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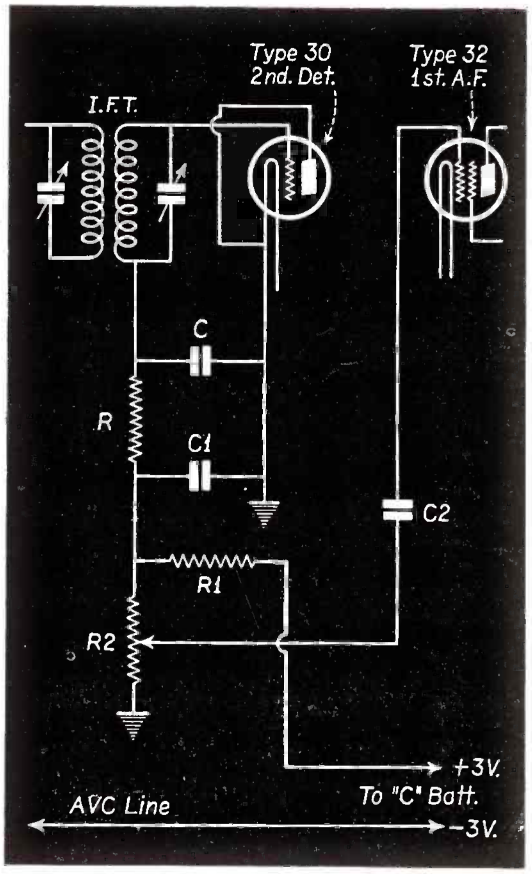
A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE



Diode and AVC in Battery Set

(See Page 290)

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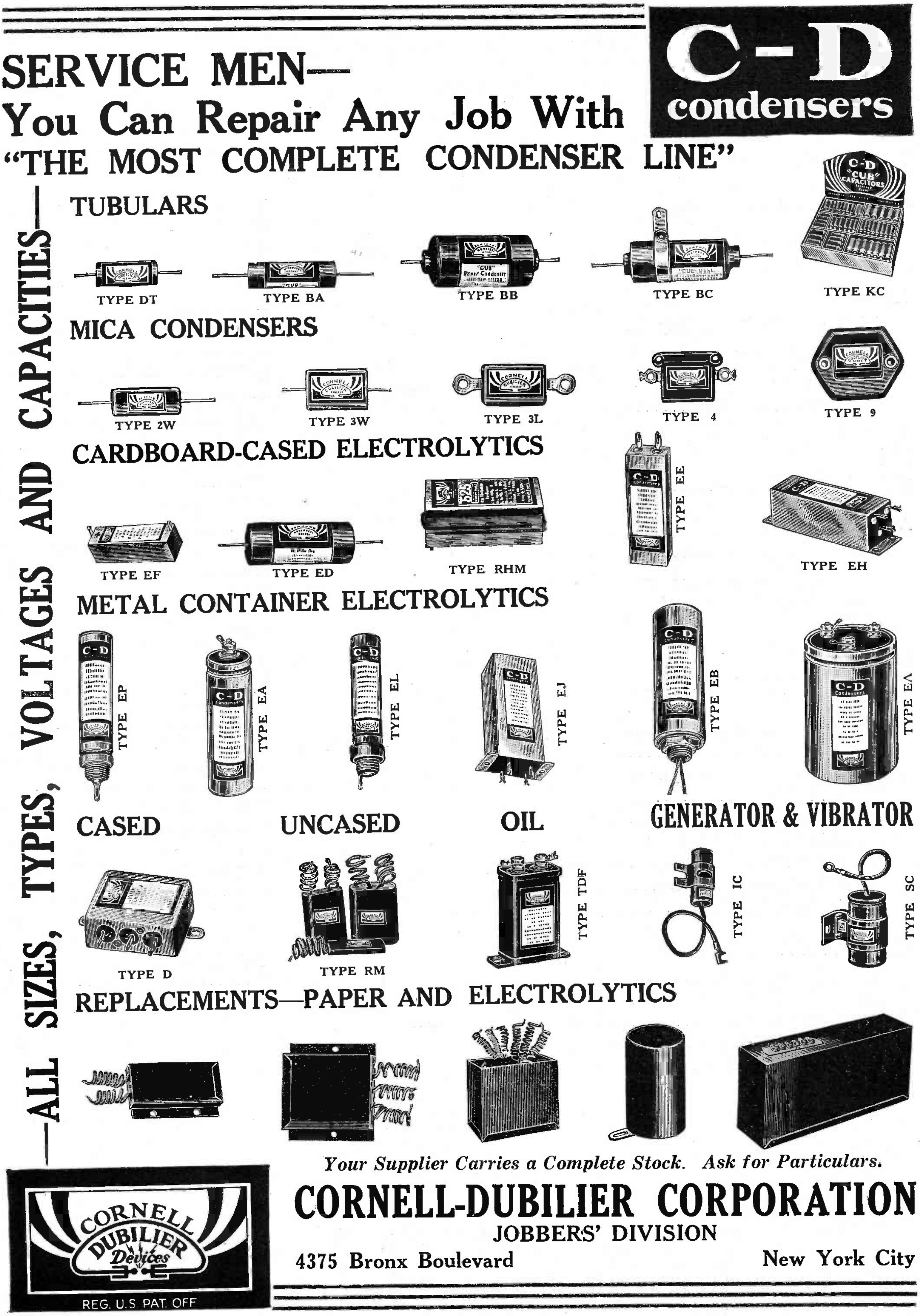
1934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SERVICE

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Vol. 3, No. 8
AUGUST, 1934

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EDITORIAL CONTENTS

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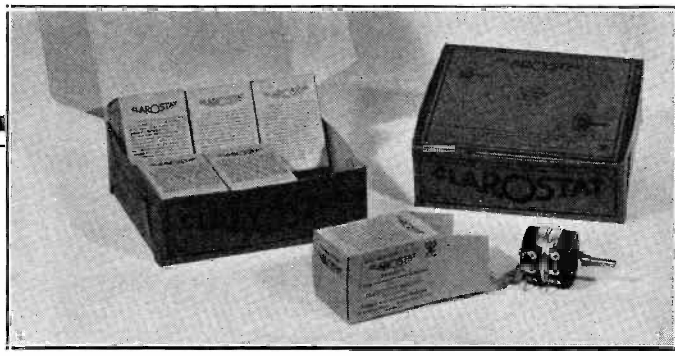

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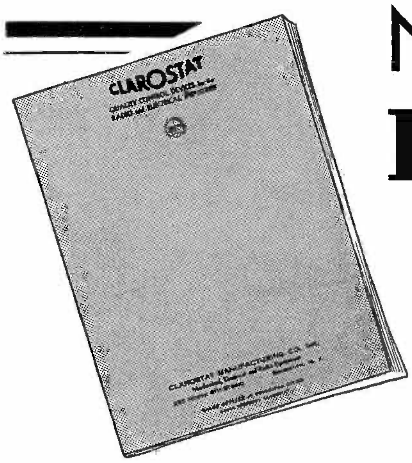

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Dated July 15, 1934. Contains detailed replacement and technical data on Volume Controls, Tone Controls, Clinch-Grip Flexible Resistors, Metal Cover Fixed Power Supply Resistors, Line Ballasts, L and T Pads, Series Mixers, Constant Impedance Devices and Standard Potentiometers.

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THE ANTENNA...

STANDARDIZED SERVICING

FOR the past two years we have received, with an astonishing degree of regularity, letters from Service Men who have very definite complaints to make about the rapid obsolescence of testing equipment, the alterations in tube design and pin numbering, and the changes in testing procedure. Such letters are still received and we expect the future will bring many more. So long as they continue to arrive we shall not lose heart, for a good complaint has behind it all the elements of the will to improve conditions, even though the will may be slightly misdirected at times. When complaints cease to arrive, that is the time we shall start worrying about the future of the radio service field, for then we will know that most of the backbone has gone out of it.

Let us say to these many men who have written us scorching letters about the injustice and foolishness of these constant changes, that they have kept us on the jump and given us some tough moments. But permit us to say also that each time we have been aroused to the point of activity, we have paused to consider King Canute who vainly commanded the sea to cease and desist from waving.

We are attempting to say, of course, that it is quite useless and a waste of time to contrive ways of staying progress. Any movement to combat improvements in tube and receiver design for the purpose of preventing obsolescence in testing equipment, is not a movement against a few persons but rather one against the very large and impersonal radio industry which in its aggregate marches forward like any other industry—improving and scrapping, instituting the new for the old.

It is a comparatively simple matter to trouble-shoot the receivers three or more years of age, and a comparatively difficult matter to trouble-shoot a new receiver; that is, if the receivers are combed with a standard analyzer. The new receiver requires something decidedly more elaborate in the way of analyzers—for an increase in the complication of the receiver necessitates an increase in the complication of the analyzer.

The Service Men could at one time get along very nicely with nothing more than a good volt-ohmmeter or, at most, a comparatively simple set analyzer. Progress in the design of tubes and receivers has since made it a necessity that the Service Man work with condenser testers, oscillators of high stability and precision, output meters, and set analyzers capable of looking in on a host of circuits and provide a number of readings or indications in each circuit. And now with the all-wave receivers, proper adjustments cannot be made unless the test oscillator covers almost the whole band of fundamental frequencies, the harmonics of fundamentals being unsuitable in most cases for precise circuit adjustments. With the advent of high-fidelity receivers it may be necessary to employ equipment for the determination of harmonic distortion, etc.

Admittedly there is injustice present, since the Service Man whose earnings are small is called upon to make continual investments in new servicing equipment or in the re-building of his old equipment. Nevertheless, this injustice is intangible to a great degree and cannot be laid at the door of the radio engineer, the radio manufacturer, or the test-equipment manufacturer. The engineers and manufacturers are also laid upon by similar injustices; everyone is in the same boat.

The Service Man is least able to withstand the hardships created by these constant changes. He cannot continue to scrap his testing equipment every year so as to be in a position to service any type of receiver at a moment's notice. Since this is the case, and more than likely will remain the case with a return to better times, something should be done to soften the blows to the pocketbook, or make up for the large outlays of money by increased earnings.

First, let us view the matter from the point of test equipment. The system of tube pin numbering is now well established, and though the change, and differences of opinion on this subject, have caused much difficulty, it is highly improbable that the standards will ever again be altered. That they *are* standards clears the air for the future.

The test-equipment manufacturers have caught up with the new tube types and it must be admitted that the new analyzers have been designed with an eye to the future. Most of them are obsolescence-proof as far as one is able to see, and unless the tubes of the future are radically altered from present design, the analyzers should remain obsolescence-proof. Still, who can say what is to come? And not knowing that, is it not best to attempt a bit of standardization in the servicing field itself?

One of the surprises in our life is the number of different ways you fellows go about testing a receiver. We have yet to meet two men who go about it in the same way. Some of the systems appear utterly ridiculous because of the great amount of waste effort; others are equally as ridiculous because they fail to provide a true picture of circuit conditions.

It would seem an excellent idea if Service Men were to decide amongst themselves how receivers should be tested and, consequently, how they will be tested in the future. There are many pros and cons to be thrashed out, but eventually a well-planned system ought to emerge from the present complexity—a system which will permit first, the possible standardization of test equipment as to type; second, the standardization of servicing procedure; and third, the standardization of the servicing literature printed by the set manufacturers.

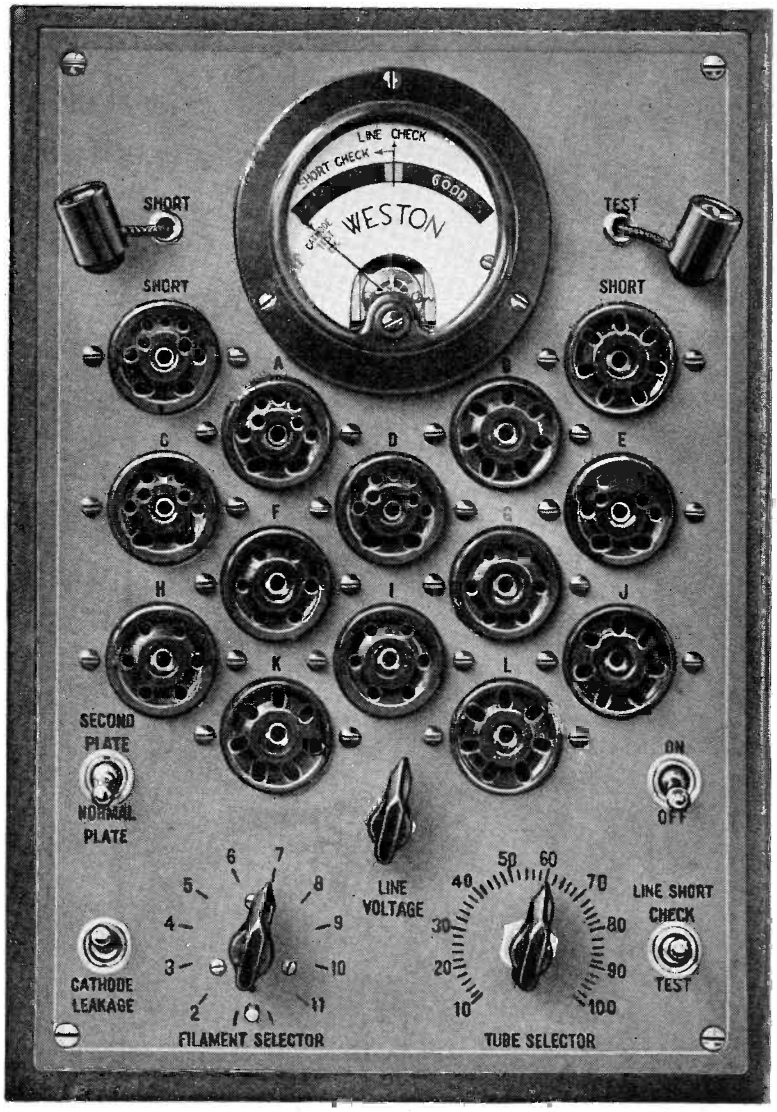
The editorial in the next issue of SERVICE will cover the points of servicing standardization we consider of most importance. In the meantime, let us have your opinion. Take up the matter at your next association meeting.

Weston scores again!

WITH A NEW TUBE CHECKER

$29 25/100 Net
WITH EITHER COUNTER OR PORTABLE CASE

The new Weston Model 682 Tube Checker, priced sensationally low for a quality instrument, is a combination servicer and merchandiser. Attractively finished in colors and with a scale with a "good tube" area, it makes an appealing and convincing counter merchandiser when mounted in the counter type case. For field servicing, the instrument can be slipped into a leatherette carrying case. Other features make Model 682 the outstanding value in tube checkers today. Here are some of them:



Panel view of Tube Checker

1. Attractively finished in two tones of fawn with silver edging.
2. Instrument can be used as counter merchandiser or portable checker.
3. Counter type case at "easy reading" angle.
4. Single arc scale shows good tubes as "good."
5. Tests tubes commercially used today. Spare sockets for future tubes.
6. Line voltage control.
7. Short check for 4, 5, 6 and 7 prong tubes.
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Radio Instruments

SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR AUGUST, 1934

USING THE RELAXATION OSCILLATOR

By O. S. HENDRICKS*

AN old circuit has recently been put to use which seemingly offers many practical suggestions to the Service Man for general application around a radio service laboratory.

The circuit shown in Fig. 1 is applied for the testing of all types of condensers found in general radio service work.

Circuit Description

As can be seen from a study of the diagram, the 110-volt input is stepped up by means of a high-voltage transformer and the current is rectified by the use of an 01-A tube. In this connection the grid and plate of the tube are connected together at the socket so that the tube performs actually as a half-wave rectifier. The output voltage appearing across a-b is controlled by adjusting an arm which contacts taps on the high-voltage transformer. The maximum output voltage available is in the neighborhood of 700 volts dc. The "Regulator Control," a wire-wound rheostat, permits small intermediate voltage changes as well as limiting the current passing through the device on a short-circuit condition.

