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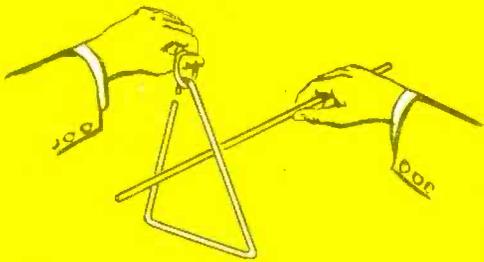
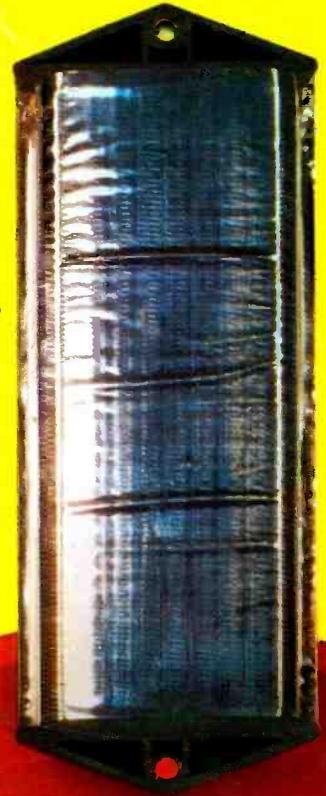
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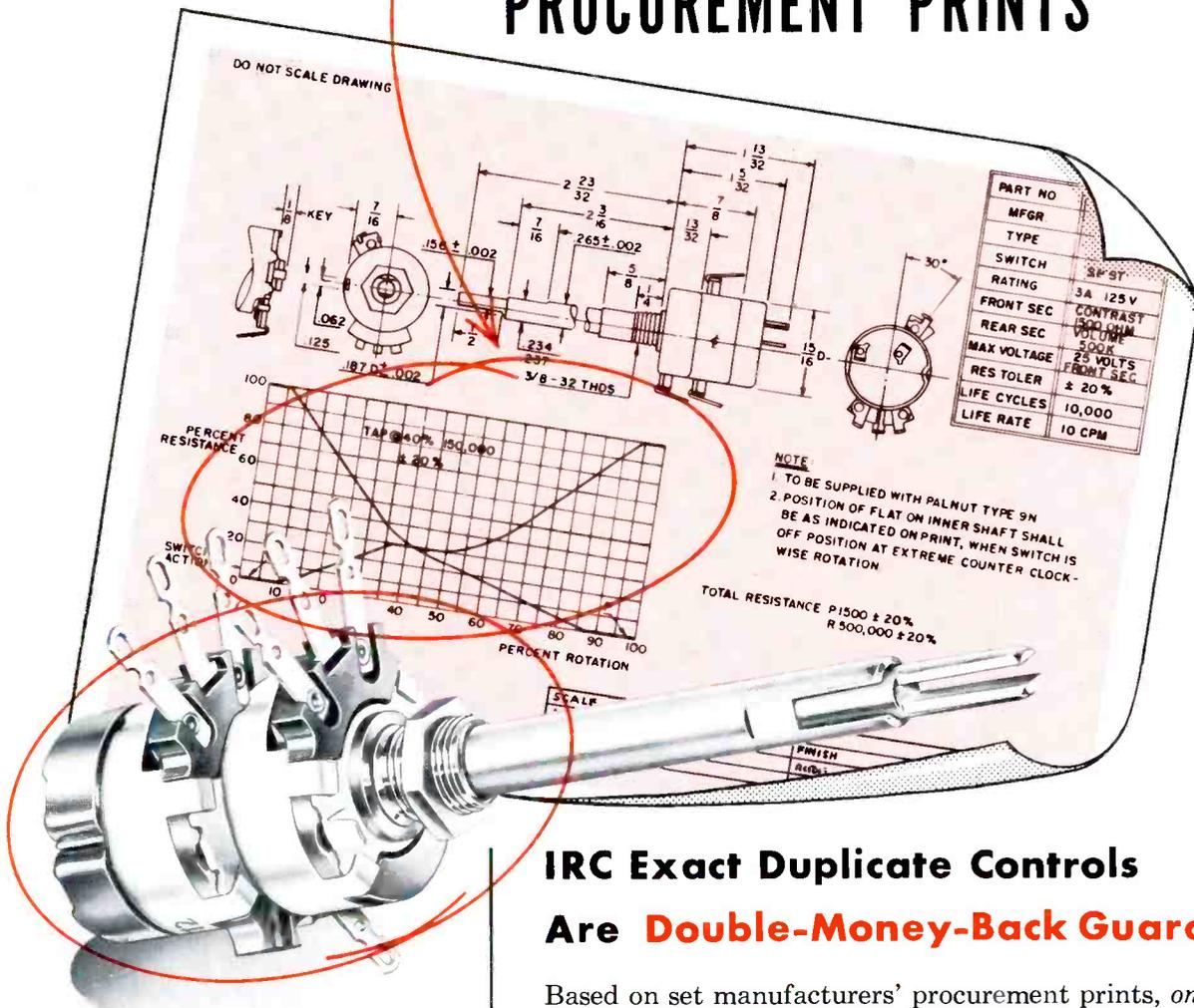
