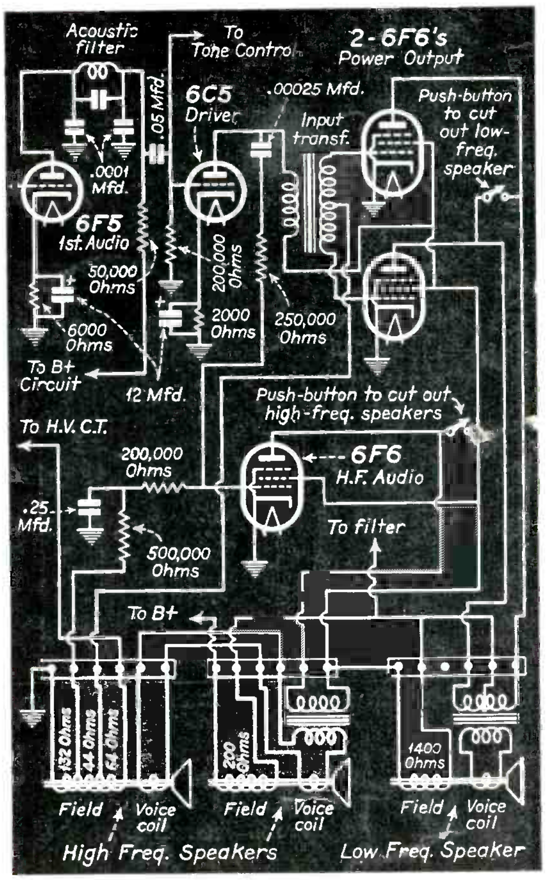
SERVICE

A MONTHLY DIGEST OF
RADIO
AND ALLIED MAINTENANCE



PER COPY 25 CENTS

Multiple Speaker System
(*See Page* 355)

AUGUST 1936

Don't worry about HUMIDITY!

MALLORY

Replacement Condensers are <u>HUMIDITY</u> Proof...

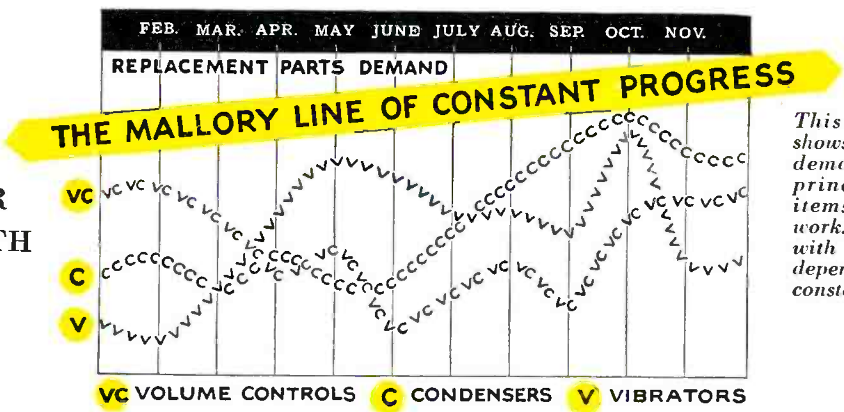
Steamy summer days may play havoc with ordinary condensers. But they do not affect Mallory Replacement Condensers because *humidity doesn't get to them!*

Mallory provides a heavy metal seal around the actual condenser unit *inside* the carton. This protection—plus a *final sealing* of the carton itself—so completely safeguards the condenser that its characteristics remain unchanged despite increasing or decreasing humidity.

The humidity proof feature of Mallory Replacement Condensers is one big point of superiority. There are many others. Mallory provides smaller sizes with greater efficiency. Mallory presents the first universal mounting features for both carton type and round can condensers. The Mallory Terminal Connector eliminates the necessity for splicing leads. And 69 Mallory Replacement Condensers provide universal application to meet the needs which heretofore have required literally thousands of condensers.

If you are not using them you are missing a real bet. Ask your distributor about Mallory Replacement Condensers—now!

BUILD YOUR BUSINESS WITH MALLORY



This composite graph shows the trend of service demand for the three principal replacement items in daily service work. Check your needs with the demand—and depend on Mallory for constant progress.

MALLORY

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INDIANAPOLIS INDIANA
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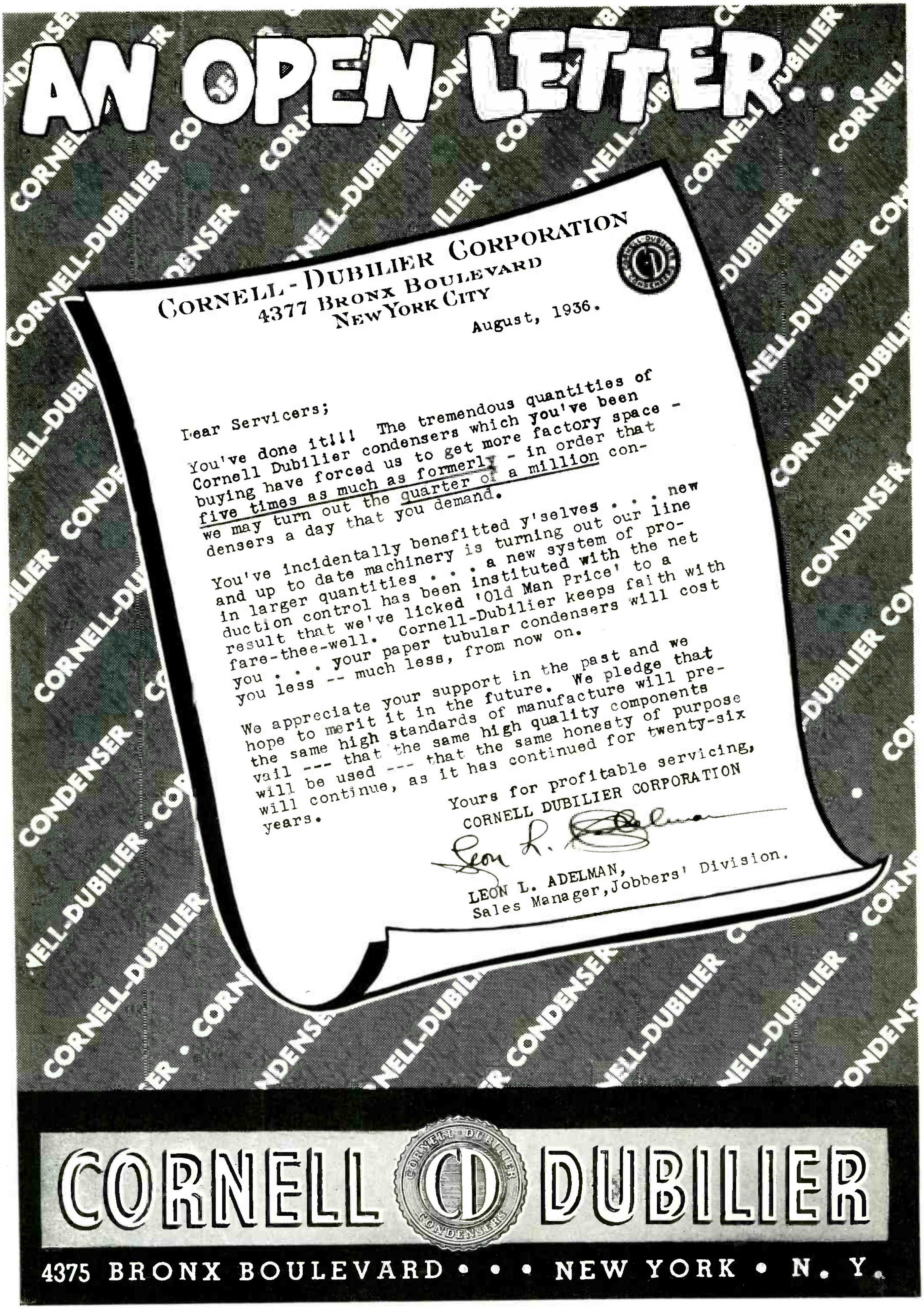


CORNELL - DUBILIER CORPORATION
4377 BRONX BOULEVARD
NEW YORK CITY

August, 1936.

Dear Servicers;

You've done it!!! The tremendous quantities of Cornell Dubilier condensers which you've been buying have forced us to get more factory space - five times as much as formerly - in order that we may turn out the quarter of a million condensers a day that you demand.

You've incidentally benefitted y'selves . . . new and up to date machinery is turning out our line in larger quantities . . . a new system of production control has been instituted with the net result that we've licked 'Old Man Price' to a fare-thee-well. Cornell-Dubilier keeps faith with you . . . your paper tubular condensers will cost you less -- much less, from now on.

We appreciate your support in the past and we hope to merit it in the future. We pledge that the same high standards of manufacture will prevail --- that the same high quality components will be used --- that the same honesty of purpose will continue, as it has continued for twenty-six years.

Yours for profitable servicing,
CORNELL DUBILIER CORPORATION

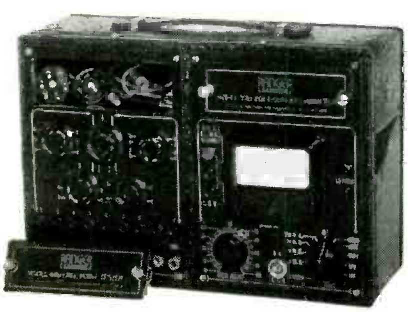
LEON L. ADELMAN,
Sales Manager, Jobbers' Division.

QUALITY COMBINATIONS FOR RADIO SERVICING

THE NEW RANGER EXAMINER LINE

COMPLETE FOR SHOP OR FIELD

COMBINATION FREE POINT TESTER AND MULTIMETER MODEL 640-740



Model 640 Free Point Tester has 5 sockets. Panel includes eight automatic switch type and ten single action jacks.
Model 740 Volt-Ohm-Milliammeter Unit has a Triplett Precision instrument scale reading 10-50-250-500-1000 A.C. and D.C. volts at 1000 ohms per volt. 1-10-50-250-M.A.; low ohms 0-300; high ohms to 250,000 at 1.5 volts. Rheostat adjustment. Case is same as for Model described opposite. Dealer Price **$27.00**

COMBINATION TUBE TESTER AND SIGNAL GENERATOR 440-540

Model 440 Tube Tester checks all glass, metal and glass-metal tubes. Condition of tubes read directly on GOOD-BAD instrument scale while load values are applied. Circuit desired to indicate inter-element shorts and leakages. Illuminated dial A.C. instrument for line volts adjustment. Shows when tester is connected to power supply.
Individually calibrated plug-in type coils in Signal Generator Model 540 set new standard for obtaining laboratory accuracy at low cost. See description for Model 557 Signal Generator. The sturdy case is metal with built-in compartments having snap-on covers for accessories, finished in electro black baked enamel. Panels in silver and black. Complete with all batteries and two type 30 tubes and necessary accessories.
Dealer Price............ **$33.60**

SENSATIONAL DEVELOPMENTS AT SENSATIONAL PRICES

DIRECT READING SIGNAL GENERATOR MODEL 557

The direct reading Signal Generator Model 557 has plug-in type coils. Five frequency bands from 110 to 20,000 Kc. All fundamentals. Each coil is individually calibrated by peaking with trimmer condensers. Accuracy less than 1% on all bands. Completely shielded. Attenuation and stability are outstanding features.
Supplied in black leatherette case. Silver and black panel. Dealer Price............ **$18.00**

Model 554-A—same as Model 557 but not direct reading. Calibrated graphs included for accuracies under 1% on any band. Dealer Price............ **$14.40**

D. C. POCKET VOLT-OHM-MILLIAMMETER MODEL 735

Contained in sturdy black molded case with silver and black panel, rounded corners. Ranges are 15-150-750 volts; 1.5-15-150 M.A.; ½-1,000 low ohms; 0-100,000 high ohms at 1.5 volts. External batteries may be used for higher resistance measurements.
Has Triplett D'Arsonval precision instrument accurate to 2%. Selector switch for all ranges. Provides for all D.C. measurement requirements of the serviceman.
Size is 3" x 5⅞" x 2½" thick—is easily carried in the pocket, and handy for the laboratory.
Dealer Price................ **$10.80**

ADDITIONAL COMBINATIONS

Model 540-740—Signal Generator and Multimeter. Dealer Price......**$36.00**

Model 440-740—Tube Tester and Multimeter. Dealer Price...........**$37.50**

The new Ranger-Examiner line of radio test instruments is precision built throughout. All instruments have been designed and constructed for the utmost in compactness, accuracy and durability.

Compare these test instruments. . . . Check their accuracy, note ease of operation and speed with which they can be used. . . . See how light they are in weight. . . . And then note the price. Ask your jobber to show you the Ranger-Examiner line. Write for more complete information.

RANGER EXAMINER

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☐ Please send Ranger-Examiner catalogue.
☐ I am interested in more information on Model.........

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office. Member, Audit Bureau of Circulations

EDITOR

AUGUST, 1936 — Robert G. Herzog — VOL. 5, NO. 8

EDITORIAL CONTENTS

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JAS. A. WALKER, *Secretary*

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"PRECISION" ELECTRONOMETER series 600

A COMBINATION TEST INSTRUMENT—A MODERN TUBE ANALYZER WITH MANY ADEQUATE RADIO SET ANALYSES FEATURES . . . FLEXIBLE FOR FUTURE RELEASES . . . *BUILT TO WITHSTAND "ROUGH" USAGE . . .*

Precision engineers developed the ELECTRONOMETER series 600 to provide the radio technician with an instrument of compact size that will enable the obtaining of modern radio tube analyses and many important radio set analyses; thus eliminating the inconvenience of carrying or the expense of purchasing several test units necessary for radio servicing.

For radio tube analyses, the "600" analyzes a tube in many rigid ways before it can pass as GOOD. . . . Hot neon inter-electrode leakage and short test; hot cathode leakage test; ELECTRONOMETER tube merit test; proper rating of loads through load control; separate tests obtainable for each section of full wave rectifiers—twin triodes—triode diodes—pentode diodes—duo diodes—pentode triodes—pentode rectifiers—and frequency converter tubes; center-tapped filament tubes (6Z5, 12A5, 12Z5) can be short checked without the use of extra switches; live voltage is checked directly on the meter; D'Arsonval type movement of 2% accuracy; English readings of REPLACE—WEAK—GOOD; more than 300 tube numbers can be accommodated, including all types of standard non-octal tubes and all "G" (glass), "GM" (glass-metal) and "M" (metal) octal based tube series; free point method of tube testing provides for extreme flexibility for future tube releases.

For important radio set analyses, the ELECTRONOMETER series 600 provides for obtaining various adequate measurements of volts, ohms and mils in addition to qualitative condenser checking. The following ranges are controlled from a master rotary switch.

Four D.C. Voltage Ranges—0-10; 0-100; 0-500; 0-1000 at 1000 ohms per volt. These ranges are adequate in coverage for modern radio set servicing and are so designed that average readings may be taken at about the center of the scale. These D.C. voltages are obtained from pin jacks through the selector switch.

Three D.C. Current Ranges—0-1; 0-10; 0-100. These ranges adequately cover requirements and are selected through the use of only two pin jacks from the external test selector switch.

PRECISION engineers have used foresight in selecting these ranges from the selector switch inasmuch as with this method a means is provided for the checking of leakage in electrolytic condensers.

These Resistance Ranges—0-2500; 0-250M; 0-2½ Megs. A single long scale with large easy reading numerals is employed for reading ohms. All other ranges are multiplied from this scale. The low ohms center scale indication is 35 ohms. Resistance as low as ½ ohm can be read very comfortably.

Qualitative Paper Condenser Test—A D.C. potential from the self-contained power pack is applied to the paper condenser under test and the neon glow lamp incorporated in the 600 is used as an indicator of leaky or shorted paper condensers caused by complete or partial breakdown of the dielectric employed.

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Apparatus Corporation

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Other important features included.
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PRECISION APPARATUS CORPORATION
821 East New York Avenue
Brooklyn, New York

Gentlemen: Please send me full information on the NEW ELECTRONOMETER, Series 600; also include the name and address of my local distributor where I may see it in operation.

NAME ....

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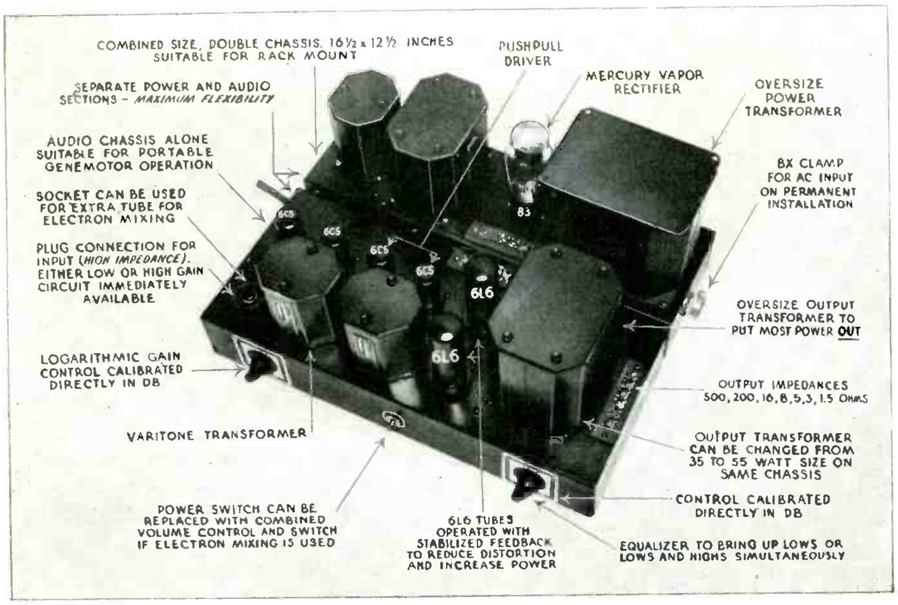
Most Complete Transformer Line in the World!

QUALITY · RELIABILITY

THE UTC BEAM POWER AMPLIFIER



The UTC beam power amplifier kits are designed to take full advantage of the unusual characteristics of the new 6L6 tubes. Some of the unique features of this amplifier are:

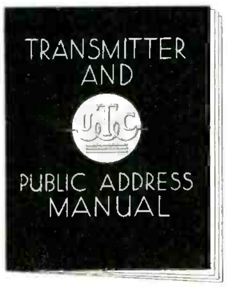
- **HIGH POWER** . . . 35 watts self bias, 55 watts fixed bias.
- **HIGH GAIN** . . . 118 DB with provision for immediate change-over to 95 DB.
- **SEPARATE CHASSIS** for power supply and audio sections permitting maximum flexibility and minimum hum pickup.
- **STABILIZED FEEDBACK** . . . effects increase in output power and reduction in overall distortion
- **EQUALIZER** with calibrated control to bring up the low frequency end or to bring up both low and high frequencies simultaneously.
- **MOBILE OPERATION** can be obtained using the audio chassis alone and genemotor. 20 watts available.
- **RACK PANEL MOUNTING** or rack cabinet mounting permissible. Combined overall dimensions 16½ x 12½ x 8 inches.
- **ELECTRON MIXING** can be added to this kit with very little change.

		Net
PAK-1	Self bias amplifier kit. 35 watt operation. Output transformer impedances 500, 200, 16, 8, 5, 3, 1.5 ohms. Includes all accessories, including perforated covers as illustrated, except tubes. Fully mounted. List price, $75.00	**$45**
PAK-1X	Same as PAK-1, but with Varimatch modulation output transformer. List price, $75.00	**$45**
PAK-2	Fixed bias amplifier kit. 55 watts operating condition. Output transformer with impedances of 500, 200, 16, 8, 5, 3, 1.5 ohms. Includes all accessories, including perforated covers as illustrated, except tubes. Fully mounted. List price, $80.00	**$48**
PAK-2X	Same as PAK-2, but with Varimatch modulation output transformer. List price, $80.00	**$48**

NEW UTC TRANSFORMERS for use with 6L6 TUBES

		List Price	Net Price
PA-428	Power transformer for push-pull 6L6 tubes, self or fixed bias primary, 115 v. a.c., 60 cycles. Secondaries 450-0-450 at 250 ma.; 6.3 VCT-4A, 6.3 VCT-2A tapped at 2 volts-3A, 5 VCT 3-A	$14.00	**$ 8.40**
PA-233	Input transformer from two 56, 6C6 triode, 6C5, or similar tubes to 6L6's self bias.	6.00	**$ 3.60**
PA-333	This input transformer is designed to operate from 6C5's or similar driver tubes to two 6L6's fixed bias	6.00	**$ 3.60**
PA-433	From 45 or 2A3 plates to two or four fixed bias 6L6 grids	6.50	**$ 3.90**
* **PA-2L6**	6600 ohms. plate to plate. Will match 35-40 watts output. Secondary impedance, 500, 200, 16, 8, 5, 3, 1.5 ohms.	10.00	**$ 6.00**
* **PA-4L6**	3800 and 3300 ohms. plate to plate. Will match two 6L6's fixed bias, 60 watts output; four 6L6's self bias, 60-80 watts output. Secondary impedance, 500, 200, 16, 8, 5, 3, 1.5 ohms.	15.00	**$ 9.00**

**These transformers incorporate the new UTC Feedback (patent applied for) Winding, which reduces harmonic distortion, increases available power and reduces plate resistance tremendously. No resistors or condensers are necessary.*



VALUABLE . . . Our engineering staff has compiled a thorough study of transmitter design, public address hookups, circuits and applications into a 44-page illustrated bulletin. It is now available at your local distributor for only 25c.

UNITED TRANSFORMER CORP.

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EXPORT DIVISION: 100 VARICK STREET NEW YORK, N.Y. CABLES: "ARLAB"

New! —and YEARS AHEAD

YOUR KIND OF ANALYZER—

1. New patented "movement" as sensitive as a cat's whisker . . . yet the sturdiest ever built.
2. Roto-dial . . . twelve independent scales that flash into view in synchronism with the range selector. No maze of scales. No multiplying or dividing.
3. Range of each scale suited to practical testing. Faster . . . more accurate.
4. Complete set of plug adaptors, full range of sockets, twelve testing ranges (see illustration), complete equipment for both socket, and point to point analysis.
5. An instrument you will be proud of . . . with handsome metal panel durably finished in black and silver by a new process. The greatest value ever offered at any price.