The Neon Tube

A special neon tube having a low striking voltage is connected in the negative return. In parallel with the neon tube are connected three resistors of various values and a flash control condenser C1. The condenser or each resistor may be connected in the circuit by means of the "Leakage Control" arm.

For testing condensers of the solid dielectric type such as paper, mica, or oil, the "Leakage Control" is set to position No. 2 and the other controls set to give the highest voltage output. The condenser to be tested is connected across the output of the device marked "Test." Connected in this manner the circuit is actually set up as a relaxation oscillator, in which actually the effective dc resistance of the condenser under test will be indicated.

How It Works

When the condenser CX to be tested is applied across the test terminals, and if the condenser is good, a charging current will immediately flow through the condenser CX, charging up condenser C1 to a potential sufficiently high to cause the neon glow tube to ignite. As soon as the condenser CX has become charged, the charging current will stop flowing, the potential across C1 will disappear and the neon tube will become extinguished. The effective resistance of CX, however, will allow a minute current to continue to flow through the test circuit. Gradually C1 will be charged to a voltage sufficiently great to again cause the neon tube to ignite. When this occurs, the voltage across C1 will drop until again the neon becomes extinguished. Current, however, continuing to flow through the effective resistance of CX will continue to charge C1 to the striking voltage of the neon tube. This process will continue and alternately the neon tube will ignite and extinguish.

The lower the effective resistance of the condenser CX, the greater will be the leakage current flowing through the test circuit, and the sooner will C1 become charged to the striking voltage of the neon tube.

Neon Flash Rate

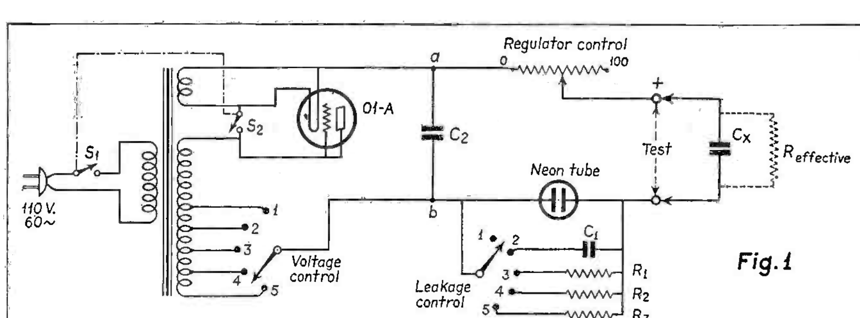
A newly made condenser having high effective resistance will permit such an extremely minute current to flow through the test circuit, that the flashes of the neon tube will be infrequent, sometimes as much as five or ten minutes apart.

Old or poor condensers having a low dc resistance will cause the period of oscillation and consequently the flashing rate of the neon tube to be as fast as one flash a second and faster. Faster rates of flashes than these indicate very poor condensers, which should be replaced or should not be used.

The period of oscillation of the circuit is dependent on several factors: First, the voltage appearing across points a-b; second, the effective resistance of the condenser under test; third, the capacity of the flash control condenser C1, and fourth, the characteristics of the neon glow tube.

Low Capacity Testing

Condensers ranging in capacity from .05 mfd to approximately 50 mmfd are tested with the "Leakage Control" set to position No. 1. In this case the circuit does not operate as a relaxation oscilla-



Schematic circuit of relaxation oscillator.

*Engineering Dept., Tobe Deutschmann Corp.

tor. However, charge and discharge currents as well as leakage resistance are indicated.

On either setting No. 1 or No. 2 of the "Leakage Control," shorted condensers will cause a steady bright red glow of the neon tube and open condensers will not allow the initial charging current to flash the neon tube.

"Intermittent" Condenser Testing

Condensers of an intermittent nature when connected to the test circuit will start out by causing a certain rate of flash of the neon tube and after a few seconds of operation, due to an internal resistance change in the condenser, the rate of flash of the neon tube will change likewise. Frequently, the intermittent condenser will open while on test, in which case the flashing of the neon will become interrupted. When the connection is made again internally, the flashing of the neon will continue.

Testing Electrolytics

Resistors R1, R2, and R3 are used only in testing condensers of the electrolytic type. Here the circuit functions mainly as an indicator of high leakage current in the test circuit.

Voltage, regulator, and leakage controls are set to the voltage rating and capacity of the condenser under test. Upon application of the condenser to the test clips of the instrument, a charging current will flow through the output circuit as well as through the resistors connected to the "Leakage Control," causing an immediate glow of the neon tube.

Superimposed on this charging current will also be the current due to the dielectric structure or the dc resistance of the test condenser CX. The greater the leakage current flowing through the leakage control resistor, the greater will be the voltage across this resistor and consequently across the neon tube. As a result the neon tube will remain ignited until the leakage current flowing through CX falls to an acceptable value.

At this point, the voltage appearing across the resistor in parallel with the neon tube will fall below the striking voltage of the neon and the light will become extinguished. This indicates the condenser is satisfactory and may be continued or placed in service.

Too high a leakage current would cause the voltage across the neon tube to continue higher than the striking voltage, in which case the neon would remain ignited continually.

Here again a short circuit condition would cause a bright red glow of the neon and an open condenser would not permit the initial charging flash nor the leakage current to strike the neon tube to the ignition point. No flashing of the neon tube, of course, will take place in testing the electrolytic type of condensers.

High Resistance Testing

The circuit shown may be used with the "Leakage Control" set to Position 1 for testing high resistances in the order of 100 to 5000 megohms, such as the resistance of cable insulation, the insulation used in transformers from winding to the case, the quality of the cables used in automobile engines for connections from spark coils to spark plugs, etc.

Safety Switch

Switches S1 and S2 are controlled by the same tumbler. When switch S1 is closed, switch S2 is open. However, when switch S1 opens, switch S2 connects the plate of the 01-A tube to the filament. This operation discharges the test condenser and thus eliminates danger of shock to the operator.

Undoubtedly a great many uses will suggest themselves to the enterprising Service Man who uses this instrument.

DIODE AND AVC IN BATTERY SET

(See Front Cover)

The Philco Model 34 is the first receiver of its type we recall seeing which has both diode detection and delayed automatic volume control. The combination is unusual for this type of receiver because it is battery operated, and employs the "30-series" 2.2-volt dry-cell tubes.

Circuit Operation

Referring to the circuit on the front cover, it will be seen that the type 30 second detector tube is connected to function as a diode, the plate of the tube being tied to the grounded end of the filament circuit. The grid of the tube acts as the usual diode plate. The diode load circuit is composed of the resistor R and the volume-control potentiometer R-2. Therefore a signal voltage impressed on the grid of the tube will develop a signal voltage in the load circuit, R, R-2. The extent of the a-f signal voltage impressed on the grid of the type 32 a-f tube depends upon the position of the potentiometer arm.

Delayed AVC

Now note the resistor R-1. This resistor connects from the point between R and R-2 to the positive terminal of the 3-volt "C" battery. The negative terminal of the "C" battery is common to the grid return circuits of the first detector and i-f tubes, this connection being marked "AVC Line."

It is evident that under no-signal conditions, a negative bias of 3 volts is placed on the grids of the first detector and i-f tubes. Also, the diode of the second detector is approximately 3 volts positive, since the positive terminal of the "C" battery connects to the diode circuit through resistor R-1, which is above ground potential.

The no-signal conditions are then: 3 volts negative bias on r-f and i-f tube grids, approximately 3 volts positive on second detector diode. The receiver is in the condition of maximum sensitivity, the 3-volt negative potential representing the initial bias.

When a signal voltage is impressed on the diode, its value must be sufficient to overcome the positive bias before diode current will flow in the load circuit. The avc action is therefore delayed. However, when the signal voltage reaches a value sufficient to overcome the positive bias, voltages are developed in the diode load circuit, these voltages being negative with respect to ground. The negative dc voltage developed in the diode circuit bucks the positive battery voltage with the result that the actual negative voltage with respect to ground is increased above the "C" battery voltage. Since the filaments of the first detector and i-f tubes in the receiver are grounded, as is the filament of the diode detector tube, this added negative voltage value is transmitted to the detector and i-f tube grids. Thus, the negative bias is increased with an increase in signal voltage and avc action results.

Silver-Marshall Type R

No reception, no plate voltage on 27 second detector. Caused by shorted uncased 0.5-mfd, 200-volt condenser (C-11 in diagram). Replace with 0.5 mfd, 400-volt unit.

Crosley 173 and 173-5

Models 173 and 173-5 are 6-tube, dual-band superheterodynes brought out in the fall of 1933. Model 173 is designed for operation from 110 volts d-c or 60-cycle a-c. Model 173-5 is designed for operation on 110 volts d-c or 25- to 60-cycle a-c.

The circuits of the two sets are similar except for the filter system. In Model 173-5 a different filter choke is employed (G6-28069) and the .05-mfd, 200-volt condenser which shunts the filter choke in the Model 173, is omitted.

Both of these receiver models can be used with the Crosley Model 38 power pack and remote speaker (See page 17, January, 1934 issue of Service).

RCA 44 and 46

Distant reception very poor, all voltages and tubes O. K. This set somehow seems to develop misalignment of the variable condenser stators. Remedy: Re-align by loosening the stator-supporting set screws and centering the plates.

General Data . . .

Wells-Gardner No. 05AA

This is a 5-tube ac-dc superheterodyne, similar in many respects to the former 05A Series receivers. The changes which have been made are as follows:

Referring to the accompanying circuit diagram, it will be noted that a 6C6 tube is used as the first detector and oscillator, a 6D6 tube is used in the i-f amplifier stage and a 6D6 tube is employed as second detector.

Oscillator bias voltage in the first detector is obtained by means of a grid resistor and condenser, replacing the cathode resistor as used formerly in the 05A Series. Resistor R-1 and condenser C-2 are assembled on a terminal strip with the grid cap. Grid-circuit rectification is used in the second detector, replacing the bias detector as used formerly. Here also the resistor R-5 and condenser C-3 are made up in an assembly with the grid cap.

An r-f choke has been inserted in the "B" line, as shown. No external ground is required with this receiver.

The tube arrangement from left to right on the chassis is as follows: 6C6 detector-oscillator, 6D6 i-f amplifier, 6D6 second detector, 25Z5 rectifier, and behind the rectifier the type 43 power pentode.

Condenser Alignment

There is no ground lead on the receiver, and the ground lead of the signal generator should therefore be connected to the metal subpanel of the chassis through a condenser of approximately .05 mfd.

As the i-f transformers are self-tuned, no i-f alignment at the intermediate frequency of 262 kc is required. The 1400-kc trimmers on the tuning condenser are first adjusted at this frequency and the 600-kc trimmer, next to the "Broadcast-Shortwave" switch, is then adjusted. The setting of the 1400-kc trimmers is then rechecked at 1400 kc.

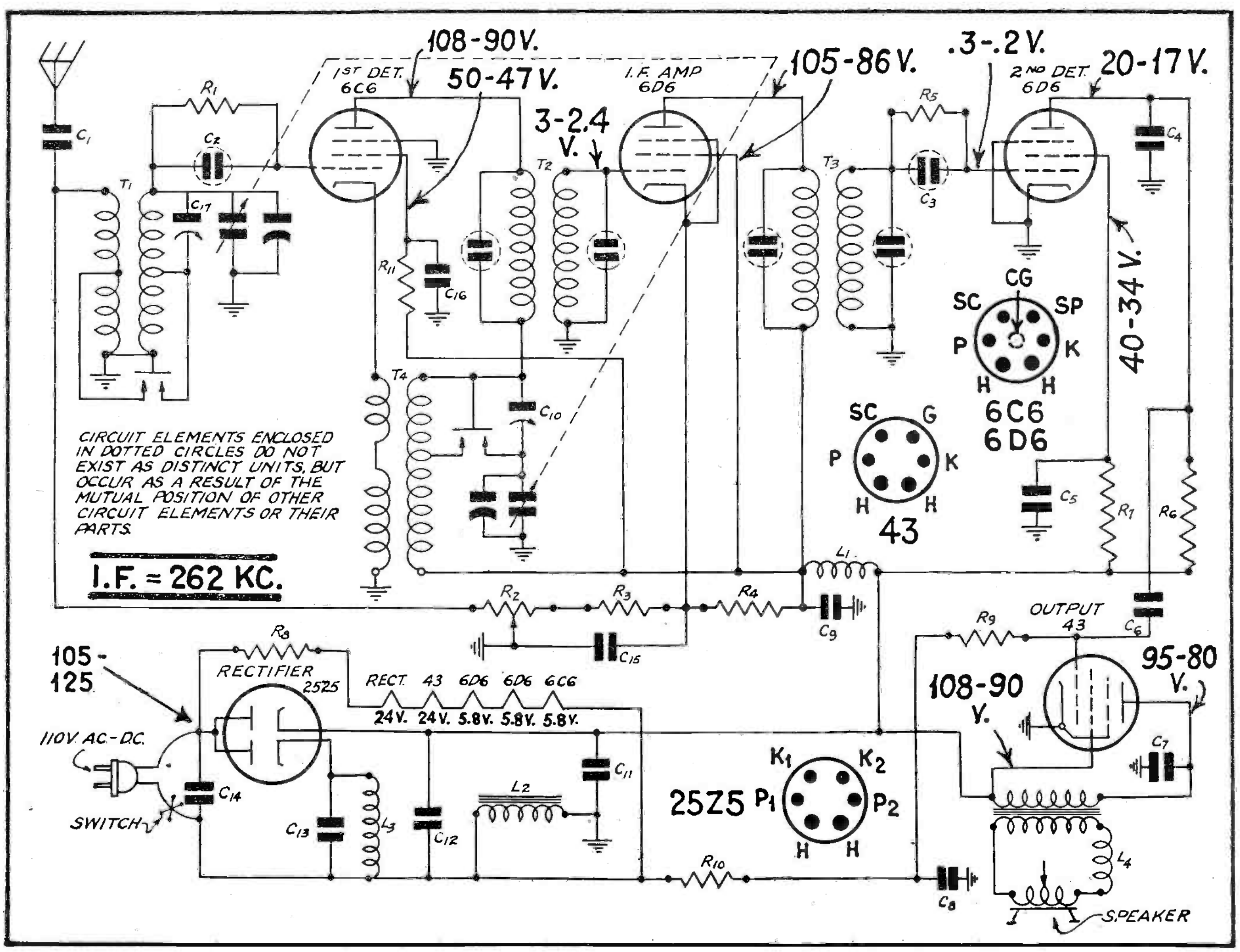
Next turn the "Broadcast-Shortwave" switch to the short-wave position and set the signal generator for 3000 kc. Turn the tuning condenser to maximum output and adjust the antenna short-wave adjusting condenser, which is mounted at the end of the chassis over the tuning condenser.

Since the chassis of this receiver is hot, it should be placed on an insulated surface for servicing and the person doing the servicing should keep from coming in contact with any ground.

Voltage Readings

Both the ac and the dc voltage readings are given in the diagram; the higher voltages are the ac readings. The ac and dc plate and screen voltages on the second detector cannot be read except with a 1,000,000-ohm meter. The grid voltage for the 43 power pentode should be read across the filter choke. The ac and dc voltages given for the 25Z5 rectifier are the readings from plate to two cathodes.

In taking voltage readings, connect antenna to subpanel and set volume control at maximum. Take readings between element and cathode.



Circuit of Wells-Gardner No. 05AA.

Silvertone 7118, 1708A, 1760 Rectifiers

The receiver models listed above employ type 83V rectifiers and type 42 power tubes.

In any of these models, do *not* use a 5Z3 rectifier tube in place of the type 83V since the combination of a quick-heater rectifier with a slow-heater output tube would result in condenser voltages too high for safety before the type 42 power tube became sufficiently heated to draw its proper plate current.