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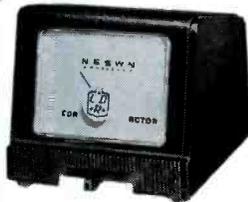
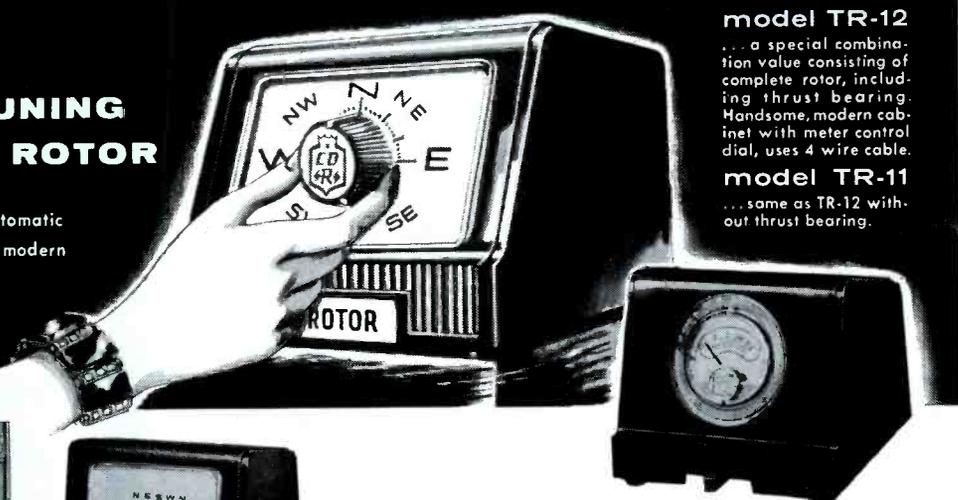
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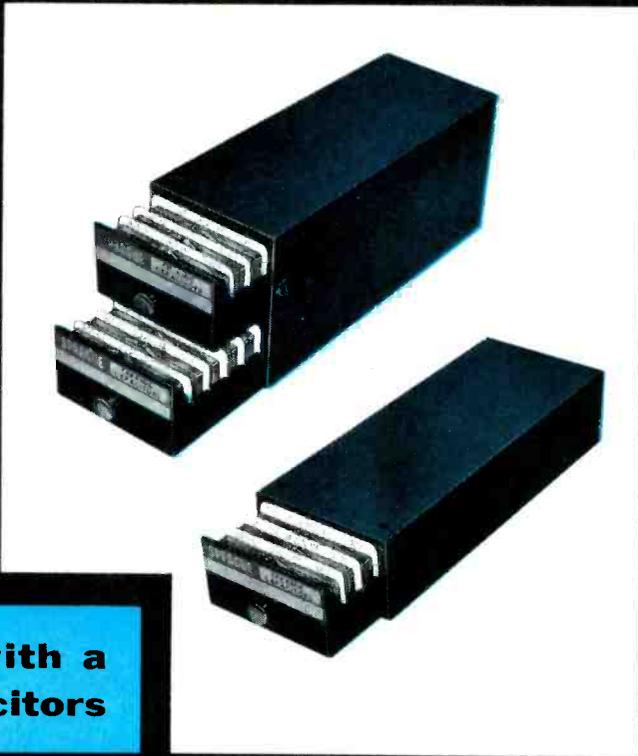


