

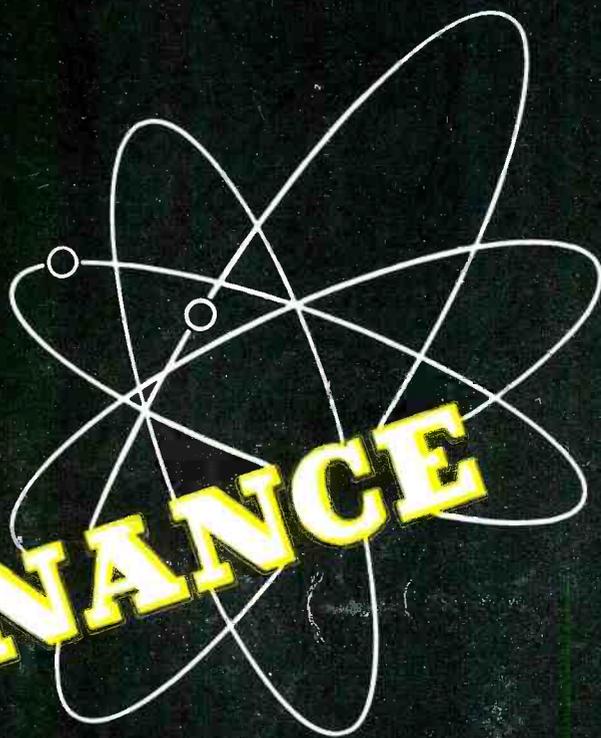
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RADIO SERVICEMAN

RADIO

MAINTENANCE



MAY 1947

VOLTAGE DOUBLERS

TELEVISION RECEIVERS—
THE CATHODE RAY TUBE

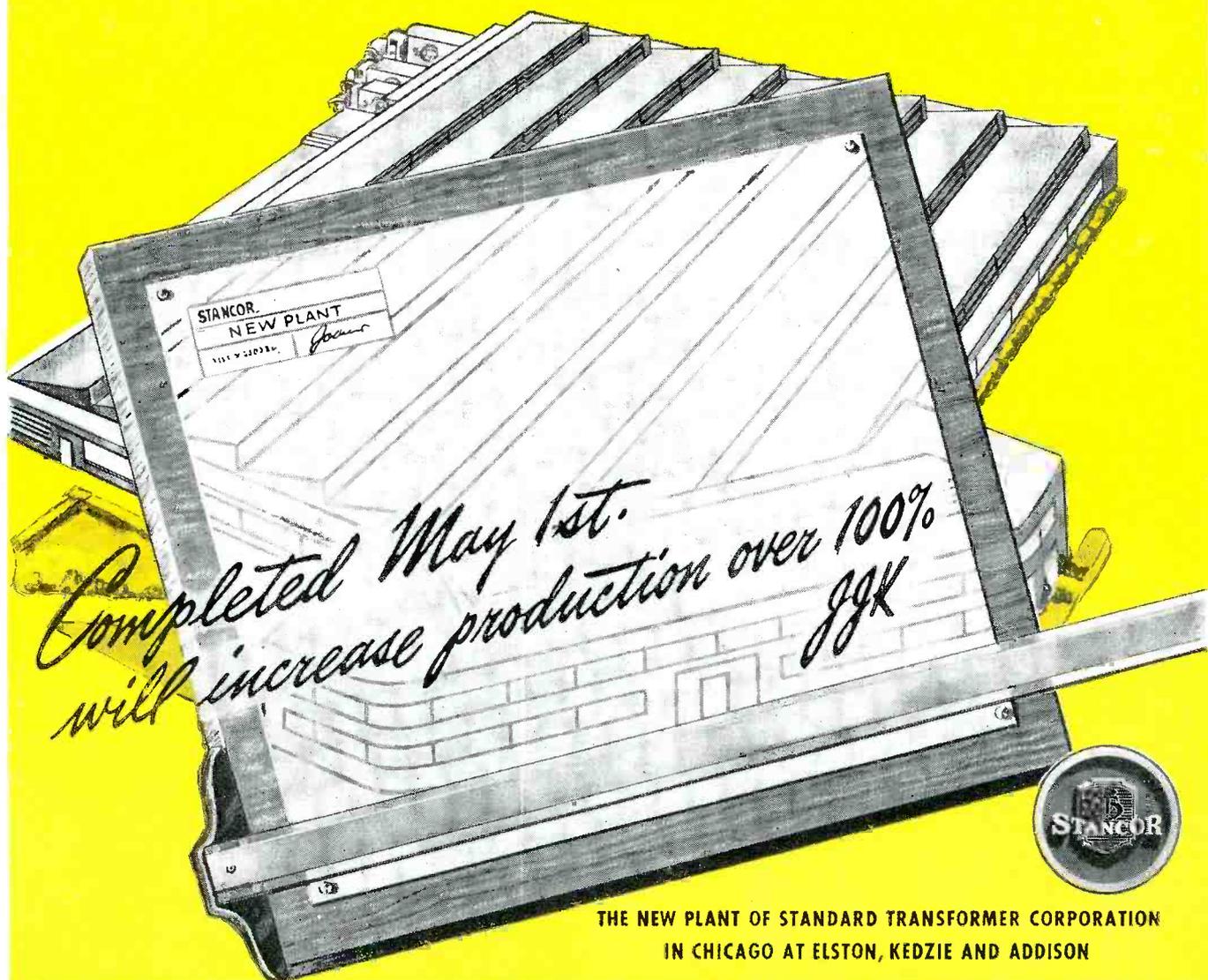
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THE OPEN AND CLOSE CASES

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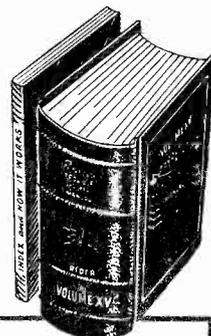
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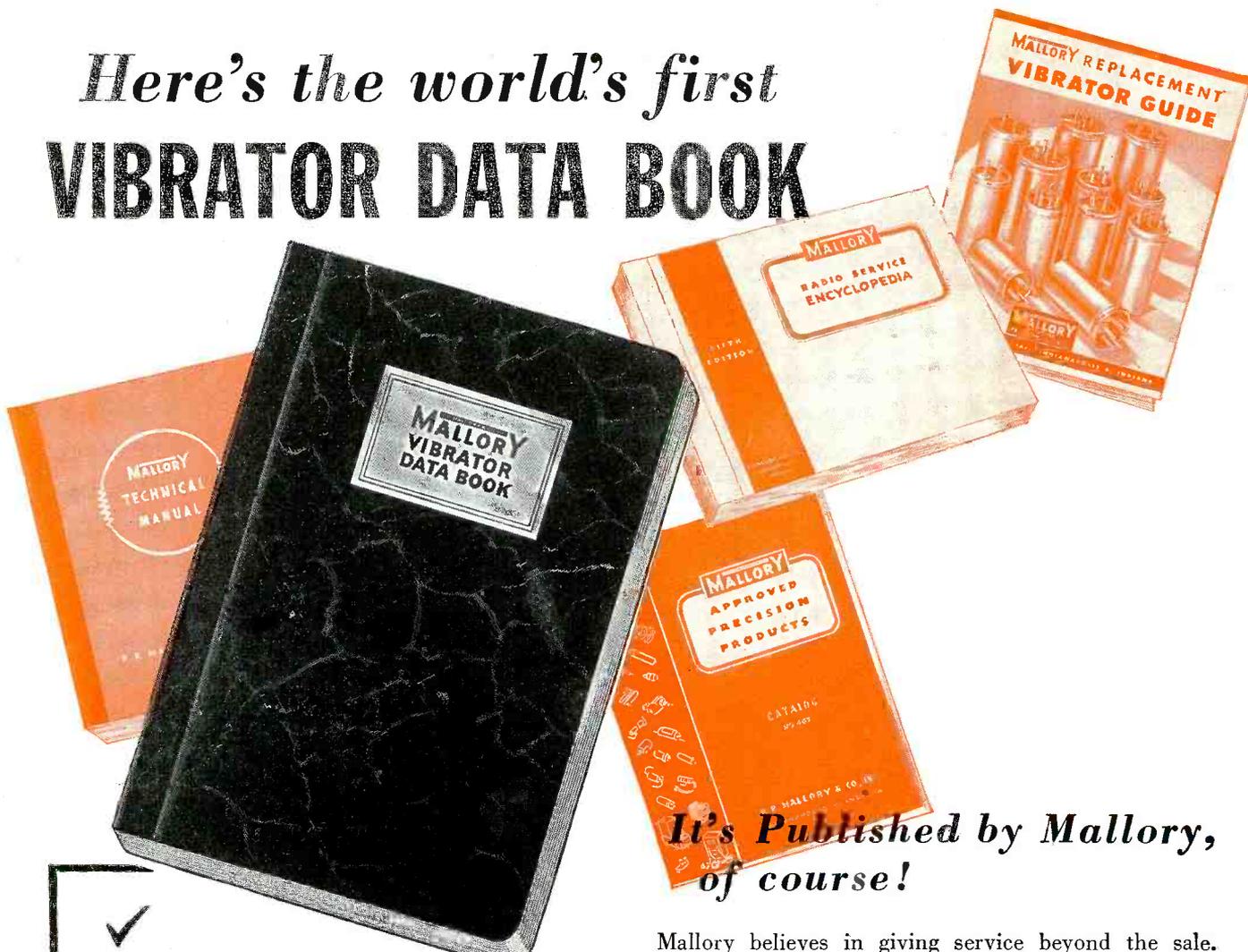
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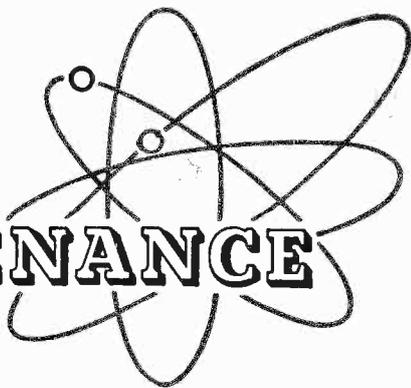
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Volume 3

MAY, 1947

Number 5

Contents

Voltage Doublers	J. Richard Johnson	4
Voltage doubling rectifiers		
The Open and Close Cases	John T. Frye	6
Locating shorts and opens		
Signal Tracer	J. R. James	8
Commercial test equipment		
The Cathode-Ray Tube . . . Television Receivers . . .	Morton Scheraga	10
The sixth of a series		
The Organizations		20
News of servicemen's groups		
Industry Presents		22
New products		
Circuit Analysis	J. Richard Johnson	24
New circuit designs		
Over the Bench	John T. Frye	29
The Notebook		31
Shop suggestions		
Electronically Speaking		33
News items		
Review of Trade Literature		35
Catalogs, books, etc.		

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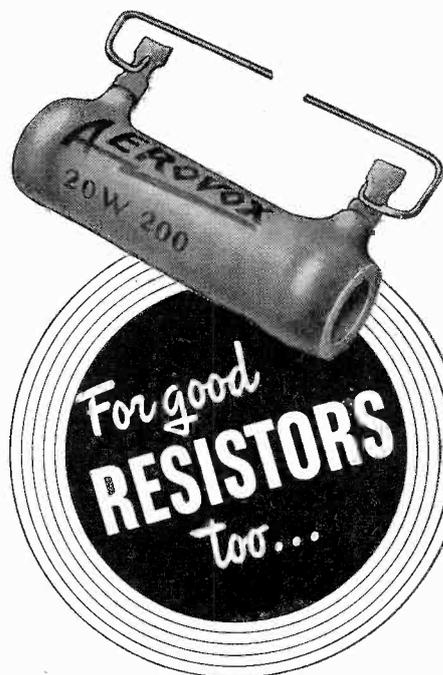
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Voltage DOUBLERS

by
J. Richard Johnson While voltage doubling circuits are not used in the majority of receivers being manufactured today, they are found often enough to make it important that the serviceman be familiar with their operation.

VOLTAGE DOUBLING CIRCUITS are used just often enough to require that the serviceman have a fundamental understanding of their operation in order to save time in his work. It is easy to mistake a voltage doubler for an ordinary half wave AC-DC type of rectifier. Such a mistake frequently leads to the loss of good 150 volt condensers because of the higher voltage produced by the doubler circuit. If the burn-out of the filter condensers occurs immediately, your only loss is the component involved; but if the failure occurs after the set has been returned to the customer, a greater loss will be suffered in the form of customer confidence.

Let us consider the salient features of voltage doubler circuits. There are two main types: One is called the *half wave*, the other the *full wave* circuit. These names are derived from the fact that in the half-wave type, the output ripple frequency is 60 cycles per second; whereas, in the full-wave type, it is twice that frequency. As the name *doubler* implies, both circuits are designed to provide twice the output voltage which an ordinary half-wave rectifier would produce, and do this without the use of a transformer. Since doubler circuits cannot be used with a DC power source, they are not of the AC-DC

type. A better description, one which also includes ordinary AC-DC rectifiers, is given by the term *transformerless* power supply.

The reason for the use of voltage doubler circuits is the fact that most vacuum tubes operate much more efficiently at voltages higher than the 100 volts supplied by ordinary transformerless supplies. When the voltage on the plates of the audio output stage is doubled, the output power which can be obtained from the stage increases several times.

Voltage doubling is accomplished through the use of two half-wave rectifiers whose output voltages are connected in series. Fig. 1 shows the basic arrangement of the full-

wave type of doubler. Notice the two complete rectifier circuits—first, the rectifier diode V1 and the condenser C1 connected in series across the power line; and, second, the rectifier diode V2 and the condenser C2 also in series across the power line except that the plate and cathode connections are the reverse of those of V1. To understand the operation of the voltage doubler, consider these circuits one at a time.

At the time in the power cycle when point (c) becomes negative with respect to point d, a surge of electrons will flow from the cathode of V1 to the plate of V1, and C1 will become charged as shown, returning some electrons

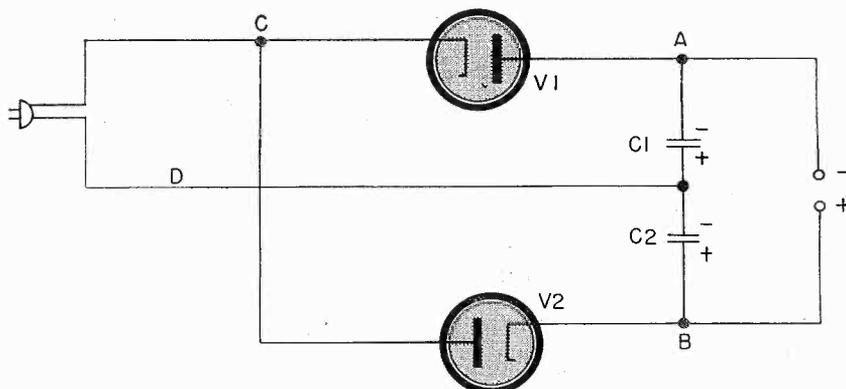


Fig. 1 A simplified diagram of the full-wave type voltage doubler.

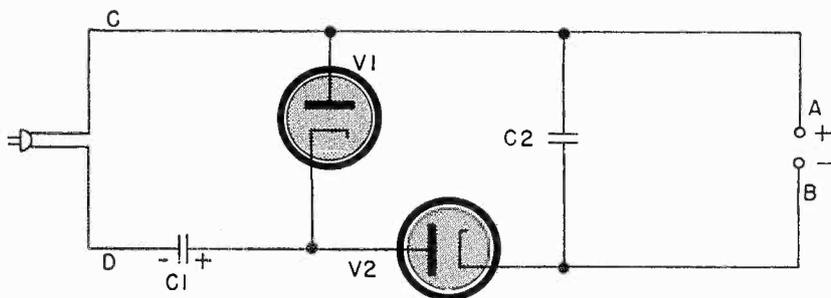


Fig. 2 A simplified diagram of the half-wave type voltage doubler.

to the other side of the power line (point d). When the next portion of the power cycle comes along and point c becomes positive, diode V1 will not conduct, and the charge remains on condenser C1. Diode V1 thus acts like a check valve in a pump; it allows electrons to be "pumped" into C1 but will not allow them to slip back into the power line. Now examine the circuit associated with diode V2. It is the same as that of V1, except that the plate of the diode is connected to point c instead of the cathode. Thus, V2 conducts and charges condenser C2 when point c becomes positive and while V1 is not conducting. Condenser C2, therefore, becomes charged with a polarity as shown in the figure, and with a voltage equal to that developed across C1. Now, if there is no load to draw the charge off these condensers, they will each have reached a DC voltage equal to the peak value of the line AC potential, minus a small drop in each tube. This peak value is 1.414 (square root of 2) times the standard (rms) voltage rating of the line. For the regular 115 volt AC line, this amounts to about 163 volts. The voltage drop in the tubes is small, although it increases some with

increases in load. The condensers are in series, with their voltages adding; the total voltage from point a to point b is the sum of these voltages, and under no-load conditions can be over 300 volts. Since one of the condensers gets a charge every half cycle, the output ripple frequency is 120 cycles, or twice the frequency of the source voltage.

The half-wave type of connection is shown in Fig. 2. When point c becomes positive with respect to point d, C1 will charge up to the peak value of the line voltage with the polarity indicated. Next, when point d goes positive, current flows through V2 and charges condenser C2. When this latter operation takes place, the voltage already built up across C1 is applied in series with the positive line voltage peak to the plate of V2. The potential on the plate of V2 will reach a maximum of twice the peak line voltage, causing C2 to charge up to a voltage approximately twice the DC output that would be obtained with a simple half-wave rectifier.

The half-wave voltage doubler has one advantage and one disadvantage when compared to the full-wave type. The advantage is that B minus is isolated from

the line and, therefore, can be grounded to the chassis without danger of a short circuit or personal shock when the chassis comes in contact with external grounds. The disadvantage is the fact that the ripple frequency is only 60 cycles, making more filter necessary. No more filter is needed than is used in ordinary half-wave AC-DC sets, however, since they also have a 60 cycle ripple.

A word about the condensers used in these circuits. Ordinary filter capacitors are used although their function is *not* primarily one of filtering. They are placed in the circuit as loads on the rectifier diodes in order to hold their charges during periods when these diodes are not conducting. Each of the two types of doublers described must be connected to the usual filter circuit for practical use. Since C1 and C2 must be large enough in capacity to hold an appreciable charge and yet not be too bulky, electrolytics are normally used. Polarities must, as usual, be carefully observed in connecting or replacing these condensers.

In any filter circuit, the percentage of ripple in the DC output voltage varies with the amount of current being drawn and increases with the load. This is due to the fact that the charge on a condenser is limited. If we draw enough current so that a good deal of the condenser's charge is lost before the next charge is fed to it from the rectifier, there will be large fluctuations (ripple) in the output voltage. Also, since under heavy load there will be longer periods of low voltage in each cycle, the average DC voltage will be lower than it

→ To Page 18

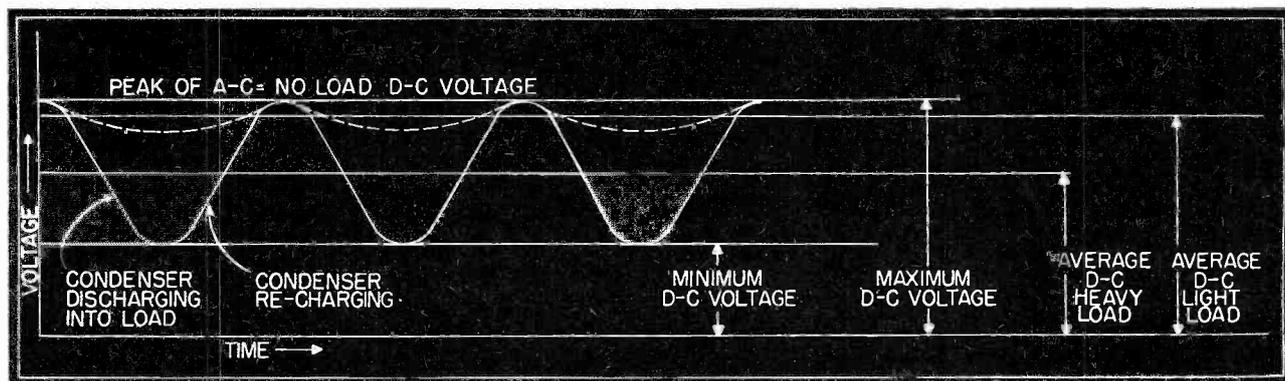
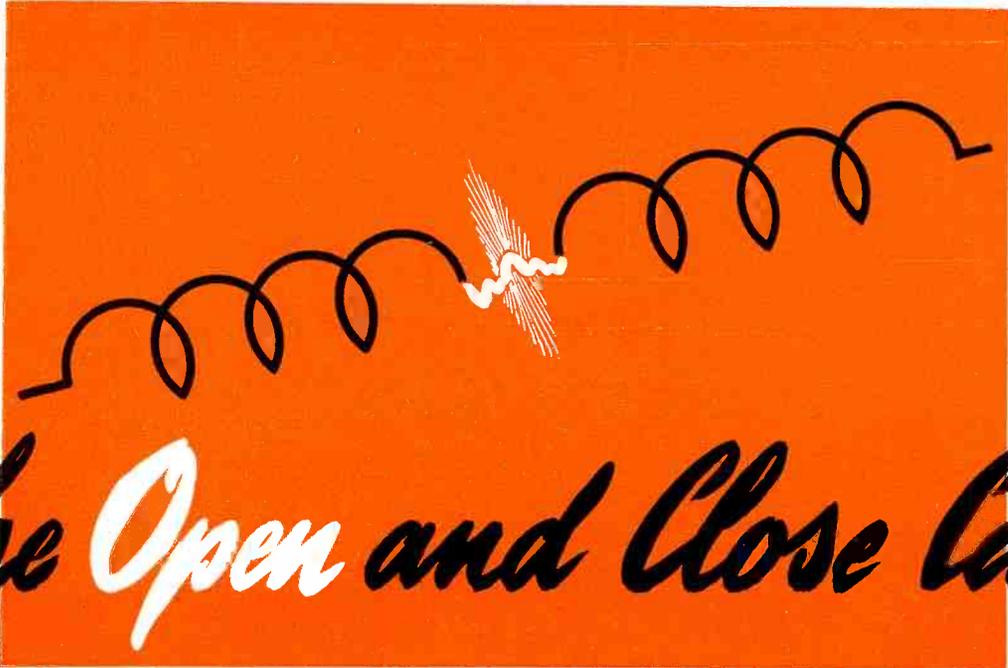


Fig. 3 The above figure shows the way in which the average DC output voltage falls when the load is increased.



the Open and Close Cases

The author describes a unique and effective method for locating open coil windings. He describes a test instrument which he has been using successfully for a score of years.

by
John T. Frye

THE MOST DIFFICULT PART OF repairing a radio, the part you should charge for, is locating the trouble. Once the fault is discovered, repairing it is usually a matter of minutes. There *are* cases, though, that consume considerable time in the actual making of repairs. Outstanding in this respect are what I call the "open and close cases": The open RF, IF, oscillator, and field coils; and the speakers that have voice coils rubbing on the pole pieces, or the tuning condensers with rubbing plates—in short, moving mechanical parts that are too close together.