•

Stromberg-Carlson No. 69 All-Wave Selector

The No. 69 All-Wave Selector contains the frequency-changer circuits of a superheterodyne system which, connected to the input of a standard broadcast receiver, gives an extension of the tuning range from 1,500 kc to 25 megacycles. For installation details and antenna connection details see page 221, June SERVICE.

CIRCUIT DESCRIPTION

The diagram for the No. 69 All-Wave Selector is shown on this page. A 6D6 tube is used in the r-f stage and is self-biased by the voltage drop in the 300-ohm cathode resistor. A 6A7 tube, connected to function as a pentode, is used as first detector or modulator. This tube is also cathode biased. Grid No. 1 of this tube is connected through a small capacity to the plate of the type 76 oscillator tube. The oscillator voltage is therefore impressed on grid No. 1 of the 6A7 tube for the purpose of frequency conversion.

The plate circuit of the 6A7 tube feeds an iron-core i-f transformer tuned by condenser C-16 to a frequency of 545 kc. The i-f output of this circuit is fed to the input of the broadcast receiver through the coupling condenser C-18, which keeps high voltage from entering the primary of the broadcast-receiver antenna transformer.

It will be seen that the No. 69 Selector has its own power supply. It is interesting to note that the heaters of all the tubes, including the rectifier, are supplied from a single winding on the power transformer. This is possible since the type 84 rectifier used has a cathode which may be isolated from the heater circuit of the tube.

Band switching is accomplished in the usual manner. There are separate antenna, r-f and oscillator coils for each of the three bands, and a fourth contact on each section of the tandem switch for broadcast reception. The switching in the antenna circuit is so arranged that a doublet antenna may be thrown into circuit when operating the Selector on the two highest frequency bands. (Points C and D on switch section 6T). Point A on each switch section represents the broadcast band position. In this position the long antenna is connected through to switch section 7B and thence to the antenna post of the broadcast receiver. At the same time switch sections in the r-f circuit ground the grids of the r-f and modulator tubes, and cut out the r-f transformers. The grid of the oscillator tube is also grounded, and the voltage reduced on the plate of this tube, so that it ceases to oscillate.

Another section of the same tandem switch is used to light different colored lamps for each band. These lamps also obtain their current from the single low-voltage winding on the power transformer.

VOLTAGE READINGS

The voltages given in the diagram were obtained by measuring between the various tube socket contacts and the bases with the tubes in place. Values are given for a line voltage of 120 volts and allowance should be made for differences when the line voltage is higher or lower. Use a 1,000 ohms-per-volt meter.

•

Crosley Models and I-F Peaks

The following list includes the intermediate-frequency peaks of some of the more recent Crosley receivers. For an additional listing, see page 17 of the January, 1934, issue of SERVICE.

Models	*I-F Peaks*
103	181.5
167	456.0
178	456.0
179	181.5
181	456.0

The model 103 is an auto receiver.

•

Philco Model 16 Change

Starting with Run No. 15, a No. 30-4125 tubular condenser, .006 mfd, will be added to Model 16 receivers. It will be connected between the plate of the 77 tube and the tone control. This gives a smoother variation in control and prevents too great a change in tone from one step to another.

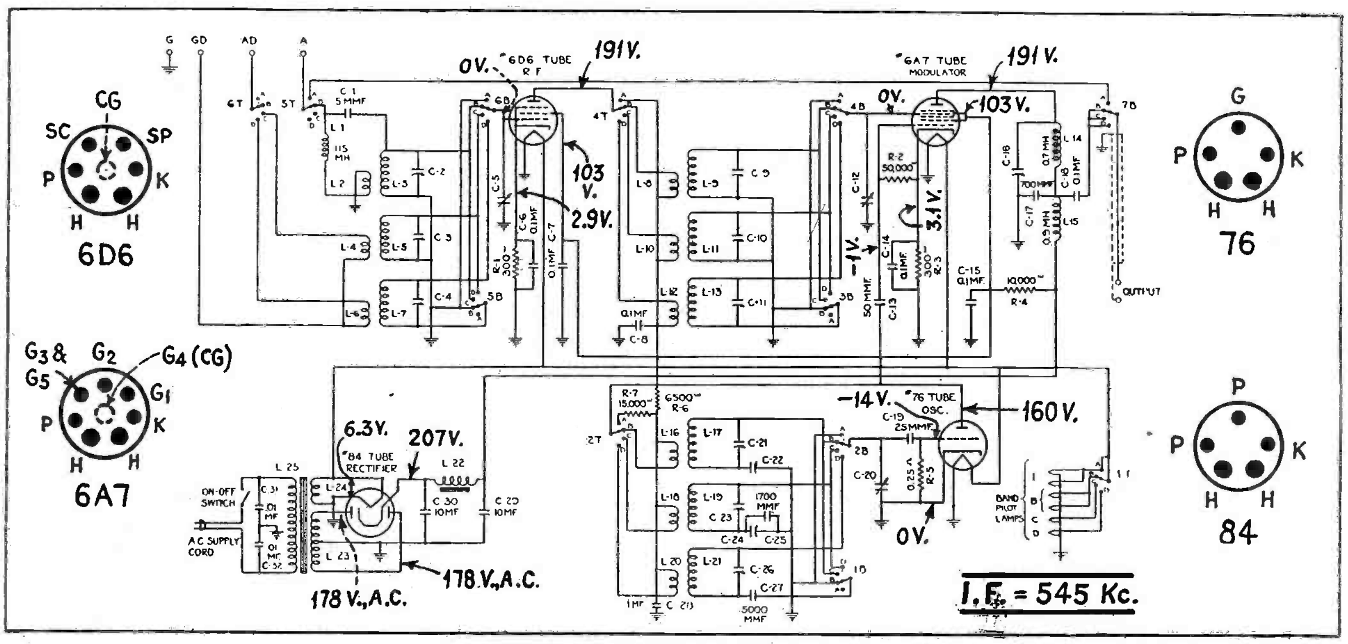


Diagram of Stromberg-Carlson No. 69.

Fada Model NA

This chassis, used in receiver Models 141 and 141-Z, employs a band-pass circuit to improve selectivity and image ratio, and a 6A7 tube as mixer and oscillator. The police waveband is covered by shorting a portion of the oscillator coil (switch indicated by X in the diagram).

The Circuit

The mixer feeds a 6D6 tube through an i-f transformer peaked at 265 kc. The second i-f transformer is coupled to a type 37 tube used as a diode. The output circuit of the diode second detector contains the AVC feed line which places AVC voltage on the grids of the mixer and i-f tubes. The diode output circuit also contains the volume-control potentiometer across which may be shunted a 50,000-ohm resistor for reducing the input to the audio tube. This is accomplished by the "Local-Distance" switch, being in the "Local" position when closed.

The type 77 first a-f tube is a pentode and is cathode biased. Note that there is also a coil in the cathode circuit of this tube. This is a hum-bucking choke and functions very much the same as the usual type of filter.

The 77 tube is resistance coupled to the type 42 power pentode. This tube is also cathode biased, and has the tone control in the grid circuit. The effectiveness of the tone-control by-pass capacity depends upon the position of the arm of the potentiometer resistance.

Adjustments

In order to adjust accurately the various trimmer condensers of the receiver it is necessary to use a well-shielded test oscillator capable of providing a modulated carrier frequency which can be accurately attenuated at 265 kc, 600 kc and 1400 kc.

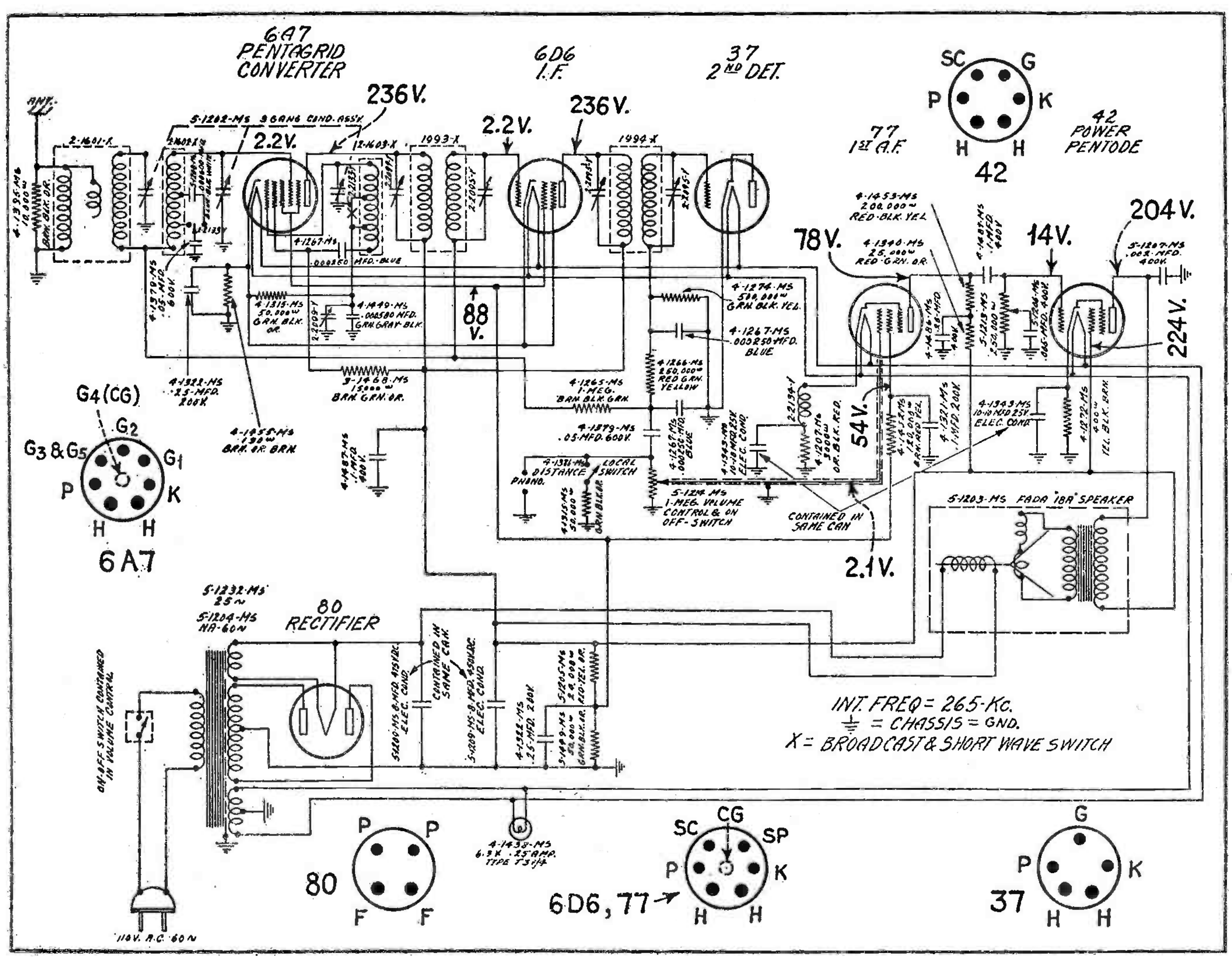
Since the receiver has AVC, it is necessary to set the manual volume control to its maximum position, to assure accuracy in alignment. To control the signal output of the receiver it will be necessary to use the attenuator control of the test oscillator.

I-F Adjustments

The four i-f condensers are spread about a bit. When facing the front of the chassis, the third i-f condenser nut will be found below the right side of the speaker. When facing the rear of the chassis, the first i-f nut is on the left side and the second i-f nut a bit further on to the right. The fourth i-f nut is reached from the top of the chassis and is directly behind the speaker.

Proceed as follows: Disconnect the antenna from the receiver and connect a lead wire from the output post of the test oscillator to the control grid of the 6A7 tube. *Do not remove the control grid connection from the tube nor remove the tube shield.* Then connect the ground lead (slate) of the receiver to the ground post of the test oscillator. In the event that the test oscillator used does not have a dummy antenna system, connect a 250-mfd condenser in series with the lead wire.

Now connect the output meter across the secondary of the output transformer (which is mounted on the speaker) so



Schematic for Fada Model NA.

that the variations in signal output can be noted. Then set the test oscillator to 265 kc and regulate its attenuator so that the output signal is low enough to insure accuracy in adjusting the i-f condensers of the set. Then, with the aid of a No. 4 socket wrench, adjust the four i-f condensers to resonance as indicated by the greatest swing of the needle of the output meter.

Alignment of Gang Condensers

The compensators are located at the top of their respective tuning condensers and can be adjusted with the aid of a screwdriver. Adjust the rear compensator first, the front compensator second, and the center compensator last.

For these adjustments, connect the test oscillator to the antenna and ground leads of the receiver and adjust the output of the oscillator to 1400 kc. Then set the receiver tuning dial to 1400 kc and adjust the compensators, in the order mentioned, for maximum output. In making these adjustments the receiver volume control should be at maximum and the output adjusted by the test oscillator attenuator.

Oscillator Series Condenser

The oscillator series compensator can be adjusted through the hole in the right hand side of the chassis.

Set the carrier frequency output of the test oscillator to 600 kc and set the receiver tuning dial to 600 kc. Then, with the aid of a No. 4 socket wrench adjust the oscillator series compensator for maximum output. To insure perfect adjustment it is necessary to rock the gang variable condenser in order to follow the maximum signal output.

After the oscillator series compensator is properly adjusted, turn the receiver tuning dial to 1400 kc and set the test oscillator to the same frequency. Then readjust all variable condenser compensators as previously outlined.

Voltages

The voltages given are based on a line voltage of 115 and were read with a 1000-ohm-per-volt meter. The plate and screen voltages for the 77 a-f tube are approximate. The grid voltages can not be read at control grids due to series resistors. They should be measured across each respective bias resistor.

The voltages across the electrolytic condensers 5-1209-Ms are as follows: First section, 361 volts; second section, 238 volts. The potential across the 2000-ohm speaker field is 123 volts.

Westinghouse WR-20

This is one of the new Westinghouse ac, dc receivers, for operation on a 100- to 135-volt line, and for operation on a 220-volt ac or dc line by the utilization of a ballast adapter.

Circuit Description

It will be seen from the accompanying diagram that the WR-20 is a tuned-radio-frequency receiver, employing a 6D6 as r-f amplifier, 6C6 as power detector, and a 38 pentode as power amplifier.

The receiver antenna transformer employs both inductive and capacitative coupling. A high impedance is used in the plate circuit of the r-f tube, to obtain high gain, and the coupling is principally capacitative.

Volume is controlled in the antenna-cathode circuit of the r-f tube, a variation of the control resistance simultaneously increasing or decreasing the bias on the r-f tube and decreasing or increasing the resistance in shunt with the primary of the antenna transformer.

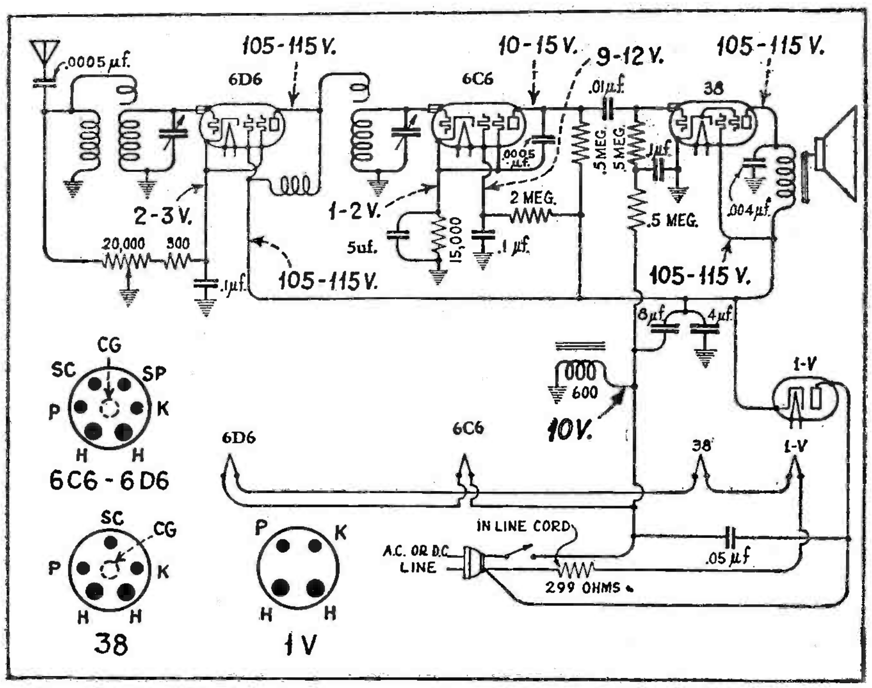
Bias for the detector tube is obtained by the drop in voltage across the 15,000-ohm cathode resistor. The type 38 power tube is biased by the voltage drop across the 600-ohm filter choke in the grounded leg of the plate supply circuit.