See us at the **I-R-S-M SHOW**
Hotel Penna. N. Y.
Sept. 18-19-20
Booth 18 and 19

DEALER'S NET PRICE
$49.00

THE story of this new instrument is the story of all engineering progress—a long period of sluggish development and then . . . a sudden dazzling flash ahead. For a number of years service men have had to be content with minor improvements in radio testing equipment, but now the Roto Ranger suddenly soars to new heights. Tests . . . ranges . . . findings that have been beyond your reach . . . are now at your finger tips in the new Roto Ranger.

The illustration will give you some idea of its advanced construction. Note that there is just one long, clear scale visible—the 8 V. DC scale at which the range selector switch is set. But now move the selector to any one of its twelve ranges, and a corresponding scale, equally simple, equally legible, will automatically come into view as the proper circuit is cut in by the selector.

Gone is the complicated scale, the necessity for multiplying and dividing, the difficulty in reading, the need for cramped calibrations, the possibility of errors. This ingenious patented roto-dial with a complete range of independent scales eliminates the necessity for observing metric relationship in calibrating the scales. Therefore every scale has an ideal, practical, *usable* range . . . and that means faster and better analysis.

A study of the ranges around the selector switch explains this clearly to experienced service men. A typical case is the 100 ohm scale in which the calibrations for the first five ohms occupy half of the scale length. Readings fine enough to detect faulty soldering on low resistance circuits can be made on this scale, and this is merely representative of the closer readings that can be made on many of the scales.

Beyond these outward evidences of advanced engineering are many other revolutionary improvements. The basic movement (patented) . . . the heart of an analyzer . . . is the result of long and patient development combined with advanced manufacturing methods guided by unsurpassed knowledge of electrical instrument design.

Ask your jobber or mail coupon below for complete information covering the Roto-Ranger and the complete Simpson line of radio service men's testing equipment and instruments for radio or industrial purposes.

Other Simpson products include panel meters as illustrated opposite—D. C. Meters, A. C. Meters, Rectifier-type meters, and Thermo-couple meters.

WHO
is qualified to build your analyzer?

The Roto-Ranger and other Simpson instruments are the fulfillment of a manufacturing ambition to build the most accurate, rugged and practical equipment of this type ever produced. Behind the Simpson organization is Ray R. Simpson, formerly president of the Jewell Electrical Instrument Co. and in full charge of all design and manufacturing throughout Jewell's long and successful career. Collaborating with Mr. Simpson are many of the men who were responsible for the Jewell reputation for unmatched precision and ruggedness. Who could be better qualified to build YOUR testing equipment?

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SIMPSON ELECTRIC COMPANY, 5218 W. KINZIE ST., CHICAGO

Roto Ranger
RADIO ANALYZER

The ONE big development in recent years

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Send facts covering Simpson instruments checked.
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☐ Panel Meters
Name ____
Address ____
City ____ State ____
My Jobber is ____

THE ANTENNA . . .

TELEVISION

THROUGHOUT THE COUNTRY television companies are staging demonstrations and are expanding their experiments out into the field.

On April 24 in Camden RCA held a television demonstration, as discussed in our editorial for May. Peck in New York followed with his mechanical televisor; General Television Company in Boston; The Don Lee Studios in California, and Farnsworth in Philadelphia are conducting experiments with cathode-ray scanning of high-definition pictures.

On August 11, just as this issue goes to press, the Philco Radio and Television Corporation transmitted television from their station W3XE, in Philadelphia, to a point some seven miles distant. At that point the reception was demonstrated to a group of newspapermen and magazine editors. The video-frequency carrier was 51 mc with an accompanying 54.25 mc sound carrier. The received picture was about 10 inches by 12 inches, reproduced in black and white on a mirror located above the scanning tube. The pictures were at the rate of 30 frames per second with 345 lines per frame. Philco has been conducting field tests since their first broadcast in December of last year. Regular nightly broadcasts are made from Philco's station W3XE since June 18, using an output power of about one kilowatt.

At a recent hearing of the Federal Communications Commission called for the purpose of allocating the ultra-high frequencies, James M. Skinner, chairman of RMA's television committee, recommended a five-point program. Briefly, the five points were as follows:

1. One single set of television standards for the United States, so that all receivers can receive the signals of all transmitters within range.

2. A high-definition picture approaching ultimately the definition obtainable in home movies.

3. A service giving as near nationwide coverage as possible.

4. A selection of programs; that is, simultaneous broadcasting of more than one television program in as many localities as possible.

5. The lowest possible receiver cost and the easiest possible receiver tuning.

At this same meeting Albert F. Murray, also of the RMA committee made recommendations concerning television standardization. It was the RMA's suggestion that the band allocated for television broadcasting extend continuously from 42 to 90 mc, with the exception of the 56-60 mc amateur band. An additional band beginning at 120 mc was also requested.

Mr. Murray also presented the Committee's recommendations for television standards. The RMA recommends that channel widths be 6 mc, and that the picture and sound carrier be spaced approximately 3.25 mc with the sound higher in frequency. A frame frequency of 30 frames per second with an interlaced field frequency of 60 per second was also recommended with 440 to 450 lines per frame. Further stipulations as to aspect ratio, percentage of synchronizing signal and polarity of signal were also recommended.

It is our opinion that the Service Man and dealer should read technical periodicals and books covering this all important subject. Every available moment should be spent in keeping up with this rapidly advancing science.

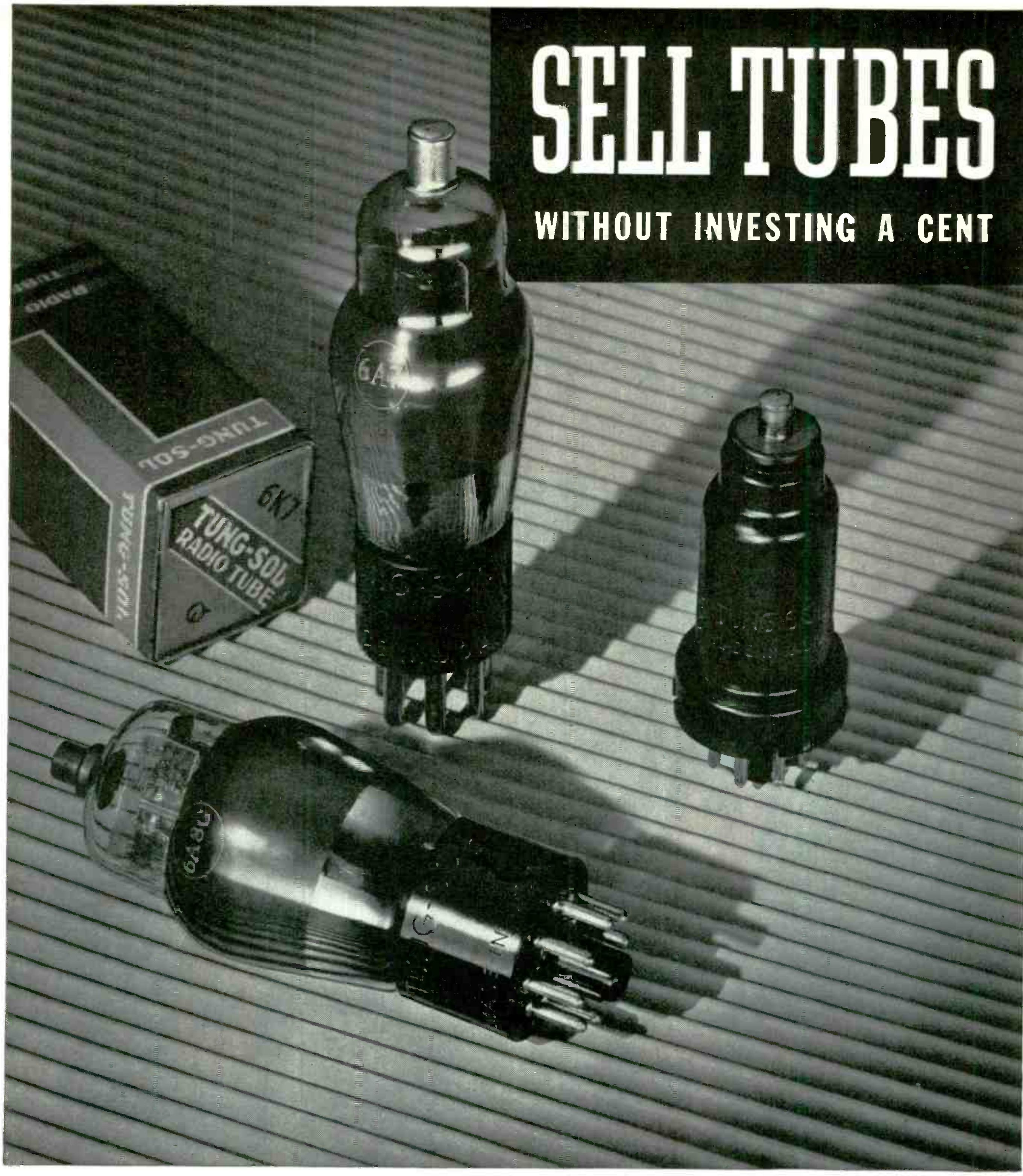
• • •

EXPOSITION AND TRADE SHOW

THE GRAND CENTRAL PALACE, in New York City, will be the scene of the 1936 National Electrical and Radio Exposition to be held September 9 to 18 inclusive. Approximately a hundred radio and electrical manufacturers will display their products on the main and mezzanine floors at the palace.

Coincidently with the closing of this exposition and continuing through September 20 the New York Chapter of the IRSM will hold its Annual Trade Show on the mezzanine floor of the Hotel Pennsylvania in New York City. From a display space standpoint this Trade Show promises to be the largest of its kind held in the east. An interesting program has also been prepared.

Considering the registration and interest given to these types of shows, especially to the recent IRSM Trade Show in Chicago, it seems that every radio-minded individual, be he Service Man, parts jobber, dealer, amateur, or experimenter, anywhere in the vicinity should attend both shows. Here the manufacturer and distributor can meet the Service Man face to face and the Service Man, amateur, and experimenter can discuss his problems directly with the manufacturer or jobber.



Tubes must be made right in order to be sold successfully on such a basis. Tung-Sol tubes were the first and are today the only line sold nationally on consignment.

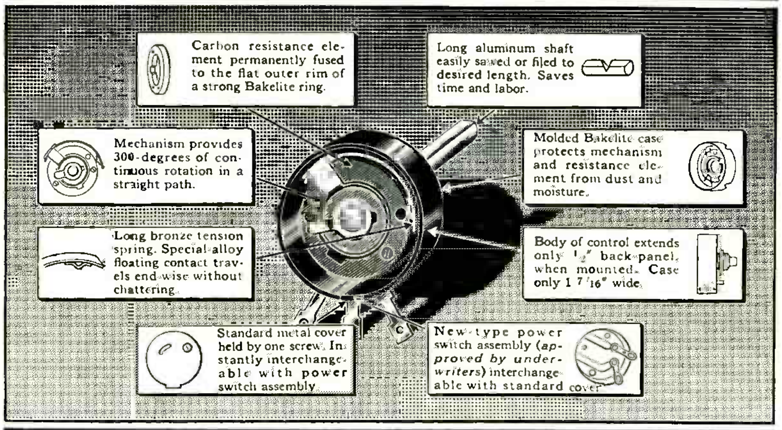
There are still desirable locations where independent service organizations who can meet requirements may be appointed as Tung-Sol agents. Ask your nearest Tung-Sol tube wholesaler who will supply details.

TUNG-SOL

Tone-flow radio Tubes

TUNG-SOL LAMP WORKS, INC.
Radio Tube Division
SALES OFFICES: Atlanta, Boston, Charlotte, Chicago, Cleveland, Dallas, Detroit, Kansas City, Los Angeles, New York.
General Office: Newark, N. J.

New ELECTRAD CARBON VOLUME CONTROL



SMOOTH • • QUIET • • LONG-LIVED

You can insure SATISFACTION on any Replacement Job With an Electrad Control

THERE is never any need to resort to makeshifts on a volume control replacement if you use an Electrad Control.

Electrad offers in its complete line a control that is electrically and mechanically right for *any* receiver model—and the Electrad Guide tells you *exactly* which control to use.

An Electrad replacement starts out right and it stays right—because the longer it is used, the smoother and quieter an Electrad Control gets. The direct friction contact principle used by Electrad insures that.

Try an Electrad Control on your next replacement job. Every Electrad Control is noise tested at the factory and guaranteed for trouble-free performance.

Send Today for the New 1937 Edition Electrad Volume Control Guide

The new 1937 edition of the Electrad Volume Control Guide now ready for distribution is the most complete ever issued. Thousands of hours of work and thousands of dollars of cost have gone into its production. It contains more than 100 pages of valuable information, including the latest and most comprehensive list of set models and manufacturers available, with specifications, resistances in ohms and list prices of correct replacement controls. It gives you at your finger tips every fact you need to make a quick, accurate and profitable volume control replacement. Every up to date service man absolutely needs this book, because much of the information it contains is not available in such handy form anywhere else.

FREE — if you will send us *one complete* Electrad Volume Control carton, with your business card or letterhead. Act now — the supply is limited — requests will be filled in order of receipt. Electrad, Inc., 173 Varick Street, New York, Dept. S-8.

ELECTRAD

RESISTOR SPECIALISTS IN RADIO AND ELECTRICAL INDUSTRY SINCE 1923

SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR AUGUST, 1936

VOLTAGE DIVIDERS

By JOHN F. RIDER

TO start with, the operation of voltage dividers is founded upon basic principles outlined in connection with the ordinary division of voltage by means of resistances. . . . In each and every case, the division of voltage is the consequence of the presence of current flow through a resistance. . . . The marked difference between the types of voltage dividers used for the division of operating potentials, such as plate and screen voltages, and the division of potentials in an ordinary series circuit is that in the former case the current is not the same throughout the circuit of the voltage divider.

Take as an example the three resistance series network R_1, R_2 and R_3 shown in Fig. 1. These three resistors, connected across a filter system of a rectifier, constitute a simple series circuit and as such, the current due to the voltage impressed from the filter of the rectifier system, is the same throughout the system and this conforms with the basic facts. . . . The drop across the respective resistance is a function of the total current and the respective values of resistance. . . .

However, if this network without any changes is used to divide the voltage E, available from the filter system, to a number of different circuits—each of which requires current, the current is no longer the same through the three resistors and the drop across the individual resistors depends upon the current and the resistance. For example, suppose, that we connect three vacuum tubes to this network and arrange that the voltage available at the terminals A, B and C constitute the plate voltage of these three tubes. . . . Just what we mean is illustrated in Fig. 2. Point A along the divider supplies the plate voltage for tube 1; point B along the divider supplies the plate voltage for tube 2, and point C supplies the plate voltage for tube 3. The electrical equivalent of this circuit is shown in Fig. 3, wherein the d-c plate-cathode resistance of each tube is identified as R_P.

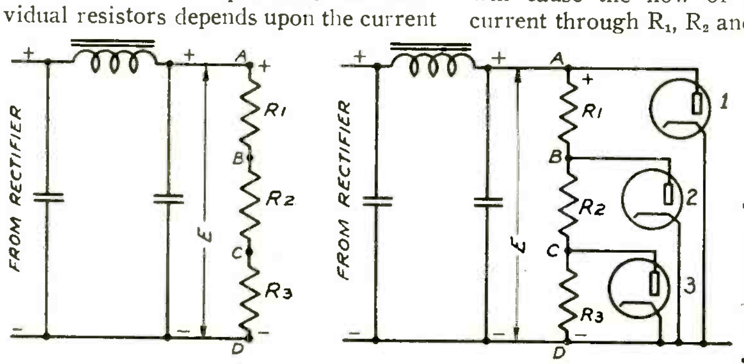
Suppose for the sake of illustration that the rated plate voltage of tube 1 is 200 volts and the plate current is 20 milliamperes. . . . The rated plate voltage of tube 2 is 150 volts and the plate current is 15 milliamperes and the rated plate voltage of tube 3 is 100 volts with a plate current of 10 milliamperes. (These plate voltage and plate current values are not typical of any particular type of tube and are given simply for the purpose of illustration.) The various voltages and the various currents are identified in Fig. 3.

Let us now analyze the path of these currents. . . . What currents flow in this system? . . . In the first place, the series network of R_1, R_2 and R_3 constitutes a complete path across the filter network, consequently, the voltage E will cause the flow of some value of current through R_1, R_2 and R_3—irrespective of what happens in connection with tubes 1, 2 and 3. . . . In other words, the three tubes can be removed from their sockets and some value of current, small or great—depending upon the total resistance of the three resistances R_1, R_2 and R_3—will flow through the divider. . . . This current is the bleeder current, usually predetermined in value when the voltage divider is designed, but whatever value it may be, the fact remains that some value of bleeder current flows through R_1, R_2 and R_3. . . . So much for that and it should be remembered for future reference.

Now for the currents flowing in the various plate circuits. . . . The plate current of tube 1 flows out at tap A and finds it way back into the power supply system via the d-c plate-cathode resistance of tube 1 and the junction between the cathode and point D on the divider. We have 20 milliamperes of current flowing out of the power supply and not passing through the divider.

Now, the plate of tube 2 is operated at a lower voltage than the plate of tube 1, so that a drop in voltage is required. . . . This is the function of R_1. . . According to the figures shown in Fig. 3, a 50-volt drop takes place across R_1. . . . However, this drop does not take place as the consequence of the relative values of R_1, R_2 and R_3. . . Instead it is a function of the amount of current required by tube 2 plus other currents. . . . In the first place, the current through R_1 is not only the plate current of tube 2, which is 15 milliamperes; in addition to this amount of current, there is flowing through R_1 the 10 milliamperes required by the plate circuit of tube 3. . . . In addition to the 10 milliamperes required by the plate circuit of tube 3, the bleeder current also flows through R_1. . .

If we arbitrarily set the bleeder current at 12 milliamperes, the total current flowing through R_1 is the 15 milliamperes of tube 2, the 10 milliamperes re-



Figs. 1, 2. Resistors R_1, R_2, R_3 form a voltage divider with taps at A, B and C.

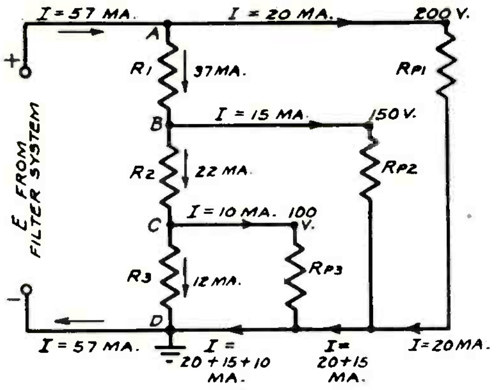


Fig. 3. The plate resistances of the tubes are indicated as pure resistance.

quired for tube 3, and the 12 milliamperes bleeder current making a total of $15 + 10 + 12 = 37$ milliamperes, *and the voltage drop across R_1 is* I $\times$ R, where I is the aforementioned 37 milliamperes, and R is the ohmic value of R_1.

Now for tube 3. The plate circuit of this tube requires 100 volts at 10 milliamperes, which means that this plate is operated at a lower voltage than the plate of tube 2. . . Another voltage drop is required and this is the function performed by R_2. . . . A drop of 50 volts takes place across R_2. . . At what value of current? . . . How much current is flowing through R_2? . . . We know that the 10 milliamperes required for the plate circuit of tube 3 flows through R_2, because of the location of point C and the direction of current flow. . . . Since the bleeder current of 12 milliamperes flows through all of the resistors, it stands to reason that it flows through R_2. . . . What about the 15 milliamperes required for the plate circuit of tube 2? This current flows through R_1, but it does not flow through R_2, because it passes out through the feeder lead joining point B and the plate of tube 2. . . . Hence, resistor R_3, carries 22 milliamperes of current,—and the drop of 50 volts, which is necessary so that the plate of tube 3 will receive the required 100 volts, is secured at a current of 22 milliamperes and *not* at the 10-milliampere current required by tube 3.

What about R_3?. . . The 12 milliamperes of bleeder current flow through R_3 and the voltage drop across this unit is that required to drop the 100 volts difference existing between points C and D.

How about the current? . . . If we review the currents flowing in the various branches, we have 20 milliamperes to the plate circuit of tube 3 and 12 milliamperes bleeder current making a total of $20 + 15 + 10 + 12 = 57$ milliamperes,—which is the total current flowing out of the filter towards point A, or out of point A in all directions and is the amount of current flowing into point D and then back to the filter system.

Having determined the several currents and voltage drops, it is a simple application of Ohm's law to find the values of R_1, R_2 and R_3:

$$R_1 = \frac{50 \text{ volts}}{.037 \text{ ampere}} = 1350 \text{ ohms}$$

$$R_2 = \frac{50 \text{ volts}}{.022 \text{ ampere}} = 2270 \text{ ohms}$$

$$R_3 = \frac{100 \text{ volts}}{.12 \text{ ampere}} = 8333 \text{ ohms}$$

It might be well to close this article with a brief example of the relations existing in a modern power supply and voltage divider system, in which the output tube bias voltage is developed across the speaker field winding located in the *negative* leg of the power supply filter system.

In general, circuits of this type follow along the lines indicated in Fig. 5. This voltage divider system makes available four different voltages: the highest voltage with respect to ground being at point A, the next highest at point B, the next highest at point C, and the lowest voltage at point D. In addition to the above voltages, which are all (+) with respect to ground, there is a voltage drop across the speaker field coil. The direction of the current through the speaker field is such as to make point F (—) with respect to the ground, point E. An additional voltage divider across the speaker field serves to provide the correct value of bias for the power tube and for other purpose, if so desired. It should be noted that no current is drawn from the tap C— on the bias voltage divider and that the resistance of the voltage divider is high in comparison with that of the field resistance, so that the current through the bias voltage divider is negligible in comparison with the current through the field.