You may argue that the best thing to do with an open coil is to replace it. Quite often that is right. There are, however, many instances when it is impossible to secure a special coil, or when the securing of one would mean that the radio would be out of commission for weeks, sitting forlornly around the shop while the owner wears out your telephone asking if it is ready yet. If you can repair the defective coil and get the set out promptly, it will add to your reputation as a serviceman who puts out repaired sets instead of excuses.

Repairing coils is not really the hobgoblin that many servicemen

seem to think. Very fortunately, breaks usually occur outside of the winding proper. Most of them are found where the lead is fastened to the solder-lug or along the lead that goes from the lug to the winding. The trick, then, is to find the break quickly, in spite of the fact that it is usually masked by wax and insulation.

That is where my "gadget" comes in. Said gadget is nothing more than a discarded neon transformer, rated at 5,000 volts at 18 milliamperes. The voltage from this transformer is sufficient to jump a gap of 3/16 of an inch; and once the arc is started, it can be drawn out for a full half-inch. It is shown in Fig. 1.

To use this transformer to locate a break in an RF or IF winding, I simply plug the primary into the 110 volt line and use my test leads to place the high voltage across the open winding. As soon as the voltage is applied, a tiny arc appears at the break, an arc that can be easily seen, heard, and *smelled*. Yes, a strong odor of ozone actually accompanies the arc.

Once the break is located, it is repaired quite easily. I find that a couple of pairs of eyebrow tweezers and an old crochet needle fastened in a handle are excellent tools for picking out a nearly buried lead and for preparing the broken ends of a lead for soldering.

This same method works with speaker voice coils. Unsolder the output transformer secondary and place your high voltage across the solder-lugs for the voice coil leads. Occasionally, you will find voice coils that are broken in the winding proper; but the most of the "opens" are in the leads, especially where the flexible leads are attached to the voice coil winding. At any rate, you can use the gadget to discover quickly which ones you can repair and which ones will require a new cone or a new speaker.

Field coils can usually be repaired without removing them from the speaker. Carefully split and peel back the paper covering of the field coil winding, making your cut so that you can lay bare the places where the heavy leads are connected to the fine wire of the winding proper. Apply your high voltage to the leads—of course the speaker should be entirely disconnected from the set—and look and listen for the tiny arc that will reveal the position of

the break. Four times out of five, it will be close to where the heavy leads are soldered to the winding. This will almost certainly be the case if there is any trace of green corrosion around these soldered joints.

If you can hear the arc but cannot see it, you will probably have to remove the field coil. This is quite simple if the speaker is bolted together; but if it is one of the kind where the field coil is held in position simply by a pole piece that is a pressed or driven fit in the frame of the speaker, you will have to use extreme caution in driving out the pole and in driving it back if you are not to mangle the voice coil. Going slow and taking plenty of time at a job such as this is the best kind of insurance. The trick is to drive the pole piece *straight* out and *straight* back in, without letting it become cocked so that it pinches the winding between itself and the enclosing frame of the speaker.

When you have the field coil out, you can carefully pull back the paper cover of the end of the coil and again apply your high voltage. The break will usually be found where the inside lead of the winding comes out of the coil. If the wire is broken off so that you cannot recover the portion inside the coil, use a very sharp probe that will penetrate the enamel insulation of the wire—I use a needle—and see if you cannot find a wire near the center of the coil that reveals at least 90 per cent of the proper resistance between this wire and the other end of the winding, your ohmmeter being used for this test. If you can, simply bring out that wire for the beginning of your winding. The small portion of the wire not in use will not affect the operation of the set.

I feel confident that any serviceman can secure one of these transformers for a very modest outlay of cash. I picked up one out of the alley (yes, I am an alley rat!) and I bought another for seventy-five cents. I do not know why they were discarded; possibly they have shorted turns that prevent their proper functioning with signs. I am certain, though, that the servicemen should be able to pick up one around a neon sign shop. When you think of the millions of neon

signs that are glowing around over the country, you can see that these transformers must be plentiful.

If you cannot obtain one, however, you are still not licked, for a Model T Ford buzzer coil, connected as shown in Fig. 2 will serve exactly the same purpose, the only objection being the necessity of using a six-volt battery; but since most radio shops already have this battery, this is a small matter.

I hardly think it is necessary to tell a radio serviceman that only a *low-current* transformer should be used. A high-current transformer at this voltage would kill you just as dead as would an atomic bomb. No special precautions are observed in the installation of neon signs, however, and I have received the full voltage of mine on countless occasions with no damage being done to anything except my New Year's resolution to quit using that kind of language. The "bite" you get is exactly the same as that you receive when you touch a sparkplug on your car when the motor is running. After you get this two or three times, you handle your leads gingerly enough to prevent a recurrence of the experience.

One thing to watch, though, is not to leave the voltage across the coil any longer than is necessary to locate the break. When the arc starts, it generates a lot of heat; and if you leave it going long

enough, it will burn back the broken ends of the wire. I just touch the voltage across the coil long enough to spot the arc. If I do not see it the first time, I turn the coil around and dab the voltage to it again. The arc is so bright that it can be easily seen in broad daylight; in fact, I can usually see it through the heavy paper that is wrapped around the outside of a speaker field coil.

This same device is used in making easy another tedious job: Straightening out tuning condenser plates that are rubbing. This is a job that is hard on the neck, nerves, and patience. If you can get the tuning condenser entirely out of the set and hold it up between you and the light, the locating of the too close plates is not hard; but with modern slide-rule dials, complicated dial-cord systems, etc., it is a huge job to remove the tuning condenser. On the other hand, it is seldom possible to arrange to have the tuning condenser plates between your eye and a strong light while the condenser is in place on the chassis, even though you employ a tiny cordlight. An ohmmeter will tell you which condenser section is shorting out, but it will not tell you what you really want to know: Which particular rotor plates are the offenders.

Here is where the gadget comes

→ To Page 16

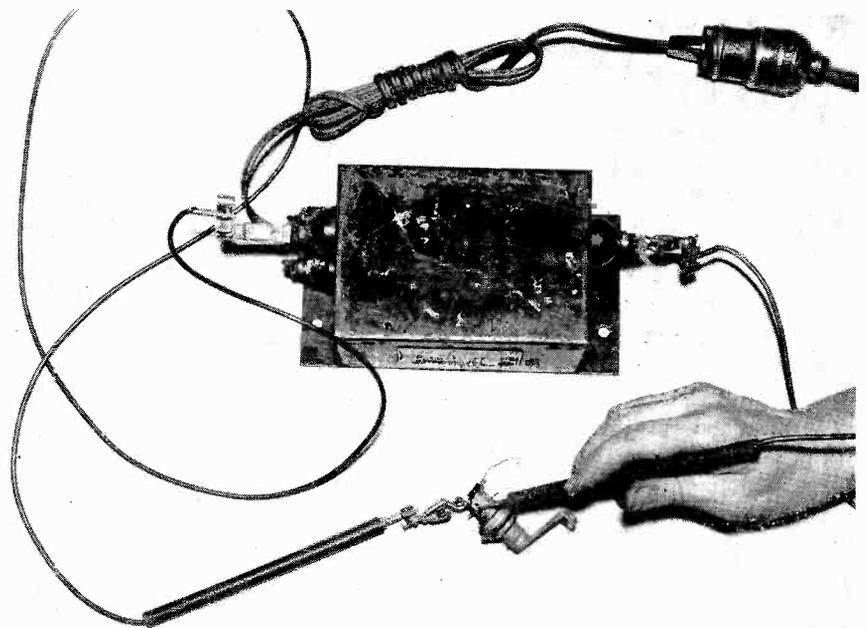


Fig. 1 The test unit described in the text. It consists of a neon transformer, test leads, and a line cord and plug.



SIGNAL TRACER

by *J. R. James*

SINCE its inception before the War, the signal tracing method of troubleshooting receivers has found wide use. Thousands of signal tracing units are now in use and thousands more will find their way to the benches of the nation's service shops in the next few years.

The editors of *RADIO MAINTENANCE* decided to obtain typical pieces of test equipment, check them in actual operation, and present a description of them in the form of a series of short articles. The first unit checked was the Feiler Electronic Stethoscope. The unit is manufactured in two models, the TS-2, completely battery operated, and the TS-3, a 115 volt AC operated model.

Both models consist essentially of a detector and two stages of high gain amplification. The detector, which is identical in both the battery and AC models, is mounted in a probe, the tip of which is used to connect directly to the circuit under test. The other tubes in the lineup consist of a 1T4 first audio stage, which is identical in both models;

a 3Q4 output tube used in the battery-operated TS-2; and a 6F6 GT/G output tube used in the AC operated TS-3. The AC operated model uses a 6X5 rectifier in the power supply.

The AC operated model uses a transformer for its power source.

If asked what two things are most important to efficient servicing, most servicemen would answer: personal ability and the proper test equipment. Because test equipment is of such great importance, *RADIO MAINTENANCE* will present a number of short articles describing various pieces of commercially available equipment. All of the units described will be put through their paces on the bench before being presented. It is hoped that the information given will prove helpful when choosing from the great variety of instruments available.

This is a decided improvement over the usual AC-DC arrangement in which one side of the line is grounded to the chassis because it removes the danger of short circuits which exists when using the latter arrangement. DC voltage for the filaments of the 1T4s is obtained from the cathode bias resistor of the 6F6 output tube; and filament voltage for the output tube itself is provided by a 6.3 volt winding on the power transformer.

The self-contained battery pack used with the TS-2 consists of two 45 volt and one 4.5 volt units. The battery-operated signal tracer will find its greatest use on outside jobs, especially in rural areas where AC power is not always available.

The probe which was previously mentioned consists of an aluminum cylinder one inch in diameter and $4\frac{3}{8}$ inches long. The ends of the cylinder are sealed by bakelite inserts. The test prod is mounted on one of the bakelite inserts and a shielded cable protected by a rubber sheath passes through the other. The metal case of the probe pro-

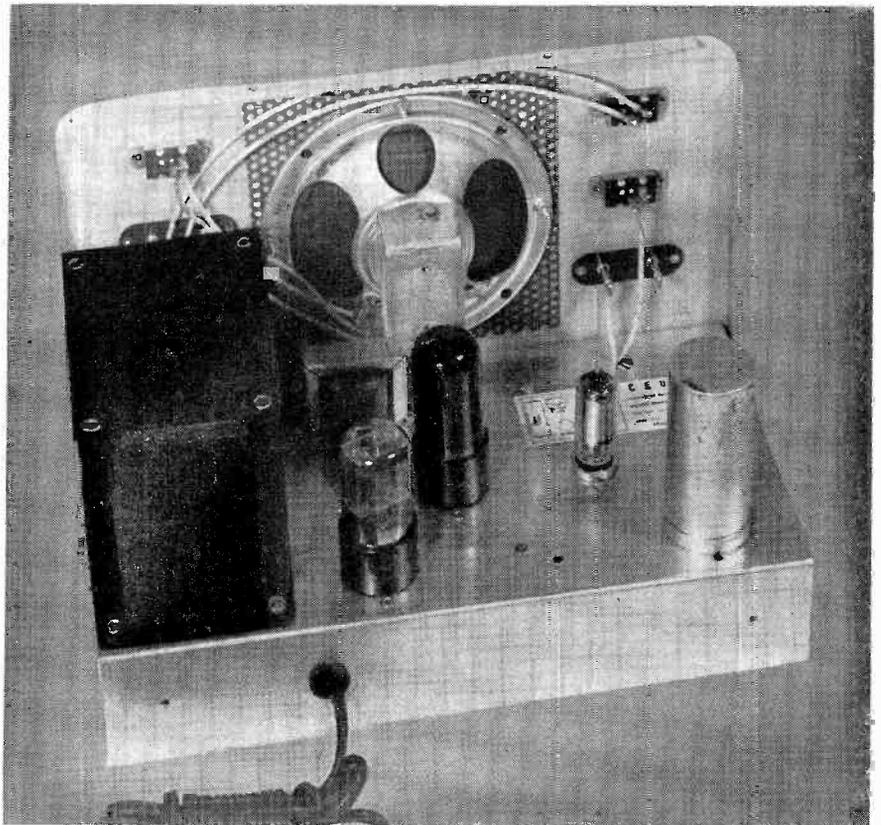
vides complete shielding which minimizes pickup hum and hand capacity effects. The test prod extends $1\frac{1}{8}$ inches beyond the case. The probe is provided with a lead and alligator clip which is used to ground it to the chassis of the receiver under test. All external connections to the tracer are made on the front panel as can be seen from the photograph in the heading.

The controls and connections consist of the following:

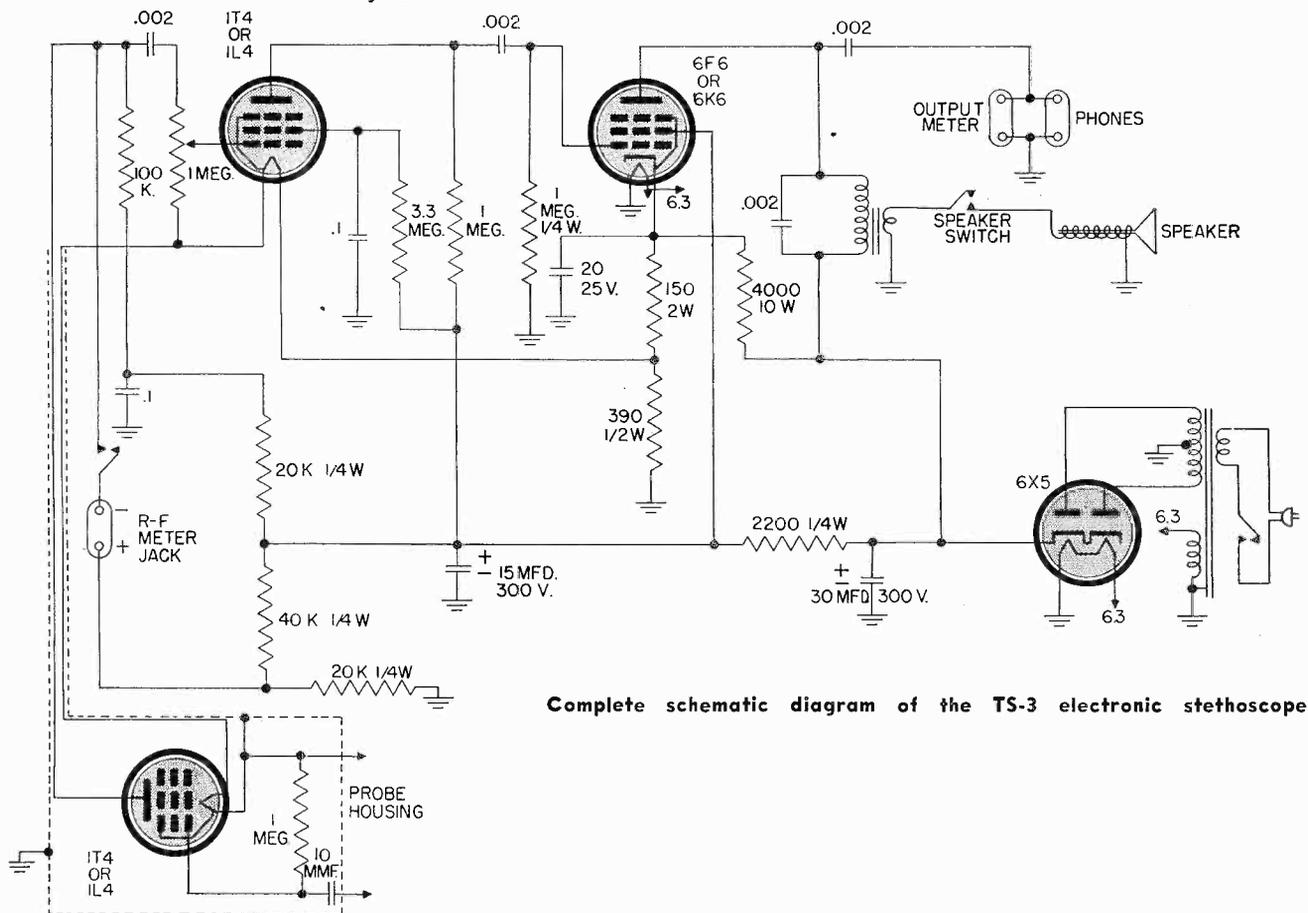
1. Power on-off switch.
2. Speaker on-off switch which enables the operator to disconnect the speaker when using phones or an output meter, or to identify the tracer output when the receiver's speaker is also operating.
3. RF VTVM terminals and on-off switch. An RF vacuum tube vtmeter can be connected to the set of tip jacks provided; and using the probe, stage gains may be checked.
4. Output meter connections. The audio output of the tracer appears across these terminals; by connecting an output meter to them, the unit can be used to align receivers by visual indication.

5. Phone connections. These

→ To Page 28



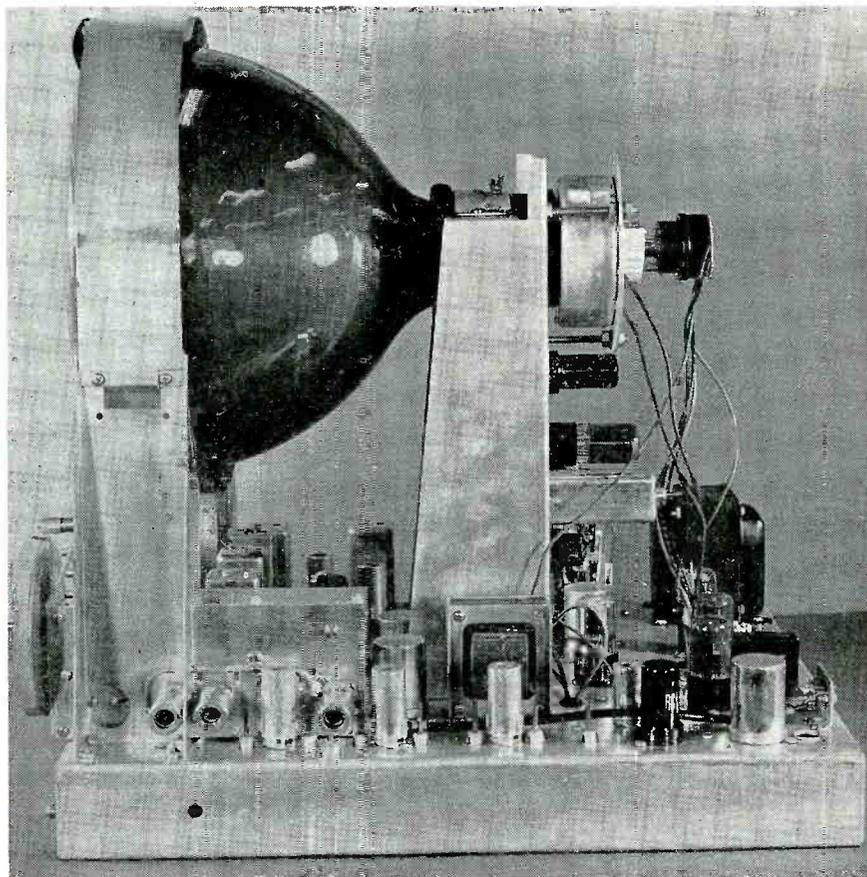
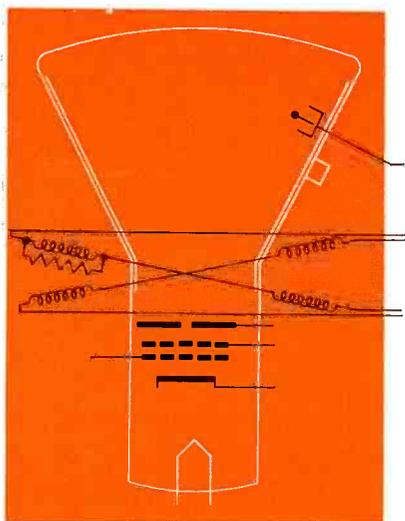
A rear view of the TS-3 with the cover removed. Note the husky power transformer. Mounted next to the transformer is the 6X5 rectifier. Mounted in the center of the chassis is the 6F6 output tube; and on the right of it is the 1T4 voltage amplifier.



Complete schematic diagram of the TS-3 electronic stethoscope.

by
Morton Scheraga

Allen B. DuMont Labs.



This is the sixth of the seven sections of the television receiver to be discussed. The cathode-ray tube is of particular importance because almost all of the circuits in a television receiver in some way contribute to its function.

THE CATHODE-RAY TUBE

PRESENT DAY TELEVISION receivers are built around the cathode-ray tube. The development of the cathode-ray tube made possible all electronic scanning and picture formation. The serviceman should have a clear understanding of the structure and operation of cathode-ray tubes because every circuit in the receiver in some way contributes to its operation and control. After studying this article on television tubes, it is suggested that the reader review the previous articles on receiver circuits in order to tie in their connection with the picture tube.

Cathode-ray tubes for television

receivers are divided into two main categories: (1) the electrostatically deflected tube; and (2) the magnetically deflected tube. The choice of type is governed by cost, size, and quality of picture. These factors will become apparent in the

succeeding paragraphs.

Fig. 1 is a simple cross-section of an electrostatically deflected and focused tube, showing the relative position of the electrodes. As in ordinary receiving tubes, a heater element is mounted within the cathode-sleeve and heats the oxide coating on the end of this sleeve causing it to emit electrons. The electrons are made to flow away from the cathode by the positively charged electrode known as the first anode. The amount of the electron current flow is regulated by a grid electrode which is between the cathode and the first anode. This grid is biased negatively with re-



spect to the cathode and can cause more or less current to pass, depending upon the voltage applied to it. Later we shall see how this electrode helps produce the television picture and controls its brightness.

The electrodes just described are similar in many respects to the cathode, grid and plate of a receiving tube triode. Here the similarity ends, however, for instead of the first anode receiving the electrons, they are permitted to pass on through. When they have passed through the first anode, they are narrowed down to a fine beam and finally strike the fluorescent screen at the end of the tube. A tiny spot of light is produced at the point where the electron beam strikes the screen. If now this spot of light is moved very rapidly from left to right and up and down by deflecting the electron beam, the entire screen will light up and produce the pattern shown in Fig. 2 and known as a *raster*.

The formation of the narrow beam begins at the cathode. Only the tip of the cathode facing the fluorescent screen is coated so that the emitted electrons are radiated in this direction. The electrons then pass through the grid. Instead of the common mesh wire type in ordinary tubes, the grid consists of a hollow cylinder, closed at the end nearest the cathode except for a small pinhole. The electron stream is forced through this pinhole and forms a beam of small cross-sectional area. The sharpened beam continues on through the cylinder which is open at the other end. The beam then enters another hollow cylinder, the first anode, which has a baffled end with a small hole, and thus further confines the cross section of the beam. The high positive potential on the first anode also sets up an electrostatic field which acts much like a glass lens and focuses the beam to a point between the grid and the first anode. See Fig. 3.