The 299-ohm filament-dropping resistor is a part of the line cord. For this reason the cord should not be shortened by cutting out a section.

Voltage Readings

The ac and dc voltage readings are given in the diagram. These readings should be taken with the volume control full on and the set tuned to 550 kc. Though the voltages will not change materially when the set is operated from a dc line, the lower values are more in order.

The set may oscillate if the antenna wire is laid too close to the cabinet.



Westinghouse WR-20 diagram.

A.K. Battery Models

A.K. Battery receiver Models 387 and 427Q have a "B" consumption ranging from 20 to 27 ma depending on signal strength and volume level. The average is 25 ma. (The latest 387 and 427Q receivers have a police switch for both police bands.)

The "B" consumption of Models 165Q and 525Q is from 16 to 24 ma depending on signal strength and volume level. The average is 22 ma.

"Universal Analyzer"

A glance at the circuit diagram of the "Universal Analyzer," on page 218, June SERVICE, will show that the shorting button is omitted. This button connects across the two pin jacks marked + and —, just to the left of the rectifier tube.

Also, the value of the condenser to the left of the selector switch should be 0.1 mfd., rather than 1 mfd. as indicated.

It should also be noted that both sides of the ac outlet plug connect to the same side of the line. The upper terminal of the receptacle plug should connect to the lower rather than the upper lead of the ac plug.

Philco Model 19

The circuit shown here is for the Philco Model 19, Code 128. This chassis is of the dual-wave type covering the frequency range of from 550 to 3260 kc, in two steps. The short-wave band is reached by shorting sections of the r-f and detector secondary coils. Note that the range switch which accomplishes this is in tandem with the power switch.

Bias for the grids of the r-f and i-f tubes is obtained from the drop in voltage in resistor (7) which is common to both cathodes. This is the steady or minimum bias. The grids of these two tubes are tied in with the AVC circuit, the AVC voltage being supplied by the diodes of the type 75 tube.

The diode load circuit contains the resistor (23), the compensated volume control potentiometer (40), and the tone control (47) made up of condensers (48), *and condensers* (31) *in the plate circuit of the type* 42 *power tube.*

Bias for the grid of the 75 triode is obtained from the drop in voltage in the resistor (52) in series with the center tap of the power transformer and ground. This resistor also supplies the bias for the grid of the 42 power tube. In this case the bias is the voltage drop across the entire resistor.

The Shadow Tuning Meter is connected in the plate circuit of the i-f tube.

Voltages

The voltages given are based on a line voltage of 115, and were read with a high-resistance voltmeter from the underside of the chassis, with test prods. When taking these readings the station selector should be set at 550 kc and the volume control set at maximum. Do not take these readings with a plug-in adapter as they will not be reliable.

Adjustments

If it is necessary, the i-f transformers should be peaked at 260 kc. The adjusting screws will be found on the rear chassis wall. They are, from left to right: first i-f primary, first i-f secondary, and second i-f primary. The secondary of the second i-f transformer is self-tuned.

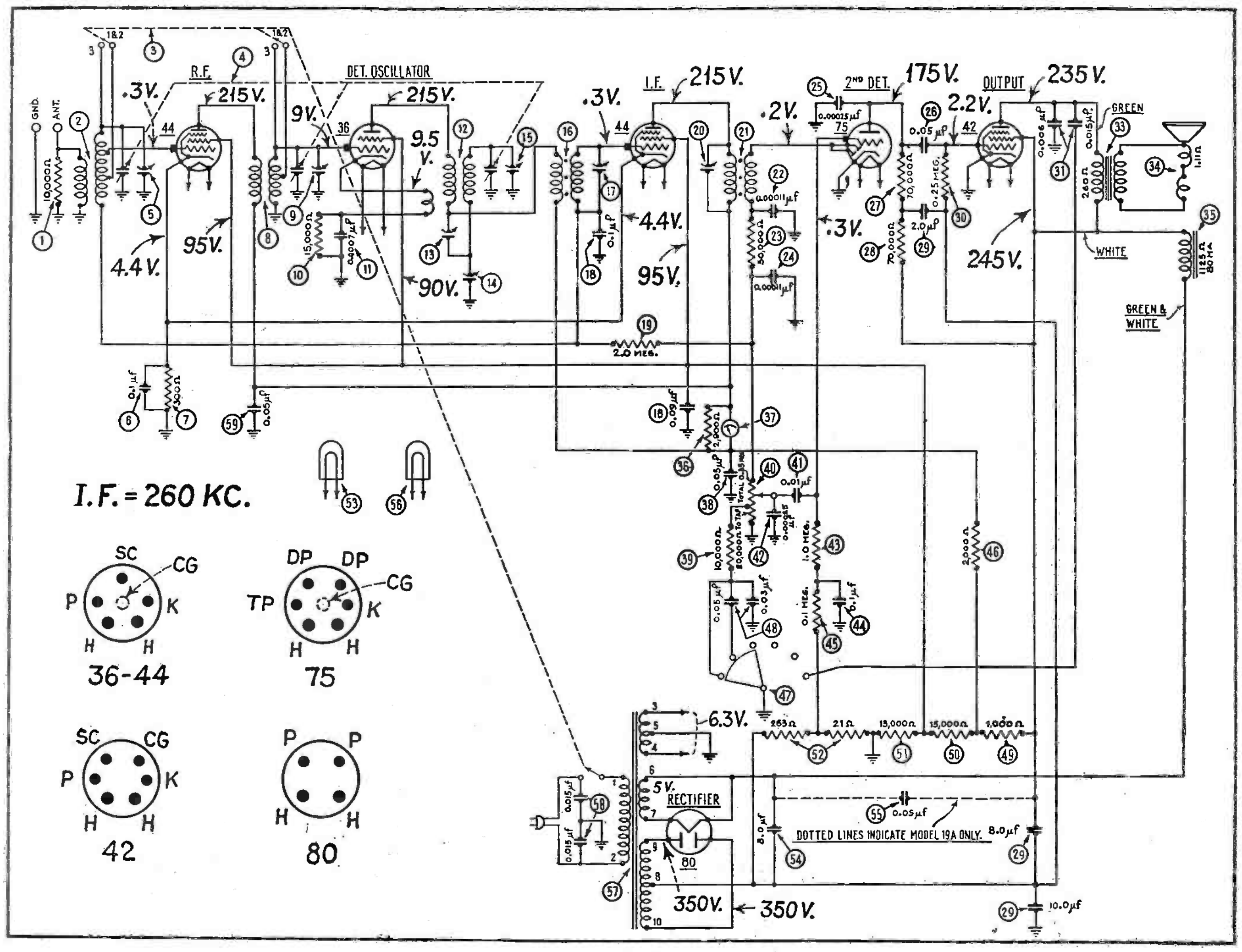
The compensating condensers are mounted along the front of the gang condenser. The extreme left condenser is the high-frequency oscillator compensator. This should be adjusted at 1400 kc—with the test oscillator set at that frequency. Next comes the detector compensating condenser, and to the extreme right the antenna compensating condenser. These should also be adjusted to 1400 kc, in the order mentioned.

The last adjustment is that of the low-frequency compensating condenser which is accessible from above the chassis through a hole just to the rear of the antenna gang condenser. This adjustment is made with the test oscillator set at 700 kc.

A final re-setting of the high-frequency condenser—with the test oscillator at 1400 kc—is desirable.

Philco Model 34 Change

Starting with Run No. 3, Model 34 will be equipped with a 4-point tone control instead of a 2-point. The Part No. of the new control is 30-4168, which replaces 30-4152.



Philco Model 19 schematic diagram.

Auto-Radio . . .

Colonial Model 164

This 6-tube superheterodyne receiver is similar in many respects to the Model 164B which has a plug-in type vibrator unit. The following data on the Model 164 applies to all receivers having a serial number below 50600.

Receiver Circuit

It will be seen from the accompanying diagram that a 78 r-f amplifier feeds the incoming signal to the 6A7 detector-oscillator. The 175-kc output of this tube is amplified by the 78 i-f stage and then fed to the 6B7. This duplex diode pentode provides avc, diode detection, and pentode a-f amplification. The audio output of the 6B7 is fed to the 41 output pentode.

The plate supply is of the vibrating-reed type with an 84 rectifier tube.

AVC and Sensitivity Control

The 175-kc output of the 78 i-f stage is impressed between the cathode and diode plates of the 6B7, in series with R-10, R-11 and R-12. The diode current flowing causes a voltage drop across these resistors. Only the drop across R-12 is used for avc. Since the grid returns of the 6A7 and 78's are connected to R-12, the negative bias across it is impressed upon the grids of these tubes. Increases in signal strength are offset by decreases in tube amplification resulting from this increased negative bias. The effect is to tend to maintain the output of the 78 i-f at a constant value.

Residual bias for the tubes is furnished by R-2. In addition, the residual bias, and therefore the tube amplification, is affected by the setting of the Local-Distance switch. When the switch lever is on contact No. 2, the drop across R-13, due to the plate current of the 6B7, bucks the residual bias from R-2, decreasing the total negative bias and increasing tube amplification. In the "Local" position, contact No. 3, only the residual from R-2 is applied to the tube grids.

Be sure the sensitivity control is either *full* clockwise or *full* counter-clockwise. If allowed to remain halfway between the two positions, R-13 will be shorted, removing the 6B7 bias.

The volume control shunts R-11 and R-12 for audio frequencies. Accordingly, any desired amount of the audio component across R-11 and R-12 can be picked off by the movable arm of the volume control and fed to the control grid of the pentode portion of the 6B7. It is there amplified and then resistance-capacity coupled to the 41 pentode output tube.

I-F Tuning Adjustments

When peaking the i-f stages, use a low enough output from the test oscillator to render the avc action inoperative. The screw adjusts the primary tuning condenser; the nut adjusts the secondary.

R-F Tuning Adjustments

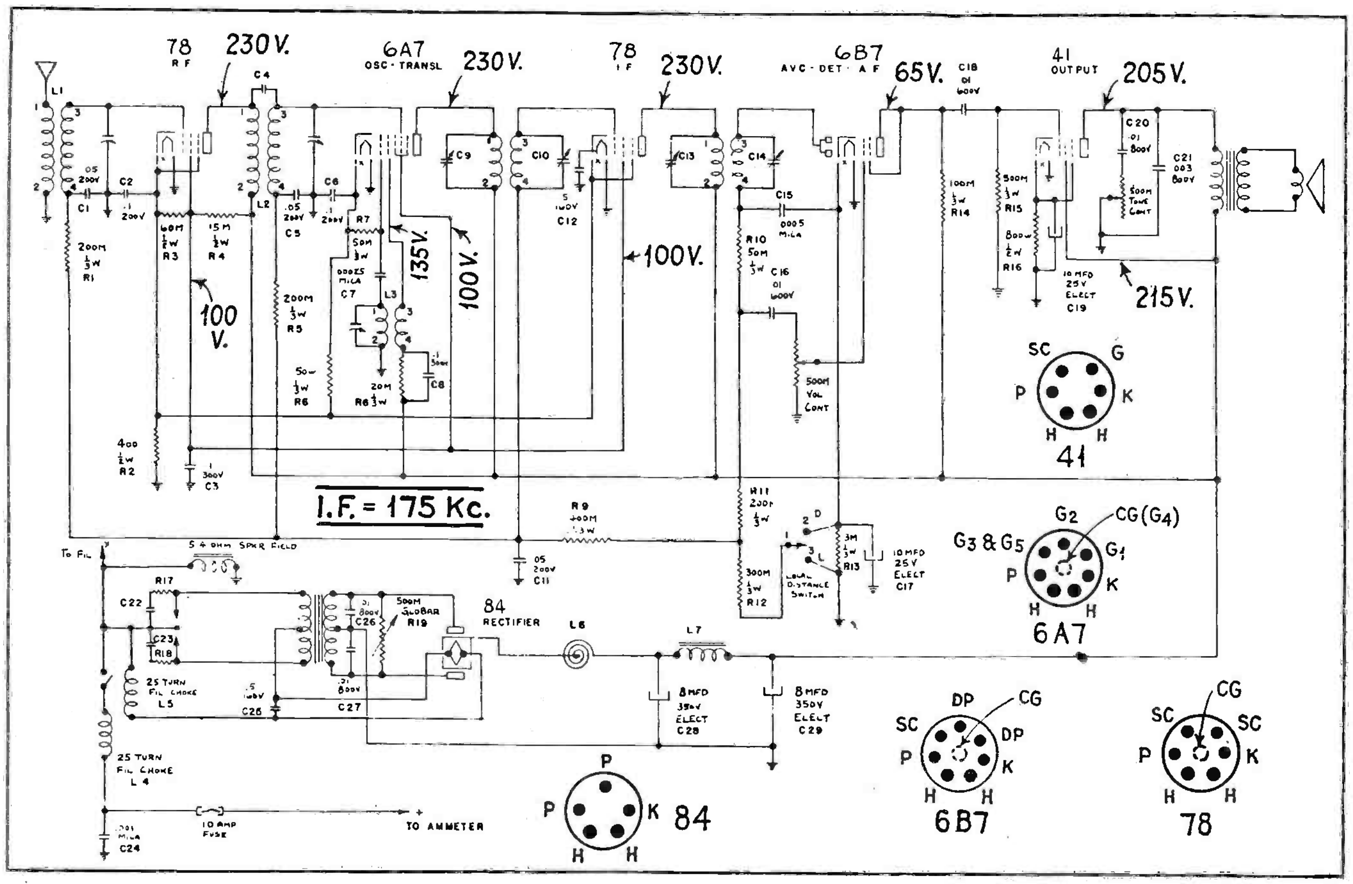
There are three holes at the back of the chassis through which the condenser trimmers are accessible. The unit nearest the control end of the chassis is the r-f unit. The next one is the detector and the last one the oscillator.

Any trouble with oscillation will be due to proximity between grid and plate leads of the r-f and i-f stages. Moving the leads apart will correct the trouble.

Speaker Adjustment

Should the speaker cone ever need centering, it will be necessary to remove the speaker from the chassis. Two screws, their heads accessible from the under-side of the chassis, hold the speaker to the chassis.

Loosen the two nuts and screws that



Circuit of Colonial 164.

hold the cone spider, insert thin paper spacers between the pole piece and voice-coil support, and re-tighten the spider nuts and screws. Then remove the paper spacers.

Notes on the remote control unit of this receiver will be found on page 225 of the June 1934 issue of SERVICE.

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Stewart-Warner R-117 Chassis

An occasional customer may complain that the intensity of illumination of the dial of the new Model 1171 auto-radio interferes with night driving.

For complaints of this sort, the 15-ohm pilot light resistor (No. 51 in the temporary circuit diagram) should be removed and a new 35-ohm resistor (Part No. 84197) be substituted in its place.

The use of the 35-ohm resistor will materially reduce the voltage on the dial pilot light, thus reducing the illumination considerably.