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5	5GA-Q22	5	5GA-T47
5	5GA-Q33	5	5GA-T5
5	5GA-Q39	5	5GA-T68
5	5GA-Q47	10	5GA-D1
5	5GA-Q5	5	5GA-D15
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DEFLECTION YOKES

Types, Design Features, and General Servicing Hints

BY CALVIN C. YOUNG, JR.

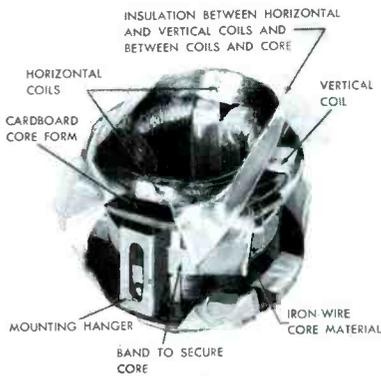


Fig. 1. Early Type 50-Degree Deflection Yoke.

A deflection yoke is an assembly of four coils of wire arranged to provide deflection in both a horizontal and a vertical plane when suitable driving signals are applied.

Fig. 1 is an illustration of one of the early types of deflection yokes with the outside cover removed. The horizontal coils, vertical coils, mounting bracket, and core may be seen in this photograph. The core is constructed of a number of turns of iron wire separated from the coils by a paper form and suitable insulation material, and it is tightly bound with a metal band.

Fig. 2A is a cross-sectional view of one pair of the deflection coils of an early type of yoke. The shaded sections form one of the coils, and the light sections form the other coil. The nonuniform magnetic field produced by a yoke of this design is illustrated in Fig. 2B. The distortion caused by this nonuniform field is illustrated by the elliptical spots in the outer portion of the field.

The cosine yoke is a product of research by engineers in their efforts to eliminate such distortion. The

yoke is called a cosine yoke because the distribution of the windings in any one coil is in proportion to the cosine of the angle between the deflection axis of that coil and the radial position of the windings in that coil. The drawing in Fig. 3 shows the location of the deflection axis of the horizontal coils and the radial position X of one winding. The angle θ is the radial angle between the axis and the windings at point X . The number of windings at point X is proportional to the cosine of the angle θ . The number of windings at any other point along the horizontal coil will also be in proportion to the cosine of the angle formed by the radius of that point and the deflection axis.

As the angle θ nears ninety degrees, the number of windings increases greatly. This follows the basic rule of mathematics which states that the cosine of an angle approaches infinity as the angle approaches ninety degrees.

The photograph in Fig. 4 is that of a modern cosine yoke that has been partially disassembled to show some of the construction details. The core in this yoke is made up of four sections of a ferrite material. These

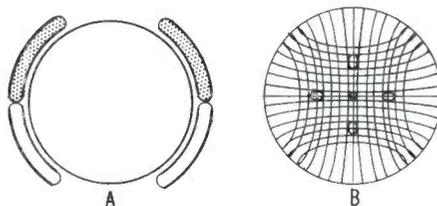


Fig. 2. (A) Cross-Sectional View of One Pair of Deflection Coils. (B) Nonuniform Field Produced by the 50-Degree Deflection Yoke.

four sections are cemented to the rest of the assembly and tightly encircled with the metal band. A suitable insulation material which is also shown in the photograph of Fig. 4 prevents short circuits between the core material and the deflection coils. The mounting lug is fastened to the metal band which secures the core.

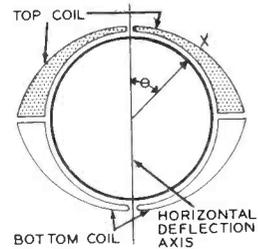


Fig. 3. Distribution of Windings in a Cosine Yoke.

Fig. 5A is an illustration of the cross-sectional view of the horizontal pair of deflection coils. You will notice that the coils are thick at the center and taper off very rapidly so that at the top they are very thin. This is the cosine distribution of the deflection-coil windings. The effect of this type of winding is to produce a uniform magnetic field with straight lines, as illustrated in Fig. 5B. Notice that the electron beam (illustrated by the small circles) is free from distortion at all parts of the magnetic field.

The uniform magnetic field produced by the cosine-distributed winding is responsible for the appearance of the bow in the top, bottom, and sides of the picture on flat-faced picture tubes. In receivers using the earlier type of deflection yoke, no pincushion effect was present because the nonuniform magnetic field had the effect of cancelling it. The pincushion effect produced by a cosine yoke may be corrected by positioning small magnets at the top and bottom of the bell of the picture tube near the neck. See Fig. 6 for an illustration of this placement. The pincushion effect at the sides is usually so small that no correction is required.