It is from this point source of electrons (between the grid and first anode) that the second lens system, consisting of the first anode and a second anode, focuses the beam onto the screen. The second anode is operated at a much higher potential than the first anode and speeds up the beam so that it im-

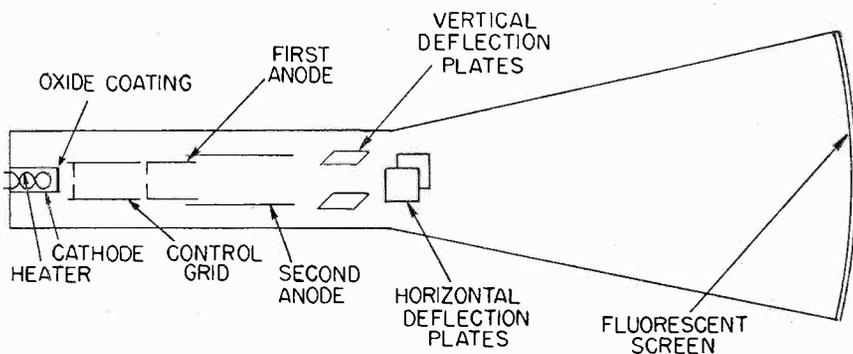


Fig. 1 Electrostatic cathode-ray tube.

pinges on the screen with great energy, causing it to emit light. The combination of voltages on the two anodes sets up another electrostatic lens field which has its focal point at the screen. See Fig. 4. This focal point can be varied by changing the ratio of the two anode voltages, or what amounts to the same thing, leaving one voltage fixed and varying the other. Thus, in practice, the focus control in a television receiver is obtained by varying a potentiometer which changes the positive voltage applied to the first anode.

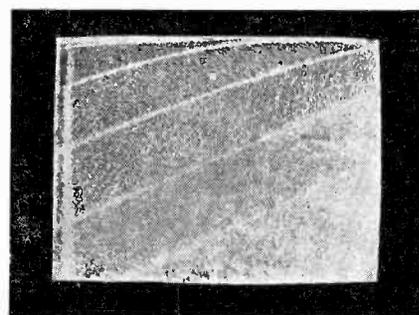


Fig. 2 A test pattern showing the raster which is formed when the vertical and horizontal sweeps are applied to the tube and no picture is being received.

Deflection of the focused beam is accomplished by two sets of deflecting plates: One set providing motion in the vertical direction; and the other in the horizontal direction. These plates are located immediately after the second anode. The vertical and horizontal saw-

tooth voltages generated in the previously described sweep circuits are connected directly to the two sets of plates and cause the beam to oscillate between the plates 60 times per second vertically, and 15,750 times per second horizontally. The resulting motion of the beam traces

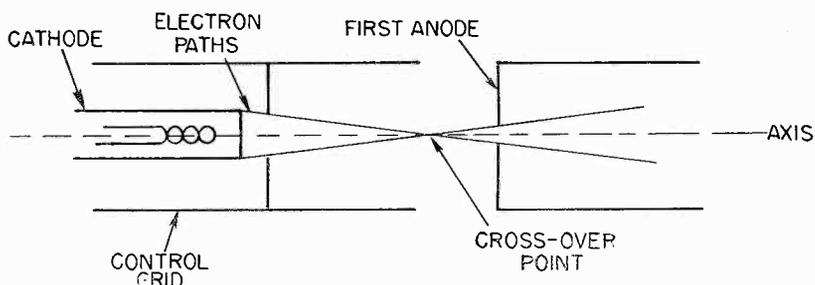


Fig. 3 The first lens system, showing the focusing of the electrons to a point between the control grid and the first anode.

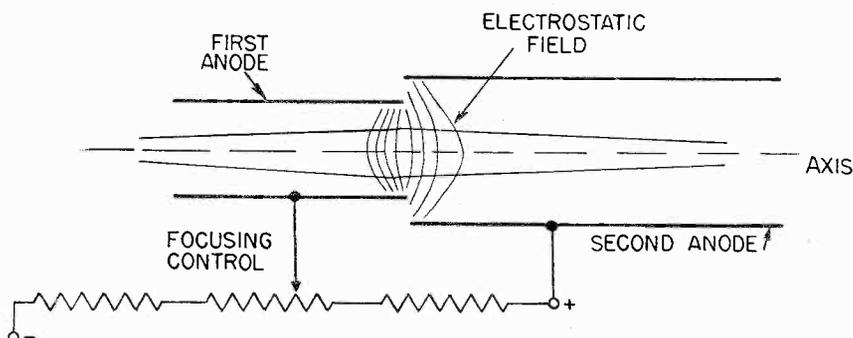


Fig. 4 The second lens is produced by an electrostatic field set up between the first and second anode. Focusing is accomplished by varying the potential on the first anode.

The Cathode Ray Tube

→ From Preceding Page

out a 525 line raster 30 times per second.

In television receivers using electrostatically deflected tubes, one deflecting plate of each set is connected directly to the second anode as shown in Fig. 5. This is done because the relative closeness of the deflecting plates and the second anode serves to maintain both the anode and plates at the same potential. Otherwise, a voltage difference between these electrodes would set up a disturbing field and cause defocusing and change in velocity of the beam. The other deflecting plate is connected to the saw-tooth voltage generator. This saw-tooth voltage varies the average potential between the plates above and below the second anode potential. In small tubes, the deflecting voltages are not large and the difference between the average plate potential and the second anode is minor. In the larger tubes (about 12 inches and more in diameter) the voltage difference is appreciable and the defocusing effect serious. This effect is known as astigmatism; and in receivers with large electrostatically deflected tubes, an anastigmatic control which minimizes this potential difference is added. It is adjusted in combination with the focus control for the best focusing of the picture.

Another means of preventing astigmatism (a more expensive one) is to use push-pull deflecting amplifiers. This results in the balanced system of Fig. 6 as compared to the unbalanced amplifier system of Fig. 5. Since both deflection plate voltages vary in opposing manner, the average DC voltage is zero; thus, the plates remain effectively at the second anode potential.

Let us see briefly how the picture tube is controlled by the rest of the circuits of the receiver. It was shown above how the proper saw-tooth voltages generated in the vertical and horizontal sweep circuits trace out the raster pattern of Fig. 2 when applied to the deflecting plates. If now the video signal coming from the RF and IF stages

is applied to the grid, the intensity of the beam as it scans will vary from full brightness to black, depending upon the amplitude of the negative grid voltage. The beam of varying intensity is synchronized to the scanning beam in the pick-up camera at the station by the synchronizing circuits, producing an exact reproduction on the receiving tube. The negative DC voltage on the grid is adjusted by the user of the receiver to obtain the desired average brightness. This control is known as the brightness control.

The electron gun structure of the magnetically deflected tube is similar to the electrostatically deflected tube, the difference, of course, being that the former has no deflection plates. In this case, the deflection is effected by two sets of coils placed at right angles to each other over the neck of the tube. The assembly of the two coils is known as a yoke; a typical type used in modern receivers is shown in Fig.

7. The yoke is transformer-coupled to the vertical and horizontal sweep circuits which were described in the two previous articles. The saw-tooth currents in the coils set up two perpendicular magnetic fields which deflect the beam vertically and horizontally.

Most magnetically deflected television tubes are also magnetically focused. The focusing is accomplished by a coil also placed over the neck of the tube, but behind the yoke. The first lens system remains essentially the same as in the electrostatically controlled tube, but the focus coil eliminates the need for the second anode. It will be recalled, however, that the second anode was also required to accelerate the beam in addition to providing the focusing action of the second lens. The accelerating of the beam is, therefore, accomplished by another means; namely, a conductive aquadag coating around the inside of the glass bulb, extending from the first anode up

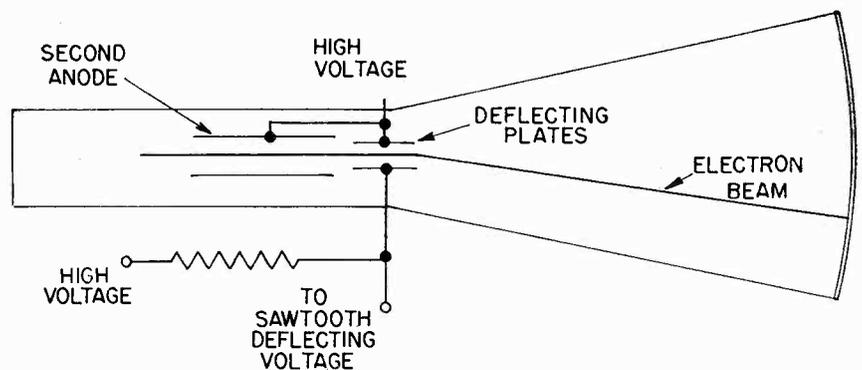


Fig. 5 An unbalanced system for deflecting the electron beam which causes defocusing at the extremes of deflection.

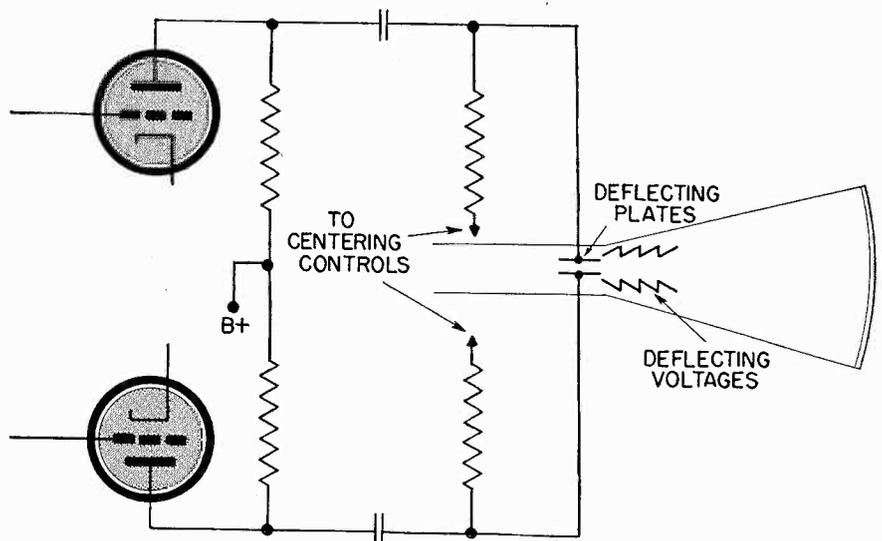


Fig. 6 Balanced deflection with push-pull amplifiers eliminates astigmatism.

to the fluorescent screen. This coating is given a high positive potential and functions much like the second anode. The aquadag and the accelerator electrode connected to it are visible on the type 12JP4 tube shown in Fig. 8.

The current in the focus coil (See Fig. 9) produces a magnetic field parallel to the electron beam. As long as the electrons move along the axis of the beam from the sharply focused crossover point in the first lens system, the magnetic lines of force do not affect them. Electrons that tend to spread out from this point are forced back onto the axis by the magnetic field. The current in the coil is DC and is adjusted to make the focal point occur just at the screen.

The gun structure of a commercial type magnetically focused and deflected cathode-ray tube is shown in Fig. 10. Note also the yoke over the neck of the tube. It is mounted as close as possible to the bulb. This keeps the beam from striking the glass walls after being deflected, which would be the case if deflection started farther back along the neck. The focus coil is located behind the yoke. The accelerating electrode in the shape of a ball cap can also be seen on the bulb part of the tube. It is connected to the rib structure, visible in the cross-section cut-away. This rib structure makes contact with

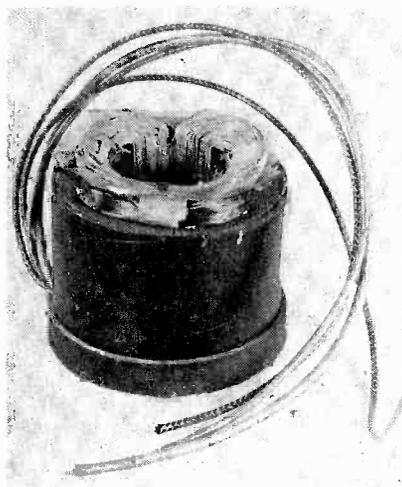


Fig. 7 A typical deflection yoke used with magnetically deflected tubes.

the aquadag coating on the inside of the bulb.

The foregoing discussion covers the basic types of electrostatic and magnetic television tubes now being used in receivers. With the numerous types on the market, what guides a manufacturer to use one type and not the other? The first consideration is usually the cost of the receiver, cost being proportional to tube size. Larger tubes permit bigger pictures, but in turn must operate at higher accelerating voltages and require greater deflecting voltages or currents.

The cheaper receivers on the market are usually limited to seven inch tubes. They are electrostatically focused and deflected be-

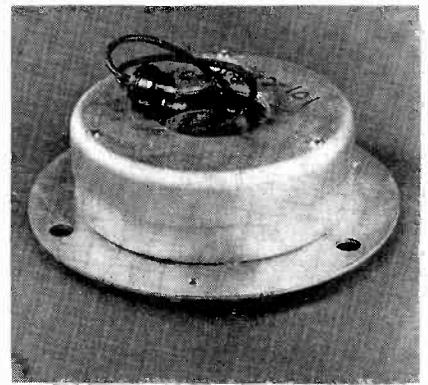


Fig. 9 A focus coil used with magnetically deflected tubes.

cause the circuit components are cheaper and the expensive yoke and focus coil are not required. The other sizes found in sets are the 10-inch, 12-inch, 15-inch, and finally the largest commercially made 20-inch types. All these are generally magnetically focused and deflected because of the superior focusing obtained with this system. It is also easier to generate the deflecting currents required for the bigger tubes than it would be to generate saw-tooth voltages if the tubes were electrostatically deflected. In a forthcoming article, we shall treat each tube type now on the market in detail and discuss its features.

The nomenclature used for cathode-ray tubes has been standardized so that the tube number gives us important information. The first number (5, 7, 10, 15, etc.) indicates the diameter of the screen in inches. This is followed by a letter (A, B, C, etc.) which distinguishes between different electron-gun structures or some other feature, though the tubes be of the same diameter. This letter is always followed by the letter P and a number to indicate the type of fluorescent screen used. A P4 screen is the one most commonly used for television. It produces a black and white picture. Cathode-ray tubes used in oscillographs, on the other hand, usually use P1 screen material which produces a green trace.

Thus, for example, a 12JP4 tube has a 12-inch diameter bulb and a P4 screen. The letter J differentiates it from other tubes of this size, such as the 12AP4 and the 12DP4.

The serviceman called upon to replace a television tube should be

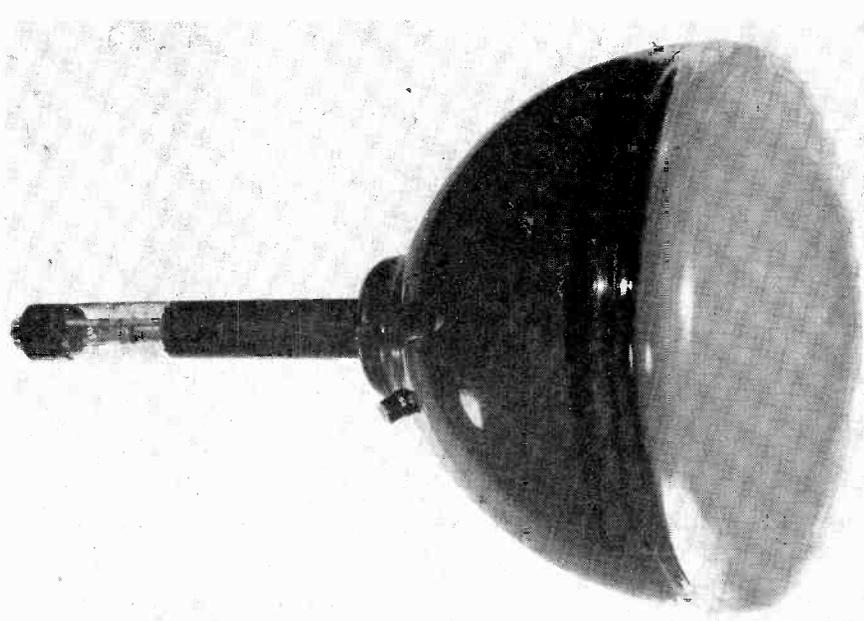


Fig. 8 A type 12JP4 magnetically deflected and focused television tube, showing the aquadag coating and accelerator electrode.

The Cathode Ray Tube

→ From Preceding Page

extremely cautious when handling it. These tubes are evacuated and subjected to great pressures. A sharp blow against the glass may cause the tube to shatter. Very high voltages are used to operate the tube so that the set should be turned off and the high voltage condensers given time to discharge before disconnecting the high voltage lead from the accelerating electrode. The usual troubles requiring replacement of the cathode-ray tube are:

1. Aging of the tube through use. The cathode emission becomes weak and the screen material decays from continual bombardment by the electron beam. The result is a picture with reduced brightness and a brownish tinge. Most manufacturers of tubes guarantee them for one thousand hours of operation or one year, whichever occurs first.

2. Spots may have been burned at the center of the screen. When

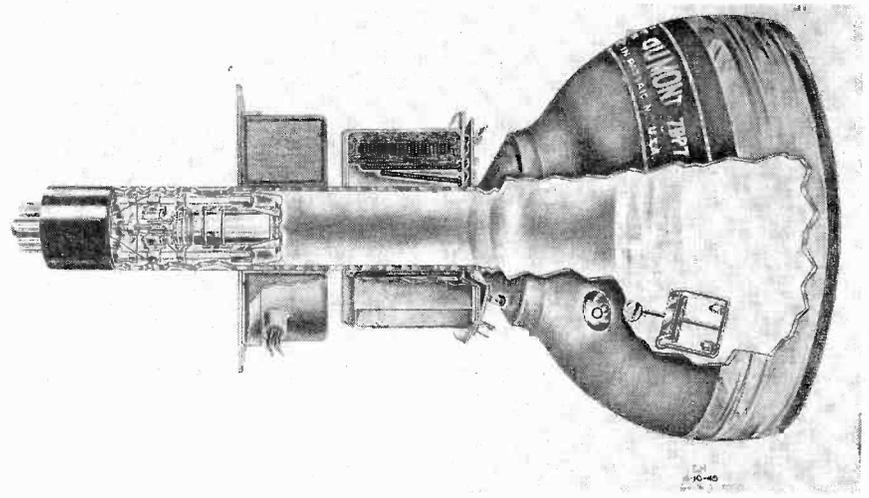


Fig. 10 A commercial type television tube, showing the electron gun, focus coil, deflection coil, aquadag coating, and high voltage terminal.

deflecting circuits fail, the electron beam concentrates at one point and burns away the screen material. Some receivers are provided with protective circuits that shut off the high voltage in case the sweeps fail, thus cutting off the beam and preventing this screen burning.

3. The tube may have "gone down to air." This is the term used to describe any leak that might have developed in the tube so that it fills with air. No usable

picture will be obtained under this condition.

4. The tube base may work loose. In most cases, the tube can be returned to the manufacturer and the bakelite base cemented on again.

5. The filament may have burned out.

6. In tubes with deflection plates, these electrodes may be out of line as a result of some severe jarring

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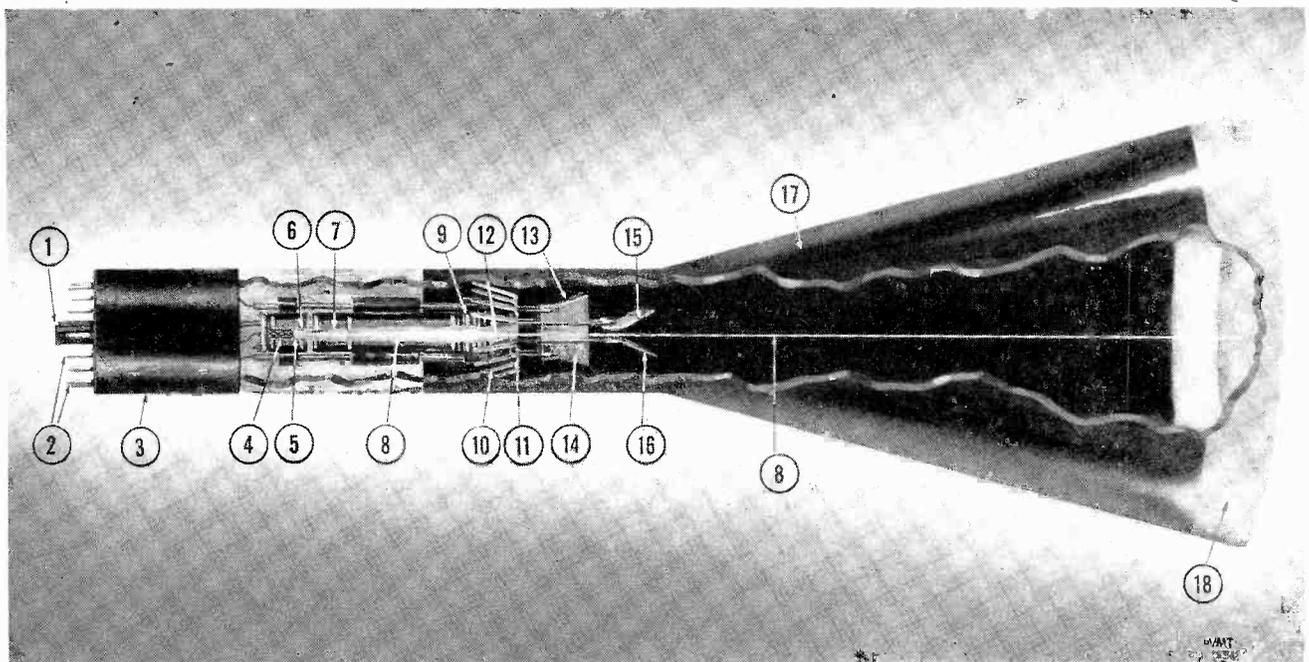


Fig. 11 A cross-section of a commercial cathode-ray tube with latest type zero focus current gun. Note path of electron beam and how it is sharpened by baffles and focused at the first and second lenses.