•

Stewart-Warner Model R-112

The volume and tone quality of the Stewart-Warner receiver Models 1121 and 1122, using Model R-112 chassis, may be improved by making the changes listed below. A complete schematic diagram for the R-112 chassis appeared on page 22, of the January, 1934, issue of SERVICE. The changes are as follows:

(1) Increase the voltage on the plate of the output tube. This is done by disconnecting the B plus (yellow and red lead) side of the output transformer from the screen grid terminal of the output tube and connecting it to the high-voltage side of the combination relay and filter choke. The most convenient point to do this is at the cathode terminal of the rectifier tube. This will raise the plate potential about 40 volts.

(2) Change the grid resistor of the 41 tube from 510,000 ohms to 250,000 ohms. This resistor is enclosed in a piece of large spaghetti and is connected from the grid of the 41 tube to ground.

(3) Change the permanent tone-control condenser (No. 29 in the original diagram) which is connected to the plate of the output tube, from .01 mfd, 600 volts, to .006 mfd, 600 volts.

After these changes are made, it may be necessary to readjust the spring on the relay, since the plate current of the output tube no longer passes through the filter choke and consequently there is less magnetic pull to open the relay. The pull of the spring which tends to keep the contact points closed should be reduced by slightly stretching the spring so that the relay will now both open and close at the reduced currents which operate it.

•

Philco Model 700

This is a single-unit receiver, with dynamic speaker. From Fig. 1, it will be seen that there is a stage of tuned r-f, a type 77 detector-oscillator, one stage of i-f, a type 75 diode detector providing avc for the r-f and i-f tubes, with the a-f triode of the 75 resistance-coupled to a type 42 power pentode.

All five receiver tubes are cathode biased. The volume control is in the grid circuit of the 75 triode. The type 84 rectifier tube functions in conjunction with a vibrator-transformer unit. Both "A" and "B" leads are well filtered with chokes to prevent interference. (46) and (65) are the "A" chokes, (48) the vibrator choke, and (59) the r-f "B" choke.

I-F TRANSFORMER AND PADDERS

The new style i-f transformer, complete with padders, is used in the Model 700. The padders are placed in the top of the shield can one above the other.

The primary padder is adjusted by means of the screw slot, accessible through the hole in the top of the shield can. The secondary padder is adjusted by means of the small hex nut, also accessible through the hole in the top of the shield. (See Fig. 2.)

The coil windings terminate in leads instead of terminal lugs. The color scheme is as follows:

1st I-F TRANSFORMER

Primary—Plate	*White*
Primary—B +	*Red*
Secondary—Grid	*Black*
Secondary—Return	*Green*
Osc. Coil Connection	*Wht. & Blk.*

The 2nd i-f transformer has the same color scheme, but has no oscillator coil connection.

I-F ADJUSTMENTS

Remove the speaker lid from the receiver. Remove the grid-cap terminal from the 77 tube (for location see Fig. 2).

(*Continued on page* 308)

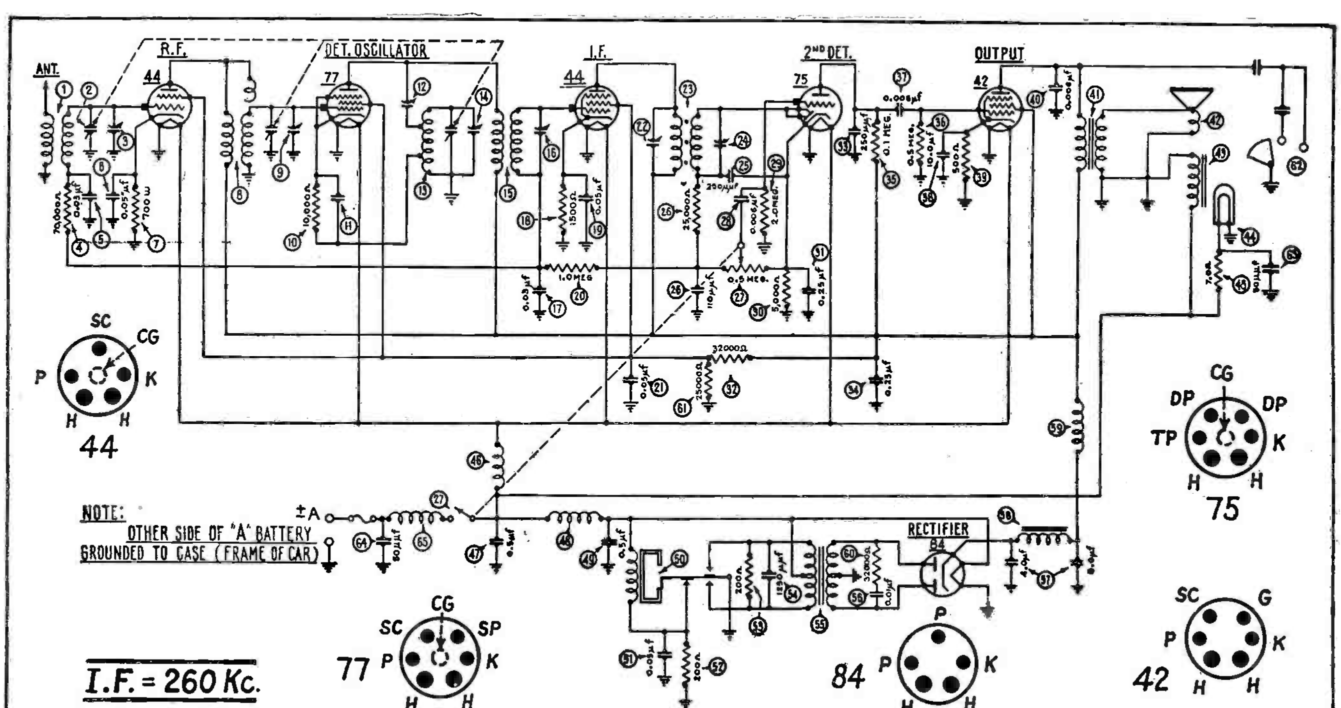


Fig. 1. Schematic of Philco 700.

ASSOCIATION NEWS . . .

EASTERN CONVENTION

Plans are progressing for the Second Annual Eastern Convention of the Institute of Radio Service Men to be held at the Hotel Pennsylvania in New York City, Friday, Saturday and Sunday, October 19-21.

Since the first announcements of the Exhibition and Convention went to the trade a short time ago, more than 30 per cent of the available exhibit space has been subscribed, in spite of the three months elapsing before the date set for the event.

The technical program will follow closely the arrangement that was found highly successful and satisfactory at Chicago last Spring, when certain parts of the speaking time was devoted to "Service Schools" on specific products, and other parts to general discussion of subjects vital to the Service Men.

BOSTON I.R.S.M.

On July 10, the Boston Section of the Institute of Radio Service Men held a meeting at the Statler Hotel. Mr. Church, Special Representative of the Apparatus Design Company, Little Rock, Ark., explained the recent development in test equipment for Service Men. Vice Chairman, Mr. Ingvar Paulsen, presided.

TWENTIETH REGION CONVENTION

The First Annual Convention of the Institute of Radio Service Men to be conducted by the 20th Region of the Institute of Radio Service Men will be held at the Hotel Seneca in Rochester, N. Y., September 16-18.

Exhibits of leading manufacturers and technical sessions with speakers of national fame will constitute the major portion of the three-day meeting. Business meetings at which the principal topic for discussion will be Regional Organization and Development will be held at various times, and representatives of other Sections and other Regions are planning to attend to take part in arranging the program for future development and growth.

The 20th Region of which Rochester is the Key Section, and of which Edgar C. Arnold is the Chairman, comprising the greater portion of the states of New York and Pennsylvania, has taken the lead in the complete organization of the larger units provided for under the organization plan of the Institute. Three new Chapters have been established by the Regional Committee during the last month and plans are laid for more meetings to be held prior to the holding of the Convention.

Frank E. Stubbs, 64 Margaret St., Rochester, is Convention Chairman, and Roy E. Massecar, 1961 Dewey Ave., Rochester, is Chairman of the Rochester Section. Edgar Arnold may be reached at 316 Flint St., Rochester.

NEW YORK SECTION

Mr. W. M. Perkins, Chief of the Applications Laboratory, National Union Radio Corp., addresses the New York Section of the I. R. S. M. on Monday, Sept. 10, on "New Tubes to Replace Old Types and Majestic Type Tubes."

Also, Mr. Hubert L. Shortt is delivering his third lecture on p-a systems, the subject being "Input Equipment Other Than Microphones."

Sept. 24, Mr. J. H. Miller and Mr. O. J. Morelock, Weston Electrical Instrument Corp., will deliver "Practical Demonstration of Weston Radio Equipment." New Weston Equipment will be shown. Herb. Zvorist will conduct a forum.

Meetings will be held in the Pennsylvania Hotel, beginning at 8 P. M.

TWENTIETH REGION PROGRESSES

The New York State Organization in the Twentieth Region, I. R. S. M., is progressing very rapidly. Syracuse will organize at their meeting on August 4, Utica will follow on August 11 and Schenectady on August 18. Preliminary arrangements have been completed for these meetings and good attendance has been promised.

The Twentieth Region is wondering what has happened to the other Regions in completing their organization plans. They have issued a challenge that they will have more Sections and Chapters organized by January 1, 1935, than any other Region. Step on it if you care to accept the challenge!

"THE I. R. S. M. NEWS"

We are looking forward with a great deal of interest to the first issue of "The I. R. S. M. News," a monthly publication ordered by the Board of Trustees of the Institute of Radio Service Men and which we understand is to be in typical newspaper form. Preparations were under way for the first issue to go into the mails on August 10.

Good luck "I. R. S. M. News"! We wish you lots of success in your new venture.

ROCHESTER SECTION

The Regional Advisory Council of the Rochester Section of the I. R. S. M. journeyed to Binghamton on Saturday evening, July 21, and had the pleasure of organizing the latter chapter.

Talks were given by Roy Massecar, Chairman of the Rochester Section, Mr. Harry Hunn, Secretary of the Regional Council, and "Doc" Arnold, Chairman of the 20th Region.

Mr. Ross E. Baxter was appointed temporary Chairman and Mr. Arthur Smith temporary Vice Chairman. The chapter will meet in the very near future and hold an election of officers and appoint the various committees. The class of men who signed as members have all the appearance of go-getters and it is our belief that a group is going to be brought together that will make the others look to their laurels.

RIDER BATS A HOMER—

"Servicing Superheterodynes"

We have before us the revised edition of Mr. Rider's "Servicing Superheterodynes", a book well-known to every Service Man. The new edition is "Dedicated to Janet (two years old) who so kindly kept her mother busy while her father stayed out nights playing with superheterodynes." It appears, therefore, that we owe a vote of thanks to little Janet, for her father has written a book of inestimable value.

There are two ways for an authority to write a book . . . he can sit down and type out all the ready-made knowledge which is his and side-step valuable facts, or he can work like the devil gathering the really important stuff which is obtainable only by digging into reference books and other people's lives. A reading of "Servicing Superheterodynes" leaves no doubt in one's mind that Mr. Rider did some tall sweating before he completed his task.

Let it be understood that "Servicing Superheterodynes" is not the usual type of "revised edition" with a few extra drawings and paragraphs to bring it up-to-date. It is nearer to being an entirely new book, with little in common with the first edition. It is right up-to-the-minute from the very first page.

The first chapter is given over to an explanation of the superheterodyne principle and is enhanced by data on double heterodyning, phase relations, zero beat phenomenon, etc. The second chapter deals with the generation of and the relation between harmonics, one of the most vital subjects in respect to servicing superheterodynes, and covered completely from every angle. A table of fundamentals and harmonics is included.

Chapter 3 explains the different types of superheterodyne circuits, including short-wave sets, followed in chapter 4 by the function and characteristics of each circuit section of a superheterodyne set. Chapter 5 deals with special circuits, such as amplified and delayed automatic volume control, reflexing, high-fidelity, etc.

Chapter 6 is, to our mind, the most valuable one in the book. There are 35 pages listing every possible trouble or symptom of trouble encountered in a superheterodyne, with complete listings of just what to look for in each case. This chapter alone is worth the price of the book.

Chapter 7 deals with the application of test oscillators, which means that this section of the book gives the real dope on adjustment and alignment procedure in all types of superheterodyne circuits. Chapter 8 is given over to vibrator units, a worthy addition. A very complete list of i-f peak frequencies of commercial receivers is given in the appendix.

There are altogether 278 pages in the book, and 94 illustrations.

We are pleased to recommend this book to our readers.

NEW NAME

The Electrical Instrument Service Corporation, Dayton, Ohio, have changed their corporate name to the Jackson Electrical Instrument Company. The change was made in order that the firm name would be associated with the trade name of their products.

The new company is incorporated under the laws of the state of Ohio by charter issued May 4, 1934. All records should be revised accordingly.

ON THE JOB . . .

Preserving Data Sheets

Special data sheets, such as tube charts, resistance tables, color codes, etc., may be preserved from both wear and dirt by treating them with a very good grade of transparent varnish.

The varnish may be applied with a soft brush or, better yet, the sheet to be preserved may be dipped in a pan containing the varnish and then hung up to dry so that any excess varnish will drip off.

If the varnish used is of a good grade, it will not crack when the data sheet is bent. Moreover, the varnish acts as a waterproofing with the result that when the treated data sheet becomes dirty from continued use it may be easily cleaned with soap and water.

GEO. PARKER,
565 *Columbus Ave.,*
New York City.

Majestic Model 50 Volume

The Majestic Model 50 has low volume after being in use for a short time. The 0.04-mfd coupling condenser between the cathode of the first detector and oscillator tube is very leaky, opening up completely at times, and often shorting out entirely. Replace condenser and the intermittent trouble is over.

AUTO-RADIO VOLUME

When low volume is encountered with auto-radio installations and the set operates properly upon removal, look for a high-capacity shielded wire lead from antenna to set. If removing ground from shield restores volume, replace with very low capacity shielded wire. This type of wire has heavy insulation between shield and wire and as a result low capacity. Never leave old shielded wire in the set without making sure there is a ground connection, as motor noise will result.

EMERSON B ELIMINATOR

Many radios using Emerson motor-generator or dynamotor B eliminators for power supply have a tendency to have low volume after several months use. The trouble is generally due to reduced B voltage, caused usually by failure to oil bearings of the generator. This results in reduced speed and hence low voltage. In three recent cases, a couple of drops of oil on each bearing made the set work like new, by increasing the r.p.m.

ECHOPHONE S3

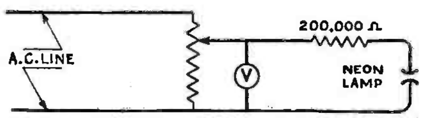
This radio can be improved considerably by replacing the screen-grid voltage resistor (R5) with a 200,000-ohm fixed resistor. The 0.1-mfd bypass condenser generally opens and should also be replaced. This trouble is extremely common with this model set.

ROGER H. HERTEL,
Hertel's Radio Store,
Clay Center, Nebraska.

G. E. Model M-128-R

This is a 12-tube super with automatic phonograph and home recorder. In the recording unit two neon "level indicating" lamps are provided so that a visual indication of the recording level may be obtained at all times.

These lamps normally give long service without attention. However, if failure occurs, and all circuits have been checked and eliminated as possible sources of failure, the lamps may be easily checked as indicated in the accompanying circuit.



The method for checking involves testing for lighting between certain voltages. The lamps must not light before 52 volts have been applied and must not require a voltage greater than 64 volts to cause them to light. Lamps requiring different voltages from these are defective and must not be used.

Silver-Marshall Frequency Drift

One of our large department stores was receiving complaints on several late types of Silver-Marshall receivers. After a set had been in operation for about fifteen minutes, the signal would either drift into the sidebands or drift out completely. In about an hour the dial setting was somewhere between one and fifteen kc away from the original setting.

After much cogitation, we decided that the trouble must lie in the oscillator circuit. Evidently some part was changing capacity or inductance, thereby changing the oscillator frequency. By removing the condenser shield and blowing a blast of cold air over the coil and condenser, we managed to keep the frequency drift down to a point where it was almost negligible.