We want to comment first on the meaning of the resistances designated as R_2, R_3, R_4 and R_5, each of which is enclosed with a circle. These represent the load across the several taps of the voltage divider due to the tubes which are connected across the point in question. While only one symbol is used to designate the load across each point on the voltage divider, it should be understood that this represents any number of tubes and that the current in question represents the combined plate current of all the tubes, which are fed

(*Continued on page* 368)

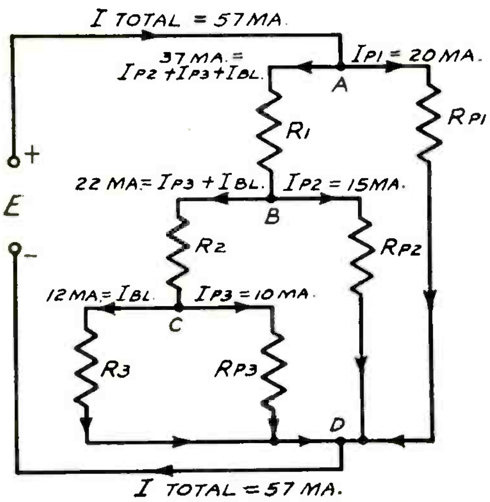


Fig. 4. Resistors are rearranged to illustrate the division of current.

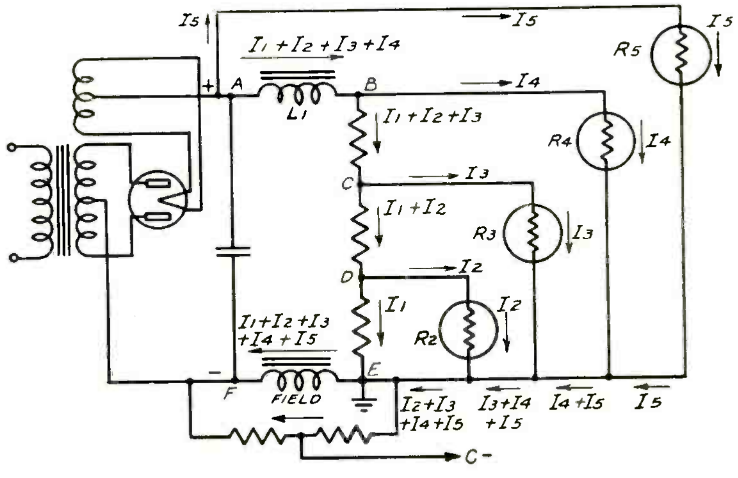


Fig. 5. A complete voltage divider circuit.

USING SIGNAL GENERATOR HARMONICS

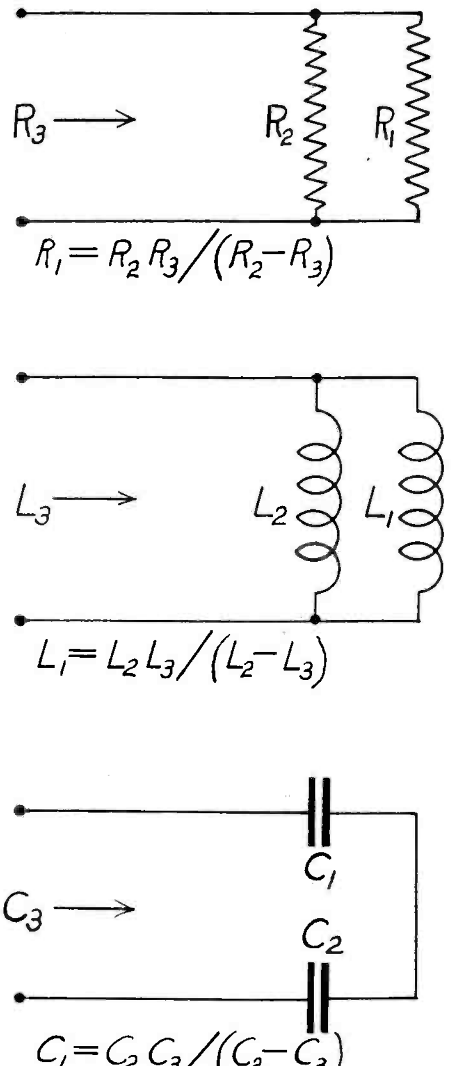
By C. E. WOODS

THE author has read practically all of the standard books on radio technique, but has yet to find anywhere a statement explaining how a *wholly* unknown frequency ever can be authentically determined from a fundamental. It is necessary to use at least one harmonic, with one other frequency which may be either fundamental or harmonic.

Let us take as examples the two outstanding ones in radio-frequency measurements: the tuner level and the intermediate level. Consider first the tuner level. We set the receiver dial at some random position on a particular band; we set the generator going and tune it from highest frequency to lower frequencies until a response is gained in the receiver, and then we say that the receiver is in resonance with the fundamental of the generator. We did not start at the lowest generator frequency, because then we might be confronted with harmonics.

Now let us assign a particular value to the generator frequency, say, 20 mc. That would be 15 meters. Nothing in detail has been said about the receiver. It is resonant to a frequency *wholly* unknown. One might be persuaded that there was no likelihood of the receiver tuning to higher than 20 mc so that the receiver frequency could not be 40 mc, etc. However, there are receivers of the 1936-7 production in stores all over the world that tune to 70 mc at one extreme, and 140 kc at the other. So in a real sense the unknown frequency is decidedly unknown, and we have assumed it is *wholly* unknown, not partly known, or approximately known. Unless a nameplate had sufficient information on it, or someone told you about the unusual frequency range, you could readily assign frequencies that were 500 percent wrong, except that in tuning the generator over the full frequency span of even its highest frequency range, you would create perhaps numerous responses in the receiver, which would lead you to believe the receiver frequency was much higher than expected. How much higher? You can not tell, for your generator does not go down to 1 meter. And besides, the numerous responses at once guide you to the correct course because of harmonics. This is just a side-view of the imperative necessity of relying on harmonics under circumstances where you take nothing for granted, except perhaps the reliability of the generator, and not even that, because the generator's accuracy can be checked.

An assumption that the first response heard when the generator is tuned from its highest frequency downward is due to the fundamental of the generator assumes that the receiver does not tune to any higher frequency than does the generator. That assumption may be false.



The same formula applying to the solution of the above may be used for determining frequencies by harmonics. The unknown is equal to the product divided by the difference. Illustrated (top to bottom) are the examples of resistance in parallel, inductance in parallel and capacity in series. R_1, L_1 and C_1 are unknown, and occupy the same position mathematically as the frequency to be measured. The unknown can never be less than any of the knowns.

There are purposes for which the fundamentals are extremely useful. The simplest case perhaps is that of a receiver that covers only a single band, say, the standard broadcast band, and a generator that likewise covers only the same band. Again the receiver frequencies are partly known—somewhere between 530 kc and 1,600 kc—and besides the receiver probably is frequency calibrated, and the problem is to obtain a frequency reading of greater accuracy, which the generator usually permits. The generator fundamental then can be relied on simply because the receiver can be relied on, and the receiver or station heard on it and compared with the generator frequency by beating, then becomes as much a part of the measuring system as the generator, whereas in this article we are principally concerned with frequencies that are *wholly* unknown, because all-wave receivers are so frequently a Service Man's concern, and they are now dipping into reception of ultra-waves.

Also, it has been known to the Service Man that sometimes there is a transposition in the band switching, so that two bands are not properly related to the indexing of the frequency calibrated dial, and by use of only fundamentals it would be practically impossible to spot this unusual trouble. By the harmonic method even the transposition causes no vexation.

At the i-f level of a superheterodyne the problem is simpler because the span of frequencies over which the i-f channel may be tuned is relatively small and the frequency is partly known to a closer approximation. However, all sorts of sets come in for servicing. Fixed frequency amplifiers have coils in about the same kind of shield cans regardless of the frequency. Sets not accounted for in service manuals, possibly because they were fly-by-night manufacturers' products or perhaps home assembled, may have fixed frequency channels of wide variety on which little if any information is generally available. Generator set at 450 kc may lead to the assumption that the fixed frequency of amplification is 450 kc, but the receiver may have a higher fixed frequency than the highest tuner frequency, a condition that actually existed in one or two receivers. The i-f may be 1,800 kc, or even much greater if the set is to tune in short waves, yet the generator's 450 kc created a response, ascribed to the fundamental, yet due perhaps to the fourth harmonic (4×450 kc $= 1{,}800$ kc).

If the generator goes to 20 or 25 mc, one may start at its highest frequency and go downward and not often go wrong in measuring any channel by ascribing the frequency of the first generation to create response as the unknown frequency, but there is no certainty and there should be an uncontrovertible assurance.

It must not be assumed that any of these remarks constitute an argument against the use of generators that cover multi-ranges on fundamentals, for such generators are the most acceptable and the most useful. The only reason they are so valuable is that they yield a strong response even on high frequencies, for the response is or should be due to fundamentals, whereas high orders of harmonics are very weak. The second harmonic may be 60 percent of the fundamental's intensity, while harmonics beyond the fifth may be less than 1 per cent of the fundamental's strength. And, when channels are found grossly misaligned, a husky output from a generator enables a response despite the mistuned channel. And, besides, the generator intended to be used on fundamentals also enables the use of harmonics, and the point is that the harmonics should be used for verification. Using fundamentals, the measurement may be right; usually is. With harmonic practice the measurement must be right.

The so-called confusion due to harmonics may arise in the type of generator that covers a single range fundamentally, say, 50 to 160 kc, and also has a calibration introducing the figures, 500 to 1,600 kc, intending that the tenth harmonic be used for the broadcast band. Of course the problem immediately arises, since for the higher frequencies of the broadcast band, as the generator dial is turned there is response after response, one can not then correlate the receiver frequency with any single reading of the generator, and doesn't know which generator setting to use. All one can say is that the broadcast band can be aligned at any dial position, but without knowledge of the frequency or resonance, although the biggest problem is to tie down a band in superheterodynes at two particular frequencies near (not at) the frequency terminals of the tuning of the band.

However, even this confusion arises really from a lack of appreciation of the relationship between two fundamentals, their harmonics and the unknown frequency. Whenever two fundamental frequencies are known, both of which cause a response in the receiver, the receiver frequency is ascertainable with mathematical certainty. The two fundamentals may cause the response through harmonics of themselves or the responses may be due to the fundamental itself in one instance and an harmonic of the other fundamental.

The relationship is mathematically the same as that of a series condenser circuit or a parallel resistor or parallel inductance circuit. Taking the capacity case, if C_2 is the larger of two series condensers and C_1 is the effective capacity resulting when condenser C_x is connected in series, then C_2 may be treated as if it were one fundamental frequency and C_1 as if it were the other and the unknown frequency would be represented by C_x. This situation obtains when the two fundamentals create consecutive responses; that is, first one fundamental through itself or one of its harmonics, causes the beat or modulation to be heard in the receiver and the other fundamental or its harmonic is the next one encountered in the generator tuning, working in either frequency direction.

In the inductance example, if L_2 is the larger inductance and L_1 is the resultant inductance when L_x is connected in parallel with L_2, then L_x is mathematically the same as the unknown frequency where L_2 and L_1 correspond to consecutive fundamentals that either by harmonics of both, or fundamental of one and harmonic of the other, create receiver response.

If there is nothing confusing about series capacities and parallel inductances or parallel resistances, then there should be nothing confusing about harmonics because the same formula applies.

Basically, the situation is this: a response is gained in the receiver due to the generator being set at a known frequency, and as a trial we turn the *generator* dial from one end to the other, just to note whether there are additional responses. If the generator tunes through a ratio of 2 to 1 or greater, and nearly all of them do, more often than not there will be two or more responses, and we know we shall be dealing with harmonics or at least with one harmonic and one fundamental, since we are to select *consecutive* responses. To return to the original generator setting, the frequency of which is known, we turn the dial carefully and with ears or eyes alert for the next response, read the frequency on the generator dial when that second result accrues. Now we have the two known generator fundamentals in mind. We multiply them together. Then we strike the difference between the two fundamentals and we divide this difference into the product we have just obtained. Using symbols the formula is:

$$F_x = \frac{F_2 \times F_1}{F_2 - F_1}$$

where F_x is the unknown frequency, F_2 is the higher of the two known fundamentals and F_1 is the lower of the two known fundamentals.

It is simply a case of "product divided by difference."

The higher the unknown frequency, compared to the fundamentals used for measurement, the closer together are the fundamental frequencies and under extreme circumstances the two fundamentals could be very close together in frequency. However, consecutive responses need not be used. Frequencies at either terminal of the generator band could be used if they created responses and still the method works, but the total number of responses must be counted, including first and last ones, and when the formula is applied the tentative answer is divided by a number one less than the total number of responses heard. Thus, for eleven responses, divide by ten, etc.

This information is useful if one has a generator that covers a low-frequency band only, and harmonics must be used for determining frequencies outside the fundamental scope. However, if one has an all-wave generator he may apply the harmonic technique to the generator band that gives adequate separation between two consecutive fundamentals that create responses. It simply becomes a matter of improving the utility of the generator and enabling absolute assurance of what the unknown frequency is. If the harmonic method does not corroborate the first results as obtained from a supposed fundamental, something is wrong somewhere; it might even be a case of a transposition of the bands in connection with the coil-switch indexing, or a short across part of an oscillator secondary winding, or any one of a few dozen other possibilities.

If a generator set somewhere near the lowest frequency of its band in use gives a response in the receiver, perhaps there will be no response when the generator dial is turned to higher frequencies in that band, and if you have tuned past twice the first read frequency, the receiver frequency is equal to the generator's first frequency setting. The reason is that a frequency three times or four times the first fundamental will not yield a response, because *all* these multiples of the first are higher than the receiver frequency, and the measurement of an unknown by comparison with a *higher* frequency is not within *service* practice.

In using harmonic practice, the question of accuracy is frequently brought up in the sense that many Service Men believe that fundamentals permit higher accuracy than harmonics. This is untrue if the frequency ratio is the same on all bands because the only basis on which accuracy is rated is percentage, and the percentage of accuracy is completely independent of whether fundamentals or harmonics are used. The idea seems to prevail that if an oscillator is "off 1 kc" at 100 kc because it reads 100 when the true generated frequency is 99 kc, it is intolerable to use the tenth harmonic, because then the determination will be "off 10 kc." But, the percentage is the same—1 per cent, and the error is a function of the generator having nothing to do with use of harmonics or fundamentals especially as fundamentals for frequencies ten times higher introduce difficulties at least ten times as great as to holding the accuracy to the percentage applicable to the lower frequency span. It is at least as hard to coincide scale with generated frequency to 10 kc at 1,000 kc as it is to have the reading agree with the generation to 1 kc at 100 kc.

While the basic formula has been discussed, it does not possess quite as much of a checkup on itself, or offer as great possibilities of mental arithmetic, as does another expression of the same formula. Taking, again, the two frequencies as F_2 for the higher and F_1 for the lower, and adhering to consecutive responses, if we strike the difference between the two frequencies ($F_2 - F_1$), and divide this difference first into one of the known fundamentals, and then into the other known fundamental, and if we multiply out by the three factors, that is, the one difference and the two quotients, the answer is the unknown frequency. In symbols this is:

$$F_x = \frac{F_2}{F_2 - F_1} \times \frac{F_1}{F_2 - F_1} \times F_2 - F_1$$

Using consecutive responses, the quotients equal the harmonic orders, applied in reverse, as it were, and of course the numbers representing these harmonic orders are consecutive. Thus the figures would be 5 and 6, or 8 and 9, etc., and you need divide only in one instance for the next fundamental's harmonic may be assigned since it is consecutive. The only fact you need to know concerns the direction or, if the first quotient is 8, shall the next be 7 or 9? The answer is taken from the fundamentals. If the fundamental for which the division has not been made is higher in frequency, then the consecutive number, or harmonic order, is lower, so select 7 in the theoretical instance. If the unprocessed fundamental is lower, the harmonic order is higher, so select 9. Also, it is apparent, the difference between the two read frequencies, divided into one fundamental, yields the harmonic order of the *other*.

This method of applying the basic formula is very attractive, because it lays the harmonic orders open to inspection and comparison, and thus the two harmonic orders are multiplied by the difference between the two fundamentals.

That is the recommended way of working the solution, but it can be done also without dividing the second time. Select one fundamental frequency. To ascertain the harmonic order, gain the next consecutive response, strike the difference between the two fundamentals, divide that difference into either, and the resultant is the harmonic order of the *other* read frequency. By adhering to one practice, say, the second fundamental will be the lower frequency, the harmonic order of the first read frequency is one number greater, thus eliminating some possible experimental uncertainty.

In conclusion, an example of the application of the preferred method, of multiplying out the harmonic orders by the difference, will be given:

Generator readings are 100 kc and 120 kc. What is the unknown frequency? Difference is 20. Divide 20 into 100, result is 5. Divide 20 into 120, result is 6. Now multiply 5 by 6 by 20. Answer, 600 kc. Check: 20 divided into 100 yielded the harmonic order of 120, hence unknown is 120 × 5.

MULTIPLE SPEAKER SYSTEM

(See Front Cover)

THE circuit given on the front cover shows a dual audio arrangement wherein a two-channel audio amplifier is used—one channel coupled to two small speakers reproduces the high notes of the musical range, and the other channel coupled to a larger speaker reproduces the low and middle register of the musical range.

The particular circuit shown with the values indicated is that of the audio system used in the Grunow 12A. Similar circuits are used by other manufacturers.

The audio signal from the plate of the first audio tube (a 6F5 in the diagram) is fed through a 10,000-cycle audio filter to the grid of the 6C5 driver by means of a 0.05-mfd coupling condenser. At the plate of the 6C5 the amplied signal is divided. The low and middle audio frequencies pass to the input transformer; the high frequencies are by-passed by the 0.00025-mfd condenser and 250,000-ohm resistor to the grid of the 6F6 high-frequency audio tube.

The signal from the secondary of the input transformer is applied to the grids of a pair of 6F6's in push-pull. The 6F6's amplify the low and middle frequencies and pass them on to a large low-frequency speaker. To assure the absence of high-frequency notes in this channel each 6F6 is by-passed with a 0.001-mfd condenser. Bias for the push-pull stage is obtained from a tap on the field of one of the smaller speakers which is connected in the negative leg of the power supply circuit.

The grid of the high-frequency audio 6F6 also receives its bias from a tap on this field through a condenser and resistor network. The signal from the plate of the high-frequency audio is fed to an output transformer which in turn feeds the two smaller speakers.

The field coil of the first of the smaller speakers is included in the positive leg of the high-voltage supply circuit where it assists the choke in filtering the ripples from the B currents and simultaneously receives the power necessary for its excitation. The entire plate, screen and bleeder current used throughout the receiver flows through this coil.

The field coil of the larger (low-frequency speaker) is also connected in the positive side of the B-supply circuit but the plate supply for the push-pull 6F6's is taken off before passing through this coil.

The second of the smaller speakers receives power for the excitation of its field coil from the negative return of the high-voltage supply circuit. This field coil is suitably tapped to give the negative voltages necessary to bias both the high- and low-frequency output tubes. The entire B current used for the receiver also passes through this field.

If it becomes necessary to replace or change any part of the speaker system, care should be taken to see that the polarity of all transformers, voice coils and tube connections remains as originally connected. Otherwise there is a possibility of the speakers working out of phase causing one of the speakers to cancel out certain frequency responses of the others. Switches are provided to short out either speaker system as an aid in determining the proper phasing of the individual speakers.

General Data . . .

Grunow 11C

The Grunow 11C chassis is an 11-tube, 115-volt, 60-cycle, 4-band receiver with avc, an expanded i-f system of fidelity control, tone control, band-spread dial and signal beacon. The frequency range is divided into four bands or divisions, one covering the band of approximately 550 to 1750 kc (green), one the band from 1700 to 5500 kc (orange), one the band of 5.4 to 18 mc (amber), and one the band from 150 to 410 kc.

Continuity and voltage readings should be taken from the under side of the chassis. The values given on the diagram (Fig. 1) are average, and allow the Service Man to make a quick check of the chassis constants. The socket layouts show each socket from the underside.

Alignment Procedure

Before aligning the 11C turn the dial knob until the condensers are fully meshed. The dial pointer (hour hand) should be on the horizontal line of the dial, pointing to 9 and 3 o'clock. The minute hand should be at 12 o'clock or in a vertical position.

A high-fidelity system is employed in this chassis and the following procedure must be adhered to strictly. When aligning the i-f transformers see that the control is in the position (No. 1) of greatest selectivity.

Before any adjustment of circuit constants is attempted, allow the chassis to heat up to normal operating temperature. This heating period should take from 20 to 30 minutes and is necessary to allow all coils and condensers to reach their normal temperatures so that when alignment is completed, there will be no inductance or capacity changes due to thermal expansion or contraction.

It is good to remember this heating condition when logging a station—that is, do not attempt to log or tune in a station previously logged on a cold chassis, as the station being tuned in would drift and the calibration on the previously logged station would be incorrect.

I-F Alignment

(A) Connect signal lead of test oscillator to grid of 6A8 (first detector tube) through 0.25-mfd condenser. Connect the ground lead to the chassis.

(B) Set dial pointer to 1400 kc and range switch on green (No. 2) position.

(C) Place test oscillator in operation at 455 kc. Turn receiver volume control to maximum and high-fidelity control to position No. 1, which is the maximum selectivity position.

(D) Attenuate test oscillator output to lowest value, consistent with obtaining a readable indication on output meter.

(E) Adjust six i-f trimmers, A1, A2, A3, A4, A5, A6, located on the i-f transformers on top of chassis (Fig. 3) until maximum output is obtained. During alignment, maintain as low a value of signal as will allow obtaining of accurate adjustment.

(F) Turn the on and off switch clockwise to the signal beacon position.

(G) Adjust signal beacon trimmer (A7) Fig. 3, which is located on side of i-f transformer (near dial) to zero beat with the 455-kc incoming signal.

R-F Alignment

175-kc alignment:

(A) Connect signal lead of test oscillator through 200-mmfd condenser to antenna binding post on chassis.

(B) Connect the test oscillator ground lead to the ground post of chassis.

(C) Place test oscillator in operation at 175 kc.

(D) Place high-fidelity control in position No. 2.

(E) Turn range switch to red (No. 1) position.

(F) Tune in signal to maximum (this point does not have to be exactly at 175-kc dial setting).

(G) Adjust the 175-kc padding condenser (A8) Fig. 4 (which is on rear of chassis) in direction of signal increase. At same time rock the tuning condenser back and forth through resonance while adjusting padding condenser until maximum output is obtained.

350-kc alignment:

(A) Place test oscillator in operation at 350 kc.