- | | | |
|-------------------------|--|--|
| (1) Locating socket key | (7) Pre-accelerator (connected internally to second anode) | (12) Second anode |
| (2) Pins | (8) Electron beam | (13) & (14) Vertical deflection plates |
| (3) Tube base | (9) Focusing electrode | (15) & (16) Horizontal deflection plates |
| (4) Heater | (10) Spider spring support | (17) Aquadag coating |
| (5) Cathode | (11) Mica insulator | (18) Screen |
| (6) Grid | | (19) Illuminated trace |

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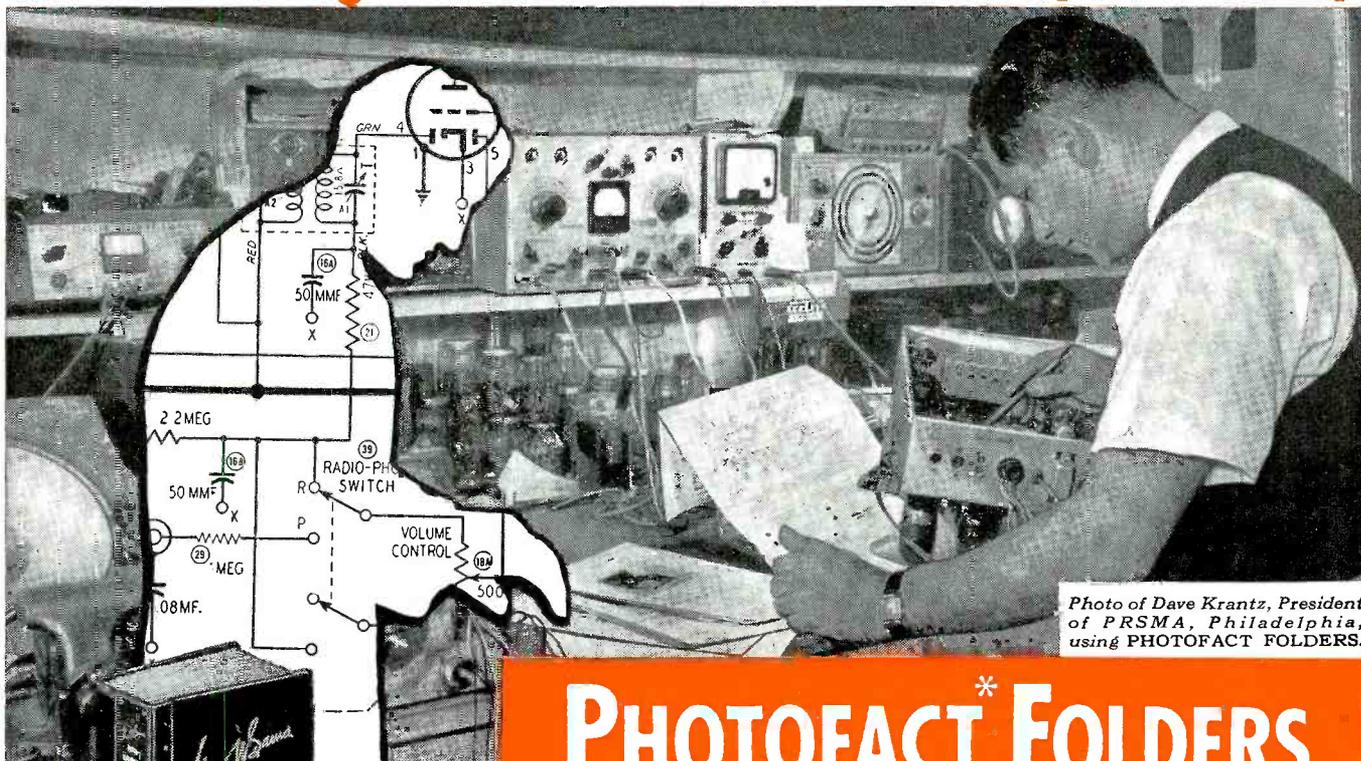
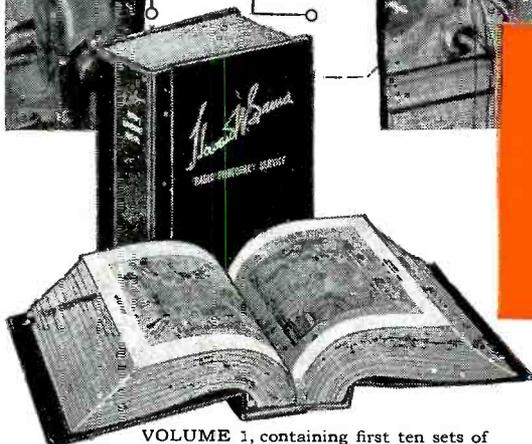


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The Open and Close Cases

→ From Page 7

in again. Unsolder the leads from the stator plates of the shorting section and place your high voltage from the stator plates to the frame of the condenser. Slowly turn the condenser from the fully meshed toward the unmeshed position. At the instant that the short is broken, you will see a bright arc appear across this shortest path. The arc will furnish its own illumination to reveal just which way the rotor plate should be bent. Straighten that rotor plate and repeat the process until no setting of the condenser stops the arcing. When this is achieved, you can be sure that none of the plates are touching; what is more, you will have burned out all the dust from between the plates. In fact, I often give the non-shortening section a treatment with the gadget simply to burn out this dust and get rid of scratchy tuning. With a little practice, you can straighten out even badly bent condenser plates without having to discount the tuning mechanism.

Unfortunately, the gadget is of no help in solving a problem that is becoming more and more common: That of the speaker with the voice coil rubbing on the pole piece. I think that the old-timers will bear me out when I say that this used to be a rather rare thing in the days of large dynamic speakers with up two-inch pole pieces. Those speakers had a gap between the voice coil and the center pole that you could see; moreover, each speaker had some method of easily centering the voice coil.

The picture is different today. Speakers are, in general, smaller; and they are chiefly of the PM variety. In order to take advantage of the limited amount of magnetism available, the voice coils fit very snugly around the pole pieces, and there is very little room between the frame of the speaker and the voice coil. Close tolerances are fine if they stay put, but paper is not a very reliable medium with which to work in measurements of a few thousandths of an inch. As a re-

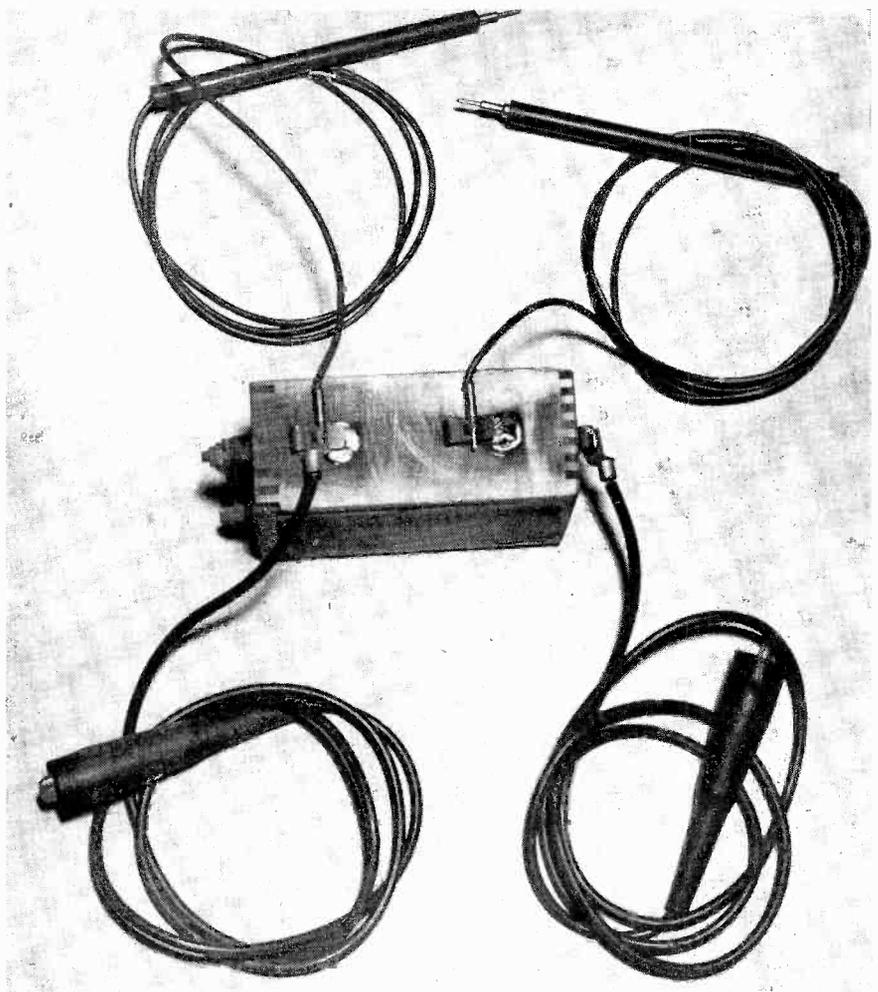


Fig. 2 A battery version of the unit shown in Fig. 1. A model T spark coil is used. Power is provided by a 6 volt storage battery.

sult, we servicemen are being plagued by a host of sets with that easily recognized, low-volume type of distortion that results from friction between the paper sleeve carrying the voice coil and the pole of the speaker. What is worse, many of the speakers are of the type that makes no provision for recentering the voice coil, having a treated-cambric type of spider that is cemented to a plate behind the cone.

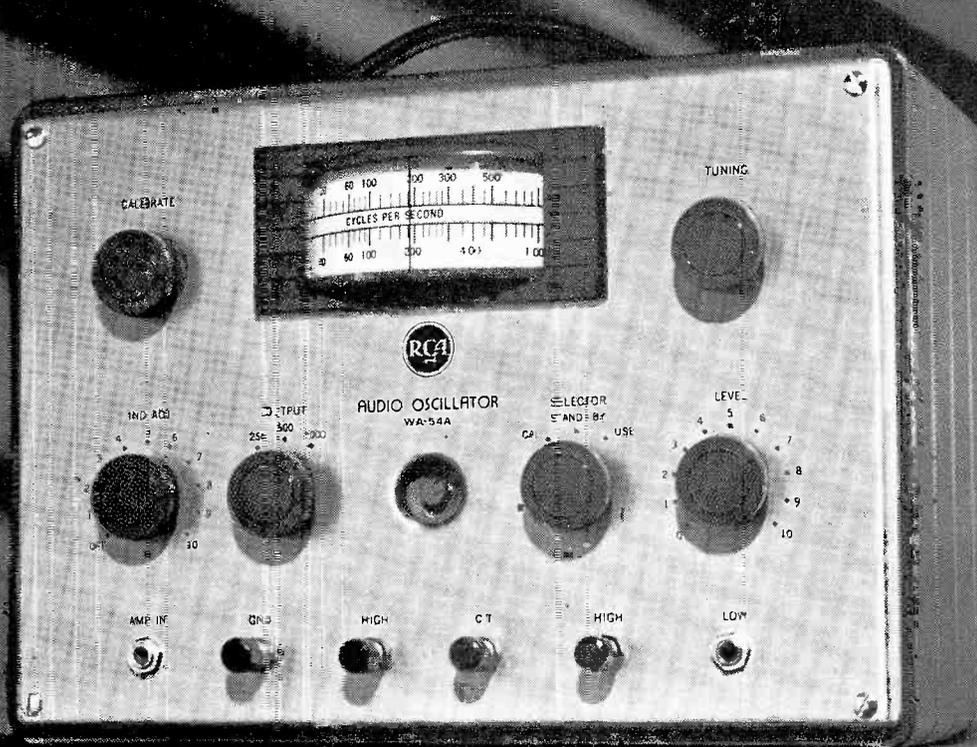
The first thing to do is to locate where the voice coil is rubbing. Use an eye-dropper and acetone to soak the dust-cover loose from the center hole. Let the cement-solvent soak in thoroughly, and then lift the cover off gently with a pair of tweezers. Examine the voice coil cylinder to see if it is out-of-round and to see if you can locate where it is touching. If the light is good enough and your eyes are young enough, you can usually locate the point of friction; but if you cannot, turn on the set and try pressing gently inward on the rim of the

cone. As you move this slight pressure around the edge, you will find one place where a very light pressure will cause the quality to become normal. Diametrically opposite to this point is the place where the voice coil is rubbing. Your pressure causes the whole cone to move a few thousandths of an inch so as to relieve the friction.

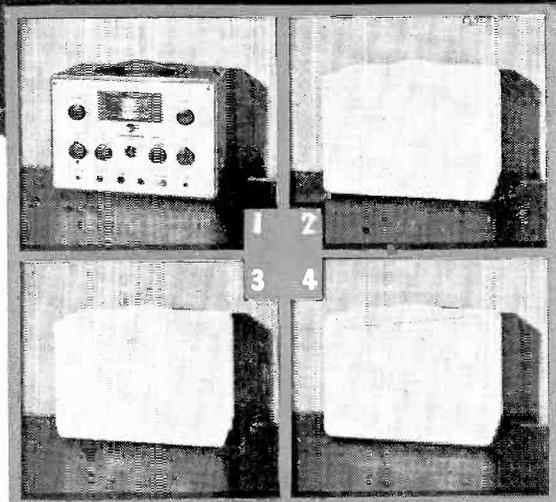
Now take a steel speaker shim that is just about as thick as you can shove between the pole and the voice coil at the widest gap without danger of damaging the paper cylinder upon which the coil is wrapped, and work it entirely around the pole piece one and a half times, using a gentle sawing motion and holding the shim at such an angle that any particles of dust or iron are worked toward the front of the cone. I say one and a half times because it is essential that the shim be at the point of former friction when it is withdrawn. The voice coil cylinder will be dis-

→ To Page 26

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Voltage Doublers

→ From Page 5

would be under no-load conditions. An oscilloscope connected across the output will show this effect. The type of wave form to be expected in each case is shown in Fig. 3.

Fig. 4 shows official data on the performance of a typical voltage doubler tube (25Z6) when used as a half-wave rectifier on two different power voltages and as a voltage doubler. In each case, output voltage is plotted against load current. Notice that the doubler curves (solid lines) approach the theoretical maximum of 326 volts as the load approaches zero. Notice also that the output voltage of the straight half-wave rectifier connection with a 235 volt line potential is higher than that of the doubler working on half of that line voltage. Although we might expect them to be equal, the difference becomes clear when we remember that the two diode sections are in series with each other in the doubler circuit and their plate resistances add up to a total of twice that of each diode. On the other hand, in the case of the regular half-wave rectifier, they are connected in parallel (plates and cathodes joined) so that the total resistance is one half that of each diode. It is thus clear that in the latter case the voltage drop is only one-fourth of that found in the doubler circuit. Fig. 1 and 2 are drawn for the purpose of explanation and some details have been omitted for the sake of simplicity. A more complete circuit of a practical full-wave voltage doubler is shown in Fig. 5. Notice that a limiting resistor is placed in the plate lead of each tube to prevent the initial rush of current through the tube and into the uncharged condenser from becoming excessive. The value of this resistor will usually be from 15 to 100 ohms. A resistor to take the place of both of these could be connected at R1.

How do we recognize a voltage doubler easily and quickly? First, we know it has to have two completely separate rectifier diode sections either in the same tube, or in different envelopes. We know,

→ To Page 28

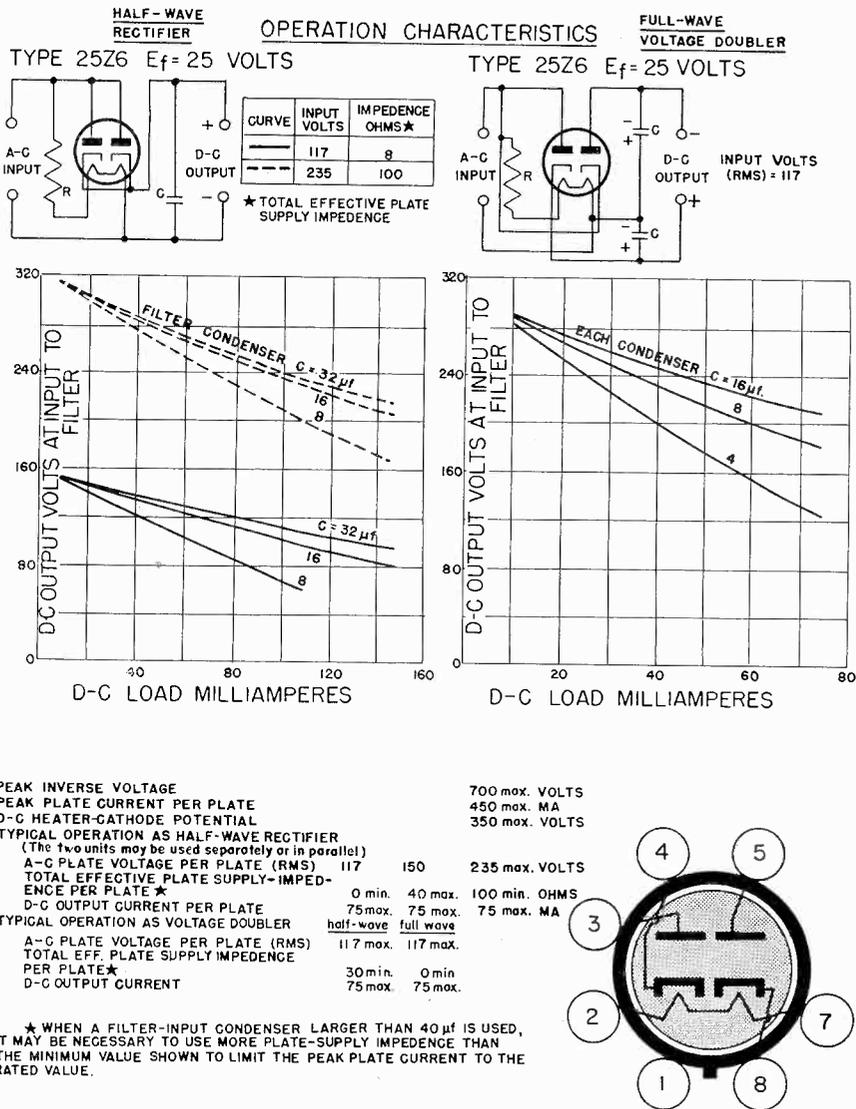


Fig. 4 Performance data for a typical voltage doubling tube, the 25Z6.

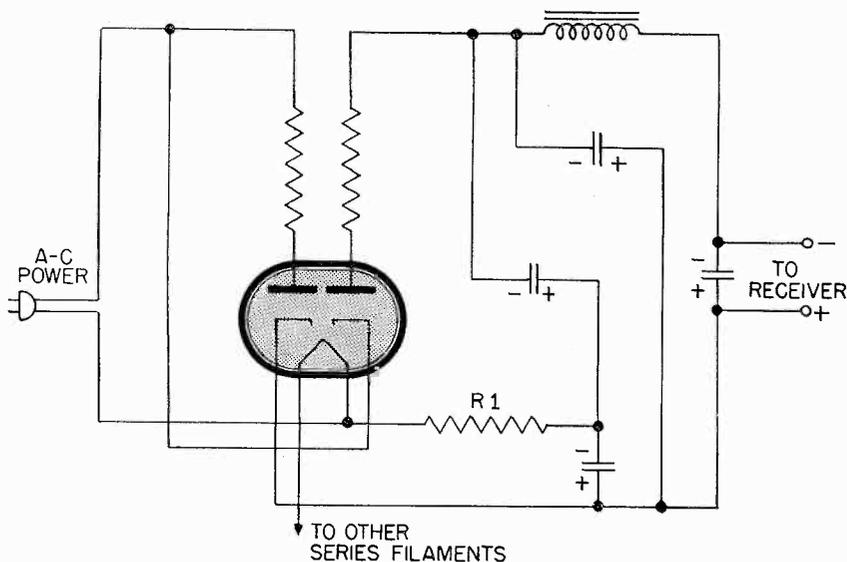
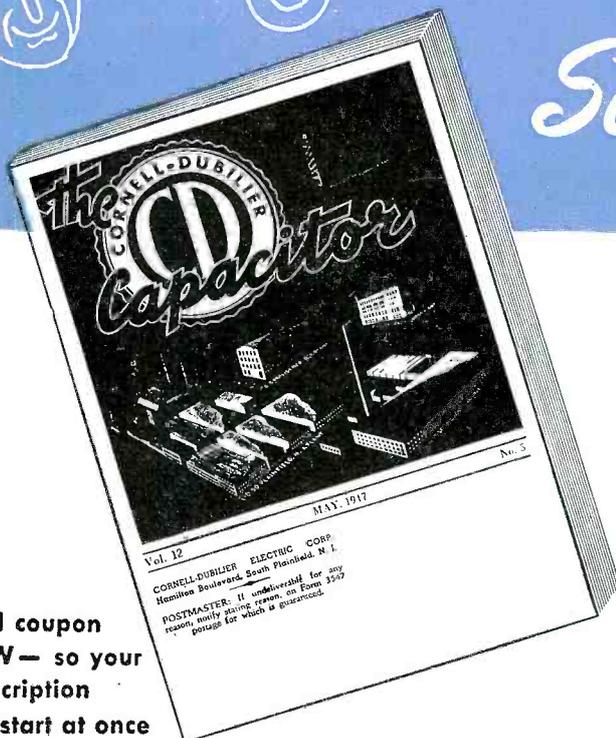


Fig. 5 Circuit diagram of a complete power supply using the voltage doubling principle.



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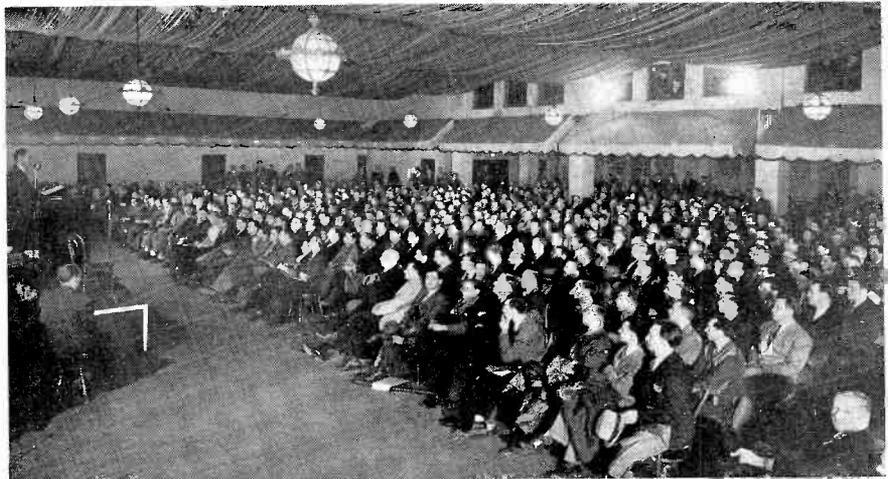
The Organizations

In the last few years, there has been a marked increase in organizational activity in the trade. Feeling that the reader would like to know more about the organizations and their activities, Radio Maintenance is inaugurating this column containing correspondence received from servicemen's organizations. If you are a member of an organization, we would like to hear about the activities of your group.

T. P. Robinson, Vice President of the Dallas Radio and Service Association, Inc., writes telling something of the recent activities of his organization as follows:

"Our group is chartered under the laws of the State of Texas as a non-profit educational enterprise. It is a result of past efforts, all of which have ended not too well. We sincerely believe that this time we have found a successful formula, and are, therefore, directing all of our efforts to making a success of it.

