ELECTRON TUBES

NATIONAL UNION RADIO CORPORATION · NEWARK 2, N. J.