(B) Turn dial pointer to 350 kc.

(C) Turn range switch to red (No. 1) position.

(D) Place high-fidelity control in position No. 2.

(E) Adjust weather band oscillator

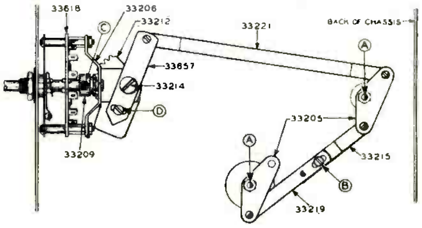


Fig. 2. Mechanical adjustments for i-f transformers.

trimmer (A9), Fig. 3, to maximum output.

(F) Adjust detector trimmer (A10) Fig. 4 to maximum output.

(G) Adjust antenna trimmer (A11), Fig. 4 to maximum output.

Recheck 175-kc padder condenser.

1400-kc alignment:

(A) Place test oscillator in operation at 1400 kc.

(B) Turn dial pointer to 1400 kc.

(C) Turn range switch to green (No. 2) position.

(D) High-fidelity control remains in No. 2 position.

(E) Adjust broadcast oscillator trimmer (A12) Fig. 4 to maximum output.

(F) Adjust first detector trimmer (A13) Fig. 4 to maximum output.

(G) Adjust antenna trimmer (A14) Fig. 4 to maximum output.

600-kc alignment:

(A) Place test oscillator in operation at 600 kc.

(B) Tune in signal to maximum (this point does not have to be exactly at 600-kc dial setting).

(C) Adjust the 600-kc padding condenser (A15), Fig. 4, which is on rear of chassis, in direction of signal increases. At same time rock the tuning condenser back and forth through resonance while adjusting padding condenser until maximum output is obtained.

Recheck 1400-kc alignment.

5000-kc alignment:

(A) Set range switch to orange (No. 3) position.

(B) Place test oscillator in operation at 5000 kc.

(C) Turn dial pointer to 5000 kc.

(D) Adjust set oscillator trimmer (A16) Fig 4 to maximum output.

(E) Adjust detector trimmer (A17) Fig. 4 to maximum output.

(F) Adjust antenna trimmer (A18) Fig. 4 to maximum output.

18-mc alignment:

(A) Connect signal lead of test oscillator through 400-ohm resistor to antenna binding post of chassis.

(B) Connect the ground lead to ground terminal of chassis.

(C) Set range switch to amber (No. 4) position and turn dial pointer to 18 mc.

(D) Place test oscillator in operation at 18 mc.

(E) Adjust set oscillator trimmer (A19) Fig. 4 to maximum output.

(F) Adjust detector trimmer (A20) Fig. 4 to maximum output.

(G) Adjust antenna trimmer (A21) Fig. 4 to maximum output.

(H) On the 18-mc oscillator alignment it will be noted that there are two settings at which the signal will be received. Use the lower of the images for alignment point, that is, the setting

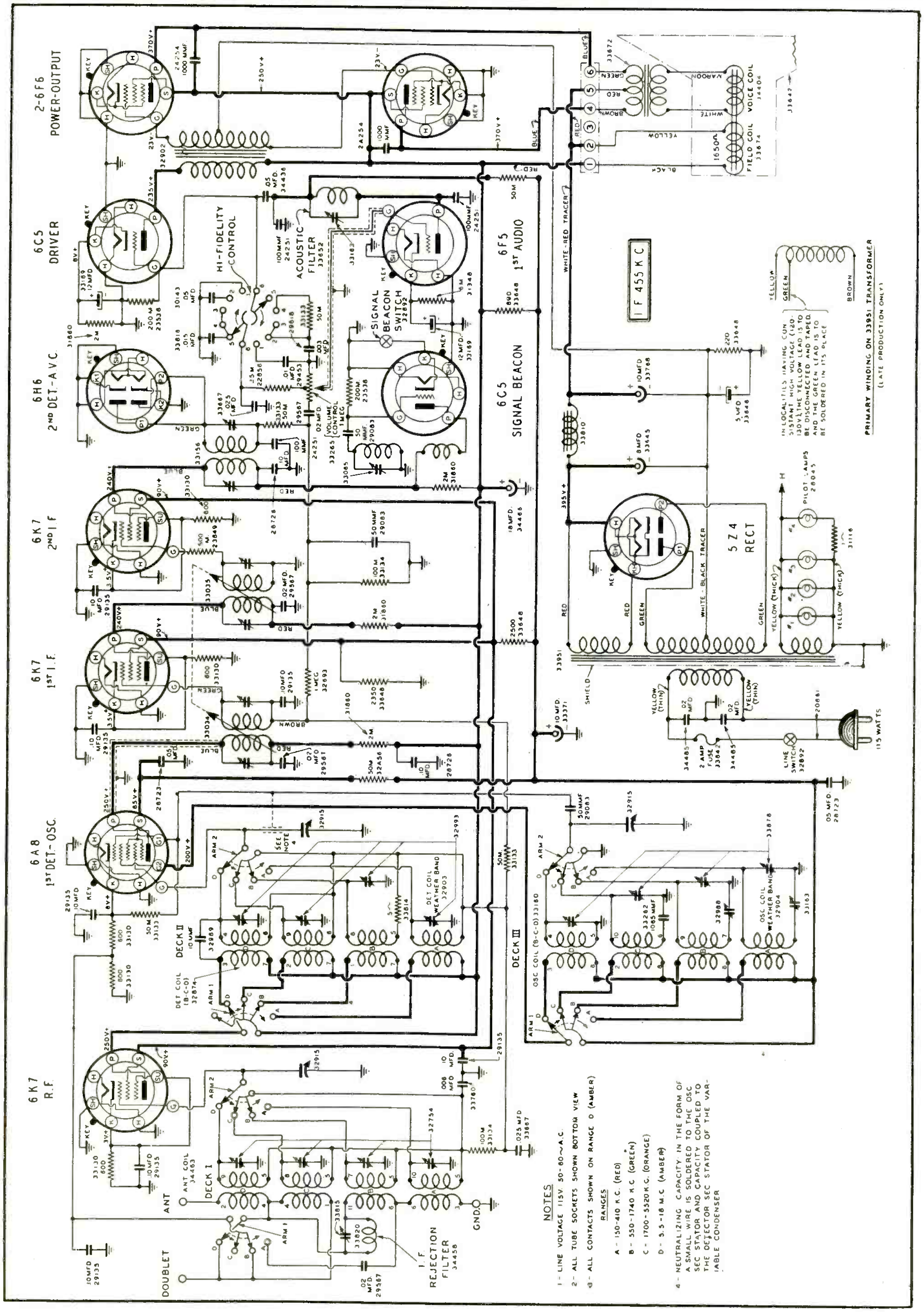


Fig. 1. Complete circuit diagram Grunow 11C.

giving most capacity or the point at which the trimmer screw is farthest in.

Alignment of i-f rejector filter circuit:

Due to interference caused by commercial code stations operating on wave lengths near the frequency at which the i-f amplifiers of this receiver are aligned, an i-f filter has been incorporated in the antenna circuit to act as a rejector system, thereby lessening the possibility of this form of interference entering the receiver.

The filter should be tuned to the same frequency as the i-f transformers, and this operation should be performed after the set has been completely aligned.

(A) Connect signal lead of test oscillator to antenna binding post through a 200-mfd condenser.

(B) Connect ground lead to ground terminal of chassis.

(C) Set dial pointer to 1400 kc and range switch on green (No. 2) position.

(D) Place test oscillator in operation at 455 kc—turn receiver volume control to maximum and high-fidelity control to No. 2 position.

(E) Attenuate test oscillator output so that a fairly strong signal is applied, and tune filter condenser (A22) Fig. 4 so that the output meter indicates a minimum reading.

Tuning acoustic filter:

The i-f system of a high-fidelity receiver is expanded or broadened so that audio frequencies of the higher musical range will be passed through the selective circuits. It is desirous to pass audio frequencies only up to a value of 10,000 cycles, so that the entire musical range may be reproduced, at the same time frequencies above this value must be cut off—so that station noises and atmospheric disturbances are not admitted to the speaker system.

An acoustic filter is incorporated in this chassis, that may be tuned so that frequencies above 10,000 cycles are excluded. This filter is tuned as follows:

(A) After all other adjustments are completed, apply a 10,000 cycle note, produced by an audio oscillator or phonograph frequency record, connecting one of the signal leads to the grids of the 6F5 (first a-f tube) and the ground lead to the chassis.

(B) Set high-fidelity control to maximum (No. 6) position.

(C) Attenuate audio signal so as to obtain a good reading on the output meter.

(D) Tune acoustic filter condenser (A23) Fig. 3 until a *minimum* output is indicated on the output meter.

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Crosley 626

The Crosley 626 is a 6-tube superheterodyne designed to operate on a-c. The 626 is available with power transformers for either 25 or 60 cycles on 110 volts or for 25 cycles on 220 volts. The rating of the power transformer used for any set is stamped on the rear of the chassis.

A circuit diagram is given in Fig. 1 showing the tubes used, their functions and the various voltages encountered at the socket prongs. These voltages were measured from the contact indicated to the receiver chassis with a 1000-ohm-per-volt voltmeter with the receiver in operating condition and no signal input. The readings obtained may vary 10 percent from those given.

The receiver is designed to use either metal or metal-glass tubes. If glass tubes are replaced with metal or if metal tubes are replaced with glass it will be necessary to completely realign the circuits of the receiver.

The three bands of the receiver and the dial are divided as follows: blue (American broadcast band), 540 to 1800 kc; red (police and amateurs), 1800 to 6000 kc; and green (high-frequency band), 5800 to 18,500 kc.

The power consumption of the 626 is approximately 78 watts. The undistorted power output is approximately 3 watts.

Alignment Procedure

All the circuits in this receiver were very accurately adjusted at the factory. If it is definitely known that readjustment is necessary the circuits may be most accurately aligned with the aid of an oscilloscope. However, if an oscilloscope is not available a good alignment may be obtained by means of a signal generator and an output meter provided the following procedure is carefully observed.

Connect the two terminals of the output meter to the two plates of the 6N6 output tube. Be sure the meter is protected from d-c by connecting a condenser 0.1 mfd or larger—not electrolytic—in series with one of the leads.

I-F Alignment

(a) Connect the output of the signal generator through a 0.02-mfd condenser to the top cap of the 6K7 i-f amplifier tube, leaving the tube's grid clip in place. Connect the ground lead from the signal generator to the receiver chassis. Keep the generator output lead as far as possible from the grid leads of the other screen-grid tubes.

(b) Turn the band selector switch to the broadcast band and rotate the station selector to approximately 60 on the dial. Turn the volume knob to the right (on) and turn the tone control knob to the left (treble).

(c) Set the signal generator to 450 kilocycles.

(d) Adjust the trimmer condensers located on top of the second i-f transformer for maximum output.

Always use the lowest signal generator output that will give a reasonable output meter reading.

(e) Transfer the output lead of the

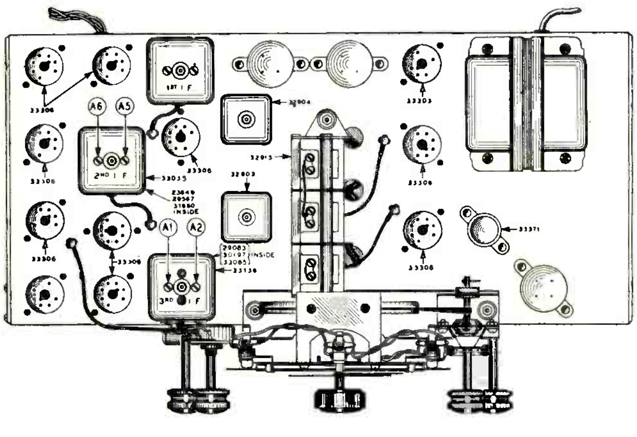

Fig. 3. Tube and i-f trimmer locations.

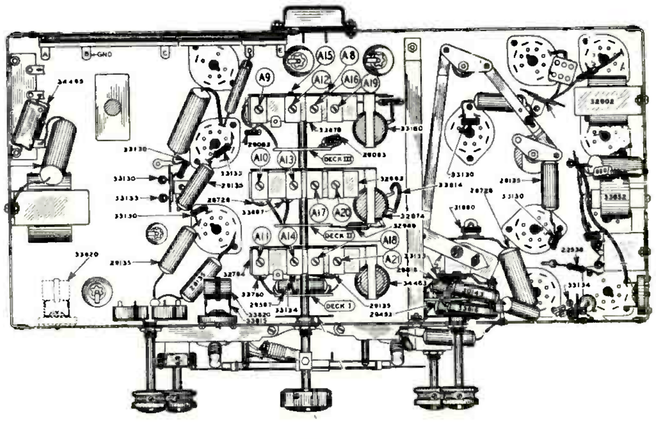

Fig. 4. Trimmer locations.

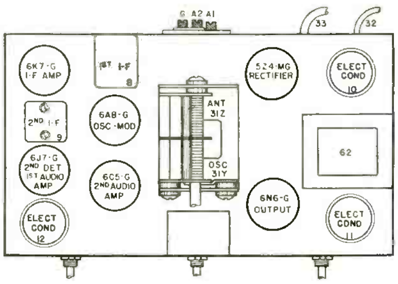

Fig. 2. Tube and i-f trimmer locations.

signal generator from the 6K7 tube to the top cap of the 6A8 oscillator-modulator tube, leaving the tube's grid clip in place.

(f) Close the middle trimmer (Tert. Fig. 4) on the first i-f transformer so that it is moderately tight. (Do not force adjusting screw.)

(g) Adjust the top trimmer on the first i-f transformer for maximum output.

(h) Adjust the bottom trimmer on the first i-f transformer for maximum output.

(i) Transfer the signal generator output lead from the 6A8 tube to the "Ant" terminal of the receiver and in-

PARTS LIST (SEE FIG. 1)

Condensers No.	Capacity	Resistors No.	Ohmage
10	35 mfd., 400 v	34Z	1st a-f control, 3 meg
11	40 mfd., 300 v	34Y	2nd a-f control, 1 meg
12	50 mfd., 150 v	36	300,000 ohm, ¼ w
13Z	12 mfd., 25 v	37A	100,000 ohm, 1 w
13Y	12 mfd., 25 v	37B	100,000 ohm, 1 w
14	.01 mfd., 400 v	38A	40,000 ohm, ¼ w
15A	.02 mfd., 160 v	38B	40,000 ohm, ¼ w
15B	.02 mfd., 160 v	39	1 megohm, ¼ w
16A	.05 mfd., 400 v	40A	250,000 ohm, ¼ w
16B	.05 mfd., 400 v	40B	250,000 ohm, ¼ w
17	.00025 mfd., (molded)	41A	750,000 ohm, ¼ w
18	.000025 mfd., (molded)	41B	750,000 ohm, ¼ w
19	.0001 mfd., (molded)	42	500,000 ohm, ¼ w
20	.01 mfd., 200 v	43	400,000 ohm, ¼ w
21	.017 mfd., 200 v	44	150,000 ohm, ¼ w
22A	.02 mfd., 400 v	45	1.5 megohm, ¼ w
22B	.02 mfd., 400 v	46	10,000 ohm, ¼ w
23	.0005 mfd., 400 v	47	750 ohm, ½ w
24	.00005 mfd., (molded)	49	15,000 ohm, ¼ w
25A	.05 mfd., 200 v	50	100,000 ohm, ¼ w
25B	.05 mfd., 200 v	51A	500 ohm, ½ w
26Z	.004 mfd., 400 v	51B	500 ohm, ½ w
26Y	.05 mfd., 400 v	52Z	10,000 ohm
30	.0053 mfd. h-f osc.	52Y	25,000 ohm
31Z, 31Y	Var. tuning gang	52X	60 ohm

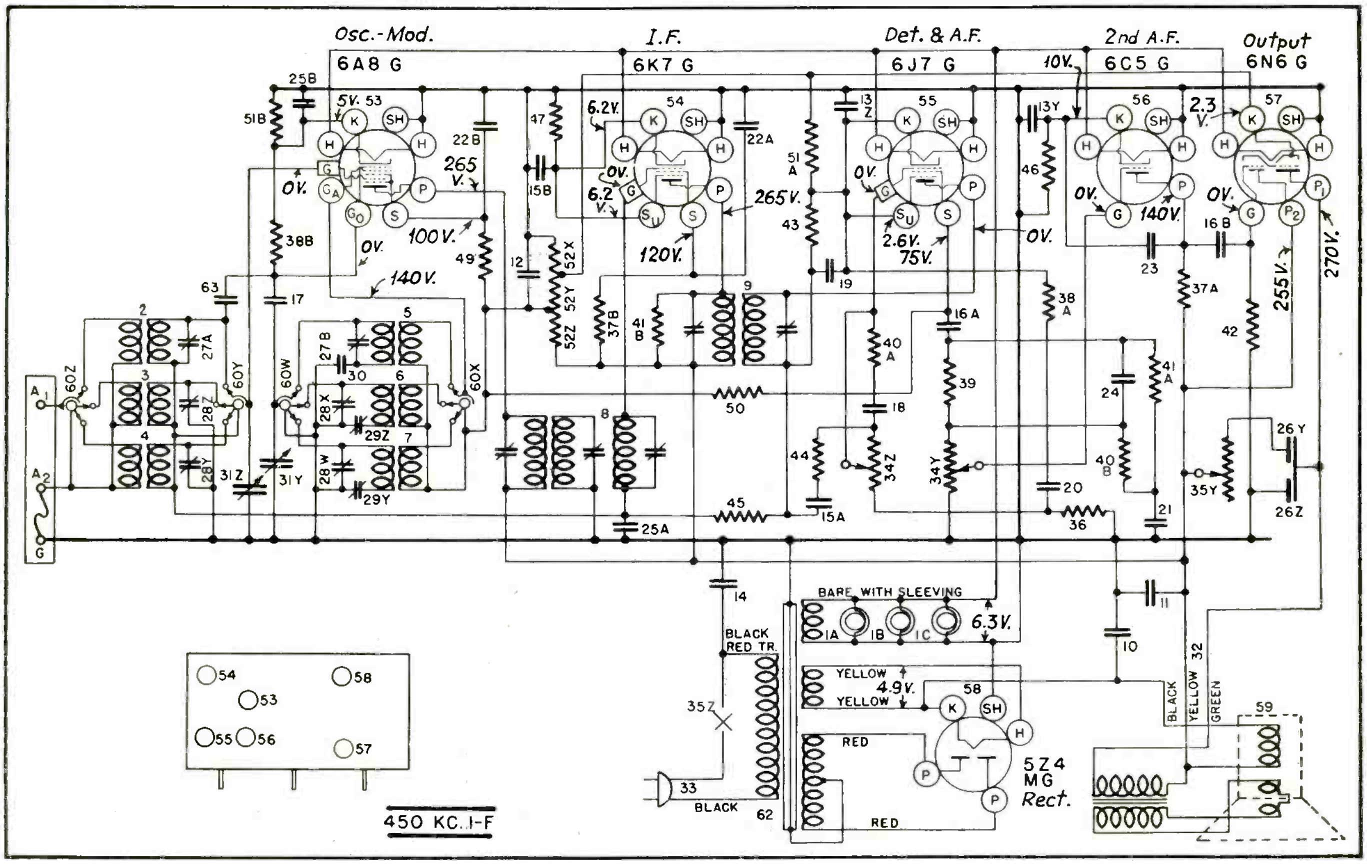

Fig. 1. Circuit diagram Crosley 626.

crease the output of the signal generator if necessary.

(j) Check the adjustment of the bottom trimmer of the first i-f transformer. Do not readjust the top trimmer.

(k) Adjust the middle trimmer of the first i-f transformer by opening condenser until maximum output is obtained. Do not readjust the top and bottom trimmers.

R-F ALIGNMENT

When aligning the r-f amplifier the output lead of the signal generator is connected to the "Ant" terminal of the receiver. For the blue and red bands a 0.00025-mfd condenser must be connected in series with the output lead of the signal generator and for the high-frequency band a 400-ohm carbon resistor should be used in place of the condenser.

Each band should first be shunt aligned and then series aligned, where provision is made for series alignment (blue and red bands). The band selector switch should be set for the band being aligned and the station selector and signal generator should be set to the frequency indicated (c) for each adjustment.

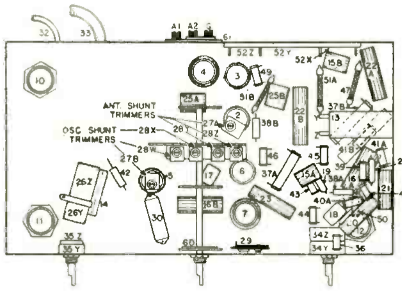

Fig. 3. Trimmer locations.

(a) Adjust the "Osc" and "Ant" shunt trimmers in the order given for maximum output. Readjust the station selector slightly so that the generator signal is tuned-in with maximum output and then check the adjustments of the "Ant" trimmers. Do not readjust the "Osc" trimmer.

Note: When shunt aligning the red and green bands care must be exercised so that the circuits will be aligned on the correct frequency rather than on the image frequency which is approximately 900 kc less than the fundamental. To check on this, increase the output of the signal generator ten times or more and try to tune-in the signal both at the generator frequency as indicated on the station selector dial and at approximately 900 kc less than the correct frequency. If the circuits have been properly aligned the signal can be tuned-in at both positions, but much stronger at the correct position.

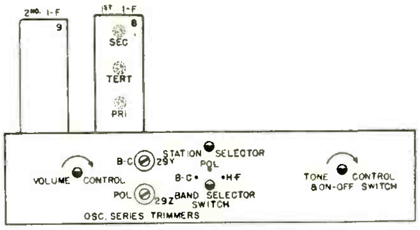

Fig. 4. Trimmer locations.

(b) To align the series trimmers (29Y-29Z, Fig. 4) set the signal generator to the frequency indicated (c) and then tune-in this signal with the station selector for maximum output. To obtain the best adjustment for each series trimmer it will be necessary to rotate the station selector back and forth slightly while adjusting the trimmer for maximum output.

(c) Signal input frequencies for alignment follow: blue-band shunt alignment, 1700 kc; series, 600 kc; red-band shunt, 6000 kc; series, 2500 kc; green-band shunt, 18,000 kc; no series alignment.