"It is composed of sales and service dealers, each of whom pays an initiation fee and regular monthly dues. Its purpose is to provide educational programs in both sales and service, to protect both the customer and the dealer, and to promote ethical, healthy, and legitimate competition. It has been an example of unselfish and whole-hearted cooperation on the part of the members, and has received the



The above photograph illustrates the tremendous interest in organization being expressed by the servicemen of Philadelphia. It was taken earlier this year during a meeting of the Philadelphia Radio Service Men's Association at Town Hall, Philadelphia. Over 1,000 servicemen attended for the purpose of hearing a talk on television servicing problems by W. K. Burlingame of Du Mont Laboratories.

endorsement of the manufacturers' agents and wholesale houses in this territory. Each member firm displays a decalcomania similar to the emblem at the top of this page, and it is copyrighted and closely controlled by us. We have two classes of membership, full and associate, a firm being a full member, and any servicemen employed by them being associate members.

"Attached is a copy of a recent advertisement which appeared in a local paper, and which contains a copy of our 'Code of Ethics.'"

T. P. Robinson,
Vice President

C. F. Bogdan, Director of Public Relations for the Federation of Radio Servicemen's Associations of Pennsylvania, tells us of the recent efforts made to organize the servicemen of Scranton, Pa.

"The Radio Servicemen's Asso-

ciation of Luzerne County held its last regular meeting in Scranton, Pa., on April 2. The purpose of this meeting was to demonstrate to a group of interested Scranton men the benefits of association. The turnout for Scranton was over 125 with approximately 50 in addition present from Wilkes-Barre and Philadelphia. The good turnout was due to the excellent cooperation of all Scranton wholesalers with the RSA of Luzerne County sponsors of the affair. Mr. Austin Renville of Luzerne, Pa., traced the 10-year history of the Luzerne County group, pointing out the many benefits derived. Mr. Dave Krantz, president of the Federation of Radio Servicemen's Associations of Pennsylvania, gave an excellent presentation on how to go about organizing an association with the able help of Mr. Devaney, vice

→ To Page 30

ANNOUNCING

• • •

THE DISPLAY OF THIS EMBLEM IN YOUR RADIO DEALER SHOP GUARANTEES OBSERVANCE OF THIS CODE OF ETHICS

1. Members displaying the Association emblem thereby warrant and guarantee to the public fair treatment in accordance with fair business practices.
2. Accurate statements of work done and charges therefor shall, in every case, be rendered the customer.
3. No misleading advertising statements calculated to prevent customers from being fully acquainted with his job, nor any unreasonable or indefinite promises or guarantees shall be made by a member of the association.
4. All requests of customers shall be treated with due care and diligence, and the better service of the public on their radio problems shall be our aim.
5. All work done shall be done in a neat and competent manner by any member of the association.
6. All replacement parts shall be of equal or better quality than those used originally, and on request all parts replaced shall be tendered to the customer when his radio set is returned.
7. All workmanship of members of the association shall be guaranteed for a reasonable length of time, and all disputes as to guarantees may be referred to the association after all efforts to adjust same have failed.
8. A comprehensive record of all work done shall be kept in a permanent record, and all complaints shall be courteously and expeditiously handled.
9. Technical assistance shall be rendered to all members at their request.
10. All members, their shops and personnel shall present at all times a neat and businesslike appearance, both in person and in the premises. The display of the emblem of the association in a member's place of business indicates association approval of the place of business, and the appearance thereof should reflect credit upon the emblem.

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SPRAGUE TRADING POST

SWAP — BUY OR SELL

FOR SALE—35-watt amplifier with 2 mike taps, phono and tone control, 8 tubes; also super-het tuner with power supply; Jensen JAL-60 dual speaker 11.7, and automatic record player. All new, sacrifice \$170. F. Freeman, 617 W. 169th St., New York 23, N. Y.

WANTED—New or used r.f. amplifier to use mostly on 10 meters, approx. 2-0 watts output. W.K.R.B., 219 High School Ave., Columbia, Miss.

FOR SALE—Gen. Industries model E Blue-Flyer heavy duty phono motor, 12" weighted turntable with Astatic FP-8 1-oz. pick-up, on mahogany board; Astatic AB-8 needle type, interchangeable with above. Reasonable. W. N. Warren, 20472 Russell Ave., Detroit 3, Mich.

WANTED—For cash or swap, recording equipment and/or accessories. Have all types of parts and tubes. What do you offer? S. Gilman, c/o Radiolabs Institute, Ste. 11, 431 Main St., Winnipeg, Manitoba, Canada.

FOR SALE—GE, Sylvania, RCA tubes in original cartons. Hard-to-get types. Any quantity 50% off; also industrial type tubes. John Mangus, 9415 S. 55th Ave., Oak Lawn, Ill.

FOR SALE—Or trade, complete late NRI television course in binders; complete set radio servicing instruments; BC-284 for 75 or 80 mtrs., transmitting and receiver, dynamotor, \$30. Want BC-610, K. H. Stello, 12026 Peoria St., Roscoe, Calif.

FOR SALE—Army morale receiver 8 tubes, a-c, d-c 110-220 V. or batteries, (not included). Cost \$70 will sell for \$50 or equivalent in Rider's manuals or good 3" scope. Julio Bellier Arroyo, c/o Pan American Airways, Inc., San Juan, Puerto Rico.

WANTED—A mine detector or metal locator. Send full description. L. Seibuth, 620 S. Paea St., Baltimore 30, Md.

FOR SALE—Power units, surplus PE-214B, new, Portable electricity for P.A., radio, lights, xmitter, 300 watts 110/220 V., 60 cy. a-c 1 h.p. engine, 8 hours per gal. Complete tools, spare parts. Weighs 36 lbs. \$107. W. S. Lockman, Box 535, Hendersonville, N. C.

WANTED—Magnetic wire recorded mechanism. Prefer surplus navy type magazine, complete with wire, less amplifier and motor. M. L. Hughtett, 209 1/2 S. Summit St., Arkansas City, Kansas.

FOR SALE—U.S. Army Sig. C. communications set—3 receivers: BC-453B, BC-454B, BC-455B on rack FT220A and transmitters BC-636A, BC-457A, on rack FT 220-A. All prepaid for \$30. S. Weinstein, 504 S. Edith St., Albuquerque, N. Mex.

FOR SALE—New radio tubes at 40% off in lots of 10 or more. Will ship C.O.D. Want 500 watt movie projector, have 10mm projector to trade or sell. Bon W. Mueller, Nash Rd., N. Tonnawanda, N. Y.

FOR SALE—15" Wurlitzer juke box speaker, 3200 ohm field. Excellent condition, \$75 value. Will trade for PE-103 dynamotor; BC-946B aircraft receiver or what have you? Will sell for \$25. Bob Webb, c/o WNCA xmitter, Asheville, N. C.



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FOR SALE—Philco Sig. gen. good condition. 5 bands continuous 110 kc. to 20 mc. Complete with power supply. \$35. Wallis Radio, Beaufort, N. C.

FOR SALE—Gone out of the radio repair business. Will sell parts valued at \$300 net, for only \$50.00; tubes, transformers, condensers, resistors, vibrators, etc., etc. L. S. Rising, 6580 W. 88th Pl. ace, Los Angeles 45, Calif.

FOR SALE—Rider manuals I & III, \$7.50 ea.; 6 V to 180 V. generators, \$5 ea.; 1946 Sams' Foto Facts complete, \$16.50. Want 3" scope in any condition, standard make. No junk! Don't send money, write first. C. D. Lessig, 24 8th St., Frenchtown, N. J.

FOR SALE—Philco record changer tools with service manual for '42 changers, \$12; custom built 15-watt amplifier, 5 tubes with 12" spkr. and 25' cable, \$38. Shipped C.O.D. Guadio V. Imbruglia, 8 Upland Rd., Brookline 46, Mass.

FOR SALE—Many service manuals. Gernsback, Supreme, RCA etc.; Aero-vac L-C checker; large diathermy unit; new, used radio parts for experimenters; All or any cheap for cash. Write for list, Stout's Appliance Service, 2241 E. Broadway, Muskegon, Mich.

FOR SALE—Precision 844 multi-tester, fine condition, slightly used, \$25. Superior #450 tube tester, perfect condition, \$30; Hallcrafters sky champ S-20R, brand new, \$55. C. S. Danna, 817 Hopkins St., New Iberia, La.

FOR SALE—Rider manuals 1 to 5 with index in perfect condition, \$15. Bill Neumann, 1440 14th St., Lewiston, Idaho.

FOR SALE—Meissner analyst #9-1040; Bendix-Dayrad tube tester and multi-meter roll tube chart, 200-23954. Mickey Berry-Radios, 5 N. National, Ft. Scott, Kansas.

SELL OR SWAP—G.E. Trutone; Wilcox-Gay radios; Webster amplifier; tubes; transformers; chokes; speakers; new Olson 60 airplane motor, new with prop., coils, boat for motor; manual single record player; meters for what have you? W. R. Schalla, 1801 Illinois Ave., Lansing 6, Mich.

FOR SALE—RCP 802 tube and set tester; Hickok 18 sig. gen. Both factory reconditioned 1946, A-1 condition, both for \$70; Mallory VP554 Vibrapack in original carton, never used \$10. Benny's Radio Shop, 411 Arcadia Ave., Arcadia, Fla.

FOR SALE—Itek-O-Kut single speed 12" recording assembly. Low imp., high-fidelity cutting head. RK number meter, over-lead feed mech. 1/20 tip G.E. constant speed motor. Complete \$90 f.o.b. Baldwin Radio, 113 S. Grand Ave., Baldwin L. I., N. Y.

SELL OR SWAP—Completely equipped, stocked radio service store, doing excellent business, low rent. Am returning to overseas service; must sell. Does between \$150-\$200 business each week — picking up. G. H. Mulford, 1005 Walnut St., Hamilton, Ohio.

FOR SALE—Simpson 216 V.O.M. A-1 condition, \$25; RCP sig. gen A-1 condition, \$22 f.o.b. J. D. Curtice, 1630 Park Rd. N.W., Washington 10, D.C.

FOR SALE—Lafayette 263 35-watt amplifier, 8 tubes, 2 12" Magnavox hvy. duty spkrs., in leather case. Like new, very powerful for inside or outside work. 2 mike, 2 phono inputs, \$125. M. J. Difini, 1698 Lexington Ave., New York 29, N. Y.

FOR SALE—A-200 sig. gen; 305 Jackson tube checker; 200 receiving tubes, all new—the lot for \$250. W. E. Miller, Box 738, Okmulgee, Okla.

FOR SALE—Well equipped radio repair shop. Complete line of merchandise in N.W. Nebraska \$3000 or will trade. L. E. Bottorff, 232 Main, Gordon, Neb.

FOR SALE—New radio tubes in cartons, 40% off list price; Perfox 35mm camera with F2.8 Wollensak anastigmat lens and case, \$85. Jimmy's Radio Service, 203 North St., Cleveland, Miss.

FOR SALE—Riders Cathode Ray Tube at Work, \$3.25; Servicing by Signal Tracing, \$3.25; Servicing Receivers by Resistance Measurements, \$1.50. Ghirardi's Radio Physics, \$4; T. Wojciechowski, 2837 Fulton St., Brooklyn 7, N. Y.

FOR SALE—Philco C-1808 auto radio, less spkr; 0-500 ma Weston; 0-7 5-150 V. Weston \$3.25 ea. postpaid. Test equip. repaired. Chambers, 255 Long Lane, Upper Darby, Pa.

WANTED—Sig. Generator, prefer Triumph 130; Precision E-200; Trip-lett 1632; Jackson 640 or Clough-Brengle or Simpson for cash. Casey Jones, 1606 Ashboro St., Greensboro, N. C.

SELL OR SWAP—5" scope rebuilt from BC-412 on new chassis with new panel, no case. Has built in sweep, using 884, pushpull horizontal and vert. amplifiers. Complete with all tubes. L. I. Fleming, 361 W. Fulton St., Farmington, Ill.

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FOR SALE—Vomax vacuum tube volt intr., \$58; Simpson 260 set tester, \$37; Precision E-200 sig. gen., \$65; Aero chassis cradle, \$4.50; Ghirardi Trouble Shooter, \$4.50; Sams' Foto Facts 1, 2, 3, \$4.25. All new. M. Thomas, Flandreau, S. Dak.

FOR SALE—New test equip. Hickok 305 scope, \$125; 191X sig. gen., \$110; 125 VTVM, \$80; Precision E-200 sig. gen., \$54; RV-10-P VTVM, \$60; Rider manuals VI, \$9; VIII, IX, XI, XII, \$12.50 ea. Express paid to destination. Rader & Pasig, 1316 Lorraine Rd., Reading, Pa.

FOR SALE—Rider manuals 3 to 8 \$35 for all; also home-built VTVM, \$15. Need 6UGT, 25B5 tubes. Hamilton Radio, Spirit Lake, Iowa.

WANTED—Solar CP-EXAM-ETER capacitor analyzer or other standard make; also Supreme 561 sig. gen. Quote price Driskley Elec., Farmland, Ind.

FOR SALE—Supreme 503 tube tester, \$45; Supreme 547 multi-meter, \$40; both in fine working condition, f.o.b. Dixie Radio Shop, Jonestown, Miss.

SELL OR SWAP—NRI multi-tester, in black carrying case for home servicing. Full instructions included. Will trade for good outdo meter for aligning receivers or sell for \$6. R. D. Vosbury, 38 Andrews Ave., Binghamton, N. Y.

FOR SALE—39" radio, electric, electronic books, \$40. Free with all 39 books, 1947 Radio Electronics reference manual; also have 5 Radio News, 5 Radio Craft magazines all for \$2. C. Otto, 2932 N. Leithow St., Philadelphia 33, Pa.

FOR SALE—Radio shop and sales business in a good town located 5 miles from St. Joseph. Mo. Write for details. E. Kienkoff, Watliena, Kan.

WANTED—Rider's Manuals Vols. 1-14 or whatever vols. you have on hand. No pages missing. Fred M. Merrill, California, N. Y.

FOR SALE—Tubes: 15, 19, 31, 30, 32, 33, 1E7, 1F1, 1F4, 1P5, 1F7, 2A6, 2B7, will sell or trade. W. B. David, 2006 Rosselle St., Jacksonville 4, Fla.

FOR SALE—Supreme 502-S tube and set tester, 20,000 ohms-per-volt meter. Excellent condition \$35. W4APY, 2915 9th St. North, St. Petersburg, Fla.

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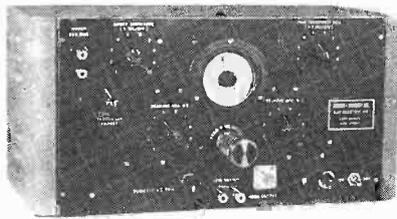
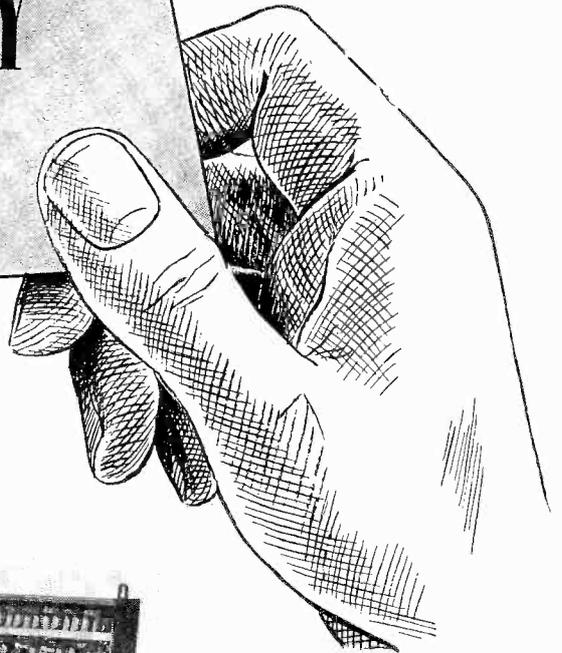
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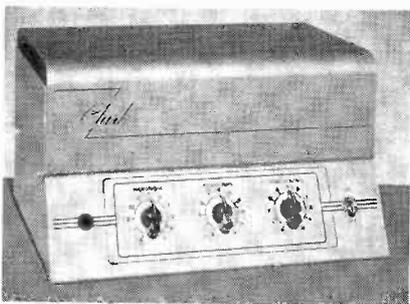
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THE INDUSTRY PRESENTS



MEGA-SWEEP JR

A new sweeping oscillator test unit, manufactured by the Kay Electric Company, East Orange, N. J., is a simplified model of a standard laboratory unit currently installed in most FM and television labs and manufacturing plants. It is designed to withstand hard shop service. It provides a frequency sweep up to 30 megacycles over the entire frequency spectrum of 400 kilocycles to 500 megacycles. The output frequency is measured by means of a high precision microwave wave-meter, calibrated up to 900 megacycles. The unit's power supply is self-contained, operating on 117 volts, 60 cycles; weight is 20 lbs.



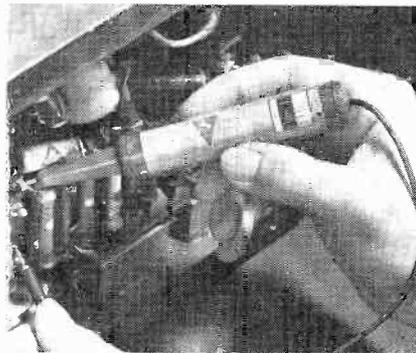
P A AMPLIFIER

A moderately priced 10-watt public address amplifier for use in small and medium-sized auditoriums is now being produced by the Clark Radio Equipment Corporation. Model PA-10a has terminal strip mounting of small components and generously rated power and output transformers. It has a virtually flat response from 50 to 10,000 cycles with less than 3% harmonic distortion at 10 watts output; hum level is at least 60 db below full output. Complete information is included in Technical Bulletin #134 which will be mailed upon request from the Clark Radio Equipment Corp., 4636 Ravenswood Ave., Chicago 40, Ill.



RESISTOR KIT

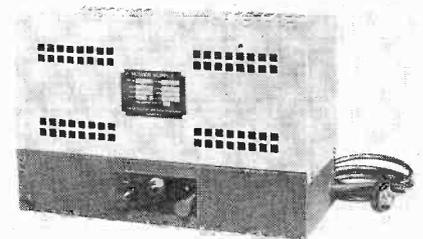
A new "Basic Kit" for normal service use has been announced by International Resistance Company. It is an assortment of 471 resistors covering the most used types and ranges, plus 6 additional bands for adjustable types, packed in a sturdy metal cabinet. The IRC Basic Kit was specifically designed as a time-saver for servicemen.



POCKET-SIZE OHMMETER

A compact, inexpensive pocket-sized ohmmeter for spot checking radio and electronic circuit components and other electrical equipment has been announced by Sylvania Electric Products Inc., New York City. It was designed primarily for servicemen

to use in preliminary isolation of electrical faults, for prompt estimates of service charges, time required for repairs, etc. This miniature test prod instrument has a range of 0 to 10,000 ohms. Direct readings are given on a 1.5 milliampere full-scale sensitivity Weston meter in series with a 1000 ohm molded carbon resistor and a standard penlight dry cell. The ohmmeter is enclosed in a tubular plastic case $\frac{7}{8}$ inch in diameter and $5\frac{3}{4}$ inches overall, with bakelite prod tip base and top cap.



HEAVY DUTY POWER SUPPLY

FTR 3246-BS, heavy duty selenium rectifier power supply produced by Federal Telephone and Radio Corporation, is an efficient and effective test bench power supply for all types of auto radio sets. This unit has no adjustments and only requires plugging in of the AC line cord and connection of the load to the output binding posts. The FTR 3246-BS features an insulating type transformer; a Federal single phase, full wave selenium rectifier with center-tap connection; an input choke and condenser filter, and a bleeder resistor. The entire unit weighs 30 lbs., is 14 in. wide, 9 in. high, and 6 in. deep.

NEW MULTIMETER

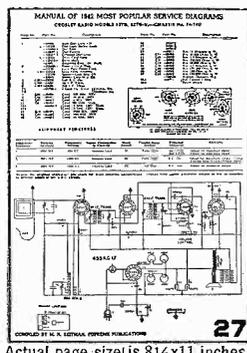
The Byohmmeter 796 Multimeter, manufactured by r m s Electronics, Inc., features 1% accuracy on all current and voltage ranges AC and DC from a full-scale read-
→ To Page 40



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Compiled by M. N. Beitman, radio engineer, teacher, author, and serviceman.

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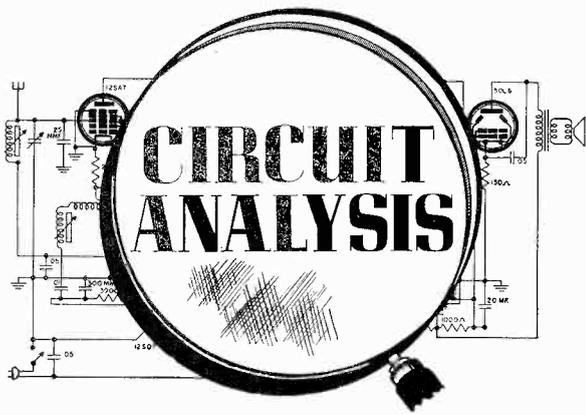
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by
**J. Richard
Johnson**

The Meck model PM-5C5-PW-10 is an AC operated combination radio-phonograph. It uses the superheterodyne circuit with the antenna coupled directly to the converter stage. One of the main features is the use of slug tuning of the oscillator and signal grid input stages. The shortage of variable condensers has prompted several manufacturers to install this system in their sets. Instead of reaching resonance in the tuned circuits by varying the capacity, it is done by moving an iron dust slug in and out of each coil, thus varying the inductance until the proper amount is obtained. Meanwhile the capacity is kept constant, being provided by a fixed condenser across each coil.

The two slugs (one each for oscillator and mixer circuits) are connected mechanically so they will both move together, thus providing

tracking which would ordinarily be provided by the shaft of a two-section variable condenser.

Notice that the oscillator voltage is injected in a rather unusual manner in this set. The oscillator coil is divided into two parts. One part is slug tuned; the remainder is used, in conjunction with coupling coil, to feed oscillator voltage to the injection grid of the 12SA7 converter tube. The usual method of obtaining feedback by means of a grid condenser is thus replaced by use of the capacity between the turns of this coupling coil and the tuned circuit.