It has been found that by using a deflection yoke having cosine-squared distribution and by using a picture tube having a slightly curved face, the pincushion effect can be reduced to the point at which no correction is required. This cosine-squared distribution also provides a uniform magnetic field so that the electron beam will not be distorted. Cosine-squared distribution means that the distribution of the windings

* * Please turn to page 76 * *



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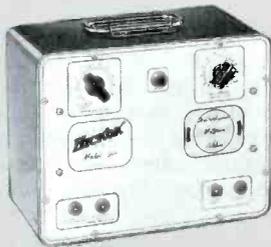


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PART X THE COLOR PICTURE TUBE AND ASSOCIATED CIRCUITS

by C. P. Oliphant and Verne M. Ray

A general discussion of the three-beam color picture tube was presented in the last issue. It was pointed out that tubes of this type are divided into two categories; those that employ electrostatic methods of obtaining beam convergence and those that use a magnetic principle to obtain beam convergence. A detailed discussion of a tube which employs the electrostatic principle and of the associated components and circuits was concluded last month. This month, the data presented concerns a picture tube in the second category and also concerns the auxiliary components and circuits associated with this type of picture tube.

A THREE-BEAM TUBE EMPLOYING MAGNETIC CONVERGENCE

Actually, a tube which uses the magnetic principle of convergence is a later development than the tube which employs the electrostatic method. Although the viewing screen, the shadow mask, and the electron-gun assembly still constitute the major components of the three-beam tube, several changes in these components have been made. These changes have been incorporated in the tube which uses the magnetic method of obtaining beam convergence.

Shadow Mask and Viewing Screen.

One of the changes in the three-beam picture tube concerns the viewing-screen assembly. As shown in Fig. 9-28, this assembly in the earliest tubes consisted of a shadow mask, a phosphor-dot plate, a decorative mask, and the necessary mounting frames. It can be seen that the phosphor screen is not a part of the faceplate and that the screen and shadow mask are flat.

A later development of the shadow mask and viewing screen is shown in Fig. 9-29. In this arrangement

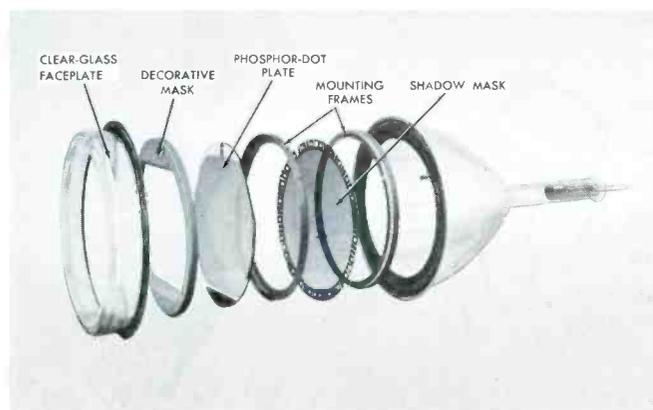


Fig. 9-28. Parts Used in an Early Commercial Color Picture Tube

the phosphor dots are applied directly to the inner surface of the curved faceplate. In addition, a simple mounting procedure allows a curved mask to be placed directly behind the faceplate so that the stringent requirements are maintained between the viewing screen and the mask. As shown in Fig. 9-30, the fact that the screen and mask are curved reduces the need for dynamic control of the beams. Although the curvature of the arc described by the points of convergence of the beams is still greater than the curvature of the mask and screen, a larger viewing surface can be used with a given amount of dynamic convergence force.

Electron-Gun Assembly.

Both the static control and the dynamic control of the three beams have been improved by changes in the design of the electron-gun assembly. A side view of the improved assembly is shown in Fig. 9-31. A close examination would reveal that each of the guns is tilted slightly so that each beam will be directed toward a common point. This is done with the intention of providing static convergence of the beams at the shadow mask; consequently, a convergence element such as that used in a tube which employs the electrostatic method of convergence is not necessary.

The expanded drawing of one of the guns shows that a gun is composed of a heater, cathode, control grid (grid No. 1), accelerating anode (grid No. 2), and a focusing anode (grid No. 3). The final anode which is grid No. 4 in Fig. 9-31 is located at the end of each gun and is electrically connected to the neck coating and to the shadow mask. The mask, coating, and grid No. 4 together form the ultor anode of the tube. The drawing in Fig. 9-31 shows a pair of pole pieces at the end of the final anode of each gun. Each pair of pole pieces is used in conjunction with a magnetic field from an external source.