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RCA Magic Voice

An interesting device for increasing the response at lower frequencies is featured in the recently announced RCA receivers. This device, known as the "Magic Voice," is shown in Fig. 1. It consists of a speaker unit mounted in a closed cabinet. Both sides of the diaphragm are utilized. The air displacement from the back of the diaphragm is shifted approximately 180° in phase and led out the bottom of the cabinet. The volume of air in the chamber and the mass of air in the outlet passages result in the desired acoustic stiffness and mass. The air in the passages and the volume velocity of the diaphragm are so related in phase as to resemble a low-pass filter in which the current in the two series arms is approximately 180° out of phase above the cutoff frequency of the filter. The power output of this acoustic system, however, is considerably different from its electrical counterpart, the low-pass filter, since the air mass and the radiation resistance of the passages, and the radiation resistance and air mass of the diaphragm have a mutual reaction on each other.

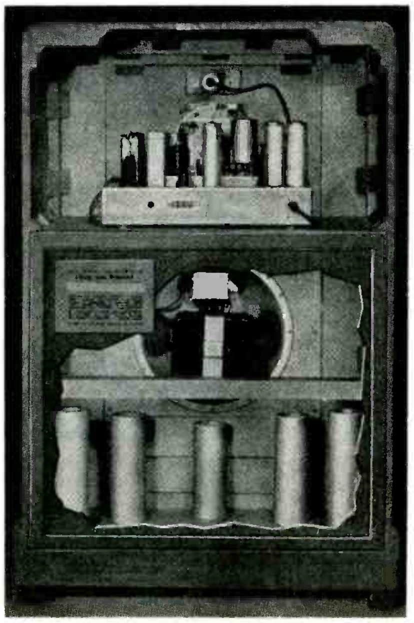
Fig. 1. RCA Magic Voice system.

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Stromberg Carlson 61

This superheterodyne receiver has 7 tubes and may be operated on a power supply circuit of either alternating or direct current. It has three tuning ranges and employs some metal tubes. A complete circuit diagram is given in Fig. 1 showing the tubes used, their functions, and the voltages encountered on the various elements.

These voltage readings are obtained by measuring between the points marked and the heavy bus wire, with the tubes in their respective sockets, with a 1,000-ohm-per-volt voltmeter. The receiver is therefore in operation when the measurements are made. The heavy bus wire is the negative side of the grid and plate voltages. Readings are given for a line voltage of 120 volts. Allowance should be made for the difference when the line voltage is higher or lower. If the receiver is operating from a d-c source the voltages will be slightly lower than those given.

Preliminary to alignment, remove the chasis from the cabinet, connect to the power supply after making sure that all tubes are in their proper sockets and the dynamic speaker is connected. Turn on both receiver and test oscillator and allow a few minutes to warm up.

I-F ADJUSTMENTS

The four trimmers of the two i-f transformers are located as shown in Fig. 2. Each must be aligned to a basic frequency of 465 kc. To do this, attach the output meter across the voice coil circuit or across the output transformer primary. Connect the output of the test oscillator between the control-grid of the 6A8 first detector tube and the heavy bus wire, through an 0.25-mfd condenser. Tune the oscillator to 465 kc. Advance the receiver volume control to its

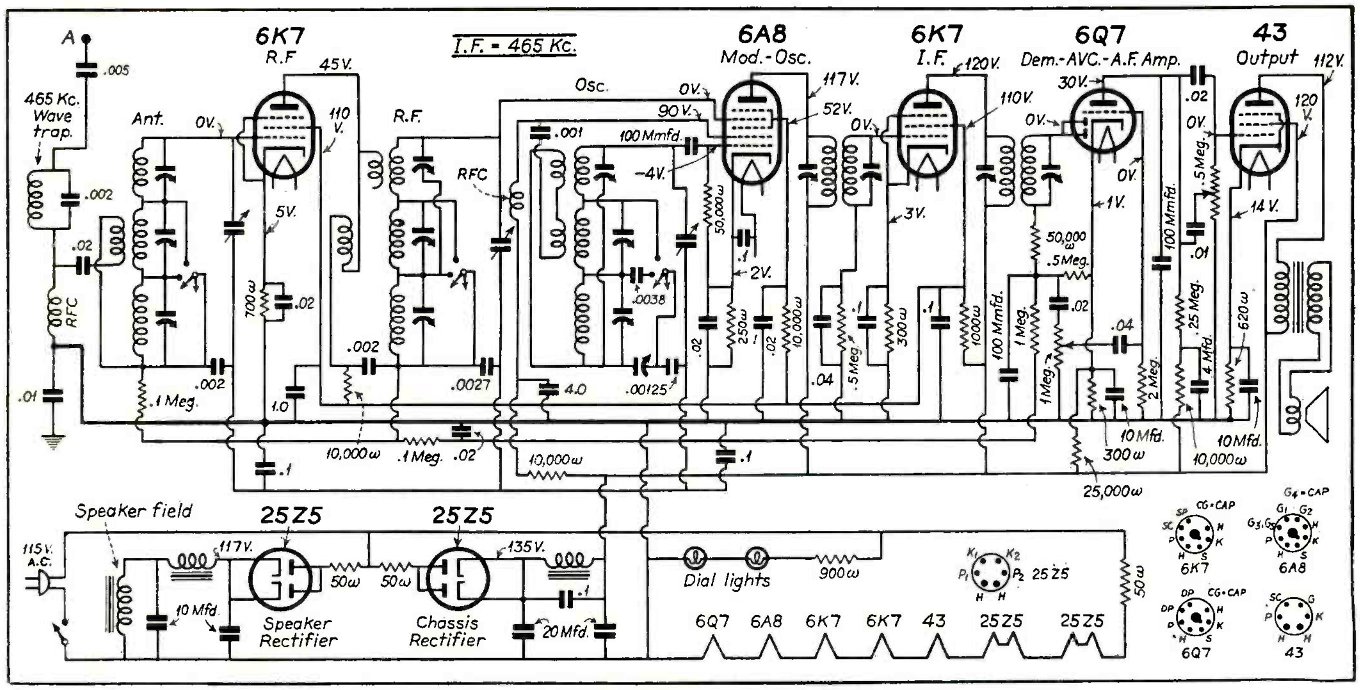


Fig. 1. Complete circuit Stromberg 61.

full-on position and adjust the receiver tuning control to a point within its range where no interference is encountered either from local broadcast stations or the heterodyne oscillator. Increase the output of the test oscillator until a slight indication is apparent on the output meter. Then adjust the two trimmers of the second i-f transformer to produce maximum output. Then, adjust the two trimmers of the first i-f transformer for maximum output. During these adjustments, regulate the test oscillator output so that the indication is aways as low as possible. By doing so, broadness of tuning due to avc action will be avoided. It is advisable to repeat the adjustment of all i-f trimmers a second time to assure that the interaction between them has not disturbed the original adjustment.

R-F Alignment

The 10 trimmers associated with the r-f, first detector, and oscillator tuned circuits have their locations shown in Fig. 2. Calibrate the dial by rotating the tuning control until the variable condensers are in their full mesh (maximum capacity) position and adjusting the dial pointer so that the end point on the low-frequency end of the scale is indicated.

The output indicator should be left connected to the output of receiver. Attach the output terminals of the test oscillator to the antenna post and to the heavy bus wire.

Band A Alignment

Turn the band switch to band A position. Set the test oscillator at 1450 kc. Tune the receiver to 1450 kc. Adjust the band A shunt aligners starting with the oscillator for maximum output. Repeat the adjustments.

Turn both the receiver and test oscillator to 600 kc. Adjust the oscillator A band series aligner, at the same time rocking the condenser gang through the frequency until the peak of greatest intensity is obtained as a result of the combined operations. Repeat the adjustments at 1450 kc to compensate for any changes caused by the adjustment of the series aligner.

Band B Alignment

Tune the test oscillator and the receiver to 3,000 kc (turn band switch to position B).

Regulate the output of the test oscillator until a slight indication is perceptible at the receiver output. Adjust the oscillator band B shunt aligner for maximum output. Then adjust the interstage trimmer and then the antenna stage trimmer for maximum output. Repeat the adjustments in the order given.

Tune the receiver and test oscillator to 17,500 kc (band C). Adjust the oscillator, r-f and antenna stage trimmers in the order given for maximum output. Two points of maximum output will be found for the oscillator trimmer. The one of *maximum trimmer capacitance* is correct and should be used. The oscillator will be 465 kc below the signal frequency at this point.

Repeat the band C adjustments.

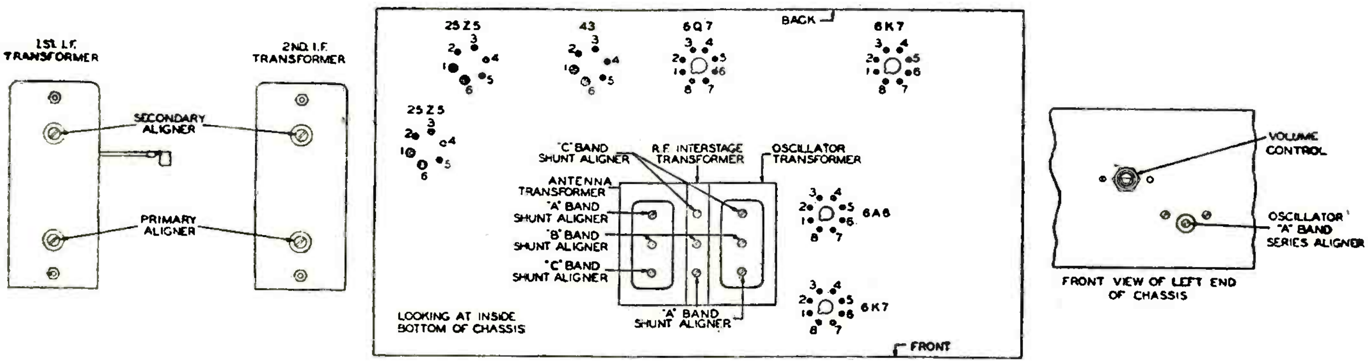


Fig. 2. Tube and trimmer locations.

Technical Features of 1937 Fairbanks-Morse Receivers

Model No.	42T0B / 42C1B	43T1B / 43C1B	73T3B / 73C3B	57T0	58T1 / 58T2 / 58C1	72T3 / 72C2 / 72C3	91T4 / 91C4 / 91C5	12C6
Cabinet	Table / Console	Table / Console	Table / Console	Table	Table / Table / Console	Table / Console / Console	Table / Console / Console	Console
Power Supply	Battery	Battery	Battery	115 V. A.C. 60~	115 V. A.C. 60~	115 V. A.C. 60~	115 V. A.C. 60~	115 V. A.C. 60~
Range	540-1750 Kc.	540-1750 Kc.	540-1750 Kc. 2.34-7.7 Mc. 7.45-23 Mc.	550-1750 Kc. 2.4-7.8 Mc.	540-1750 Kc. 2.34-7.7 Mc. 7.45-23 Mc.	540-1750 Kc. 2.34-7.7 Mc. 7.45-23 Mc.	540-1750 Kc. 1.7-5.8 Mc. 5.6-18.2 Mc. 17-65 Mc.	540-1750 Kc. 1.7-5.8 Mc. 5.6-18.2 Mc. 17-70 Mc.
I.F. Peak (Kc.)	456	456	456	456	456	456	456	456
Tone Control	2 Point	2 Point	F-M Voice Control	2 Point	2 Point	F-M Voice Control	F-M Voice Control	F-M Voice Control
Selectivity Control								Yes
Vernier Indicator			Yes		Yes	Yes	Yes	Yes
Volume & Tone Indicator							Yes	Yes
Variable Condensers	2	2	3	2	2	3	3	3
Number of tuned circuits	6	6	7	6	6	7	7	9
Semaphore Band Indicator							Yes	Yes
R.F.			—			6K7G	6K7	6K7
1st. Det.	—	—	—	6A8G	6A8 G	6A8 G	6L7	6L7
Osc.							6J7	6J7
Intermediate Frequency	—	—	—	6K7G	6K7 G	6K7G	6K7	6K7 / 6K7
2nd. Det.	—	—	—	6Q7G	6Q7 G	6Q7 G	6H6	6H6
A.V.C.								
1st. Audio	—	—	—				6F5	6C5
Output	—	—	—	6F6 G	6F6 G	6L6	6L6	P.P. 6L6
Rectifier				5Y3	5Y3	5Y3	5Z4	5W4 (2)
Tuning Indicator						6E5	6E5	6E5

Public Address . . .

TRUE FIDELITY CONSIDERATIONS

By MERWYN HEALD*

TO determine the frequency limits that are most desirable on a high-fidelity line, an inquiry into the results desired from the assembled units with which these components are to be used is desirable. There is a definite demand for recording and broadcast amplifiers with frequency limits on the order of plus-minus 1 db. from 30 to 10,000 cycles. To obtain such overall characteristics, the individual audio components must be appreciably better, since the losses of the overall characteristic will be approximately the sum of those in the individual components, plus the losses occasioned by other circuit constants. We use the term approximate because the curves of the different audio units tend to compensate to some extent, i.e., the rising characteristic of one unit will tend to balance the falling characteristic of another at a given frequency. This is especially true at the low end where parallel feed is usually employed with at least one of the components. A plus-minus ½ db. characteristic on the audio units themselves is enough to insure plus-minus 1 db. in the overall characteristic of a well designed amplifier. The story is a little different at the high-frequency end. Rising characteristics indicate resonance and in this region are usually accompanied by appreciable phase shifts. For this reason resonance on the high end should be carefully avoided. So we cannot use it as a compensating factor for the falling characteristics of other units. The only other alternative is to make the characteristic response of each of the units essentially *flat* at 10,000. If we set a limit of plus-minus ½ db. at 15,000 cycles and do not depend on resonance to get it, we will have a flat characteristic at 10,000. With these units an amplifier will be well within 1 db. at 10,000 cycles and probably within a couple of db. at 15,000. Plus-minus ½ db. from 30 to 15,000 cycles then is the goal for a high-fidelity audio line.

In setting out these characteristics of desired frequency limits, we must not lose sight of the physical size of the units. They must be small enough so that complete amplifier units will not be too unwieldy, yet large enough that proper attention can be given to electrical constants that determine response characteristics.

Now for the characteristics not desired in audio components. There are probably an innumerable list of these, we will confine ourselves to those that are usually attached—like unwanted parasites. One that is most notorious is the tendency for the units to be sensitive to extraneous magnetic fields, in other words to have hum voltages induced in the windings due to the fields of power supply apparatus. Another is electrostatic coupling between windings which allows the unit to pass on longitudinal signals picked up along lines and associated apparatus. One way of taking care of the first mentioned difficulty would be to remove the sources into the next room, but this is not usually feasible, and since nothing short of that is very satisfactory, another way must be found. Shielding the unit would help. Many have tried this, and found that a case with walls on the order of an inch or so thick helped appreciably if the unit was not used at too low a level. Much has been written and everyone knows about the justly popular hum balancing type of core construction. It really works. But there are some features that must be carefully considered or it will not do its work very efficiently. By way of review, the theory of operation is as follows: A core type construction is used; that is, a rectangular shaped core of uniform section. The flux generated by the primary travels in a continuous direction around this core. If the core is mounted on a vertical axis the flux due to primary currents will go up on one side and down on the other. The flux threading through the core from an outside source will travel the same direction in both, i.e., either up in both or down in both. It will then be in the same direction as the primary flux in one leg and in the opposite direction in the other. This means that when the secondary is split in two coils and one placed on each leg and if they are connected so that the signal voltages will add, the voltages induced by the external field will cancel. The conditions for exact cancellation are that the core and coils be symmetrical in every way, turns, physical dimensions, etc. and of great importance, the external field must be uniform. If it is not, and it often will not be if the unit is very close to the source of external field, more voltage will be induced in one side than the other, and a resultant voltage will remain after cancellation. A simple method of solving this difficulty presents itself in providing for rotation of the unit in its mounting accommodations. This allows changing the relative position of the two coils in respect to the field, and in most cases a position can be found which will result in equal voltages being generated in the two coils. There is no doubt that without rotation, the cancellation results in a very great reduction in hum over the usual shell type transformer, but there is no question either but that an audio unit used in low level work has enough amplification following it that a very small residual hum in the unit will result in an intolerable amount in the output.

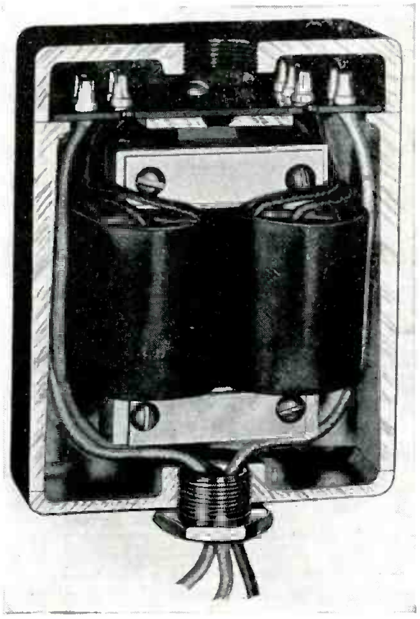


Fig. 1. Cross-section showing core construction.

This brings us to the features of the case and mounting that were determined by these same considerations. While the hum-balancing construction is used, its effectiveness is increased greatly by reducing the strength of the field in which it is operating.

With a cast case of ⅛" wall thickness, the top cast solid except for openings for leads, and with a bottom cover, all the walls are symmetrical and without seams. Thus there will be a minimum of points where the reluctance to magnetic flux is increased, only where the bottom cover attaches and this should have appreciable surface contact to keep the reluctance down. A ground fit between case and cover will further reduce the reluctance. The symmetry of the case keeps the fields inside the case uniform at the juncture.

*Chief Engineer, Thordarson Electric Mfg. Co.

Auto-Radio . . .

Motorola 80

The Motorola model 80 is a 7-tube, 2-unit, superheterodyne using all-metal tubes. The frequency range is from 535 to 1600 kc. A complete circuit diagram is shown in Fig. 1.

Alignment Procedure

Remove the receiver from its housing and connect the speaker and hot A lead into the receptacle at the rear of the chassis, as shown in Fig. 2. Connect an 1100-mmfd dummy antenna across the two antenna receptacles (A and B), Fig. 2 to replace the antenna pads located in the eliminode unit.

Use an accurate, well-shielded signal generator with a 200-mmfd condenser in series with the generator feeder at all times, and a good quality sensitive output meter.

I-F Alignment

Turn on both the receiver and the signal generator. Tune the generator to 262 kc.

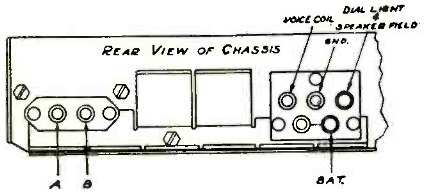


Fig. 2.

Connect the output of the generator to the grid of the first i-f tube. Turn the volume control of the receiver to maximum position and thereafter use the attenuator control of the signal generator to secure a readable voltage on the output meter connected across the voice coil.

By keeping the generator output as low as possible by means of its attenuator instead of by means of the volume control on the set, the effect of diode rectification and the application of avc voltage is very much minimized and a much better peak can be noted.

Now adjust the trimmer screws on the diode feeder for maximum reading of the output meter.

Having aligned the diode feeder, move the generator output to the grid of the first-detector-mixer tube and adjust the trimmer of the first-i-f transformer for maximum output meter reading.

R-F Alignment

The aligning of the oscillator, r-f and antenna stages in the 1936 Motorola is somewhat different from previous models; therefore, extreme care must be used or serious loss of gain will result. Because misalignment will also decrease the effective coupling and the transfer ratio of one stage to another.

The pivot around which the proper alignment of the entire r-f system revolves is the semi-fixed condenser (No. 1, Fig. 3) located at the bottom of the r-f section of the variable condenser gang (end opposite the gear). This has been adjusted at the factory to exactly 1100 mmfd.

It has purposely been placed in a position making it difficult to get at and should under no condition be touched unless you are absolutely sure that it has previously been tampered with and unless you have the proper equipment

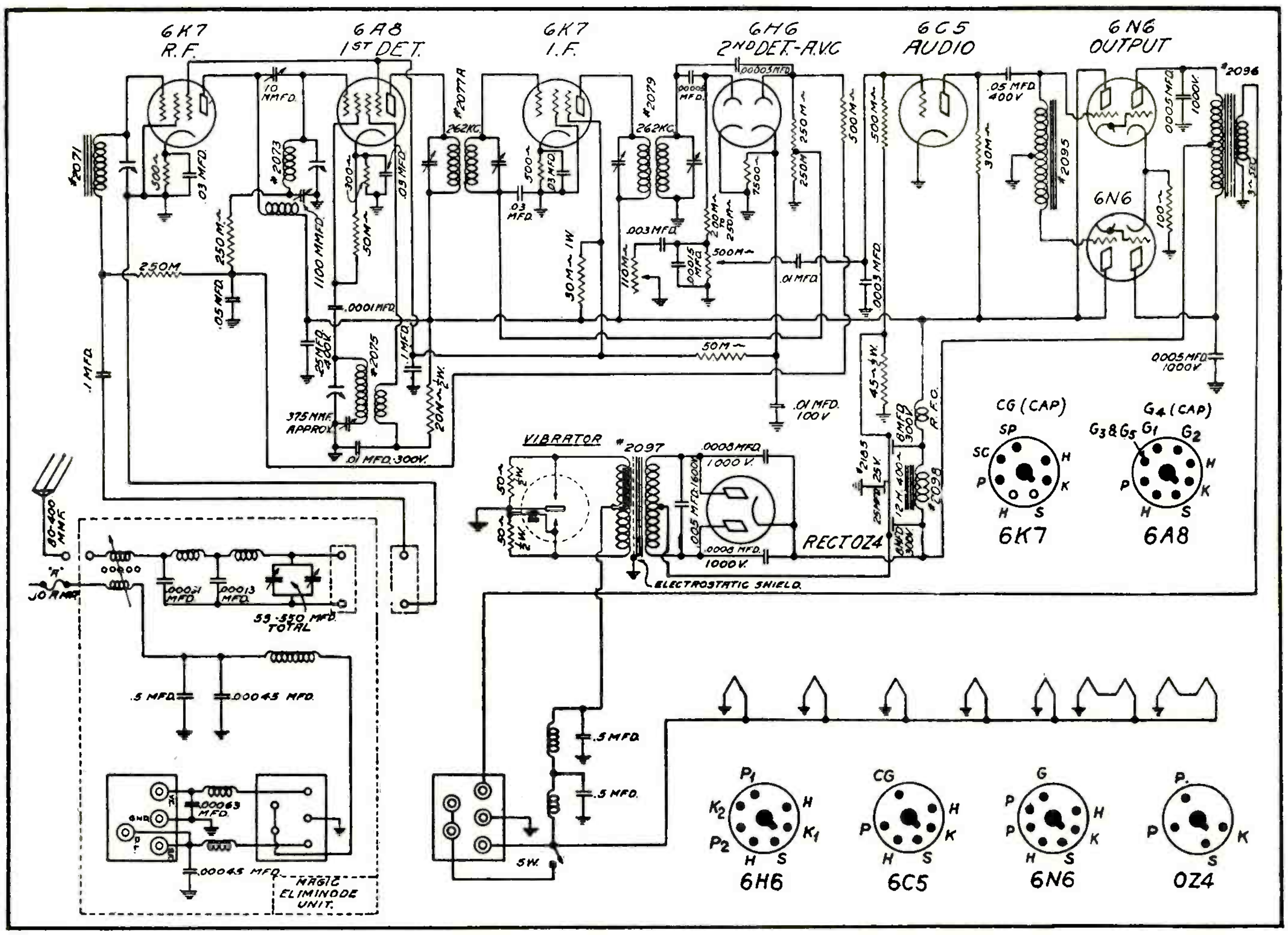


Fig. 1. Complete circuit Motorola 80.