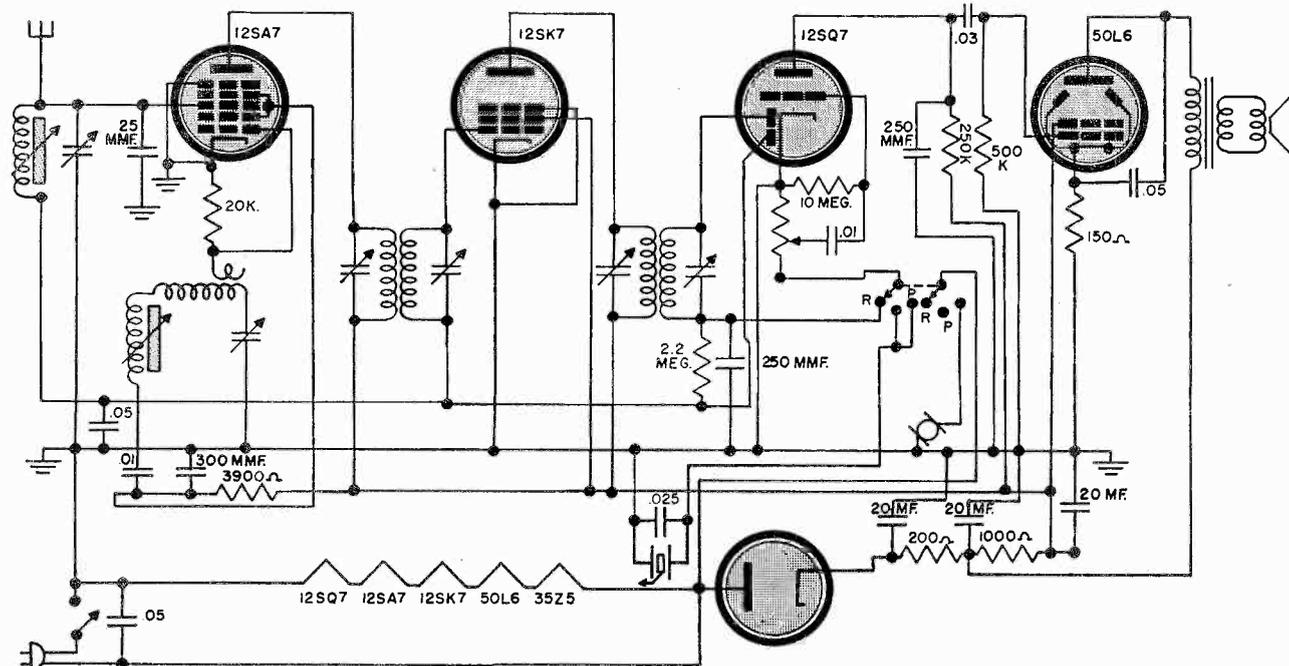
The new Aermotive model 181-AD has some interesting features. This set is of the AC-DC type but is somewhat more elaborate than the average midget receiver. As shown in the figure, the lineup uses

one RF stage and push-pull audio output in a superheterodyne circuit. Use is made of the 14 series tubes and 50A5 output amplifiers.

One rather unusual feature is the filament arrangement. Two separate filament circuits are used, each one a series connection adding up to nearly the full line voltage. These two circuits are then connected in parallel with each other. As the diagram shows, one model includes a common resistor (30 ohms) in series with the parallel combination; the other model uses a separate 60-ohm resistor in each leg of the filament circuit. Presumably, the latter arrangement should be better from a maintenance standpoint. This is because with the common 30-ohm resistor, if one tube filament should burn out, the drop in this resistor will not be as great as before, and higher voltage will then be applied to the filament group which still has continuity. In servicing this model, therefore, it would be good policy to make sure which arrangement is being used and judge any tube burnouts accordingly.

Another feature worth noting in this set is the phase inverter used. Contrary to the usual practice of using two tubes or a dual type of tube, this circuit uses only one tube for audio driver and inverter. The

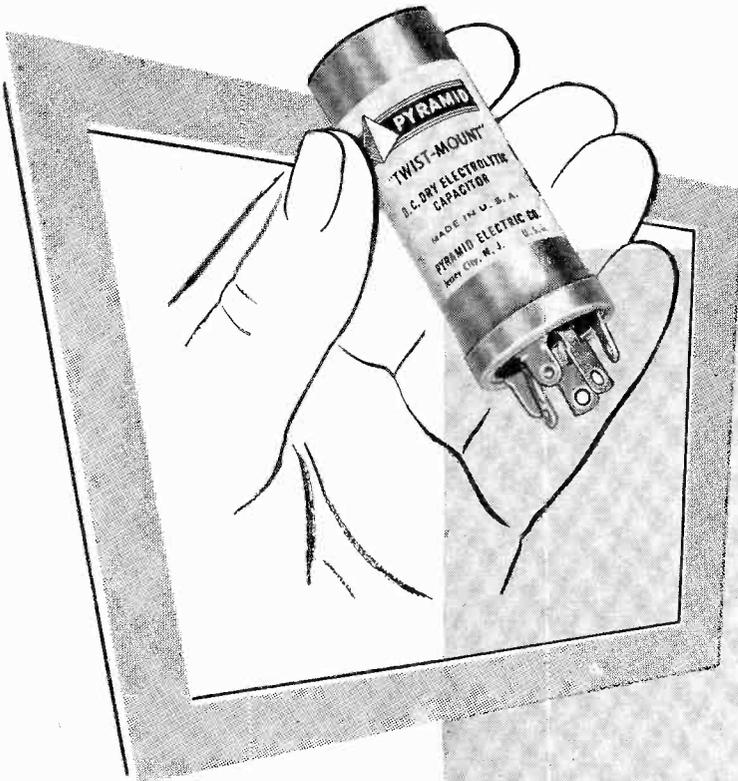
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Meck Model PM-5C5-PW-10

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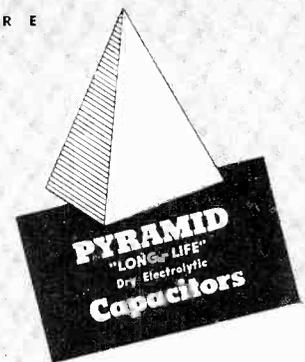
Pyramid Type TM units are
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And, like all other Pyramid
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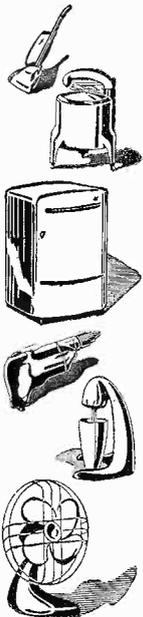
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The Open and Close Cases

→ From Page 16

torted as the shim moves around the pole, there being a slight bulge at the location of the shim, and we want to leave this slight bulge right where the coil was rubbing. I need hardly say that the shim should be handled very gently on its circuit of the pole. If you tear or even scuff up the paper cylinder, you will aggravate the original trouble beyond repair; but it is remarkable how many times this simple operation will effect a permanent cure.

In other cases, though, the speaker will sound all right until it has become thoroughly warm; then it will begin to rub again; or it may sound all right until the radio has cooled off, at which time the old distortion is again apparent. More heroic measures are obviously needed here.

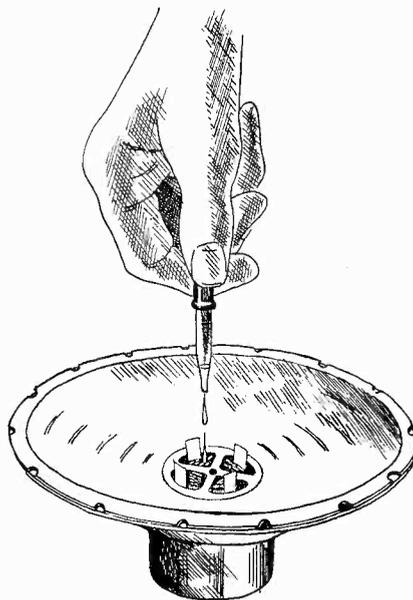


Fig. 3 Four shims are placed as shown and the spider is soaked with acetone applied with an eyedropper. Care must be taken not to get acetone on the voice coil.

First, work four steel shims into place so that the voice coil is held rigidly in position as shown in Fig. 3. Then take a long-beaked eyedropper and moisten the cambric-type spider slightly around the outside rim, taking care to see that the acetone you use in this process does

not get in close to the voice coil. At the same time, saturate thoroughly the outside rim of the cone with acetone, again taking care that the liquid does not run down into the voice coil. Incidentally, if you ever have celluloid shims in position in the voice coil and let some acetone run down on them, you can kiss that cone and those shims goodbye. I learned that the hard way.

You can use water to soften the cone, but I much prefer acetone because of its superior penetration of the fibers and because of its quick drying. In a few minutes you can pull out your shims, and you will usually have a centered voice coil that will stay put. The only precaution that you need to keep in mind is not to use too much acetone on the spider so that you cause it to become uncemented from the plate. The trick is to soften the spider just enough to let the voice coil move over a few thousandths of an inch before the pliable material of the spider sets up again. The soaking of the cone is

→ To Page 30

LOOK AT THESE 2 SET VALUES!

ALMO VALUE NO. 1 5 TUBE SET AC-DC, 110 VOLT

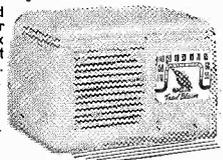
Built-in tuned loop. Vernier tuning (size 8 x 5 x 6). Walnut or white plastic.

Your Cost.....

\$15.75

3 Lot Price.....

\$15.45



ALMO VALUE NO. 2 AUTOMATIC RADIO PHONOGRAPH COMBINATION

Smart modern walnut design cabinet. Plays 10-10" or 8-12" records. Balanced tone arm. 5 tube super-heterodyne with self contained antenna. 110V—A.C.—D.C. operation.

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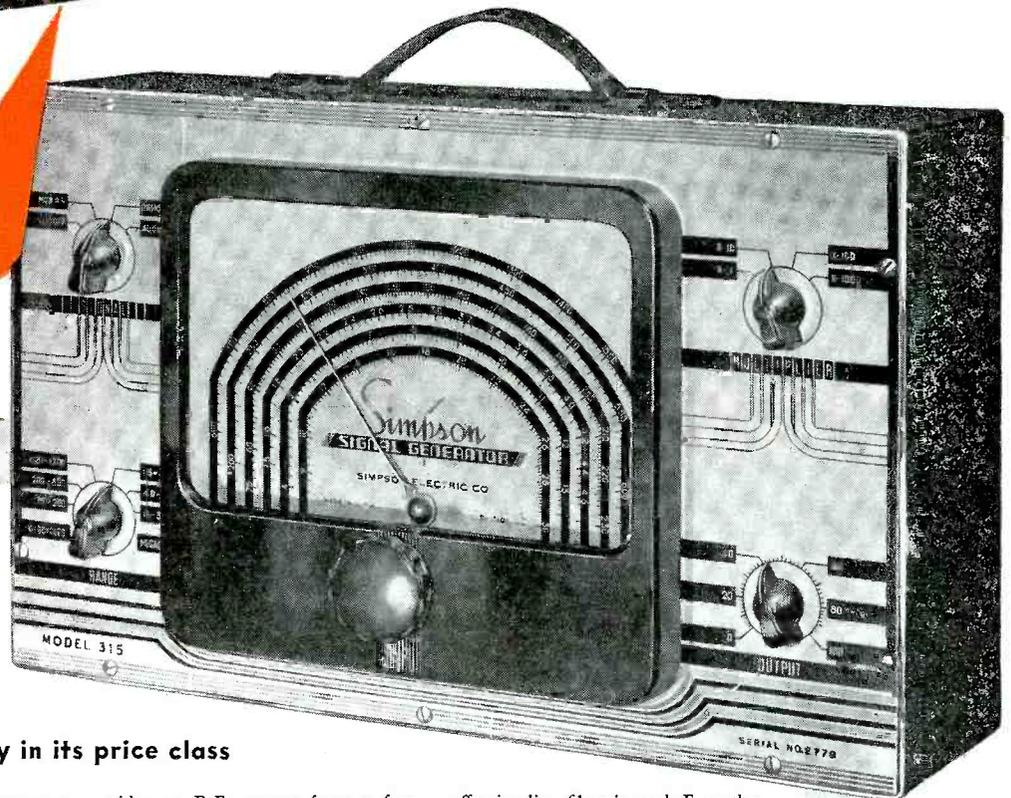
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Here's a test signal source that maintains its accuracy under constant use. The Simpson Model 315 Signal Generator produces fast and accurate "trouble-shooting" every time. The reason is as clear as its signal: this generator is Simpson engineered and built.

Like all Simpson test equipment, Model 315 is made almost entirely within the various Simpson plants. This, plus our tremendous investment in expensive production tools is your assurance that Simpson testers will not quickly become obsolete and will be of unvarying quality.

An investment in the Model 315 is an investment in lifetime, trouble-free service.

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YOUR
SIGNALS
CLEAR**



- ★ Accuracy
- ★ Stability
- ★ Minimum leakage
- ★ Good wave form
- ★ —extraordinary in its price class

The Model 315 Signal Generator has a big nine-inch meter type dial, with hair-line pointer, for high readability. Smooth vernier control permits close settings.

Circuit: Electron coupled circuit assures extreme stability and output uniformity throughout the band. Three tubes are utilized in the circuit — full wave rectifier, modulator and oscillator. Standard 30% modulation at 400 cycles is used.

Output: Signal is controlled through an ingenious step attenuator of the ladder type. Volume level of each step is regulated by a smooth non-inductive control which pro-

vides an R.F. output from a few microvolts to .15 volts and a 400 cycle output from zero to 3.5 volts.

Bands: Six R.F. coils provide ranges of 75-200; 200-600; 600-1700 kilo-cycles and 1.5-4; 4-12; 10-30 megacycles. Coils are designed to retain original inductance regardless of temperature or humidity changes. A special switch automatically eliminates "dead spots." Frequency accuracy is 1%.

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effective line filter is used. Even the line cord is shielded. Result: leakage is negligible.

Calibration: Each coil is individually calibrated to close tolerances against crystal standards by means of variable inductance and variable minimum capacitance. Tests show negligible changes over long periods of time under extreme temperature and humidity variations.

Size 16"x10"x6". Weight, 15 lbs. Shipping weight, 20 lbs.

Dealer's Net Price.....\$67.35

For 220 Volt 50 or 60 cycle add 7.50

SIMPSON ELECTRIC COMPANY

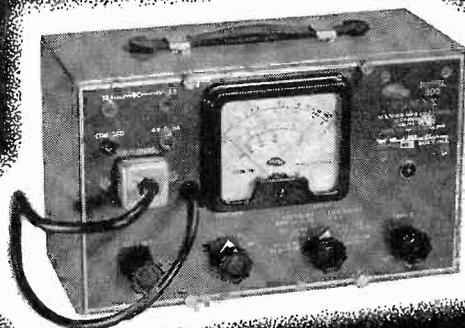
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Simpson

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If you want to guard your meter dollar investment . . . to make it only once for many years to come . . . then "VOMAX" at its present low \$29.85 net price is your logical choice . . . as thousands more wise technicians like yourself have proved to their profit.

Let's look at this matter of what meter you buy seriously . . . for your choice of this, the service technicians basic instrument, can spell either peace and profit . . . or annoyance and loss to you. You must have the best meter to meet "smart" competition. And "smart" competition overwhelmingly uses "VOMAX." The reason is simple. Other manufacturers have had to copy "VOMAX" inventions to satisfy your demand for a modern, post-war, obsolescence-proof universal meter. Yet, "VOMAX," the perfected v.t.v.m., stands head and shoulders above all other meters. This is proved by its heavy purchase and use by the Bureau of Standards in Washington, by Western Electric, G. E., Westinghouse, university after university, by top-ranking industrial laboratories, F.C.C., C.A.A., Veterans Administrations, schools, colleges . . .

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Signal Tracer

→ From Page 9

connections make it possible to use headphones instead of the speaker.

6. Gain control. Used to adjust the sensitivity of the tracer.

7. Probe cable connector.

Both units are mounted in steel cabinets finished in brown, with a carrying handle on top.

The use of the detector tube and its associated isolating circuit gives the probe a high impedance which makes it possible to connect it to the plate or grid of a stage, causing only a negligible change in the tuning of the circuit. Since the probe circuit acts as either a detector or audio amplifier, it can be moved quickly from RF through the IF and audio sections of a receiver without readjustment for the change in the type of signal.

The unit checked was the AC operated TS-3. No difficulty was experienced in following a signal of a broadcast station from the antenna to the speaker of a typical midget receiver. On a reasonably strong signal, the unit was sensitive enough to produce audible output when the probe was touched to the top of the antenna coil. ✓ ✓ ✓

Voltage Doublers

→ From Page 18

therefore, that if a 35Z5, 35Z3, 45Z5, or any other tube with only a single diode section, is used as a rectifier, it cannot be a doubler. Second, the cathodes of the two sections must not be combined into one element. This rules out most of the low filament voltage rectifiers, such as the 80, 5Y3, etc. Third, although simple half-wave rectifier circuits use doubler tubes with the two sections in parallel, the voltage doubler cannot operate with either the two plates or the two cathodes connected. In this case, a glance at the bottom of the socket will usually suffice to identify the circuit type. ✓ ✓ ✓

OVER THE BENCH



by John T. Frye

WHEN I was down at the wholesaler's the other day, picking up some IF transformers, a gang of servicemen there were engaged in a hot argument as to which was the more important in radio servicing: Theoretical knowledge or practical experience. I do not know how the thing started—it was going strong when I arrived—and I did not join in the fracas; but I did some good listening.

The old-timers, it seemed, were lined up solidly behind practical experience. They argued that there was a lot of difference between being able to read a neat diagram and being able to "see" this diagram in the tangled wiring of a receiver. Only experience, they said, would enable you to make a shrewd guess as to what was the matter with a set as soon as you saw the model number, a guess backed up by finding this set's pet weakness showing up again and again on the service bench. Experience, too, they maintained, was the only thing that would enable you to diagnose a radio's trouble by listening to symptoms so faint and obscure that using them is almost a feat of subconscious perception.

To top off this point of view, one old fellow told how he had formerly operated a service shop in a town in which there was a huge university specializing in engineering. This man said that half of his trade consisted of straightening out the badly maimed receivers that had been "worked on" by the electrical engineering students.

The younger men, especially the ones with military training in radio, were not convinced that experience was the most important. They said that the fellow with practical experience only might know the

"how" of fixing radios but that he did not know the "why" of what he did. He was like a parrot that repeats the lesson it has learned over and over without realizing the significance of what it says.

They quoted the adage, "Experience keeps a dear school, but fools will learn no other way." Theory, they explained, was simply condensed experience, experience that had had all of the fallacies and personal elements boiled out of it in the condensing process.

I do not know how the argument came out for I could not stay for the finish, but the conversation has been buzzing around in my head ever since. It was not hard to see why each faction took the stand it did. Each was simply talking up what it had the most of: The old-timers were partial to their hard earned experience; the youngsters were not going to allow anyone to belittle the skull-cracking theory that they had spent so much effort absorbing.

My sympathies were all with the old-timers. After all, it is pretty exasperating to spend half a lifetime learning your business and then have some upstart Johnny-come-lately brush aside all of your treasured knowledge with the disparaging adjective "empirical." What is worse, you have to look the darned word up before you realize just how badly you are insulted!

Yes, my sympathies are with the old-timers; but my reason places me in the ranks of the theory men. Practical experience *alone* is too inflexible for such a rapidly moving field as radio repairing. If all you know is what you have learned by doing, you are never prepared to cope with new sets and other pieces

→ To Page 37

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The Organizations

→ From Page 20

president of the Philadelphia Radio Servicemen's Association.

"Temporary officers were elected as follows:

- Ernest Ludwig, Scranton — Chairman
- Homer Kimbeck, Peckville — Treasurer
- Roland Besecker, Scranton — Vice Chairman
- Steve Urbansky, Dixon City — Secretary

"Door prizes were awarded, donated by the Scranton wholesalers. The next meeting will be April 16 at 8 P.M. in the Chamber of Commerce rooms, Scranton, Pa. Members of the Wilkes-Barre RSA will cooperate in the fullest to promote the success of this newly formed group. During this meeting, Radio Station WIZZ (FM) donated a complete program to the success of the affair."

C. F. Bogdan,
Director of Public Relations

Seth E. Lover, Secretary of the Radio Technicians Association of Kalamazoo, Michigan, tells us of the recent election held by that organization:

"At our last meeting, we elected the following officers for the coming year. They take office April 3.
J. L. Dillon, President
Roy D. Peterson, Secretary
Cliff P. Bennett, Treasurer
F. M. Louwaert, Publicity Manager

"We have at present 23 members, which we feel is a very good showing since we reorganized just a year ago with eight of the old members. Our original organization date was April 30, 1935; but during the War, our association was inactive.

"We have tried in the past to promote a radio noise reduction program and would like to hear just how other organizations have brought similar programs to a successful conclusion.

"May I express our thanks to you for your attention to the radio servicemen's organizations."

Seth E. Lover, Secretary

A. R. Guild, Secretary of the Federation of Radio Associations of Pennsylvania, would like to hear reactions to a state convention of radio servicemen. He writes as follows:

"At a meeting of the Federation of Radio Servicemen's Associations of Pennsylvania, in Harrisburg, Pa., the feasibility of holding a state convention of radio servicemen was discussed. I do not believe such a gathering, sponsored by servicemen themselves, has ever been held. We are interested in getting the reactions of individuals and groups to such a suggestion.

"Accordingly, we would appreciate it if you would publish this letter in the earliest possible issue of your magazine, along with any comments you would care to make. We will welcome any suggestions or ideas from individual servicemen or groups. Please address correspondence to:

Federation of Radio Servicemen's Associations of Pennsylvania

A. R. Guild, Secretary
410 Campbell Street
Williamsport 11, Pa."

A. R. Guild, Secretary

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The Open and Close Cases

→ From Page 26

to permit it to follow the slight movement of the voice coil and so remove strains that would tend to restore the old condition.

It is my hope, fellows, that this will make the handling of those "open and close cases" a little bit easier. ✓✓✓

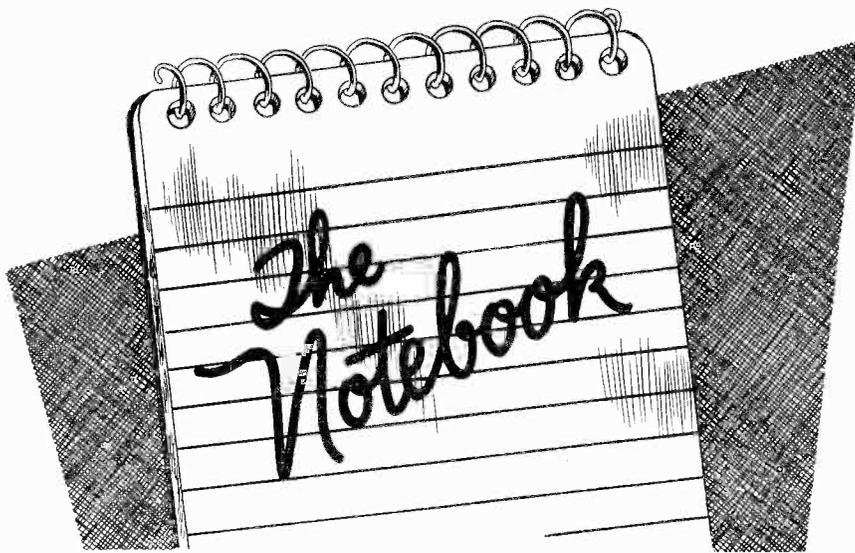
S.S.S.