An interesting method of checking on the frequency drift was used. We tuned a short-wave regenerative receiver to zero beat with one of the higher harmonics of the broadcast receiver oscillator. Let us say that we used the tenth harmonic. Then a change of 10 cycles of the oscillator frequency would produce a beat note of 100 cycles. In this manner we were able to judge immediately if any corrections, made in the oscillator, had cleared the trouble.

To make a long story short, we found the trouble in the high-frequency padding condenser. A slight change in the temperature of the condenser leaf, which was of necessity screwed down fairly tight, caused it to buckle by an infinitesimal part of an inch, changing its capacity and the frequency of the oscillator.

The trimmer was removed and, after the necessary mounting changes had been made, an air-dielectric condenser was substituted. All receivers thus repaired showed practically no frequency drift after the tubes had been allowed time to warm up.

R. O. GOETTMANN,
525 *East Ohio St.,*
Pittsburgh, Pa.

Majestic 90 Intermittent

Dies down gradually and returns to normal suddenly: Replace *both* r-f cathode-bias condensers located under the type 27 tubes. These are 0.5-mfd sections in metal cases.

Simplex Model 6

Simplex Model 6 with dynatron oscillator: Fails to operate on low frequencies or possibly on all frequencies. Replace 700-ohm oscillator cathode-bias resistor with a 400-ohm, 1-watt unit.

Stewart-Warner 102-A

Dial slips. Remove rubber drive wheel and wind one layer of tape on its shaft, then replace wheel.

Intermittent operation: Check toggle switches.

Sparton's with Kellogg Tubes

Weak or intermittent: Re-solder the filament connections behind the wood terminal strip in back of set.

Lyric "J" Hum

Replace bypass condenser from 47 tube grid return to ground, using a 0.1-mfd, 200-volt unit.

RCA R-8

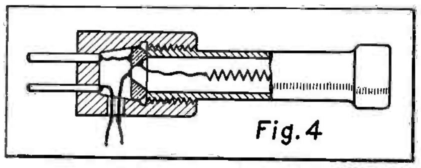
Oscillator won't oscillate over low-frequency range: The resistor from the oscillator control grid to its cathode should be 40,000 ohms. Some read as low as 6,000 ohms.

CALCULATING ELECTRICAL UNITS

PART 2

Practical Example

Let it be required to operate, say, a 110-volt dc receiver on 220 volts dc. It will be necessary to use a resistance in series with the receiver (Fig. 4

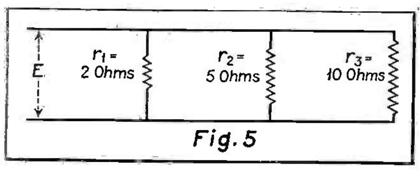


Illustrating a typical series type of receiver wall plug.

shows a common form of plug) which will cause a drop in voltage of 110 volts. In other words, it is necessary to use a resistance of such a value that 110 volts will still be applied to the receiver. If the normal current drawn by the receiver is 0.5 ampere, then

$$R = \frac{E}{I} = \frac{110}{0.5} = 220 \text{ ohms.}$$

Also $W = I^2 R = 220 \times (0.5)^2 = 55$ watts, which is the power dissipated in the resistor. The proper resistor to use will, therefore, probably be a 220-ohm, 60-watt, type, the added wattage being for safety purposes only, or equivalent.



Circuit for illustrating a problem in parallel resistance.

It might also be well to note that series resistors heat and should not only be well ventilated but should also be kept away from inflammable material.

Parallel Resistance

For resistances in parallel, the combined value of these separate resistances will be less than any individual value. In finding the single resistance that will replace the three individual resistances of Fig. 5, we will make use of the following general formulas:

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \text{etc.} \qquad (8)$$

or

$$R = \frac{r_1 r_2 r_3}{r_2 r_3 + r_1 r_3 + r_1 r_2}. \qquad (9)$$

In finding the resistance in this particular case it will probably be a little easier to use the general formula for $\frac{1}{R}$, thus,

$$\frac{1}{R} = \frac{1}{2} + \frac{1}{5} + \frac{1}{10} = \frac{8}{10}$$

$$R = \frac{10}{8} = 1.25 \text{ ohms.}$$

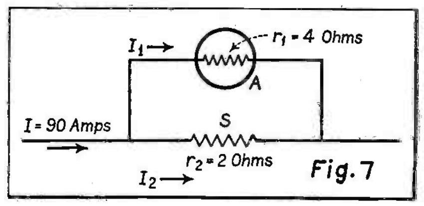
As can readily be seen, this method will apply to any number of resistances in parallel, but the length of calculation increases with the number of separate resistances. In general, then, it will be found much easier to obtain the resultant values from some form of resistance chart similar to Fig. 6.

To use this chart, lay a straight edge on the two resistance values on, say, scale (a) and scale (c), and read on scale (b)... or on (d) and (b), and read on (c). The dotted lines drawn in represent a calculated problem of three resistances of 4 ohms, 6 ohms, and 8 ohms in parallel. Thus, 4 ohms on scale (a) is joined with 6 ohms on scale (c), which indicates the resistance of 2.4 ohms on scale (b). This value is in turn joined with 8 ohms on scale (d), which gives 1.85 ohms on scale (c). This process, of course, may be carried on for any number of resistances. If the values had been 40, 60, and 80 ohms, the answer would have been 18.5.

Meter Shunt

Fig. 7 shows a simple circuit of an ammeter and shunt. For convenience of calculation we have assumed the meter shunt to have a resistance of 2 ohms, though in practice the resistance of the shunt would be more on the order of 0.0005 ohm. The calculation, however, remains the same.

The line current, I, flowing to the shunt and meter is 90 amperes and the ammeter resistance is 4 ohms. Now the current will divide and part flow



Circuit containing an ammeter and shunt.

through the meter and part through the shunt, so that

$$I = I_1 + I_2. \qquad (10)$$

This current, in addition, will divide in such a way that the largest part will flow through the smallest resistance. We may say, therefore, that

$$\frac{I_2}{I_1} = \frac{r_1}{r_2}. \qquad (11)$$

Substituting the values gives

$$I_1 + I_2 = 90$$

or

$$I_1 = 90 - I_2.$$

Also,

$$\frac{I_2}{I_1} = \frac{4}{2}$$

$$I_1 = \frac{I_2}{2}.$$

Therefore,

$$90 - I_2 = \frac{I_2}{2}$$

$$90 = \frac{I_2}{2} + I_2$$

$$I_3 = \frac{180}{3} = 60 \text{ amperes}$$

$$I_2 = 90 - 60 = 30 \text{ amperes.}$$

(To be continued)

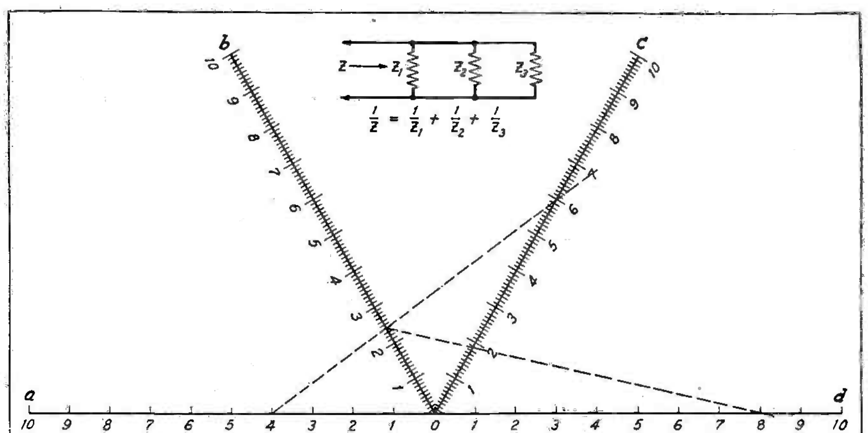


Fig. 6. Chart for finding resultant values of resistances in parallel.

Public Address . . .

NEW AND VERSATILE P-A SYSTEM

By H. G. KUNZ*

IT is an impossible task to set forth a group of specifications covering a sound system which will cover all applications. However, it is quite practical to develop an amplifying system which will meet all of the usual indoor requirements and a great majority of outdoor applications. It is the purpose of this paper to describe in detail the electrical and mechanical specifications of such an amplifier.

Requirements of System

The public-address amplifier must have a sufficiently large power output to cover the associated audience. The power-output rating should be an honest one, based on the maximum output signal voltage with 5% harmonic distortion. In the past year there have been numerous fantastic output ratings fastened to 5-watt amplifiers. The 20-watt amplifier is quite useless if full output can only be obtained with 15 to 20% amplitude distortion. The legitimate tube manufacturer is the most authoritative source of information concerning the power-output rating of vacuum tubes.

Experience in the field has shown that an amplifying system capable of delivering 30 to 40 watts of audio power will meet the great majority of public-address applications. In 50% of these cases an amplifier capable of an output of 15 to 20 watts will prove satisfactory. An audience of 5,000 to 7,000 can be covered by a 20-watt amplifier working into a battery of high-efficiency dynamic speakers. At this point it is well to remember that the full capabilities of an amplifier can only be realized by the selection of an efficient reproducer. Five watts of audio power fed into a high-efficiency speaker is equivalent to 10 watts of audio power using a conventional reproducer.

*Engineer, Kenyon Transformer Co.

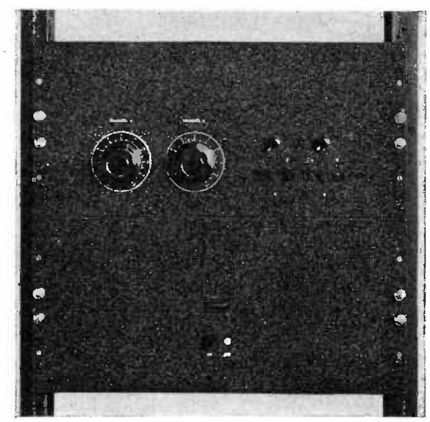
Auditorium Acoustics

Acoustics of the auditorium determine very largely the amount of audio power the amplifier must be capable of delivering. It is impossible to set forth a group of hard and fast power-output requirements which will cover all auditoriums. Each auditorium presents its own acoustic problems.

Although power output is probably the most important consideration in this type of work, fidelity of reproduction is a close second. A frequency response of plus or minus 2 db from 100 to 8,000 cycles should be considered adequate of the amplifier. A frequency response better than this probably will never be realized in the conventional reproducing system. Assuming the reproducers to be unusually good, the auditorium must possess extraordinary acoustic properties to permit a frequency response appreciably better than that set forth above.

Portability of Amplifier

Coupled with the power output and frequency response are the very important requirements of economy and versatility. The amplifier should be semi-portable and capable of use in the sound truck or operation directly off the ac lines for use in theatres, churches, dance halls, restaurants, etc. To meet sound-truck requirements, the amplifier should be economical in operation and should consume no more than 200 to 250 watts power. To meet the portability requirements, the size of the amplifier is limited to the conventional carrying case of 20″ by 20″ by 10″.



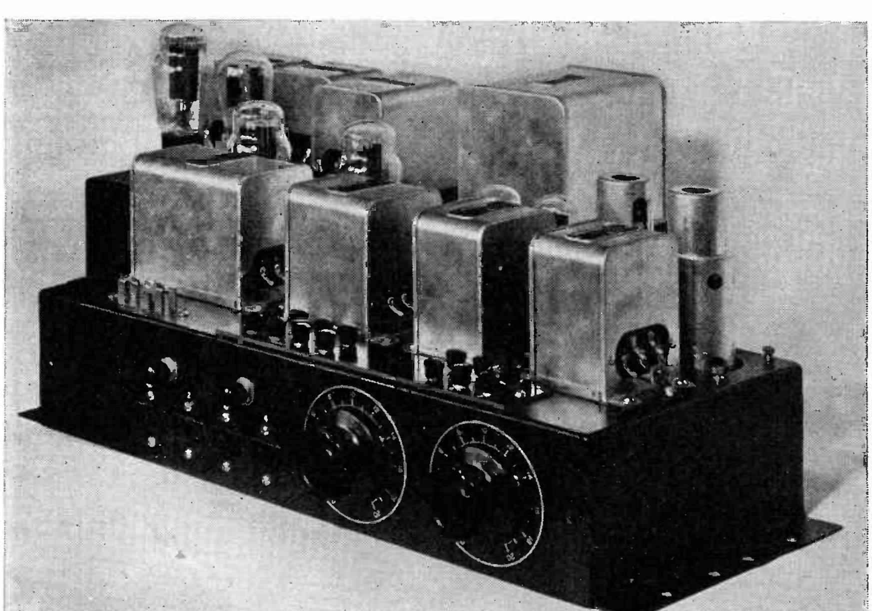
View of amplifier and power-supply unit in racked panel mounting.

Amplifier Gain

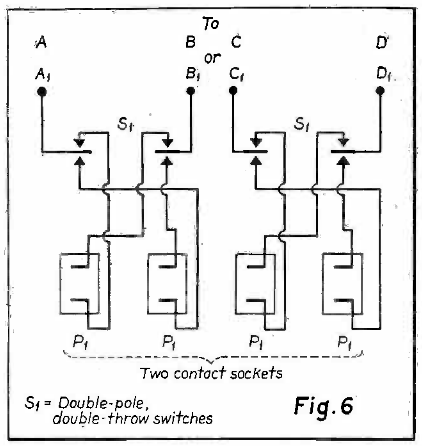
To meet the requirement of operation in such rigid applications as theatres, churches, etc., the amplifier should be capable of rack and panel installation. In addition to this mechanical versatility, the system should be as versatile electrically as is consistent with the size and weight specifications set forth above. Voltage amplifiers should be capable of providing the maximum amplification possible, consistent with stability, tube noise, and ac hum. The voltage gain thus arrived at will require a minimum of preamplification. Standard lines of 200 and 500 ohms should be provided at the input and output of the amplifier. To reduce the bulk as far as possible, some system of mixing various inputs must be made available and integral with the main unit.

Description of Amplifier

The maximum power outputs of this amplifier are 18 or 36 watts, with 5% total harmonic distortion. The output stage of the unit was designed to utilize push-pull type 45s in Class A-B, or push-pull parallel type 45s in Class A-B. The application of the 45 tube to this type of service is described in detail in



View of amplifier unit, with power-supply unit in background, illustrating table mounting.



The switching circuit used to change from series to parallel mixer.

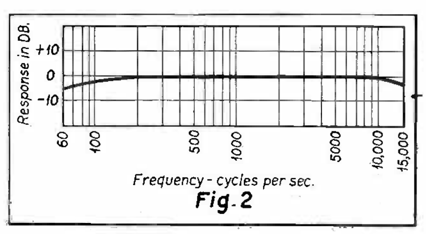
a recent engineering release by the RCA Radiotron Company and entitled: *"Application Note on High Power Output from Type* 45 *Tubes."* This application is not entirely new. Pseudo-experimenters have obtained some 10 watts of sound of doubtful fidelity from these tubes in the past. The RCA Radiotron Company has now provided very definite quantitative data concerning this application.

Class of Amplifiers

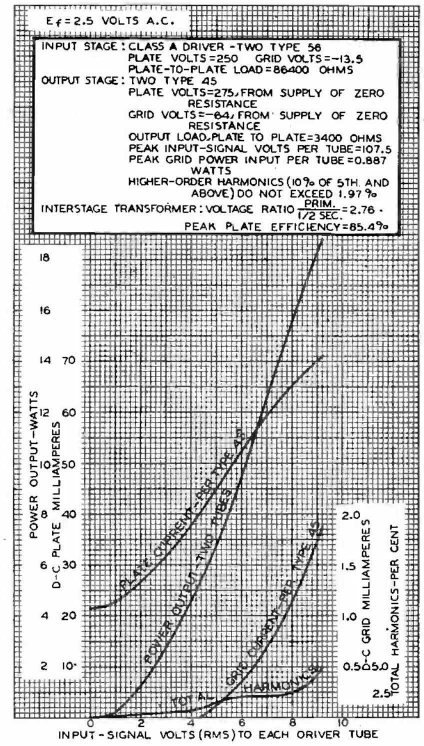
Audio amplifiers may be grouped in three general classifications, the Class A amplifier, the Class B amplifier, and the Class A-B amplifier. The Class A amplifier is one in which the bias and ac signal voltages are such that the plate current of the tube flows at all times. The Class B amplifier is one in which the tube is biased to a value which approximates cut-off value of the plate current with no ac signal voltage. The plate current in such an amplifier flows during approximately one-half of each cycle when the signal voltage is applied. The Class A-B amplifier is an intermediate condition of operation between Class A and Class B. This type of amplifier is over-biased, operating as a Class A system for small signal voltages, and as a Class B amplifier when the signal voltages are large. In this type of system, the plate current flows through considerably more than one-half a cycle, yet less than 360°.