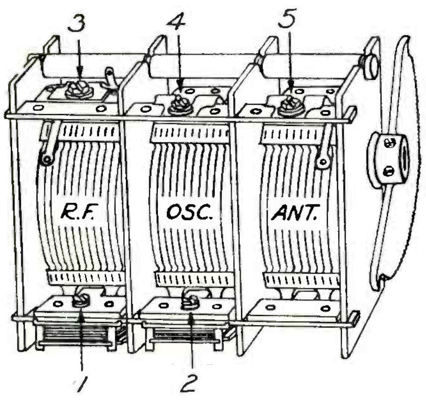


Fig. 3.

for adjusting it. To adjust it you will find it necessary to loosen the entire variable condenser mounting and rock the variable condenser forward. Then disconnect the leads to the pivot condenser and set it with an accurate capacity bridge to exactly 1100 mmfd. Reconnect the assembly and proceed with alignment.

Adjust the signal generator to 535 kc and feed its output into the grid of the r-f tube. Rotate the variable condenser to the closed positions and adjust the pad condenser (No. 2, Fig. 3) (located at the bottom of center section of tuning condenser) for maximum output.

Set the generator to 1600 kc and adjust the oscillator trimmer on the top of the center section of the variable condenser (No. 4, Fig. 3) for maximum output.

Next set the generator to 600 kc and rotate the variable condensers until the signal is heard. Now adjust the 600-kc pad located at bottom of center section of tuning condenser (No. 2, Fig. 3) for maximum output.

While adjusting rock the variable condensers back and forth to properly synchronize the r-f and oscillator tuning condensers at this frequency.

Next set the generator frequency to 1400 kc and adjust trimmer (No. 3, Fig. 3) on the end section of tuning condenser for maximum reading of output meter. At this time it is well to check several points between 1400 kc and 600 kc and if necessary bend the end plates of the oscillator section of the tuning condenser slightly to secure perfect tracking across the frequency range.

Next couple the 1400-kc generator signal through the 1100-mmfd dummy antenna plugged into the antenna receptacle (A, B, Fig. 2) and adjust the antenna trimmer condenser (No. 5, Fig. 3) for maximum reading of output meter.

This completes the alignment and no changes are necessary after placing chassis in housing.

Philco 818K

The 818K is a two-piece auto-radio receiver using glass tubes in a conventional superheterodyne circuit. The frequency range is from 540 to 1600 kc. In the 818 models two speakers may be employed. A complete circuit diagram is given in Fig. 1 showing the tubes and their functions.

Alignment Procedure

The output meter is connected to the plate of the output 41 and to the receiver chassis. With the receiver and signal generator set up for operation at the prescribed frequency, turn the receiver volume control on full and set the signal generator attenuator so that a half scale reading is obtained on the output meter. The signal in the speaker should be audible but not loud.

The shielding on the signal generator output lead should be connected to the receiver chassis.

I-F Alignment

Set the signal generator at exactly 260 kc. Connect the generator lead to the grid cap of the 78 i-f tube in series with a 0.1-mfd condenser (without removing the grid cap).

Adjust the secondary screw padder 39 on the second i-f transformer for maximum reading on the output meter. Then adjust the primary screw padder 37 for maximum reading. (See Fig. 2 for location of padders.)

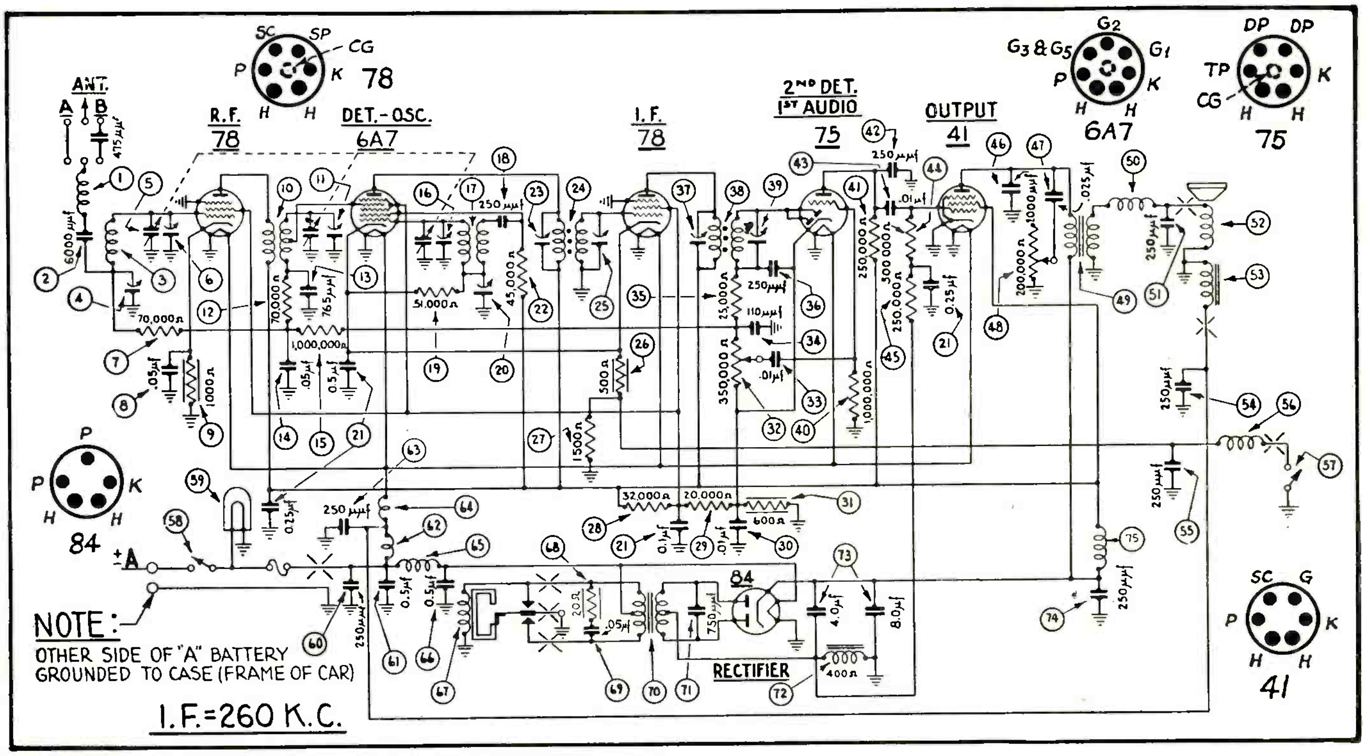


Fig. 1. Complete circuit Philco 818K.

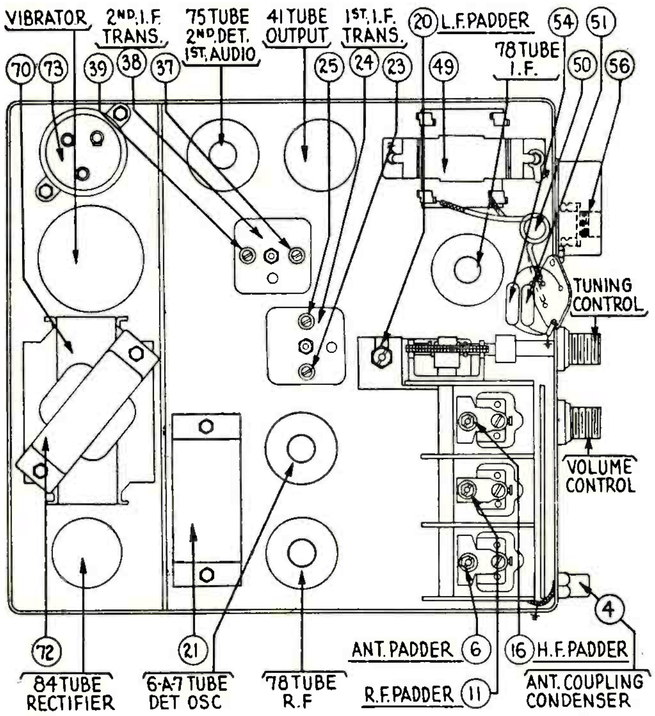


Fig. 2. Trimmer locations.

Remove the generator lead from the 78 tube.

Connect the generator lead to the grid cap of the 6A7 tube in series with an 0.1-mfd condenser (without removing the grid cap). Adjust the secondary screw padder 25 on the first i-f transformer for maximum reading on the output meter. Then adjust the primary screw padder 23 for maximum reading. (See Fig. 2 for location of padders.)

R-F Alignment

After padding the first i-f stage remove the generator lead from the 6A7 tube.

Set the signal generator at 1550 kc and then connect the generator lead to the grid cap of the 78 r-f tube in series with an 0.1-mfd condenser (without removing the grid cap).

Turn the tuning condenser plates out of mesh as far as they will go. With the tuning condenser in this position, adjust the high frequency padder 16 and the r-f padder 11 until the maximum reading is obtained on the output meter. This is the true setting for 1550 kc, 155 on the dial scale.

Turn the tuning condenser plates in mesh to approximately 580 kc, 58 on the dial scale, and set the signal generator at 580 kc. Roll the tuning condenser and adjust the low-frequency padder screw 20 for maximum reading on the output meter.

Turn the tuning condenser plates out of mesh as far as they will go and set the signal generator at 1550 kc. Then adjust the high-frequency padder 16 again for maximum reading on the output meter.

Remove the generator lead from the 78 r-f tube.

Connect the generator lead to the antenna cable assembly (made up of Part No. L1915 loom, 1-27-7133 terminal and 40 inches of 16 strand No. 30 wire), using a 200-mmfd condenser in series between the two leads. Place the connector plug in the antenna socket on the receiver. Plug the cable into the antenna socket.

Turn the tuning condenser in mesh to 580 kc and adjust the signal generator at 580 kc. Adjust the antenna coupling condenser 4 for maximum reading.

Turn the tuning condenser to 1400 kc and set the generator at 1400 kc. Adjust the padders 11 and 6 for the maximum reading on the output meter.

VOLTAGE DIVIDERS

(*Continued from page* 352)

from any one point on the voltage divider. For example, R_4 represents the combined resistance of all the r-f and i-f tubes in the receiver, which operate at the same plate voltage of say 250 volts. In like manner I_4 represents the combined plate current of all these tubes. As a further example, point D may be connected to the screen of the resistance-coupled pentode used in the a-f amplifier of the receiver and I_2 will consequently represent the screen current of this tube. If, in addition the screen of the first detector were connected to point D, then I_2 would represent the combined currents and not just a single current. Similar relations hold for the remaining currents.

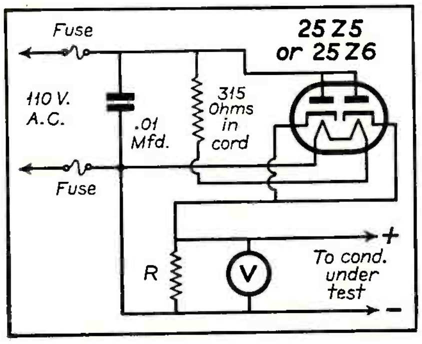
Let us now analyze the distribution of currents. Referring to Fig. 5, and beginning at the output of the rectifier, we note that a high voltage is available across point A and F, which constitutes the input to the filter and voltage divider system. At point A, the first division of the current takes place. If the current taken from point A by the power tube or tubes is denoted by I_5, then you will note that this current leaves point A and passes through the power tube or tubes, and returns to ground, as is indicated in the diagram. The remainder of the current which, for convenience, is denoted as I_1, I_2, I_3 and I_4, passes through the filter choke, which is designated L_1. At the next junction, which is B, the current again divides. This time the current, which is taken from the voltage tap at B by the tubes connected to this point, is denoted by I_4. The current returns through the respective tube circuits to ground. The remainder of the total current, which originally left point A, travels through the first resistor of the voltage divider and arrives at the junction C. The amount of this current by simple subtraction is equal to $I_1 + I_2 + I_3$. At the junction C, this current further divides, so that the amount of current taken by the tubes at this voltage is I_3 and the remainder, which is $I_1 + I_2$, passes through the voltage divider resistor down to the next junction at point D. Here a further division of the current takes place. Current I_2 flows to the tubes connected to point D, and the remaining current I_1 flows through the last resistor of the voltage divider to the ground junction of the network, which is at point E.

However, the current flow does not cease at this point, since there must be a complete circuit for the flow of current. Consequently, the current I_1 which flows through the last leg of the voltage divider, must return to the rectifier through the field coil. Furthermore, the currents distributed to the various tubes must also return to the negative leg of the rectifier output through the speaker field. The net result is that the sum total of all the currents which leave point A, must flow through the field coil and in terms of the symbols used here, the current through the field coil is, $I_1 + I_2 + I_3 + I_4 + I_5$. The drop across the field coil will then be this total current multiplied by the field coil resistance.

ON THE JOB . . .

Electrolytic Condenser Tester

Where a-c is available a 25Z5, or its metal equivalent, the 25Z6, may be used to test electrolytic condensers not only for capacity but also for filtering efficiency. The tube is connected to perform as a simple half-wave rectifier with a resistance R and a voltmeter as load. If the voltmeter is of the high-resistance type



the load R should be 1000 ohms. However, if the voltmeter draws appreciable current R should be increased accordingly. Any voltmeter having a range around 150 volts d-c can be used.

Because one leg of the instrument is connected to the a-c mains condensers tested *must* be clear from all ground or line connections. Both the line cord and the ground connections must be disconnected from the receiver whose condensers are under test.

The instrument may be calibrated with paper condensers of high quality and low leakage. A chart of these values can then be used to compare the relative filtering capacity of electrolytic condensers.

•

Volume Control Installation

Volume controls are furnished with three terminals permitting their use as rheostats or potentiometers. When used as potentiometers, all three terminals are employed. When used as rheostats, the center or constant terminal and either the right or left terminals, are employed depending on whether resistance is to increase or decrease with clockwise rotation of knob.

It is highly important when using tapered controls that terminals be connected into the circuits as shown in wiring diagrams. Otherwise, due to characteristics of taper recommended, efficient control will not be obtained.

The accepted method of connecting volume controls is such as to provide minimum volume at extreme counterclockwise rotation of the moving arm, and when rotating in the clockwise direction the signal is increased smoothly.

Use wire-wound controls only in circuits where current load is too great for composition or carbon element control. The composition control is most used in antenna, cathode and audio shunt circuits where current is light. It provides a far greater flexibility in high resistance ranges and in complicated taper curves.

It is well to test the operation of a volume or tone control before mounting and soldering the connections. When soldering, especially the composition type, never allow flux or solder to run down terminals into the case, since such materials coming into contact with the resistance element will cause the control to become noisy. Also, never solder any connection to metal cover, for the extreme heat dissipated through contact with hot soldering iron will tend to damage the control.

Never open a volume control in an attempt to improve upon its internal construction, since the element and contact member are delicate and must not be touched, scraped or tinkered with. Also, never apply oil to surface of resistance element because this will ruin the resistance and the control will no longer function properly.

When using a replacement wire-wound control in antenna cathode circuit which requires minimum resistance to be left in circuit at full volume, use an external resistor of between 200 and 400 ohms. Stock type controls do not have such minimum resistance incorporated in the control itself, and therefore due precaution must be exercised in seeing that the control is provided with external resistance if wiring diagram or original control has such internal bias resistance. Otherwise the control element may be ruined.

George Mucher

•

V. T. Voltmeter Adapter

The accompanying illustration is that of a vacuum-tube voltmeter adapter which is used in connection with an analyzer. The adapter plugs into the octal socket on my large analyzer from which it receives its power supply and at the same time the meters of the analyzer are connected into the circuits of the v.t.v.m. This arrangement makes for simplicity and efficiency. I merely insert the tube in the socket and connect the test leads—no need for bulky equipment.

The unit is mounted on a 3/16 inch bakelite panel 6 by 4 inches and is 2 inches deep. The range of the instrument with the values indicated in the

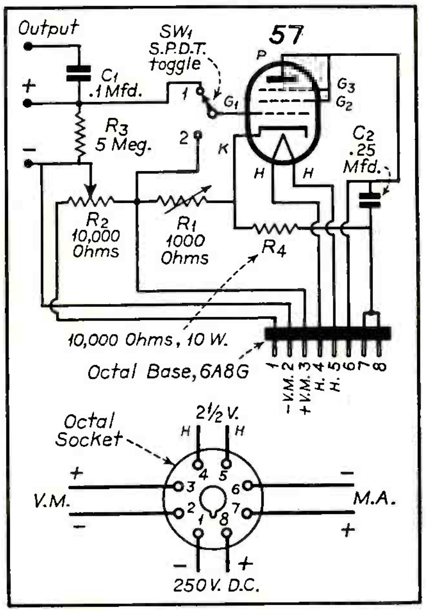


diagram is from 100 millivolts to 115 volts. Any desired range may be obtained by choosing suitable values of the various resistors. Since the instrument measures peak values a-c readings must be multiplied by 0.707 to obtain their rms value.

Operation

The adapter is plugged into the analyzer and the circuits connected so that the 10-ma range of the milliammeter is in the plate circuit of the adapter. The power supply of the analyzer should be turned on and the filament voltage adjusted for the tube used in the v.t.v.m. When the 57 has been warmed up it is biased to cut-off using the variable resistor R_1 with the switch SW_1 in position 2. Throw SW_1 to position 1 and again bias the 57 to cut-off using R_2. The reading then obtained is an indication of the voltage measured.

If absolute cut-off is desired the milliammeter can be switched to the 1-ma range after the 10-ma scale shows cut-off. This will give closer readings on low voltages.

The adapter can easily be added to an a-c operated volt-ohmeter provided the power supply is isolated from the power mains. The instrument will operate satisfactorily on 90 volts plate supply providing proper values are chosen for the various resistors. *Al Beers*

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The Model 99 will be ready for general delivery on or before September 1. Ask your jobber to advise you when his demonstration sample arrives.

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Beat Frequency Audio Generator

MODEL 79-A with greater spread on the lower frequencies and new stability achieved through improved circuit design and air trimming capacitors. Has type 6E5 tube as zero beat indicator. Uses low cost 6C5 metal tubes. Dealer net with tubes $53.75

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MODEL 88 Combination Vacuum-Tube Voltmeter and Peak Voltmeter. Reads 0-1.2 volts with input direct to tube grid (no shunts) on 4½-inch fan type meter. Supplies bucking voltage for peak voltage readings on scales of 0-10 and 0-100 volts. Dealer net with tubes .. $42.50

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Notes on the Application of the 6E5

The 6E5 is one of the most interesting electronic devices of recent times, and it promises to have many uses in various circuits. At the present time it is important and popular as an indicator of resonance in radio receiving apparatus, as an output meter, as a sensitive bridge or vacuum-tube voltmeter indicating instrument. In the author's experiments with 6E5 circuits, some of the factors and values effecting its performance were studied, and will be presented in the following discussion.

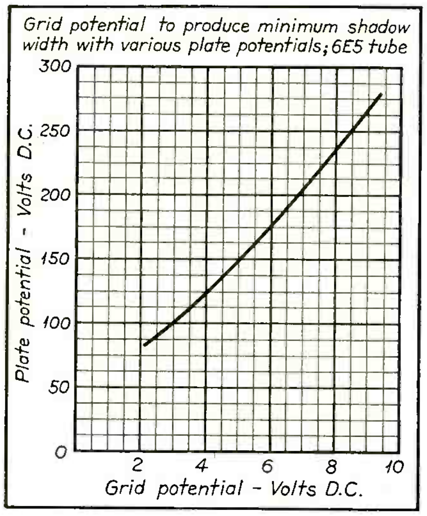


Fig. 1

In using this tube for a resonance indicator in a receiver using avc the triode grid is connected to a point of potential in the avc control circuit that is negative with respect to the chassis. Then, a carrier entering the receiver will develop a certain potential across the 6E5 grid and ground; large in the case of a sensitive receiver, and small in that of a less sensitive one, provided the signal strength is the same in both cases.

Before applying any rules for obtaining good performance in various circuits, under different conditions, let us investigate the values and the limiting factors through which the tube functions. In the first place the lowest anode voltage that will produce a satisfactory glow is about 70 volts. Below this value the brilliance of its screen is too low, not uniform, the shadow is indistinct, and in general, undesirable for visual indications. Higher potentials are more desirable as the luminous glow is more uniform, and bright enough to be readable in a room that is well lighted. Voltages up to 300 volts may be safely used.

An important characteristic of this device is the fact that its voltage sensitivtiy varies as the steady plate voltage is changed. With lower potentials on the plate, the sensitivity is increased, and with higher plate voltages the sensitivity is less, as can be seen on the accompanying graph. With 70-volts plate potential, the minimum shadow angle of zero degrees is obtained with only —1.8 volts on the grid. At the other extreme, with 275 volts on the plate, the grid requires —9.1 volts to produce minimum shadow width.