"Servicing by Signal Substitution"

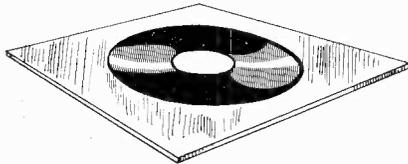
Learn about this modern dynamic approach to radio servicing with ONLY BASIC TEST EQUIPMENT.
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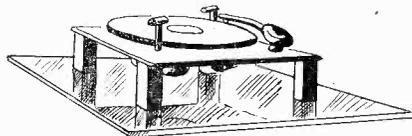
Each month the reader sending in the best suggestion receives a crisp ten dollar bill. For all others published, RADIO MAINTENANCE will pay five dollars. Let's hear from you.



Warped Records

RECORDS that have been warped can be easily and perfectly repaired by laying them on a piece of plate glass in the sun. The glass should be larger than the record and should lie on a level surface. It should be kept in a cool place until it is ready to use. The glass is laid in the sun with the record on it until the record flattens; both are then moved to a cool place. After approximately ten minutes, the record will be perfectly flat and hard.

Fred W. Buller
Homedale, Idaho

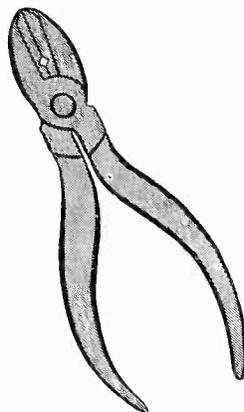


Servicing Record Changers

A piece of mirror approximately 2 ft. x 3 ft. in size is very useful when repairing record changers. The mirror is placed face up on the work bench. The record changer being repaired is supported above the mirror by changer rack, etc. This makes it possible to ob-

serve the operation of the changer while it is in the horizontal position which is a great advantage since most changers will not operate properly in any other position.

Phil Thier
Laurel Radio Service
Long Beach, N. Y.



Wire Stripper

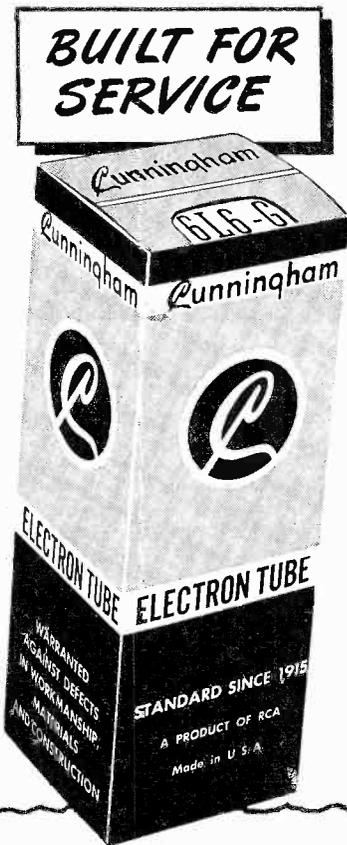
A handy wire stripper can be made from any pair of pliers equipped with wire cutting blades. Using a 3-corner file, a small V is cut in each blade as shown in the illustration. The wire is placed in the cut-out, the handles of the pliers are squeezed, and a pull on the wire removes the insulation.

Jerome Levy
2074—60th Street
Brooklyn 4, N. Y.

Soldering

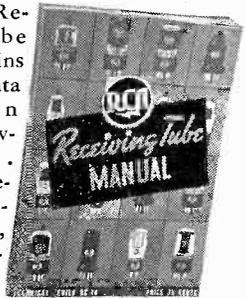
When soldering small areas in a

→To Page 34



The "RC-14"—Radio's No. 1 Technical Aid

The RC-14 Receiving Tube Manual contains the sort of data you need in your daily servicing work... basic tube theory, application notes, socket connections, circuits and charts on over 340 receiving tube types. That's why more than 900,000 copies of this 256-page manual have been sold.



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AC-DC BALLAST TUBE MANUAL

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Servicemen! Your FREE COPY of this valuable booklet is now ready for you. To get it, merely mail in twelve flaps of JFD radio dial belt envelopes. This book is also enclosed in each JFD B25 Belt Kit which contains 25 assorted JFD Radio Dial Belts (buy your JFD Belts or Belt Kits from your nearest jobber).

No Radio Serviceman can afford to be without this complete and essential source of information on radio ballast tubes. Send for YOUR FREE COPY today!



J.F.D. MANUFACTURING CO.

4109-4123 FORT HAMILTON PARKWAY, BROOKLYN 19, N. Y.

Circuit Analysis

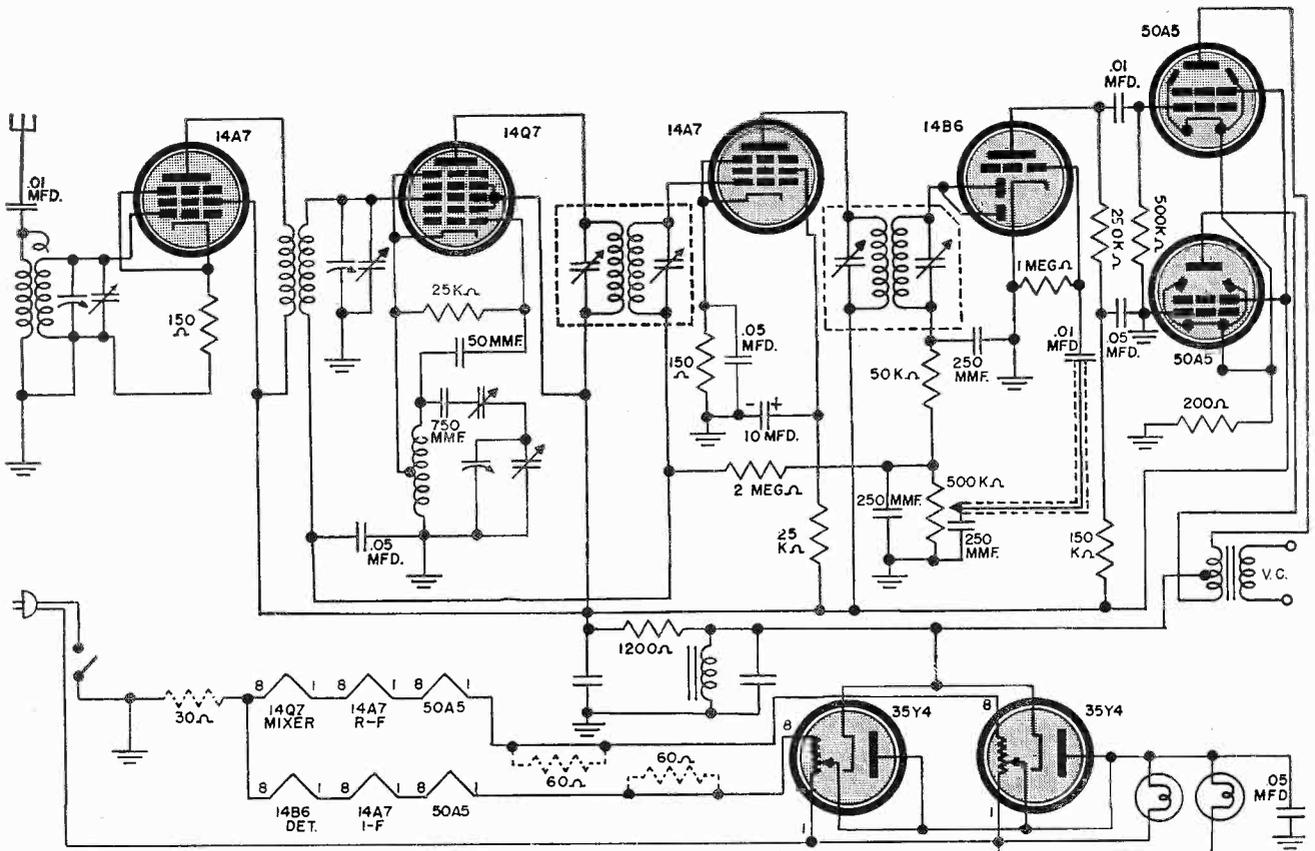
→ From Page 24

manner in which this circuit operates is as follows:

The 14B6 first audio tube, instead of having one load resistor has two in series. These are labeled 150 K ohms and 250 K ohms in the diagram. B+ is fed into the plate through these resistors in the usual manner.

The signal output voltage of the 14B6 appears across the 250 K ohm resistor. One side of this voltage is fed into the grid of the upper 50A5 tube through a 0.01 ufd condenser. The other side of the voltage is fed to the grid of the lower 50A5 tube through a 0.05 ufd condenser. But this grid is grounded so it is necessary for the cathode of this tube to be above ground so that a voltage can exist between grid and cathode. This cathode signal voltage is developed in the

→ To Page 34



Aermotive Model 181-AD

ELECTRONICALLY SPEAKING



INFORMATION RECENTLY released by the Bureau of Standards and the Navy gives us some idea of what the receiver of the future will be like. The Bureau of Standards has been working with electronics manufacturers in an effort to perfect printed wire and circuit components. The accompanying illustration shows the four steps in the wiring of a miniature two-tube amplifier. Also shown is the complete miniature amplifier compared with an identical amplifier of conventional construction.

The condensers used in printed circuits give an example of the reduction in size made possible by the use of this type of construction. Typical condensers measure from $\frac{1}{8}$ inch to $\frac{3}{8}$ inch in diameter and less than .04 inch thick. The use of Raytheon sub-miniature tubes also makes possible a tremendous

decrease in overall size.

At the Convention of the Institute of Radio Engineers, the Navy exhibited a complete miniature receiver using the sub-miniature tubes and a printed circuit.

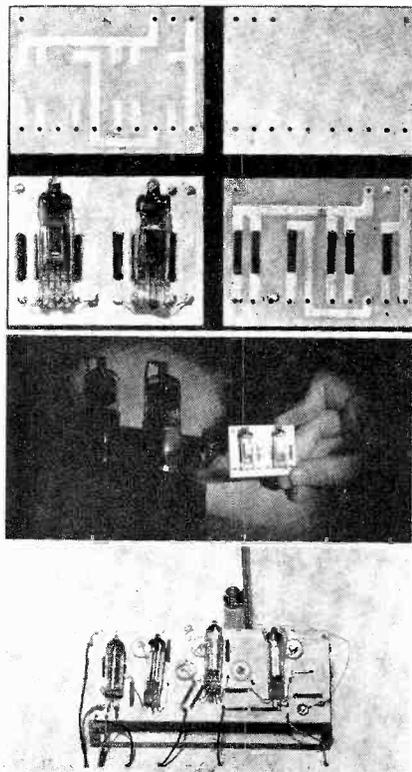
LAST MONTH, taking the lead in backing the serviceman, Sylvania Electric Products embarked on a new advertising program. Most important to the trade is the theme of the new ads; namely, the radio serviceman. Brief and to the point copy emphasizes the dependability, honesty and skill of the local radio service dealer.

The program is big. The ads will be carried in twelve issues of the *Saturday Evening Post*, thirteen issues of *Colliers*, and thirteen issues of *Life*, representing a total circulation of approximately 150,000,000.

The company states that the campaign was conceived as a follow-up of recent Sylvania market studies showing that the majority of radio set owners concede that the radio serviceman does a good job.

Because this type of advertising represents a considerable force on consumer thinking, there is no

→ To Page 38



BUILT FOR SERVICE

These Silent Salesmen Mean Business



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Cunningham tubes are *built for service*. Service is your business—and what your customers want. FOR INCREASED SERVICE BUSINESS, SEE YOUR CUNNINGHAM DISTRIBUTOR.

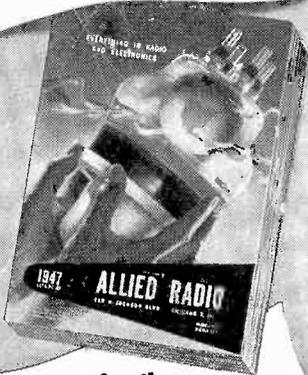
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Cunningham Electron Tubes

A product of
RADIO CORPORATION OF AMERICA
Harrison, N. J.

FREE! Send for it NOW!

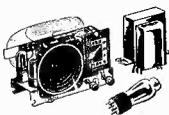
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NEW CATALOG**



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833 W. Jackson Blvd., Dept. 71-E-7
Chicago 7, Illinois

Send FREE 1947 ALLIED CATALOG.

Name.....

Address.....

City.....Zone.....State.....

**Circuit
Analysis**

→ From Page 32

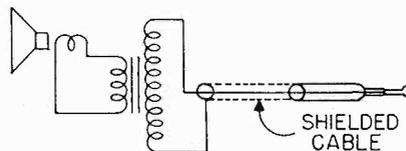
200 ohm cathode resistor due to signal fluctuations in the plate current of the upper 50A5, which flows through this cathode resistor. The signal built up on the grid of the lower tube through this cathode voltage fluctuation is in phase with the plate signal voltage of the upper tube; and, therefore, 180 degrees out of phase with the grid of the upper tube. This is the proper relation for the operation of the push-pull amplifier grids. Notice that a certain amount of negative feedback (degeneration) is secured due to the fact that the input voltage of the lower tube also operates in series with the grid circuit of the upper tube. ✓ ✓ ✓

The Notebook

→ From Page 31

tight place, the solder can be confined to a small spot by rubbing the area around the point to be soldered with a soft lead pencil. The solder will not stick to the area covered with the graphite from the pencil; thus, a small, neat joint is made.

Robert John Oja
Bob's Radio Electric Shop
Laurium, Michigan



Output Meter

An output meter which eliminates the necessity for making connections to the set under test can be made as shown in the accompanying illustration. A 2 or 3 inch PM speaker and a voice coil-to-grid transformer are mounted in a suitable case and connected by means of a shielded cord and plug to the input of an audio amplifier. The output of the amplifier is permanently connected to a suitable meter. The small speaker acts as a

pickup and by placing it directly in front of the speaker of the receiver under test, an output reading will be secured on the meter connected to the amplifier. This makes it possible to secure output readings without going to the trouble of connecting a conventional output meter to the receiver.

Neil E. Blanc
Blanc's Radio Service
Berlin, Wisconsin

**The Cathode Ray
Tube**

→ From Page 14

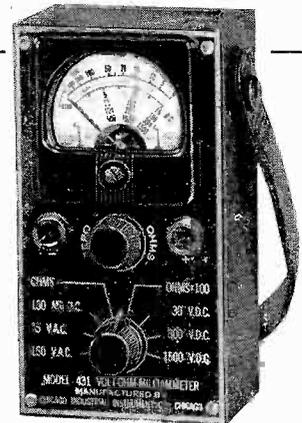
of the tube. The rectangular picture will then be distorted.

7. Severe jarring may also throw the entire gun assembly out of line so that the beam does not focus properly.

In the next issue, we shall complete this series of articles covering the seven basic sections of a television receiver. The power supplies for the cathode-ray tube and the receiver circuits will be described. ✓ ✓ ✓

**PORTAPLEX V.O.M.
Makes Quick Work
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Pocket size, test instrument has new features that make it extra easy to handle. One rotary switch selects all ranges. The Portaplex uses a sensitive 425 micro ampere movement. Multipliers are accurate to within 1%.

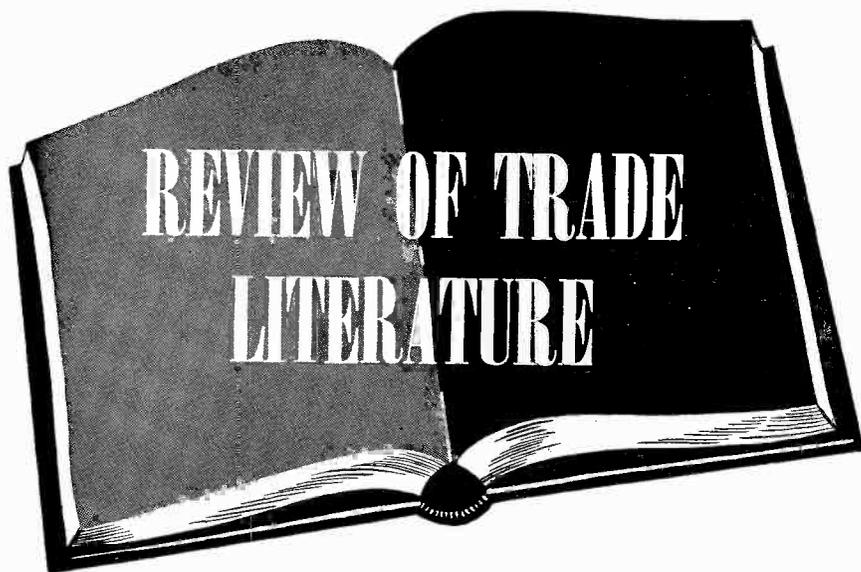


Volts DC 0-30/300/1500—
2000 ohms per volt
Volts AC 0-15/150—
1000 ohms per volt
Milliamperes 0-150
Ohms Full Scale 3,000/300,000
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At our low price, the Portaplex is the outstanding value in the test instrument field. Keep an extra one on hand. See the Portaplex model 431 at your Jobbers or order direct. Price \$16.00.

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NATIONAL RADIO INSTITUTE has just published a 64-page booklet, *How to Be a Success in Radio*, describing the NRI course in great detail. Sample pages of actual lessons are included, as well as descriptions and illustrations of the equipment in kits which is supplied to the person taking the course. A section of the book discusses the various fields open to the trained radioman.

For a copy, write The National Radio Institute, Inc., 16th and U Sts., N.W., Washington 9, D. C.

A new folder on the Federal Miniature Selenium Rectifier is now available. It shows twenty diversified applications. Of particular note is the insert which gives installation information for replacing the rectifier tube in home radio sets with the selenium rectifier and a negative temperature coefficient resistor. This latter circuit, which solves the pilot light problem and increases the life of all the remaining tubes in the set, will be of interest to all servicemen.

A copy may be obtained by writing to Federal Telephone and Radio Corporation, 67 Broad St., New York 4, N. Y.

A 1947 Catalog (164 pages) has been announced by Allied Radio Corporation, featuring the latest information and prices on radio and electronic products. Listings include over 10,000 radio and electronic parts, test units, PA and intercom equipment, etc. All items are indexed for speedy reference. A rotogravure section is devoted to

the new 1947 Knight radio models. For builders and experimenters, there is a wide variety of kits using from one to five tubes, accessories, diagrams, and all necessary tools and supplies.

This catalog is available free on request from Allied Radio Corporation, Dept. 71-E-7, 833 W. Jackson Blvd., Chicago 7, Ill.

The Precision Apparatus Company, Inc., has recently announced a new book entitled *Servicing by Signal Substitution*. The book gives a complete description of this modern approach to radio servicing, using basic test equipment.

The 120-page book is available from Precision distributors or the factory at 35c. Write to Precision Apparatus Company, Inc., Elmhurst 2, N. Y.

A catalog entitled, *Servicemen's Essential Parts*, has just been released by JFD. It covers such items as dial pointers and knobs, replacement phono radio switches, phonograph pick-up adapters, jacks and plugs, microphone connectors, stroboscope discs, interference filters, antenna loops, etc.

This catalog may be had free upon request from Dept. Q, JFD Manufacturing Co., 4117 Fort Hamilton Pkwy., Brooklyn 19, N. Y.

BOOKS

Automatic Record Changers and Servicing Information, compiled by M. N. Beitman, Supreme Publications, 9 So. Kedzie Ave., Chicago 12, Ill. Price \$1.50.

→ To Page 37

BUILT FOR SERVICE



Put "Big C" to Work in your window



This giant, illuminated Cunningham tube carton is ready to do a big job for you in selling more "Big C" tubes. It stands 18 inches high and is 6½ inches square. A 40-watt lamp brightly lights up the translucent cutouts in the sides, and makes it an eye-catching window or counter display.

This unique display is built for reliable service like Cunningham tubes. **GET ONE NOW FROM YOUR CUNNINGHAM DISTRIBUTOR.**

For expert guidance—TURN THE PAGE →

Cunningham
Electron Tubes

A product of
RADIO CORPORATION OF AMERICA
Harrison, N. J.

BACK NUMBERS

JANUARY 1946

THE PROBLEMS OF ORGANIZATION TELEVISION RECEIVER INSTALLATION — This article will initiate the serviceman into the first step in television—its installation.
RADIO MAINTENANCE IN AVIATION USING THE OSCILLOGRAPH FOR DISTORTION MEASUREMENTS

APRIL 1946

PA SYSTEMS—This article covers a general discussion of all the opportunities and procedures for the serviceman about to enter the public address field.
A MIDGET AUDIO FREQUENCY OSCILLATOR IF I WERE A SERVICEMAN
AN EQUALIZED AMPLIFIER FOR MAGNETIC PICKUPS

MAY 1946

PA SYSTEMS—This article covers initial layout of a modern PA system in bars, dance halls, auditoriums, etc.
TEST PANEL FOR THE MODERN BENCH RINGING THE BELL

JUNE-JULY 1946

FUNDAMENTALS OF TELEVISION VOLUME CONTROL TAPERS
THE ELECTRONIC VOLT OHMMETER VECTOR ANALYSIS

AUGUST 1946

AVC CIRCUITS
FM TROUBLESHOOTING
TELEVISION RECEIVER FUNDAMENTALS
RECORD CHANGERS

NOVEMBER 1946

PART II TEST & ALIGNING TELEVISION RECEIVERS
DON'T FORGET THE DIAL LAMP
THE OSCILLOGRAPH . . . HOW TO USE IT
CRYSTAL PICK-UPS

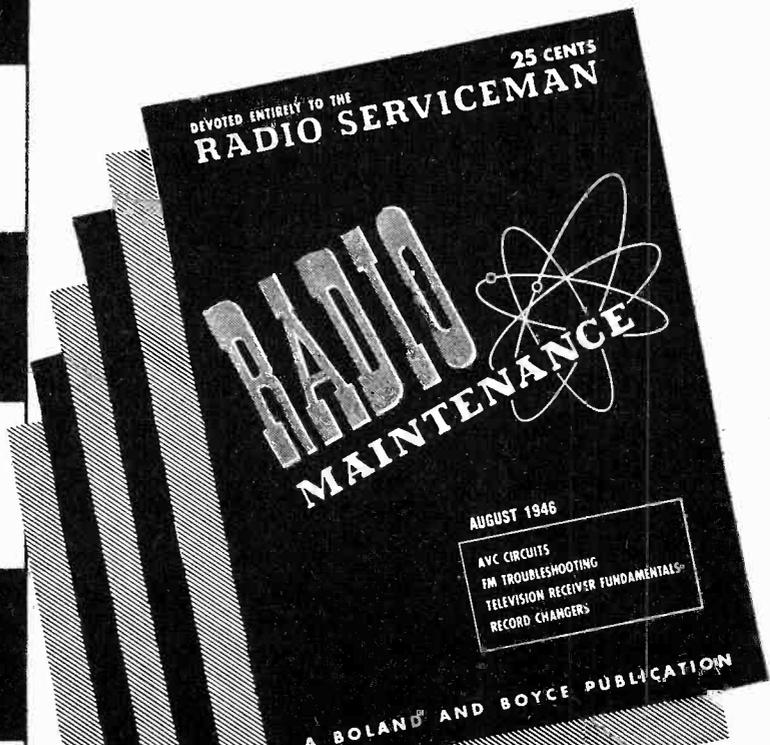
DECEMBER 1946

TELEVISION RECEIVERS . . . THE RF SECTION TUNING INDICATORS
PART II THE OSCILLOGRAPH . . . HOW TO USE IT
REPLACING AUTO CABLES

JANUARY 1947

SERVICING BY EAR
TELEVISION RECEIVERS . . . VIDEO CHANNEL
PART III THE OSCILLOGRAPH . . . HOW TO USE IT
MINIATURE TUBE CHART

Our first announcements of the availability of back numbers of RADIO MAINTENANCE brought a response much greater than we anticipated. As a result we are continuing to comply with the demand of radio servicemen for these back issues. We don't know how long we may be able to fill orders for the earlier issues as the supply is dwindling fast, and some are already sold out. Only those listed are now available, so if you are anxious to get them, send in your request as soon as possible.