The advantages of this amplifier are efficiency and output intermediate between Class A and Class B amplifiers with the amplifier acting essentially as a Class A unit on low levels and a Class B unit on high levels. By obtaining a considerable reduction in the idle plate current, ordinarily present in the Class A amplifier using the same tube, the amplifier becomes quite economical to operate, economy of operation being one of the desirable characteristics of Class B amplification. Most of the low level distortion in Class B amplifiers is eliminated in the Class A-B system.

Fig. 1 illustrates the operating characteristics of a pair of 45 tubes Class A-B. From the power output curve, it is apparent that a pair of 45 tubes used in this manner will deliver 18.8 watts with the total harmonic distortion 5%. These figures are based on a grid supply having zero internal resistance and a plate supply having zero internal resistance. In practice it is not economical to build a plate supply approaching zero resistance. Fortunately, however, experiment has shown that a change in equivalent plate-circuit resistance (equivalent plate-circuit resistance being defined as resistance added to a circuit of zero internal resistance to produce the same voltage regulation as the power supply under discussion) from zero to 500 ohms has a negligible effect on the power output.



Frequency-response curve of the amplifier described in this article.



Courtesy RCA Radiotron Co., Inc.

Fig. 1. Operating characteristics of type 45 tubes operated Class A-B.

The amplifier under discussion has a plate supply whose internal resistance is 150 ohms and a dc regulation which does not exceed 10%. The resistance of the grid supply in this amplifier is essentially zero, since fixed bias is used. Bias voltage is obtained through a separate rectifier system using an 82 rectifier in a half-wave circuit. As shown in Fig. 1, the grid current of a pair of 45 tubes does not exceed 4 milliamperes. In the case of push-pull 45s, by bleeding 25 to 35 milliamperes in the fixed bias rectifier system, laboratory tests show that the bias voltage remains unchanged up to maximum output. In the case of push-pull parallel 45s, the plate supply regulation is kept equally high, and the regulation in the bias system is maintained by a corresponding increase in bleeder current.

Driver Tubes

To drive the 45s in Class A-B, the triodes 56 or 76 are suitable tubes. A single 56 or 76 may be used as a driver, or push-pull 56s or 76s may be used. The power output obtained from a pair

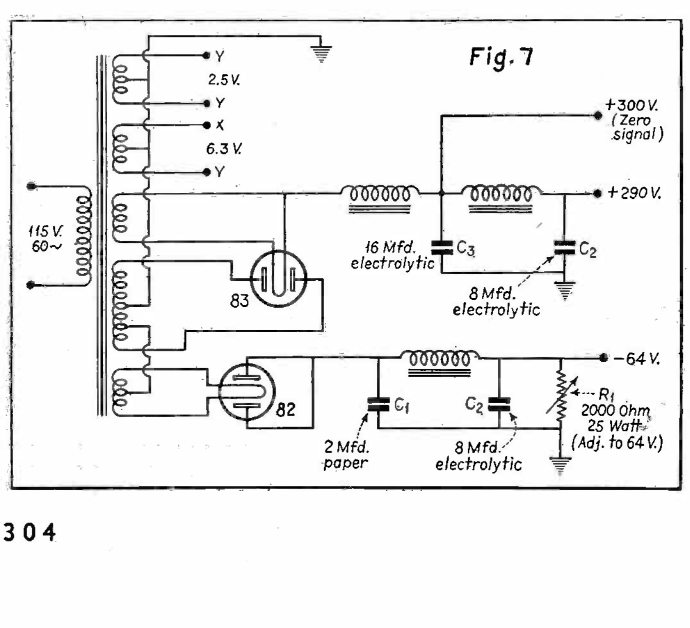


Diagram of the power-supply unit. An 83 rectifier is used for supplying the plate voltages and a type 82 rectifier, in half-wave connection, for supplying the bias voltage for the power tubes.

of 45s, operated in this manner is approximately the same, whether the driver stage uses one or two tubes. Push-pull 76s were selected in this instance, because it was desirable to have sufficient power available to drive push-pull parallel (4 tubes) type 45s and thus use the same voltage amplifier and driver amplifier for the 36-watt amplifier and for the 18-watt amplifier.

The fidelity of this system is almost entirely dependent upon the transformers. The tubes and the operating voltages to obtain the highest output levels with the least amount of distortion must also be carefully selected. An overall frequency response of the amplifying system described in this paper is shown in Fig. 2.

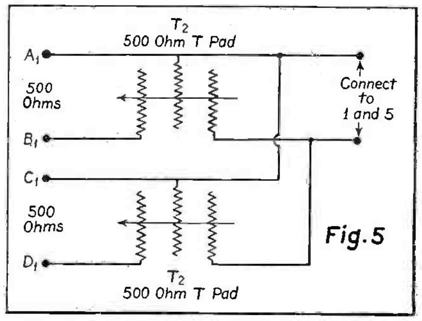
The overall voltage gain developed by this amplifier is 80 db. By isolating the audio channel and power channel on separate chassis, it has been possible to develop this gain and still maintain a hum level which is down 50 db with respect to full power output.

Noise and Hum Elimination

The combination of tubes represented by the push-pull 77s and push-pull 76s has a number of distinct advantages. In the first place, the 77 tube is a pentode with a 6.3-volt heater which draws a heater current of 0.3 ampere. The electromagnetic field developed by this low heater current flowing through the helically-wound heater is considerably less than that developed by a 2.5-volt tube. In addition, the 77 tube has the control grid brought out of the top of the bulb and thus by proper shielding it is possible to isolate this electrode from the electromagnetic field of the heater.

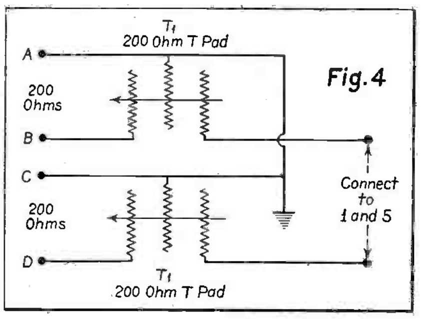
The emission noise in both the 77 and the 76 is low. Microphonic noises are eliminated by suspending all four voltage amplifier tubes in a spring cradle. By hanging all audio bypass condensers on to this cradle or suspension, the period of mechanical oscillation is kept low. The net result in practice is that this amplifier can be bumped or jarred with a very small percentage of microphonic noise as compared to that which would otherwise be developed in the output if these tubes were rigidly fastened to the chassis. The 77 tubes are prevented from mechanically oscillating in their sockets by selecting tube sockets for these two tubes which hold them rigid to the pressed steel cradle.

Mechanical construction of this suspension is best described in the various photographs of the amplifier. Push-pull 77s were selected over the use of a single tube, since in the push-pull arrangement the polarizing dc in the core



Circuit of the parallel mixer, for use with 500-ohm input lines.

of the coupling choke balances out, thus making it possible to build up a high inductance in this choke. The use of a single tube to produce a voltage amplification and a frequency response obtainable with the push-pull arrangement would mean a larger coupling impedance, the cost of which would far out-



Circuit of the series mixer, for use with 200-ohm input lines.

balance the price of the additional tube. Using push-pull throughout also results in added stability of the amplifier and completely eliminates any tendency toward motor-boating effect commonly found in high-gain amplifiers.

Mixer Circuits

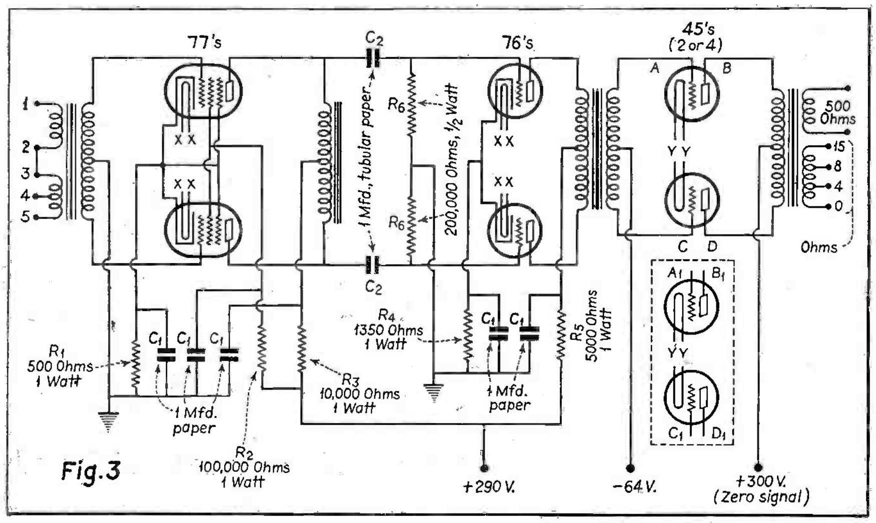
The electrical description will be concluded with a description of the mixer circuit. A two-position, four-circuit series or parallel mixer is provided. It is only in rare instances that the public-address man will ever have need for mixing more than two circuits out of a group of three or four input sources. The mixer circuits shown in the schematic diagrams permit mixing two circuits. These two circuits can be selected from a group of four circuits controlled by double-pole double-throw switches. (See Fig. 6.) The mixer circuit may be wired either as a series mixer, as shown in Fig. 4, or as a parallel mixer, shown in Fig. 5. In the series mixer, the input lines should be of 200 ohms impedance, and in the parallel mixer, the input lines should be of 500 ohms impedance.

When the amplifier uses rack and panel construction, this mixer circuit is mounted on the front panel. When the amplifier uses table mounting, the mixer circuit is mounted on one side of the chassis. Output lines of 500 ohms, and 15 ohms tapped, constitute the secondary windings of both the output transformer for the push-pull 45s, and the output transformer for the push-pull parallel 45s.

Mechanical versatility of this unit is best shown by the various photographs. By the use of this unique type of chassis construction, both the audio channel and the power channel of this amplifier can be mounted on a standard 19" rack or used for table mounting.

Accessible Wiring

In the past, on rack mounting amplifiers, built on a chassis, it was necessary to remove the amplifier chassis from the



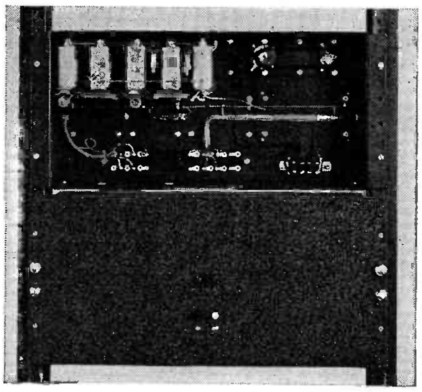
Circuit of the Class A-B amplifier audio channel. Either two or four 45s may be used.

panel before the amplifier wiring became accessible. With the scheme shown here, it is necessary only to remove four 10-24 screws, which hold the panel to the rack. The chassis is held to the rack by an additional four screws, which have no connection whatever with the panel. Thus, when the panel is removed all the wiring is exposed. This system of construction eliminates the difficulty heretofore encountered in getting at the wiring of amplifiers of this type.

An additional advantage of the chassis construction is that both the audio chassis and the power chassis have been designed for dual-purpose operation. If the amplifier is originally constructed using push-pull 45s, it can be changed over to push-pull parallel 45s by merely installing two additional sockets, holes for which are provided in the original chassis, and by replacing the push-pull output transformer with a suitable push-pull parallel output transformer, for which mounting facilities are also provided. The power channel is equally versatile. The same chassis can be used to supply plate and filament voltages of push-pull 45s or push-pull parallel 45s. The change necessary here, involves merely substituting a larger power transformer and a larger choke. It becomes apparent, therefore, that this chassis arrangement is extremelv economical. Changing from push-pull 45s to push-pull parallel 45s results in doubling the output, yet only involving the expenditure of a small percentage of what this change would cost if a completely new set or chassis were constructed.

Summary

In conclusion, summarizing the advantages of the system, we have an amplifier which will deliver either 18 or 36 watts with 5% harmonic distortion. The frequency response is flat within 2 db from 100 to 8,000 cycles. The overall gain is 80 db. The amplifier can be operated economically in a sound truck. Despite the high gain of the voltage amplifier, the hum level has been maintained low and microphonic noises eliminated. A two-channel, four-position mixer circuit is provided as an integral unit. The mechanical construction is exceedingly versatile, permitting operation either as a rack and panel unit or as a table mount unit. The amplifier provides for a change in power requirements economically.



Illustrating the accessibility of all wiring when panel is removed. Removal of panel does not necessitate removal of amplifier or power unit from rack. This photo also shows the spring cradle mounting for the voltage amplifier tubes.

AUTO RADIO—continued

Philco Model 700

(*Continued from page* 297)

Set up signal generator and adjust it exactly to 260 kc. Connect the generator lead to the grid cap of the 77 tube, and then connect up the output meter.

Turn volume control of receiver to approximately full volume and the attenuator of signal generator for a half-scale reading of the output meter.

The padders (22) and (24) (see Fig. 2) are adjusted first. Turn the adjusting screw (22) all the way in. A metal screwdriver can be used for this. Then with generator attenuator set so there is approximately half-scale reading, adjust the nut (24) with a fibre wrench for maximum output-meter reading.

Then adjust the screw (22) for maximum. This adjustment is critical. Note the maximum reading obtainable and then turn the screw in again and readjust, just bringing the adjustment up to the maximum reading. Do not pass it and then back off.

Repeat the above procedure with the condensers (12) and (16).

Gang Condenser Adjustments

After padding the 1st i-f stage, remove the generator lead from the 77 tube and reconnect the grid lead. Set the generator to 1600 kc and then connect the generator lead to the antenna lead.

There are four holes in line, one in each of the sections of the tuning condenser housing (see Fig. 2). Place a nail of the size that fits snugly through the holes and then turn the condenser plates out of mesh until they strike against the nail.

With the tuning condenser in this position adjust the high-frequency padder (14) until the maximum reading is obtained in the output meter. This is the true setting for 1600 kc, 160 on the dial scale.

Next turn the condenser plates in mesh to 140 on the scale 1400 kc, and set the signal generator at 1400 kc. The r-f padder (9) and the antenna padder (3) are next adjusted for the maximum reading in the output meter. Recheck the adjustments and then remove all test leads.