This curve will be found useful in adapting the 6E5 to various circuits in which it is to be incorporated as a null indicator, maximum indicator, or as a quantitative measuring device. Note that the maximum shadow width of 90 degrees is always obtained with zero grid potential. (The grid must not be open or floating, however.)

When installing the electric eye in some receiving sets it may be found that the avc potentials are not of the correct maximum values to properly operate the tube. In the case of the sensitive receiver, the strongest station tuned in may produce a grid potential that is too high, causing the shadow to overlap (close before the signal is tuned to exact resonance). The remedy is to connect the 6E5 plate to a point in the chassis where a higher d.c. voltage is obtained. It may be necessary to connect to the input of the filter circuit, at the rectifier cathode terminal. If this is not sufficient to produce the proper amount of shadow width with the strongest signal, then the control grid should be connected through a high resistance divider as shown in the diagram, Fig. 2. The total resistance of this potentiometer should be not less than about 5 megohms. In the second case, where the set is not so sensitive, the answer is to connect the plate to some point of lower voltage, not less than 70 volts.

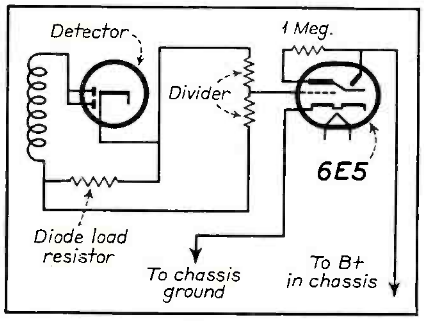


Fig. 2

E. M. Prentke

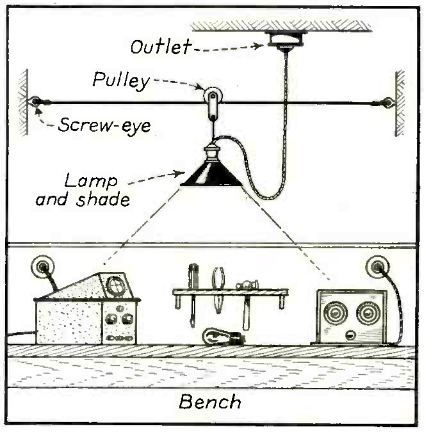
Die Cutting Bakelite

Socket hole punches can be used for making cleancut holes in pressed wood, fiber, bakelite, or wood panels. Instead of punching through with a few strokes of a hammer, the material is placed between the punch and die, and squeezed between the jaws of a large vise. If a bit of grease is used on the tool, the steady pressure of this method gives excellent results.

E. M. Prentke

Bench Light

In order to obtain maximum light on the work bench with a single bulb the arrangement shown in the accompanying sketch can be used. The light, suitably shaded, is hung from a pulley which runs on a cable stretched across the bench. The light can then be conveniently moved to any position where the most light is required.



Open I-F Transformers

In many cases i-f transformers, particularly those hard-to-get kind, can be made as good as new by unwinding a few outside turns. If the break happens to be on the inside of the coil next to the wooden core, the following method may be used to fix that too: Most of the wooden cores have a small hole through them; if not, drill one the length of the dowel and insert a metal rod or a tight fitting screw through the end on which the open coil is located.

Hold a hot soldering iron against this metal rod or screw until the dowel gets hot enough to melt the wax compound used to secure the coil to the dowel. The defective coil may now be removed and a few turns unwound from the inside past the broken point.

Heat the wooden core once again and return the coil to its place. Be sure to remove the metal that was used to heat the dowel.

The turns removed may be compensated by retuning the i-f trimmer capacitors.

RCA Service Tip File

TEST EQUIPMENT . . .

Weston Set Accessor

Time and again Service Men have been told that this or that new model was "the ultimate in servicing instruments." Then, as new receiver developments came along, we would again be told that a newer model was necessary for a thorough servicing job on any and all receivers.

Instrument makers are not wizards, and the startling progress in receiver circuits and parts was bound to cause some obsolescence. We have come a long way since the single-circuit days when we checked the "B" battery with our voltmeter, and then put it back on the shelf to begin the old "try-try-again" routine, and the instrument maker has frequently led this way. It seems that we have now reached a point

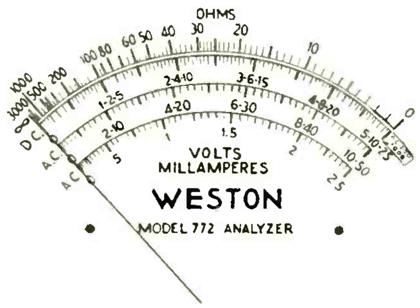


Fig. 1. Scale of Weston 772 analyzer.

where both instrument makers and Service Men have got to take a new slant.

In the case of an analyzer, for instance, the quantities we are measuring —volts, ohms, milliamperes and possibly microamperes, are certainly not being made obsolete. Why, then, should our older instruments fall down on the job? Why have we accepted such-and-such a range as the "ultimate" only to encounter new receivers within a year or so that went beyond the old-time limits? The answer is just this: Because our test instruments were designed and purchased to meet the current *receiver conditions,* instead of the basic *electrical possibilities* that underlie every kind of a hook-up, past, present, or future. After all, there are limits of current, capacity, resistance and all the rest, beyond which they just won't work for you in radio, television, or anything else where control is necessary. They're just too close to zero, or too close to infinity, or something, to have any practical usefulness. Once we get an analyzer designed for *these* basic limits of sensitivity and range, the obsolescence problem is going to be over for good.

Operating at a sensitivity of 20,000 ohms-per-volt, along with comparable increases in ranges of measurement, a new analyzer just announced by Weston sets new standards of utility for servicing radio receivers and other electronic equipment. It is said to meet completely the present requirements for analyzing critical receiver circuits involving automatic volume control, noise suppressor circuits, tone fidelity control, and the like. In addition, the sensitivity forecast as essential for television receiver servicing are fully met.

The heart of the new analyzer is a big 50 *microampere* instrument movement, equipped with a highly legible 5-inch scale. In measuring d-c, this means that but *one-twentieth of the current drawn* by most instruments previously available flows to the new meter. Thus, readings in resistance-coupled circuits will not be greatly in error, as was the case previously with less sensitive instruments.

This highly sensitive instrument offers equal advantages in current and resistance measurement. In avc measurements, for example, plate currents of 10 microamperes, 5 microamperes, or less coming from the diodes can be accurately measured. In television work, talking picture equipment, and the like, cathode ray tube, photo-cell and other minute currents, even as low as one-half a microampere can be read from the scale.

In current measurement, we need the

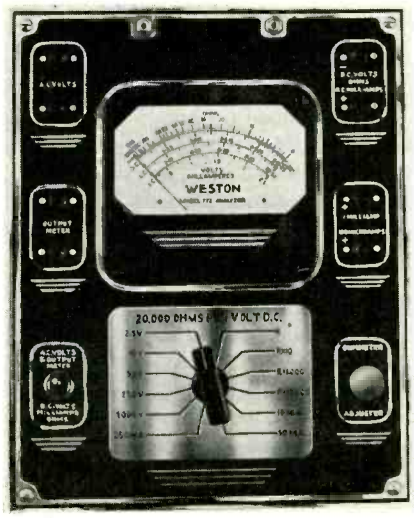


Fig. 2. Weston 772 analyzer.

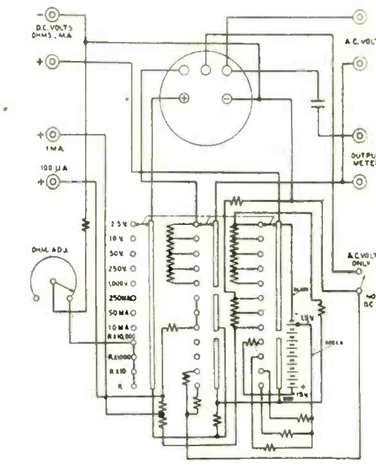


Fig. 3. Circuit Weston analyzer.

means to get down below 1 milliampere full-scale for accurate measurements of 10 microamperes or less in grid and plate current measurements and the like. Those who see the servicing prospects of television close by know the increased importance of this point that is bound to come.

Of the 4 resistance ranges, the top range provides a readable deflection as high as 30 megohms, and has the high resistance values above 1 megohm sufficiently spaced out to permit an accurate check on all resistors in common use. For d-c leakage tests on condensers, this increased deflection at high resistance values gives the Service Man a weapon of increased effectiveness against a particularly troublesome servicing problem.

A convenient system of pin-jacks, along with a rotary switch, permits rapid changes of range and function for a-c and d-c measurements, and for use of the instrument as a sensitive output meter. Separate jacks for the 1 milliampere and 100 microampere ranges protect the instrument from accidental damage. The unit is set up for use with the Weston socket selector units, but may be used without the socket selector if desired.

The unit is completely self-contained in a convenient carrying case. In the case, additional space is provided for the socket selector, spare tubes and for other small servicing tools. The compact panel is all metal, lacquered in black and red with chromium trim. At its center is the modern rectangular meter, meeting new standards of appearance as well as of sensitivity and service.

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RECEIVER CASE HISTORIES

A. K. L I

Distortion hum: This is often caused by an open bias resistor for the 45 output tubes. An attempt to measure the bias voltage will cause the receiver to play more normal since the voltmeter will take the place of the bias resistor. The bias in this case will read too high.

Allan Epstein

•

Audiola Jr.

Low volume and severe distortion: Open 400-ohm bleeder between detector screen and ground. Check all resistors for change in value as they are very unreliable.

Francis C. Wolven

•

Crosley 124

Intermittent reception and oscillation: This is often caused by an open r-f or i-f cathode by-pass condenser.

Allan Epstein

•

Delco 1936 Auto Radio

Loud intermittent hum: This is often caused by loosening of the rivets which hold the electrolytic can bracket to the chassis. A flexible bond soldered from the bracket to the chassis will eliminate the trouble. Do not solder the bracket directly to the chassis since future vibration will loosen it.

Eugene Triman

•

Erla 224AC

No bias on the 45s. High plate current on these tubes and in consequence, low plate voltages. Excessive hum with little or no field excitation. Set may play a little, but with severe hum modulation and distortion. Remove the speaker plug and test with ohmmeter across the two right-hand terminals on the terminal strip of the set. If a low resistance or a short circuit is indicated, the fault lies in a shorted 1-mfd section in the condenser block. This section is connected between the high-voltage centertap on the power transformer and the high side of the speaker field. Two filter condensers of 2 and 3 mfd respectively have their common negative connected to the high side of the above condenser. Therefore, to repair, one must either replace the entire pack, open the block and replace the defective section or disconnect all three condensers and substitute others. It is next to impossible to obtain a replacement or to open the block and repair it. However, if the terminal strip on the old block is lifted and the leads to the three above mentioned condensers removed, other sections may be connected externally in their place.

Francis C. Wolven

G. E. K-60, K-65 (RCA R-37)

Faulty electrolytics: Have had a great deal of trouble with the electrolytic condensers in this set, particularly C-30 and C-4. The screen by-pass usually loses capacity or opens and the B supply by-pass either opens or shorts. Saw two very interesting cases in which the set played when cold and gradually faded out when it warmed. When it had faded, hum modulation and oscillation would result from touching the r-f control grid; this condition is abnormal in this set. In each case, C-3 was faulty and developed a high internal resistance. The leads on this condenser should be left long enough and flexible enough to allow for expansion and contraction. C-17 may also become leaky and cause intermittent fading.

Francis C. Wolven

•

G. E. L-50 (RCA R-22)

Excessive heat: The large 180-ohm wire-wound resistor in these sets overheats the entire chassis. Have had considerable trouble in the past due to melted wax solidifying on tube prongs, in sockets and i-f trimmer condensers. The only way to remove it is to spray with atomizer containing carbon-tetrachloride and scrub with a pipe cleaner. Combination of excessive temperature changes make it almost impossible to keep set aligned. This is also detrimental to the electrolytic condensers. It is advisable to replace all condensers that have been used more than two years and to remove the voltage dropping resistor. Use a cordohm type in its place. This keeps the extra heat out of the set and will prevent trouble with wax as well as dry condensers.

Francis C. Wolven

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G. M. 110

Intermittent fading: The by-pass condensers under the chassis frequently cause fading. These condensers are located in small cans three to a can. It is advisable to replace them all with individual tubular condensers of high quality.

Stanley Neal

•

Grunows

Very short tube life, especially on chassis 11A: Filament voltage runs too high on normal line voltage. A voltage regulator will remedy the trouble.

Fading and noise: A permanent cure is to replace the canned condensers with high-grade tubular condensers of sufficient voltage rating.

Poor lug grounds: Where the bolt that holds the shield can also grounds the soldering lugs poor connection results. Each lug and shield should be bonded to the chassis to assure a low-resistance connection.

An a-c voltage on the chassis: With the set turned on and the tubes in or out. Touching the ground wire to the chassis produces a flash. This is caused by a partial short between the power transformer primary and its electrostatic shield. Replacement is indicated.

E. J. Bancroft

•

Grunow A-C, D-C

Low voltages: Set in service approximately a year or even less, the filter block gives out. I use separate filter units of small design but high grade, to get them all in the space required with enough voltage safety. These jobs will run higher in price but customer satisfaction is worth it.

E. J. Bancroft

•

Howard Model W

Blows 83V rectifier tubes, although set plays O. K.: The four 2A5 tubes are supplied 15 volts negative to their control grids through a separate 56-tube rectifier circuit. Defects such as a 2A5 tube with leakage, defect in bias circuit, or slow heating 56 rectifier tube which will cause a low grid bias voltage either continuously or momentarily while all the other tubes of the set are hot, will cause the "B" current drain of the tubes in the set to exceed the 83V tube's rating and the tube will be blown.

A 5Z3 rectifier tube used as a replacement instead of the 83V will last longer. However, the 5Z3 tube which is the filament type is faster heating and places a higher peak voltage on the condensers with increased danger of their breaking down.

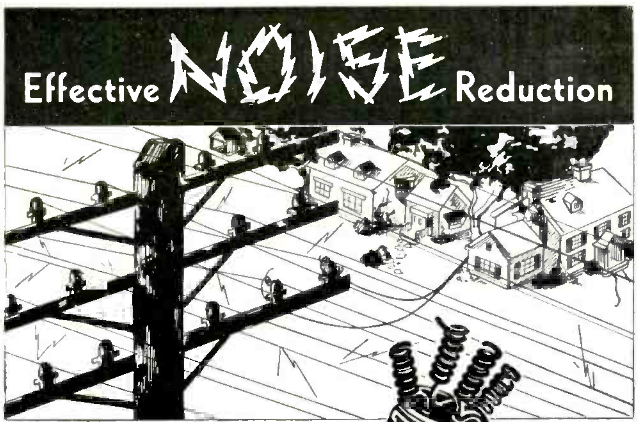
Paul D. Shields

•

Majestic 15

Low volume in these models may be caused by a partial open or high resistance connection in the i-f transformers. The normal resistance of these coils is about 150 ohms. A difference of only 50 ohms in the secondary circuit is ample to cause poor selectivity and weaker reception.

J. E. Mason



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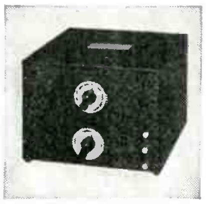

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WEBSTER-CHICAGO engineers create extraordinarily powerful amplifier in compact, sturdy, attractive cabinet.

The 6L6 is an audio amplifying tube, using the newly discovered beam principle of controlling electronic emission. Properly handled, this tube develops a new order of amplification.

Think of a sound system having 60 watts undistorted output and yet the amplifier being no larger nor weighing any more than many amplifiers that heretofore developed but one-half or less power.

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Majestic 70

Inoperative: Check oscillator plate voltage. The absence of this voltage is caused by an open plate winding on the oscillator coil. Replace entire coil.

J. E. Steoger

•

Majestic 440

Oscillation: This set would play normally for a time and then begin to oscillate, stopping and starting as the chassis was bent or twisted a little. This was caused by an open common connection on C-2, C-3, C-5, C-7 and C-14, which are encased in the metal can just under the speaker. It is better to use good tubulars than an exact duplicate. By removing the variable condenser completely and loosening the four bolts holding the speaker, one may mount a five lug terminal strip together with all five condensers. The terminal strip will hold the high sides of the condensers and the ground leads may be soldered to chassis near the output tube socket.

Francis C. Wolven

•

Majestic 460, 461, 463, 490, Etc.

Audio oscillation at certain volume control settings: This is a common complaint and is caused by a worn-out volume control which has raised its resistance from a normal 200,000 ohms to 500,000 or 600,000. It is permissible to use 250,000 ohms as a replacement. Saw one case in which the set failed to operate correctly after this was done. Volume was subnormal and decreased and became stringy over the last twenty degrees of volume control setting. It sounded exactly like an overloaded tube but there was not enough audio signal present to account for that. I proceeded on the theory that the 55 grid was being overloaded by an inaudible frequency, probably some of the i-f signal energy. This later proved correct. C-4 was open. It was found to be necessary to by-pass the opposite end of the r-f choke to ground with an 0.00025 mfd condenser. This is the end which connects to the high side of the volume control. The correct value for C-4 is 0.0005 mfd but 0.001 mfd is permissible.

Francis C. Wolven

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Motorola 57, 62, 75, 79

Loud background hum, no low a-f response and peculiar tone: This condition is the effect of the high-capacity low-voltage section of the electrolytic condenser block opening. It is advisable to remove the entire block, which is located beneath the output transformer, and replace with a completely new block.

Eugene Triman

•

Motorola 100, 110

Loud background hum, low volume, and distorted tone: Remove screws holding can in place on top of power transformer which is located next to the vibrator. Lift can off top of shielded power transformer. Replace entire electrolytic condenser found in the can.

Eugene Triman

•

Oldsmobile 1936 Auto Radio

Inoperative: If set is dead, measure plate voltage of output tube. If there is no plate voltage the trouble can be traced to a small 0.006-mfd condenser connected from plate of output tube to ground. Always replace with a mica or 1,000-volt working voltage paper condenser to eliminate future trouble.

Eugene Triman

•

Philco 59

Intermittent: Sometimes cuts out entirely, most of them drop to a low volume after warming up. The cause is an open 0.09-mfd second-detector screen by-pass condenser, located just in front of the 42 power tube.

E. M. Prentke

•

Philco CT-11

Installation: When installing this Philco in the Dodge D-2's or when servicing, do not try to remove or replace radio around right side of steering column. If you do, it will be necessary to disconnect the starter pedal and even then the job will be difficult. If, when installing, you depress the clutch pedal slightly, start the right side of the set forward along the left side of the column, then turn the set gradually to normal postion it will slip in place easily. To remove, of course, the process is reversed. Once all connections are loose, the set can be removed in less than fifteen seconds. Have experienced some trouble with power transformers on these jobs, usually opening due to electrolysis.

Francis C. Wolven

•

RCA 220, GE-K66

Intermittent oscillation: May be started or stopped by snapping power switch or by turning a light on or off. Caused by leaky by-pass condenser across resistor in cathode circuit of second-detector tube. This is a 4-mfd condenser (C_{29} circuit diagram).

No operation except on high-frequency end of dial: Caused by shorted condenser which connects from junction of oscillator coil and 20,000-ohm resistor (R-7) to chassis. This is a 4-mfd condenser (C_{24}).

This defect is difficult to detect by voltage check method as voltages are reduced only slightly.

Howard J. Surbey

•

RCA Victor 221

Hum: When there is considerable hum in the output accompanied by hum modulation and fuzzy tone at low volume, do not try replacing the filter condensers until you have tried this simple test. It is not necessary to remove the set from the cabinet. Disconnect the voice-coil lead on one side of the output transformer and short it to the other side of the voice coil. If the hum is still present, replace the lead and reverse the connections to the field coil. Do not try to do this by changing the terminals on the terminal strip, but unsolder the wires themselves. This trouble often develops in a normal set for no apparent cause.

Francis C. Wolven

•

Silver 30

Dial: It is extremely difficult to repair these dials or to secure replacements. If trouble is experienced, it is better to replace the entire dial mechanism. I have used the dial assembly from Radiolas 17 and 18 for this purpose as they are the correct size, easily installed, and very long-lived. It is not uncommon for a good bronze cord to last seven or eight years. The pulley shaft and its bracket may be removed from the Radiola condenser by grinding off the rivet heads, after which the bracket may be bent at right angles to bolt to the chassis under the shield which covers the power transformer. Then the dial drum and cord are installed in the original manner. It is necessary to drive out all pins and disassemble the mechanism to install it, but this should present no problem. It is a good idea to mark the course of the cable with pencil to aid in reinstalling it after the job is complete. Of course, it goes without saying that all shields must be removed from the chassis. One end of the cable must be soldered to the pin after installation, but this is not very difficult if the end is held with a spring type clothespin, leaving the hands free.

Francis C. Wolven

ASSOCIATION NEWS . . .

INSTITUTE OF RADIO SERVICE MEN REPORTS

Tour of the Executive Secretary

Basking in the warmth of a feeling that comes from having successfully completed a job, the chapters of the Institute have been extending a hand of welcome to the IRSM executive secretary who has been making a tour of the northeast section of the country preliminary to one of more extensive proportions.

In some of the cities special meetings have been called; in other cities, the managing officer has met with officers of the chapters and with individual members who have been readily available.

Throughout the entire organization there is a feeling of optimism, due in a large measure to the consummation of that important step in the program on which the members have put their efforts—the Qualification Project. There is evidence of accomplishment, and the members of the Institute glory in the fact that they can now hold up to fellow Service Men a concrete example of what they have done as compared with previous intangible arguments concerning what they intend doing.

Throughout the entire organization there is a feeling of optimism brought about by the gradual but definite improvement in business conditions and the consequent greater influx of service work.

Throughout the entire organization there is a feeling of optimism brought about by the association of the members one with another, and the elimination of ill-feeling that is usually created by a lack of understanding of the other fellow.

The members of the Institute feel that in the launching of the Qualification Project, operated and controlled as it is by organizations created specifically for the purpose, they have demonstrated their unselfish desire to advance the radio service profession and industry. They feel that they have made a most important step; that they have provided a means whereby the service profession and industry, the radio industry, and the clientele of the radio industry will have a definite answer to that oft-repeated question, "What is a radio Service Man?"