RADIO MAINTENANCE MAGAZINE
460 BLOOMFIELD AVE.,
MONTCLAIR, N. J.

- January 1946
- April 1946
- May 1946
- June-July 1946
- August 1946
- November 1946
- December 1946
- January 1947

Please send me the back numbers checked here . . .

I am enclosing 35c for each copy.

\$2.00 for the set of eight

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Review of Trade Literature

→ From Page 35

This book includes detailed electrical and mechanical service data on all new record changers. It is paper bound, 144 pages, and has an 8½ x 11 inch page size to accommodate hundreds of photographs and exploded views.

Most Often Needed 1947 Radio Diagrams, compiled by M. N. Beitman, Supreme Publications. Price \$2.00.

Covering 327 models of 52 manufacturers, this book presents diagrams and needed alignment information, parts lists, voltage values, stage gain, trimmer location and dial stringing on all popular sets made between June 1, 1946, and March 1, 1947. Paper bound; size 8½ x 11 inches, 192 pages.

Over the Bench

→ From Page 29

of electronic equipment as they come on the market.

A man who has a great deal of practical experience behind him is like a mechanic who has a fairly good set of tools with which to work; but a man who is well grounded in radio theory is like a mechanic who has a whole machine shop at his disposal — a machine shop in which he can fashion any

tool he may need, no matter how complicated that tool may be. It may take him a little longer to do a particular job, but he has the facilities for doing it *right*.

Very fortunately, the old-timers have much more than practical experience at their command. They have a wealth of theory that they do not know they possess, simply because they cannot express it in the language of the textbooks. As a crude example, if you were to say to one of these solder-scarred veterans, "The reactive impedance of this capacitor is an inverse function of frequency," he would probably blink his eyes at you; but you would never catch him using an electrolytic high capacity condenser to by-pass an RF screen any more than he would employ a .01 ufd condenser across the cathode bias resistor of an audio tube.

No, you cannot be in a business like radio repairing very long without soaking up a great deal of radio theory. You may learn it in the form of some rather strange analogies, and it may be hard for you to tell someone else what you know, but you have the information you need, and you know how to use it. That is what counts.

Radio servicing is in itself a trade demanding too much intelligence for a person to work at it like an automaton. A person smart enough to repair sets is too intelligent to be satisfied with knowing only *how*. He has to learn *why*, too. If he is not interested in the *why*, he will not be in the business long. He will take up some other form of endeavor where he does not have to

→ To Following Page

HOWARD W. SAMS SAYS...

(Well-known publisher of radio service data)

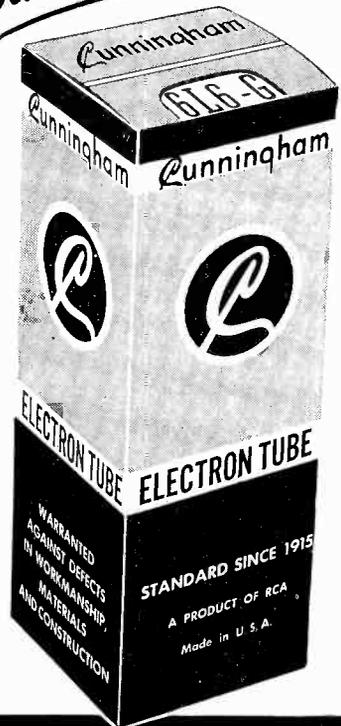
Radio Servicing is Big Business



"No one would own a radio if there were no competent men to keep it in working order. This means that both the public and the radio industry depend on you. To win public confidence and to make radio servicing the kind of *big business* it should be, you must be *sales-minded*."

"The first important job is to sell radio servicing to the public as a real profession. You can do this best by banding together in local groups made up of competent, qualified servicemen, with established high standards for service performance and business ethics. Build prestige for your group and profession through local advertising. Live up to the group efforts by keeping a businesslike, attractive shop, by staying abreast of latest methods, by using quality materials only. Radio servicing is *big business*—being a businessman pays off in radio servicing."

Built for Service



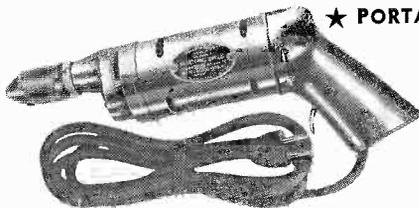
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Ward FM antennas stand head and shoulders above the field for value. Available in straight or folded dipole types (with or without reflector kit), they adapt easily to varying individual requirements. Providing the maximum electrical efficiency needed for finest FM reception, they are easy to install securely. Their trouble-free operation assures you extra profits. Write for free catalog today.



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Ready to solder in 5 seconds.

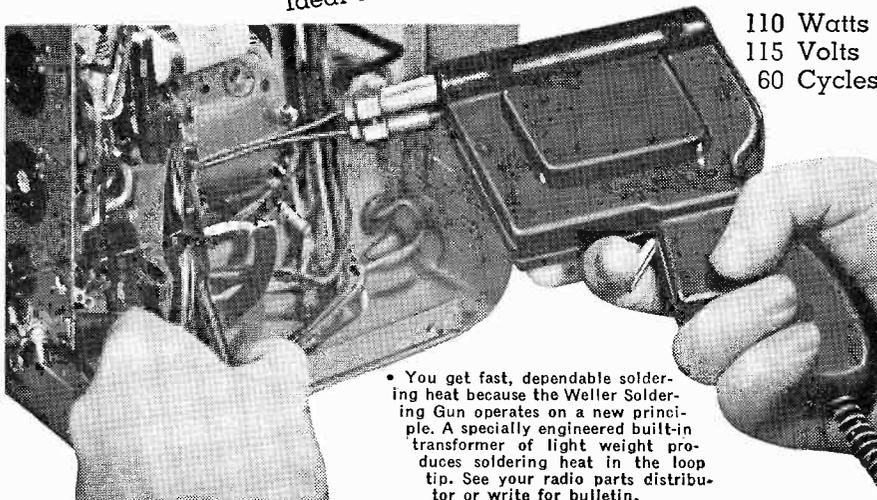
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60 Cycles

• You get fast, dependable soldering heat because the Weller Soldering Gun operates on a new principle. A specially engineered built-in transformer of light weight produces soldering heat in the loop tip. See your radio parts distributor or write for bulletin.

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In Canada: Atlas Radio Corp., Ltd., 560 King St., N. W., Toronto, Ont.
Export Dept.: 25 Warren St., New York 7, N. Y.

Over the Bench

→ From Preceding Page

use all of his wits each and every day.

It is a good thing, though, to try to accustom yourself to translating the things you know into the language of radio theory. If you do this, you will then be able to recognize your absorbed knowledge when you encounter it in the textbooks and magazines you read. Once you have learned the language of radio theory, you are amazed at how much theory you already know.

One of the best things about a good knowledge of radio theory is that it seems to throw a bright light on practical experience. When you know exactly what *should* take place in each and every part of a radio circuit, the most complicated diagram resolves itself into a collection of simple circuits. Because this is so, all of the things you learn at your bench are much more significant. When you know what *should* happen, what *does* happen has twice its former meaning. ✓ ✓ ✓

Electronically Speaking

→ From Page 33

doubt that the serviceman will benefit from it.

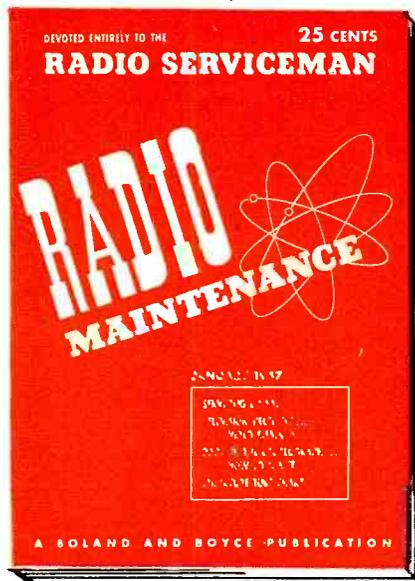
THE RMA STATES that transmitter manufacturers expect to deliver more than 700 FM transmitters in 1947. This confirms a recent statement by the Chairman of the F.C.C. to the effect that approximately 700 FM stations will be on the air by the end of the year.

A recent survey of radio manufacturers reveals that they are planning to produce approximately 2,600,000 receivers with FM facilities this year.

These facts offer proof that in the very near future customers will be calling upon you to service their FM receivers. ✓ ✓ ✓

NEXT MONTH IN RADIO MAINTENANCE

June Issue



Test Equipment Maintenance

The first of a series of three big articles on maintaining your own test equipment. Every Serviceman knows the importance of keeping his test instruments properly calibrated and in good condition—and this series of articles will help you do just that. Read about preventive maintenance on Tube Testers, VTVM, Oscillographs, Multimeters, Signal Generators, etc. . . . How often they should be calibrated . . . How to service them and the equipment needed for best results . . . A discussion of laboratory techniques of fine adjustments . . . Hints and kinks . . . meter peculiarities . . . Replacement parts, etc. Your test instruments can mean the difference between success and failure of your business . . . This series of articles will be a valuable reference for your service library!

Television Receivers

Part of a series by Morton Scheraga, Television Editor for RADIO MAINTENANCE. Mr. Scheraga describes completely each of the sections in a television receiver and its component parts . . . Alignment, Maintenance and Repair are thoroughly covered . . . In Metropolitan areas, television receivers are already in wide use and smaller communities will soon have them. The public will demand competent repair and maintenance of these new sets, and the Serviceman who knows his television is assured a successful career. Follow television in RADIO MAINTENANCE and be prepared!

When the customer isn't right!

What to do to keep good customer relations. Have you ever had a customer say that your price is too high compared to others? Or that this repair job should be free because you fixed the same radio only a month previously? Find out how some of the leading servicemen in the country handle these difficult situations brought on by some customers. The most frequently encountered problems of customer relations were boiled down into ten questions and each is answered by a different service organization. Read these answers in the June issue, and they will help you meet awkward problems with tact and assurance, and keep all of your customers happy!

And in addition you'll find

- THE RADIO SERVICE BENCH
- SERVICE MEN'S ACTIVITIES
- ELECTRONICALLY SPEAKING
- REVIEW OF TRADE LITERATURE
- THE LATEST THING IN RADIO

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WITH EVERYTHING YOU NEED**

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June Issue

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RADIO MAINTENANCE is not sold on the newsstands.

You'll feel this way too!

Although I am a comparative newcomer to the radio servicing field, I felt, as many other servicemen must have, that what our trade needed was a publisher who would devote a magazine entirely to the radio serviceman. After receiving only one copy, I am more than pleased with RADIO MAINTENANCE and wish to thank your organization in all sincerity for doing a great job.

J. M.
Chicago, Ill.

This is my first subscription to your magazine and as long as it continues to have such fine articles, you can count on me as a subscriber. It is the answer to a technician's prayer, and any one who misses your magazine is missing valuable material.

W. L. B.
Berkeley, Calif.

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Please send me RADIO MAINTENANCE magazine every month for
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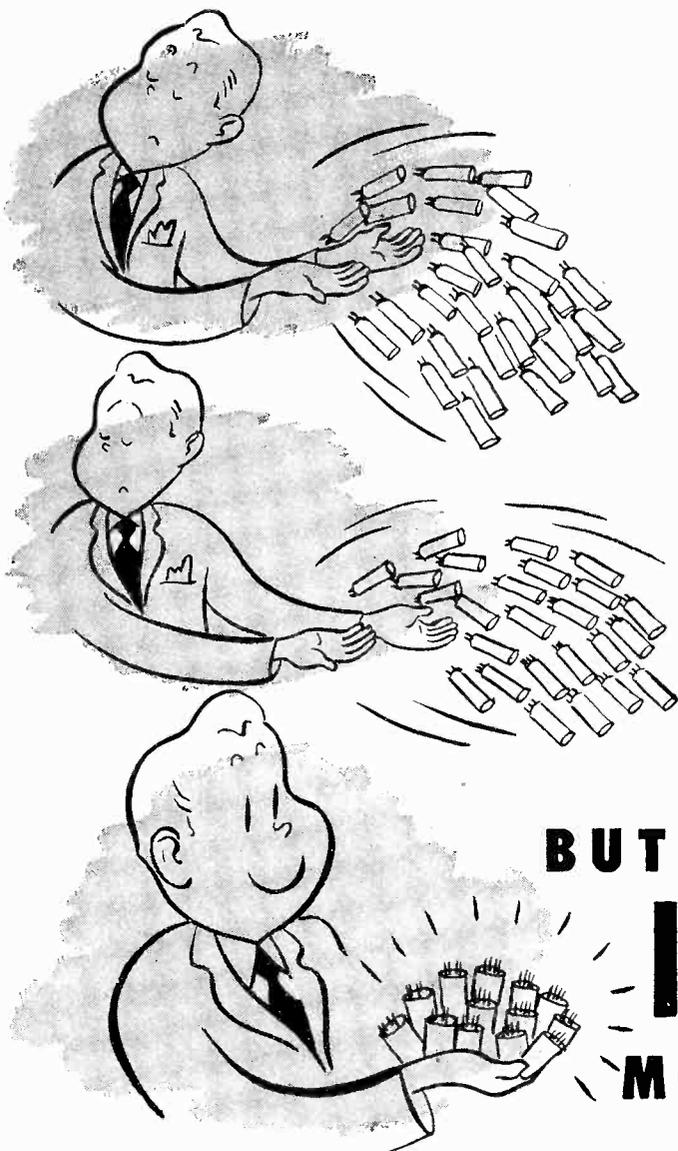
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~~NOT
31~~

~~NOT
25~~

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13
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... provide exact replacement on all auto-radio vibrator requirements

● The headlines tell the story—and hundreds of Electronic dealers enthusiastically back it up! A smaller inventory investment will get you more customer satisfaction—faster turnover—bigger profits when you **SWITCH TO ELECTRONIC . . . THE SIMPLIFIED LINE**



A complete Vibrator Replacement Guide is available. It lists alphabetically every auto-radio model serviced by E-L Vibrators, and the proper E-L Vibrator Model Number.

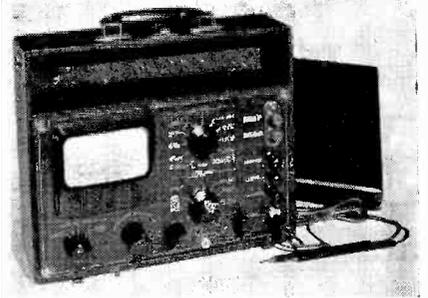


ELECTRONIC LABORATORIES, INC.

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Industry Presents

→ From Page 22



ing of 1—10,000 volts. Most resistance and leakage measurements can be made directly in a circuit without unsoldering leads. Sensitivity is 20,000 ohm/volt on DC and 1,000 ohm/volt on AC. It has 24 voltage ranges, 7 current ranges, 5 resistance ranges, 5 db ranges, etc.

Further information is available on request to r m s Electronics, Inc., 73-39 68th Ave., Middle Village, L.I., N.Y.



TRI-CORE HANDYKAN

Tri-Core, produced by Alpha Metals, Inc., is now available in 1-lb. and 5-lbs. cans for the small user. This solder with three independently filled cores of pure rosin flux offers users faster soldering and elimination of dry joints. Additional information may be obtained from Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.

EXPERIENCED FIELD ENGINEERS

wanted for general educational work with radio and television distributors and dealers.

Men selected will be assigned to distributor-dealer headquarters points on conclusion of training course in manufacturer's headquarters plant. Applications treated in confidence.

* Write to: Box 202, Radio Maintenance, 460 Bloomfield Ave., Montclair, N. J.

SERVICE EXECUTIVE

Major radio-television manufacturer in Midwest is seeking experienced service executive for home office to direct field engineers working with distributors and dealers. Applications treated in confidence. State qualifications fully in letter to: Box 201, Radio Maintenance, 460 Bloomfield Ave., Montclair, N. J.



► **Friendly**, tactful, impartial, trained to serve, these Hytron commercial engineers form the liaison between us—maker and user of electronic tubes. Few in the radio tube plant can be circuit specialists. Few outside the tube plant can be tube specialists. Both of us need these commercial engineers trained to see clearly both sides of our common problems and help us solve them.

Often their job begins with a request for advice in selecting a tube. Investigation of the circuit application helps them recommend an available type, a slight redesign, or a brand new type. If a new type is found to be the only practicable and economical solution, they cooperate with design and production engi-

neers to achieve the performance desired.

Specification of adequate factory testing procedures and preparation of characteristics sheets do not end their work. Returns are closely checked. If trouble occurs, they go into the field, help dig out the facts, and offer possible solutions—improvements in tube or application. And they stick tenaciously with the problem until it is solved.

Using a wealth of test equipment and know-how, these boys really sweat to make it easy to make Hytron tubes which will make you happy. Busy as the one-armed paperhanger, yet they always welcome the tube problems of equipment engineers. They are nice guys, and we thought you would like to meet them.

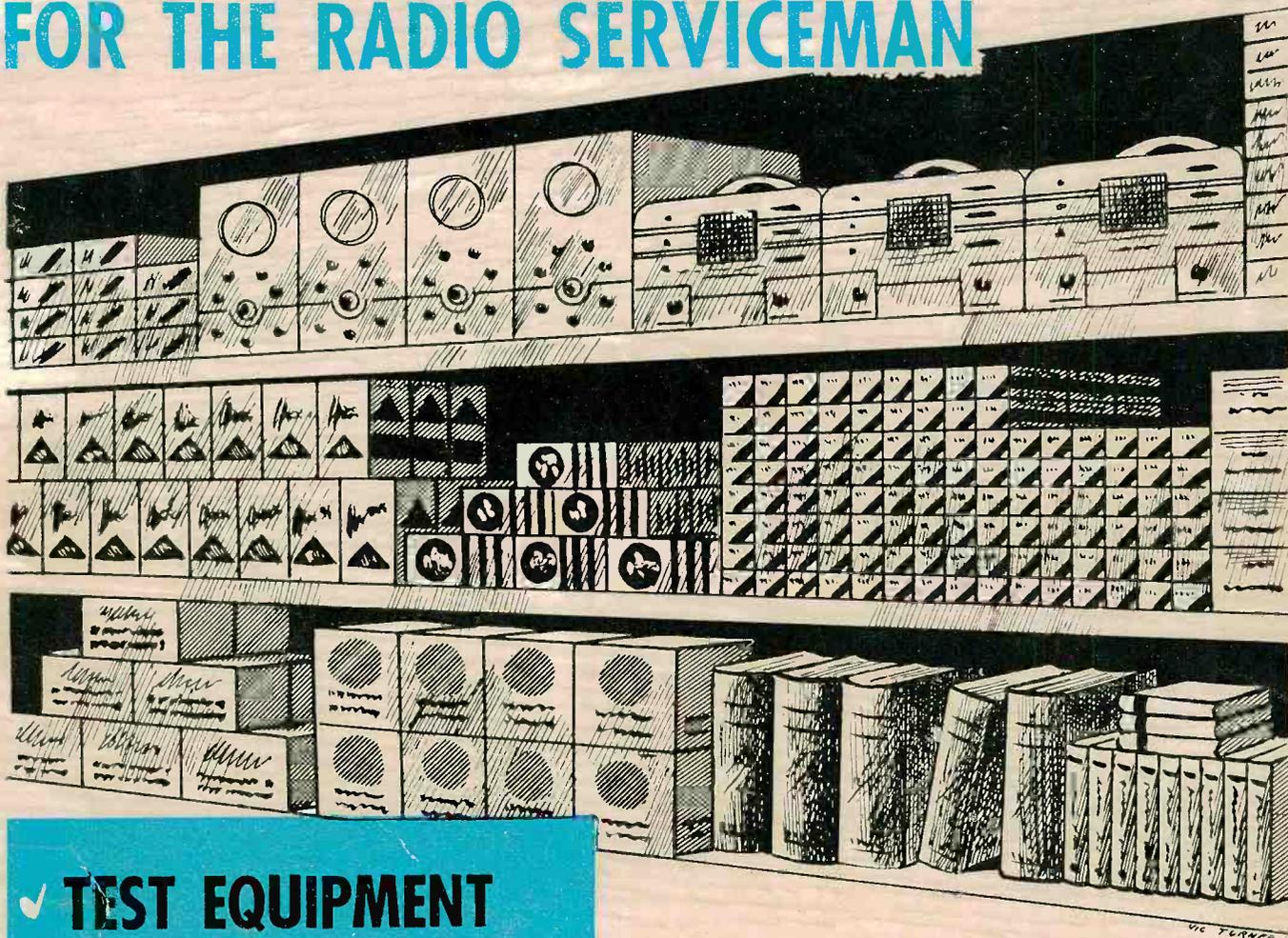
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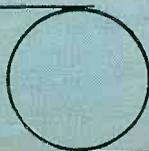


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- ✓ PA EQUIPMENT
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- ✓ TOOLS

Everything you need to equip your shop and conduct your repair and installation work can be found on our shelves . . . New equipment and replacement parts are supplied to you more quickly, economically and conveniently by us . . . Each item bears a top quality name and most are available for immediate delivery . . . There are hundreds of new, long awaited products of every kind and for every need . . . Many bargains and all good values.

Radio servicemen in this locality are regular and satisfied customers at our counters. Their continued patronage is our best recommendation. We are always glad to discuss servicing and installation problems. Come in or drop us a line!

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