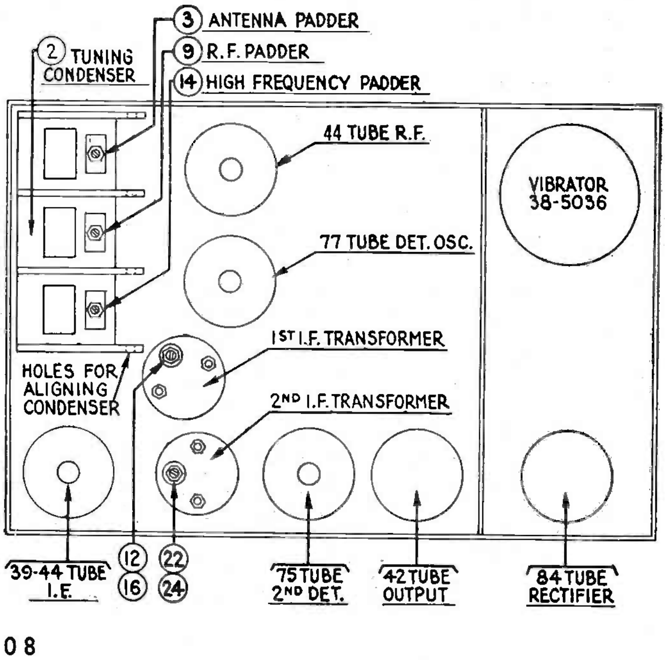


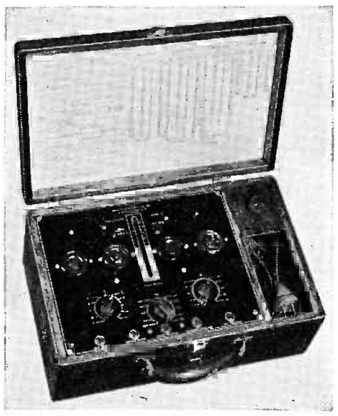
Fig. 2. Diagram showing the location of the various parts and the holes used in aligning the condenser.

THE MANUFACTURERS . . .

DACO TUBE TESTER

The Dayton Acme Manufacturing Co., Inc., Fifth and Perry Streets, Dayton, O., has just introduced their new and improved model "Daco" Neon type tube tester.

This tester operates direct from ac line and has the necessary provision for line-voltage adjustment. It is equipped with a



super-sensitive Neon Glow Discharge Tube, which has a two-color scale; this scale indicates at a glance whenever a tube is in good or bad condition. Only four sockets, a 4, a 5, a 6 and a 7-7, are employed in order to simplify the handling of tubes. There are two spares for future tubes and it is also designed to prevent obsolescence.

The circuit measures grid-to-plate transconductance and also features a cathode short test, gas test and tests second plate on duo tubes. The Daco tube tester comes complete with chart, mounted in a moveable cover type, solid oak carrying case.

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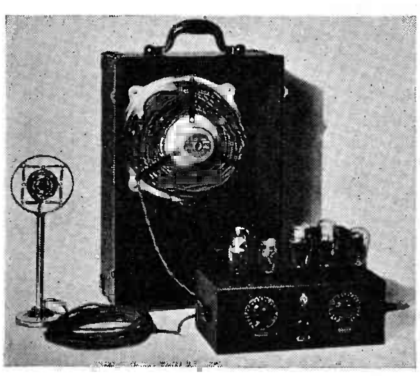
ARCTURUS ANNOUNCES MAJESTIC TYPE TUBE

To the rather complete line of Arcturus tubes have been added the special Majestic spray-shield types. These tubes come equipped with a glove-fitting metal shield, soldered in place with proper ground connection, and are identical in characteristics and interchangeable with the spray-shield tubes.

•

WEBSTER PORTABLE P-A SYSTEM

The unit shown in the accompanying illustration is known as the Webster



PA-17, a new portable public-address system that has just been announced by the Webster Company, 3825-3831 West Lake Street, Chicago, Illinois.

The amplifier has an output of 15 watts, utilizing the 2B6 tube in the power stage. The input system has a dual control with provision for fading microphone and music.

An important feature of the PA-17 portable system is the mechanical and electrical arrangements for the use of additional speakers. The system is equipped with a 12" dynamic speaker and a two-button stretched-diaphragm type of carbon microphone.

•

HEARING AID

Sound Systems, Inc., Cleveland, offer a new unit for churches to aid the hard of hearing.

A crystal microphone is supplied on a short desk stand to be placed on the pulpit. A small compact amplifier is supplied to be placed under the pulpit. For the pews, small phones are supplied with outlet boxes which contain constant impedance volume controls. The unit includes a set of six receivers and the amplifier is capable of handling fifty.

Sufficient amplification is available for the individuals who are unusually hard of hearing.

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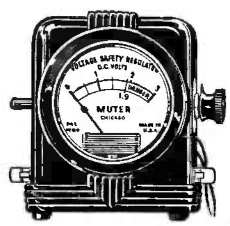
NEW VOLTAGE SAFETY REGULATOR

The new Voltage Safety Regulator just announced by The Muter Company, 1255 South Michigan Avenue, Chicago, increases the life of tubes and batteries on



any radio set using "30-series" tubes and a 3-volt battery. A slight overvoltage on "30-series" tubes greatly shortens their lives which the Safety Regulator prevents by keeping the voltage at approximately 1.9 to 2 volts, it is stated.

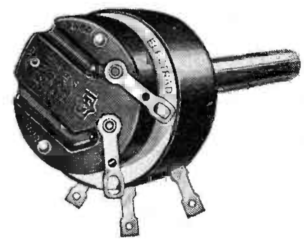
The unit is variable so that it will take care of all types of sets using "30-series" tubes, and is equipped with a special voltmeter to check tube voltage at all times. The molded bakelite case is 4½" high, 3½" wide, and 1¾" deep. The unit is packed in individual cartons with complete and simple instructions for operation.

•

NEW VOLUME CONTROL

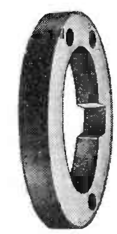
A new volume control, just announced by Electrad, Inc., 173-175 Varick St., New York City, embodies an improvement in the principle of applying a graphite resistance element to a smooth surface over which a contact arm may glide with a minimum of noise and insure a flowing, stepless graduation. This volume control is shown in one of the accompanying illustrations.

The resistance element is applied and baked at a high temperature to the flat outer-rim of a molded bakelite ring, which is shown in the other illustration. This provides a solid base and rigid anchorage



for the resistance element which cannot flex or warp out of line with the contact arm, thus making the mechanical strength of the unit, the electrical stability and wearing qualities exceptional, it is said.

Additional features are: full 300-degree rotation, molded bakelite case, metal end-



cover, aluminum shaft, and convertible power switch.

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TOBE ALL-WAVE AERIAL KIT

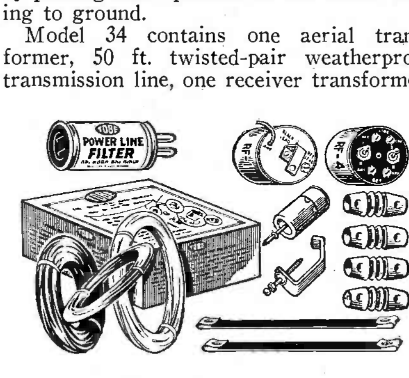
Two models of All-Wave Aerial Filterizer systems have recently been developed by the Tobe Deutschmann Corporation of Canton, Massachusetts.

Features of the Tobe Filterizer systems are: Practical and inexpensive installation requirements, true all-wave band efficiency, and great reduction in radio noise and interference pick-up, it is stated.

These All-Wave Aerial Kits are readily adapted to one-quarter wave Marconi or one-half wave Hertz aerials.

One model used is a small line filter for by-passing noise present on the whole wiring to ground.

Model 34 contains one aerial transformer, 50 ft. twisted-pair weatherproof transmission line, one receiver transformer,

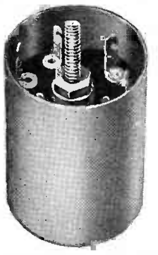


complete aerial and ground equipment, and power-line filter.

Model 35 is the same as Model 34 except that it is without aerial and ground equipment, and power-line filter.

INDEX TO ADVERTISERS

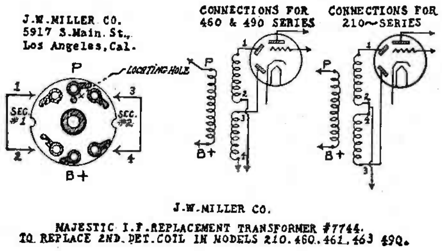
MAJESTIC REPLACEMENT TRANSFORMERS



Manufactured by MILLER and possessing all the features of Miller construction, yet retaining the original electrical characteristics.

One especially noteworthy feature of these replacement units is the method of protecting the windings from the effects of high humidity. This method, developed by the Miller Laboratories and employed in the construction of all I. F. transformers supplied by us, is universally recognized as the most superior process of corrosion elimination in I. F. windings. **We absolutely guarantee these units against coil failure due to corrosion.**

Customer satisfaction is your greatest asset, so why take a chance by replacing defective coils with units subject to the same defects? **Insist upon the best and get genuine MILLER COILS.**



Catalog #7744. Output.. I. F. coil for receivers listed above. List price, $1.25

Catalog #8214A. Input.. For Majestic Model 15 series. List price, $1.25

Catalog #8214 B. Output. For Majestic model 15 series. List price, $1.00

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THE TOBE CONDENSER ANALYZER

will save you MONEY—TIME—TROUBLE—EMBARRASSMENT! Take the guess work out of condenser trouble-shooting. It's so simple to know definitely if condensers are LEAKY, of LOW D.C. RESISTANCE or HIGH LEAKAGE CURRENT, if they are operating INTERMITTENTLY, or if they are "OPEN" or "SHORTED." Let hundreds of testimonials like this one convince you that you need this instrument!

"I have received the TOBE CONDENSER ANALYZER and am entirely satisfied with it. No competent serviceman should be without one." Chas. J. O'Hanlon, Jr., R.F.D. #2, Savannah, Ga.

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From your distributor or direct from the factory.
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A complete catalog of TOBE products sent free upon request.

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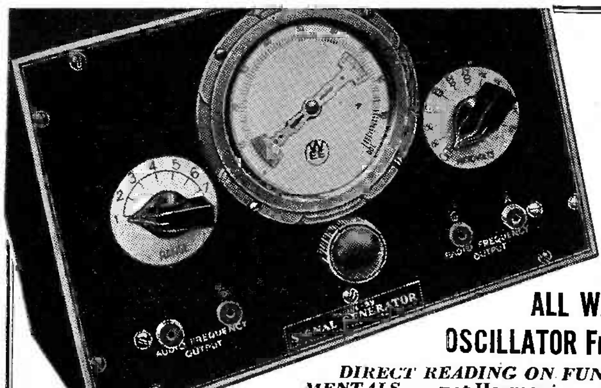

ALL WAVE OSCILLATOR Free!

DIRECT READING ON FUNDAMENTALS **.. not Harmonics .. Full Frequency Coverage .. Range 14 to 3000 meters. (100 to 21,600 K. C.) .. Absolute Attenuation at Highest Frequencies .. Frequency Stability Assured .. Extreme Accuracy .. Dial Permits Accurate Readings to 1-10th of 1% .. Compact .. Approved by National Union Engineers .. an Absolute Necessity for Modern All Wave Set Servicing .. FREE with National Union tube purchases. Small deposit. Get Details!**

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Clay Millican, Independence, Kansas says: "National Union . . . a reliable company . . . a fine tube...working for interest of the serviceman"

L. E. Conner, Seattle, Wash. declares: "We are proud to be associated with a firm whose policies are right and who build a good product . . . We thank National Union for helping our service department acquire it's present degree of efficiency . . ."

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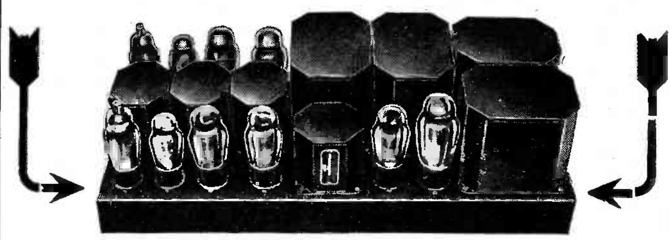
High Quality Public Address Audio Components in a Parallel Push Pull 45 A Prime Amplifier.



Ideal for broadcasting, recording, and public address applications. Will handle up to twenty dynamic speakers. High power output with low cost power tubes.

SPECIFICATIONS:

Input will match 50, 200, and 500 ohm lines. Center top on 200 and 500 ohm lines for double button microphone. Output will match 500, 200, 16, 8, 5, 3, and 1.5 ohms, Three balanced push-pull audio stages. Tubes used: 2—57's triode connected; 2—56's; 4—45's in parallel push-pull fixed bias; 1—83; 1—45. Stable fixed C bias for output stage. Undistorted class A prime output 38 Watts. Gain —90 DB. Trap resonant filter affords maximum filtering efficiency. List price **$63.50.** Net to dealers, hams **$38.10.** Fully shielded drilled deck for audio and power sections. List price **$9.00.** Net to dealers, hams **$5.40.** Other 45-A prime components.

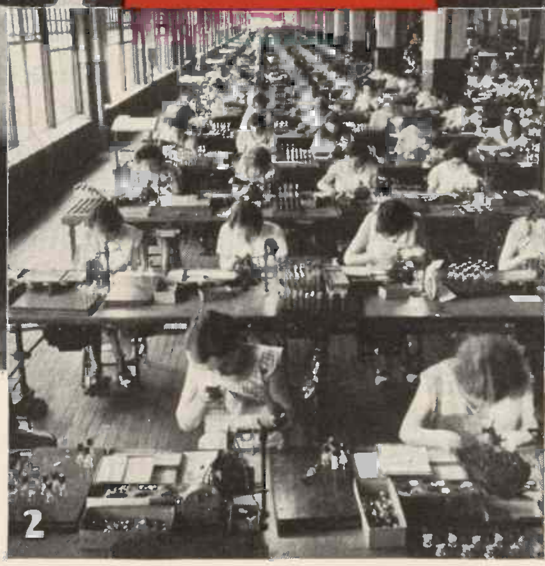
	List Price	Dealers Price
PA-233—driver 56 plates to 45 grids........................	**$6.00**	**$3.60**
PA-245—output for fixed or self bias 45's A prime (20 watt peak power) to 500, 200, 16, 8, 5.3, 1.5 ohms..............	**7.00**	**4.20**

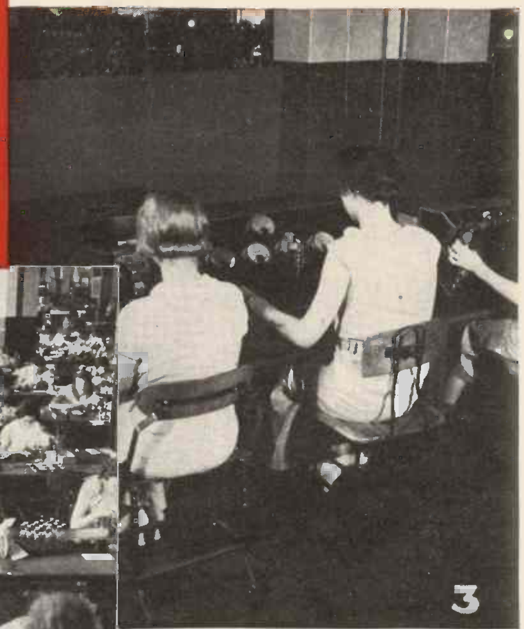
Write for Laboratory series sheet No. 10 which fully describes the construction and circuits for 45A prime amplifiers.

UNITED TRANSFORMER CORP.

264 CANAL STREET NEW YORK, N. Y.

LOOK TO RCA





(1) Gauging grids. This operation is typical of the scores of painstaking measurements and tests conducted in the Parts Assembly Section. (2) A view of the General Assembly Section. Here the mounts are assembled before being placed in bulbs. The constant concern of each operator is her "quality score". (3) A portion of the "test battery," through which every RCA Cunningham Radiotron must successfully pass before being packed for sale.

Look to RCA for fidelity to high engineering standards

In the manufacture of radio tubes, the transition from the laboratory and experimental workshop to the actual production of tubes for general consumption, is a step of the utmost importance. ★ Due largely to a remarkable spirit of cooperation existing between the Research and Development Laboratory, on the one hand, and the Manufacturing Department, on the other, the makers of RCA Radio Tubes feel that this transition is achieved, in the Radiotron plant, without sacrifice of quality standards. ★ Were it not for this spirit of cooperation, such advantages as large resources, expert personnel, the finest of equipment, and advanced methods of manufacture could not of themselves do credit to RCA's engineering and experimental background. With that cooperation and spirit, RCA produces tubes that its engineers are proud to acknowledge.

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