The tour of the executive secretary of the Institute will continue throughout the next several months.

•

IRSM Qualification Project

The National Radio Service Qualification Project has issued the following statement concerning apprenticeships under the Qualification Project, recently launched:

"The matter of what we shall at present refer to as an 'apprenticeship' under the Qualification Project has been taken into consideration by the committees, who correlated the details of the project, and by this board. However, since at the beginning we are dealing only with persons already engaged in the servicing of radio devices, the detail of apprenticeships is not applicable at the moment, but will apply to those who make their entry into the field of radio servicing. Apprenticeships will be agreed upon after the project is operating and there is a group of persons who have fulfilled the requirements and are in a position to voice their opinion in the matter.

"This board has found that the setting of a period of apprenticeship involves a study and analysis of several angles, not apparent on the surface. They must each be carefully weighed, and the final decision based upon the findings.

"The subject is made more complex in view of the professional aspects of radio servicing, and this board deems it important that nothing be done in the name of the Qualification Project that would tend to lower the status of Service Men in any manner."

•

New York Chapter

The Institute of Radio Service Men announces that assignments of booth spaces at the forthcoming 1936 New York Radio Trade Show to be held at the Hotel Pennsylvania in New York City has been going on for several weeks.

In spite of the fact that the vacation period was on when the announcement of the Convention and Trade Show was made, the absorption of space has been nearly as rapid as it was last spring at the National Show held at Chicago.

The Trade Show is to be held on the mezzanine floor at the Hotel Pennsylvania this year, having moved from the roof garden where it has been held in the past. The mezzanine floor lends itself to a finer type of exhibition than the upper floors, and, in addition, the activities attract the attention of the public in the lobby, thus aiding materially in spreading the story of what the Institute is doing.

•

Cleveland Chapter

Our two July meetings were devoted to constructional data on the vtvm, their use and application and a thorough analysis of afc as applied to the new sets. These talks were well illustrated and the practical points all hashed out so that the gang here will know what it's all about when servicing these new sets.

Cleveland is overrun by visitors to the Great Lakes Exposition and for other conventions, and we're knee-deep in delegates from here and there, which reminds me it might be well to mention that our chapter meets on the first Monday and third Wednesday of each month at 8 p. m. at 410 Hanna Bldg., and that all and sundry who are radio-minded are hereby invited to drop in for a visit with us.

The gang here are taking well to the N. R. S. Q. P. as just released by the Chicago office and promise to go to town on the proposition.

L. Vangunten, Secretary.

WATCH FOR THIS MAN

THE Bryan Davis Publishing Co., Inc., requests the assistance of Service Men in apprehending imposters now engaged in taking subscriptions to SERVICE. One imposter uses the name of Hal R. Mahoney as well as that of J. F. Burton and other aliases. He is 5 feet 8 inches tall; weighs about 140 lbs.; has black hair; thin face, with a light complexion and freckles. He is a smooth talker; wears glasses; smokes cigarettes and usually has an alcoholic breath. He does not present the regulation SERVICE receipt but merely gives a duplicate from an ordinary order pad, which he requests the Service Man to sign.

We take this opportunity of again thanking those readers who assisted in the arrest and conviction recently obtained in another similar bogus subscription case.

•

MARYLAND RADIO SERVICE ASS'N.

As per schedule the Old Timer's Get-Together was held on the 24th of July at the New Howard Hotel. An attendance of over 100 Service Men and guests were registered. The entertainment and prizes were received with great enthusiasm.

•

NRI ALUMNI ASSOCIATION

New York Chapter

We are trying out an idea, while not new, has not as yet received a thorough trial in our chapter. Our speaker, Mr. Kidd was unfortunately not able to be present at one of the recent meetings, so chairman Bennett heroically leaped into the breach and produced a spontaneous lecture which would do credit to a professional speaker. His extemporaneous topic was "Intermittent Reception," and we defy anyone present to truthfully say he didn't get a lot out of it.

Since that worked out so admirably we learned that the members could spend a most interesting and profitable evening by themselves, so now a volunteer is always ready to step into any emergency. Mr. Kidd was still unable to show up at the last meeting so Mr. Balsamello officiated and gave the boys some new slants on "Localizing Trouble with an Oscillator."

NRIAA News.

•

NEW HAVEN RADIO SERVICEMEN'S ASSOCIATION

The Connecticut Radio Servicemen's Associations have combined their efforts towards a field day for Service Men throughout the state. The event is to be held the 20th of September, at the Rustic Inn, Guilford, Connecticut.

The outing will be open to families and friends of the Service Man. Suitable entertainment will be provided as well as swimming and dancing. Information and tickets may be obtained from any Connecticut Service Men's Association.

J. E. Guetens, Secretary Outing Comm.

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EDITOR OF SERVICE TO LECTURE

The editor of SERVICE magazine, Robert G. Herzog, in response to many requests from service organizations will undertake a series of lectures on technical topics to be delivered to service groups throughout the eastern states during September and October.

Those organizations not already on the itinerary may obtain dates by communicating with SERVICE (attention: F. Walen), 19 East 47th Street, New York City.

THE MANUFACTURERS . . .

WRIGHT DECOSTER NOKOIL SPEAKER

Wright DeCoster, Inc., 2253 University Ave., St. Paul, Minn., introduces the Model 982 twelve-inch permanent-magnet dynamic speaker. The field strength of the 982 is comparable with an electro-dynamic of the same dimensions. The appearance of the speaker is enhanced by the field pot which is used to cover the universal output transformer with which the 982 is equipped. This output transformer matches

the speaker with any type of output tube.

This sensitive speaker employs a para-curve diaphragm capable of true high fidelity reproduction and is adaptable to all types of battery receiver requirements.

•

CABLE CONNECTOR

To fill the need for a small and inexpensive cable connector, the Bruno Laboratories, Inc., 20 West 22nd Street, New York City, announce a cable connector, Model CI. This is a small, all-metal coupling unit which permits instant connection or disconnection of two single-conductor shielded cables.

Its contact points are said to be positive in action, self-wiping, and maintained under extremely high pressures.

The Bruno Cable Connector is finished in gunmetal and accommodates cables 5/16" in diameter or less.

•

ELECTRO-VOICE VELOCITY MICROPHONE

The Electro-Voice Mfg. Co., Inc., 324 E. Colfax Ave., South Bend, Ind., announce the new "K" series velocity micro-

phones. It is a low-priced companion line to the present "V" series. The housing is streamlined. Furnished complete with 8′ cable, dual shock-absorber and locking cradle. Standard output impedance is direct-to-grid. Finish is black and chromium.

HAMMARLUND COIL FORM

The Unit Development Division of the Hammerlund Mfg. Co., Inc., has developed a giant coil form for use in transmitters. It employs insulating material, SP-53 dielectric. Its color is natural with no artificial coloring. The forms are grooved ribbed to permit air spaced windings for maximum efficiency. Substantial flange grips for easy handling are another feature.

The form may be permanently mounted by way of a special pair of brackets supplied with each form or temporarily mounted in the familiar plug-in coil fashion in the regulation socket. The form is

2¼" in diameter and 3⅞" long exclusive of prongs. Two types are available—four and five prongs.

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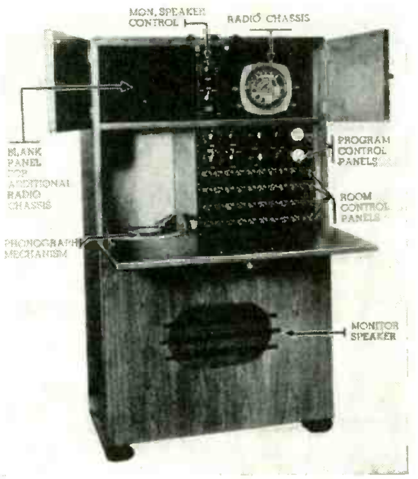
WEBSTER-CHICAGO CENTRALIZED SYSTEMS

Webster-Chicago, 3825 W. Lake St., Chicago, Ill., has just announced their sec-



tionalized sound systems for institutions. Each section takes care of approximately ten rooms. Provision is made in the cabinet to accommodate additional sections, thus permitting an institution to start with one unit and without change, to gradually expand the system to as many points as desired.

Incorporated in this system are the following features: Radio receiving set, microphone and phonograph; distribution choice of radio program, phonograph or microphone speech; two-way communications from central control, to each point; emergency cut-in switch to all points.

TACO DE LUXE ANTENNA

An automatic circuit arrangement that permits efficient reception of either standard broadcast or short-wave signals without manual switching or changing of the aerial proper, is the feature of the latest Taco deluxe self-selecting antenna. It is offered by Technical Appliance Corp., 17 E. 16th St., New York City. Packaged in attractive display box, factory assembled,

wired and soldered, this system provides for reception of domestic and overseas programs while eliminating background noise.

This system also features an armored aerial wire developed by Taco engineers. This wire has a special high-tension core, carefully water-proofed, around which the copper conductors are grouped.

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UNIVERSAL STYLI

Universal Microphone Co., Inglewood, Cal., has added to its recording accessory line professional steel cutting styli to be used in conjunction with its professional blanks, Silveroid discs and all nitrate or acetate records. It is said to be the closest approach to sapphire yet produced commercially. The styli are not mass machine production items, but are entirely hand-finished, of special alloy steel, lapped to a mirror polish and razor edge.

Universal Microphone Co., Inglewood, Cal., has published instruction sheets for recording on its line of Silveroid blank records.

The Silveroid discs can be modulated with full frequencies from 20 to 10,000 cycles and, if properly cut, are unusually brilliant and can be played back without the fuzzy objectionable tone often caused by waveform distortion. This type of recording blank is dense, easy to cut and holds the highs.

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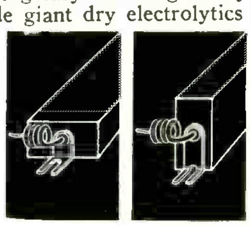
SOLAR FLEX-MOUNT CONDENSERS

Permitting easy mounting in any position, Solar little giant dry electrolytics are now



available with an adjustable mounting lug at each end of the container. They may be mounted either flat or on edge, and position is changeable at will.

These units are manufactured by the Solar Mfg. Corp., 599 Broadway, New York City.

BRUSH *Spherical* MICROPHONE

● A specially designed, general purpose microphone for remote pickup, "P. A." and commercial interstation transmission work. Low in price ... but built to Brush's traditionally high mechanical and electrical standards. Wide frequency response. Non-directional. No diaphragms. No distortion from close speaking. Trouble-free operation. No button current and no input transformer to cause hum. Beautifully finished in dull chromium. Size only 2⅛ inches in diameter. Weight 5 oz. Output level minus 66 D. B. Locking type plug and socket connector for either suspension or stand mounting furnished at no extra cost. Full details, Data Sheet No. 13. Free. Send for one.

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● For after dinner and convention speakers, lecturers, etc. Gives great mobility—the smallest, lightest microphone on the market. Size 1½ x 1¼ x ⅜. Weight with coat attachment less than 1 oz. Special internal construction and rubber jacketed outer case insures quiet operation. No interference from breathing noises, etc. Typical Brush sound cell response and trouble-free operation. Details on request.

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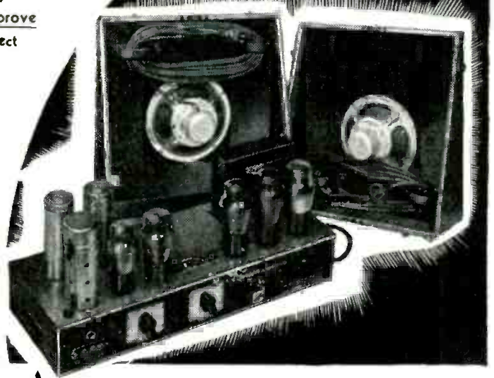

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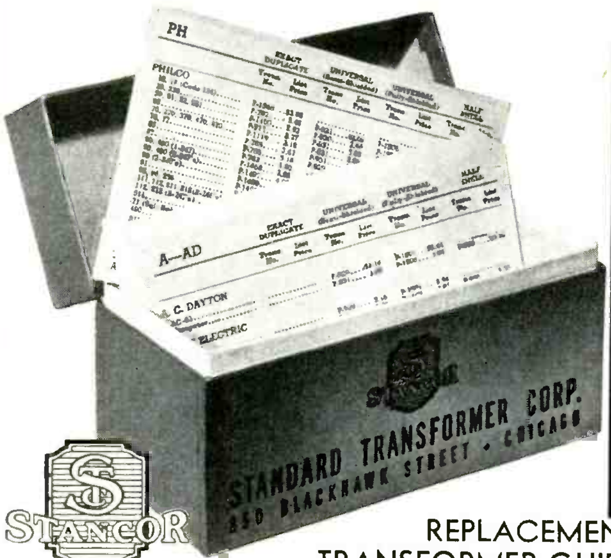

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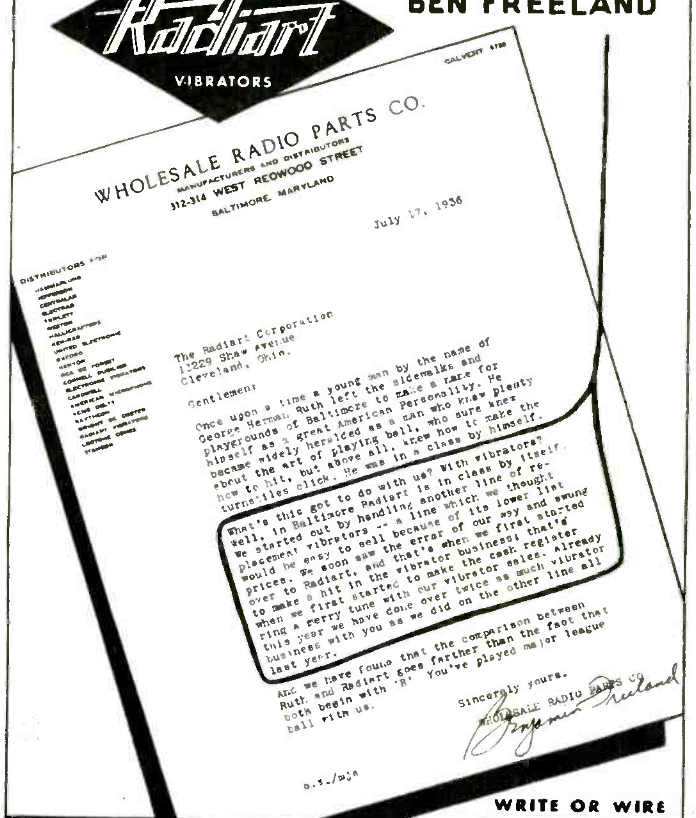
INSIST ON *Radiart* VIBRATORS

THANK YOU "BEN" FREELAND



WHOLESALE RADIO PARTS CO.
MANUFACTURERS AND DISTRIBUTORS
312-314 WEST REDWOOD STREET
BALTIMORE, MARYLAND

July 17, 1936

The Radiart Corporation
13229 Shaw Avenue
Cleveland, Ohio.

Gentlemen:

Once upon a time a young man by the name of George Herman Ruth left the sidewalks and playgrounds of Baltimore to make a name for himself as a great American Personality. He became widely heralded as a man who knew plenty about the art of playing ball, who sure knew how to hit, but above all, knew how to make the turnstiles click. He was in a class by himself.

What's this got to do with us? With vibrators? Well, in Baltimore Radiart is in class by itself. We started out by handling another line of replacement vibrators -- a line which we thought would be easy to sell because of its lower list prices. We soon saw the error of our way and swung over to Radiart, and that's when we first started to make a hit in the vibrator business; that's when we first started to make the cash register ring a merry tune with our vibrator sales. Already this year we have done over twice as much vibrator business with you as we did on the other line all last year.

And we have found that the comparison between Ruth and Radiart goes farther than the fact that both begin with 'R' You've played major league ball with us.

Sincerely yours,
WHOLESALE RADIO PARTS CO.
Benjamin Freeland

B.F./mja

WRITE OR WIRE

THE RADIART CORPORATION
Shaw Ave. at East 133rd St. Cleveland, Ohio

HIGHLIGHTS . . .

SERVICE MEN'S BUSINESS BOOK AVAILABLE

A volume analyzing and explaining the methods and procedure of conducting a radio service business has been released by RCA under the title "Radio Service Business Methods."

This 220-page volume was co-authored by John F. Rider, widely known radio service expert, and J. Van Newenhizen, radio auditor and accountant, after a survey of service businesses. The book discusses such important topics as a profit on your investment; what to charge; simplified records and bookkeeping and others allied with the conduct of a thriving service business.

The new book was originally offered as one of the units of a three-point service system plan, which was designed to help the Service Man get more business, simplify his handling of it and organize his procedure for greater profit. This plan is still open to those who have not yet made use of it through RCA parts distributors. The other two units of the plan include a volume entitled "101 Service Sales Ideas," in which have been gathered business-getting ideas successfully tried and proven in a wide field of application; and a radio service "tip" file consisting of hundreds of easy reference, time-saving answers to difficult service problems likely to be encountered in the field, housed in a metal file cabinet. Both the "Sales Ideas" book and the tip file may be had separately through special RCA tube deals with the distributor.

CINAUDAGRAPH CATALOG

The Magnet Steel Division of the Cinaudagraph Corporation, Stamford, Conn., has made available a catalog describing the characteristics of Nipermag, a permanent-magnet alloy. This magnetic material has been introduced to the radio field in the Cinaudagraph magic magnet speakers. The brochure will be of interest to the design engineer in the electrical, radio and industrial fields. Many applications of this magnetic material are discussed. Copies furnished free on request at the home office of the Cinaudagraph Corporation in Stamford, Conn.

CORNELL-DUBILIER TO MOVE

The Cornell-Dubilier Corp., after a search of manufacturing localities and facilities, decided to locate their new factory in South Plainfield, New Jersey. The new plant contains approximately 210,000 square feet, 33 acres of land and its own power plant. The entire plant will be devoted to the exclusive manufacture of condensers. Both the New York plant and the Plainfield plant of the company will be operated during the remainder of the year.

TCA REPRESENTATIVES

Transformer Corp. of America, at 69 Wooster St., New York City, manufacturers of Clarion p-a equipment, announce the appointment of the following sales representatives: Northwestern Agencies, Third and Vine Sts., Seattle, Wash., for the states of Washington, Oregon, Idaho, Montana, Utah and British Columbia Province; C. B. Strassner, 1425 S. Flower St., Los Angeles, Calif., for the states of California, Arizona, Nevada and New Mexico; H. Gerber, 94 Portland St., Boston, Mass., for the states of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island and Connecticut; G. O. Tanner, 600 Grant St., Pittsburgh, Pa., for the states of West Virginia and the western part of Pennsylvania, as far east and including, Altoona.

UNITED SOUND CATALOG

The United Sound Engineering Co., 2233 University Ave., St. Paul, Minn., have recently published supplement sheets Nos. 210-C and 211-C to their catalog No. 106.

The United Sound Engineering Co. manufactures a complete line of sound systems and accessories. Copies of the sheets or of the catalog may be had upon request.

UTAH APPOINTMENT

Mr. Ira J. Owen, president of the Utah Radio Products Co., Orleans St., Chicago, Ill., announces the appointment of Mr. O. P. Smith as general sales manager with his radio parts company.

SERVICE COPIES AT A PREMIUM

Several requests have been received for copies of the November 1932, issue of SERVICE. Readers that are willing to sell their copy can do so by communicating with the Circulation Department, SERVICE, 19 E. 47 St., New York City.

UTC CONTEST WINNER

More than ten thousand entries, from this country and abroad, were received in a contest to select a name for the United Transformer Corp. transmitter kits (variactor carrier control system). The winner, Mr. W. S. Cobb, whose call letters are W6KOB, of Santa Maria, Cal., submitted the chosen name, "Unitype." Judges were Frank Jones and L. M. Cockaday.

SPECTACULAR USES ATLAS RESISTORS

The Wrigley Spectacular on the east side of Times Square, said to be the largest of its kind in the world, uses resistors manufactured for the purpose by the Atlas Resistor Co., 423 Broome St., New York City.

The Atlas Resistor Co. manufactures wire-wound resistors for every purpose and to specifications.

MANUFACTURERS—continued

ACME HEADSET

The Rex—a new bi-polar headset in the low-priced field, has just been announced by the Acme Specialty Co. of Chicago, Ill.

The manufacturer calls special attention to the fact that this headset should find wide application in the centralized radio field in addition to short wave and all-wave radio reception.

AUDIO OSCILLATOR

Communication Instruments, Inc., 125 W. 40th Street, New York, N. Y., have released information on their new audio oscillator for laboratory use.

The oscillator, which is battery operated, is said to have an output that remains

constant over the entire range; the output is essentially sine wave.

The frequency is adjustable in ten steps over the range from 50 to 20,000 cycles per second. Output terminals are provided for both low and high impedance circuits.

ARCTURUS 6L6-G

The Arcturus Radio Tube Co., Newark, N. J., has recently marketed type 6L6-G beam amplifier tube. Similar in characteristics and pin connections to its metal counterpart, the 6L6-G is in a ST-16 bulb.

TWIN MARVELWAVE AERIAL

The Ward Products Co., 2129 Superior Ave., Cleveland, Ohio, manufacturers of automobile aerials, have recently announced their new Twin Marvelwave Aerial. This aerial has such features as cadmium plated rods, power-house type insulators and heavy rod insulators. This aerial is rust-proof and has the same no-drilling, quick-installation features as in all Ward aerials.

EX-STAT SPEAKER CONES

The Tilton Electric Corp., 15 E. 26 St., New York City, distributors of Ex-Stat resistors and condensers, have added replacement speaker cones to their line. Premiums are given to Service Men that continue to use Ex-Stat products.

TOBE FLEXIDONS

A new electrolytic condenser design announced by the Tobe Deutschmann Corp., Canton, Mass., features unit or "Flexidon" construction which permits the removal of any single section of a multiple section condenser in case of failure. Obviously, the rest of the condenser is salvaged, with resulting replacement economy. Individual sections have separate positive and negative leads. Made in the usual capacities up to and including 16 microfarads. A companion item, the replacement section, is known as the "Unidon."

INDEX TO ADVERTISERS