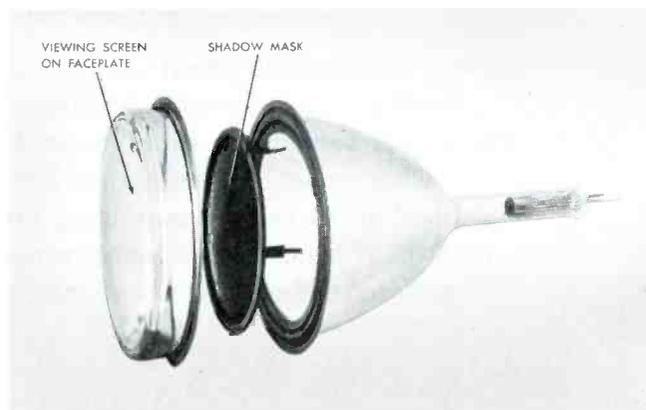
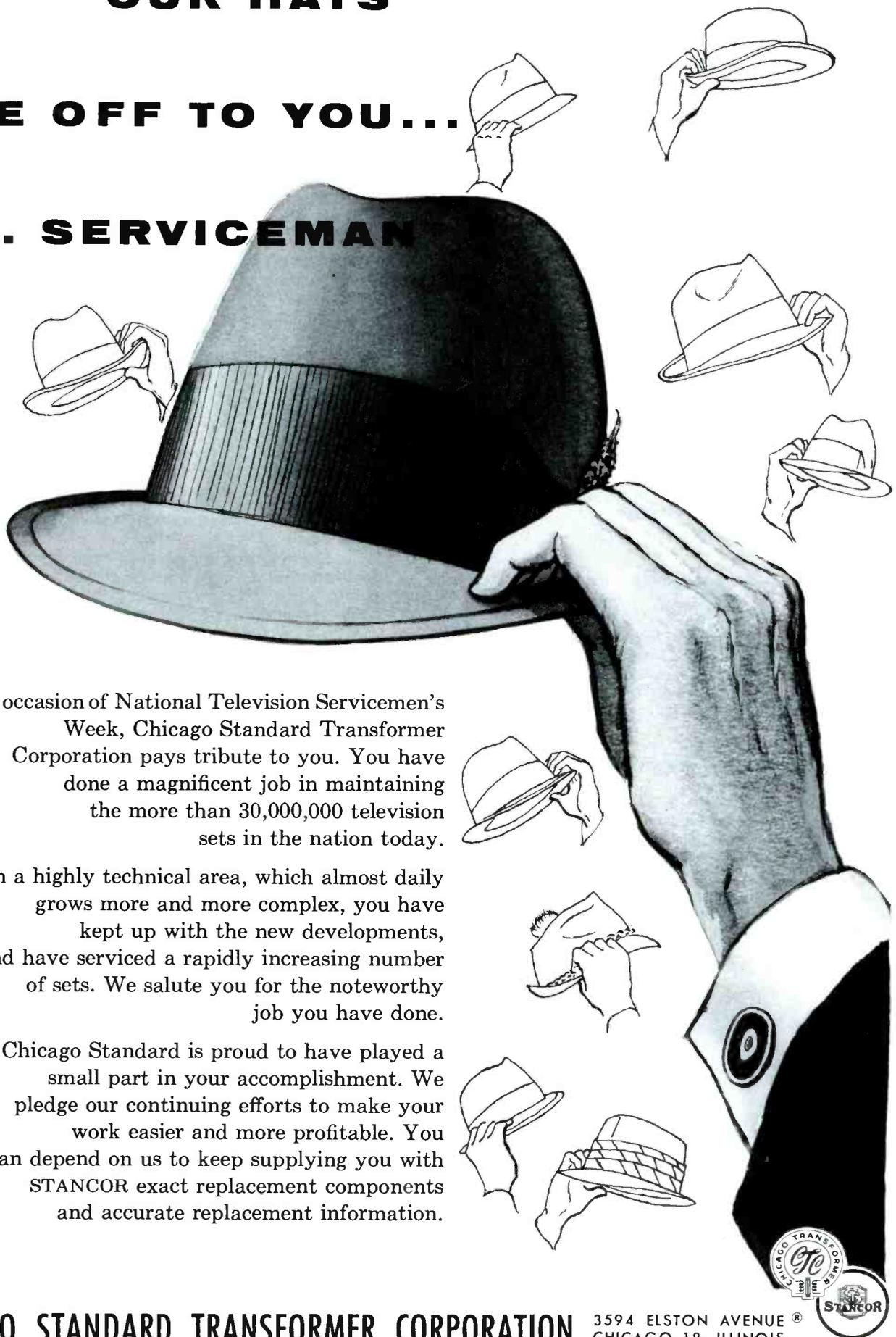


Fig. 9-29. Parts Used in a Later Commercial Color Picture Tube

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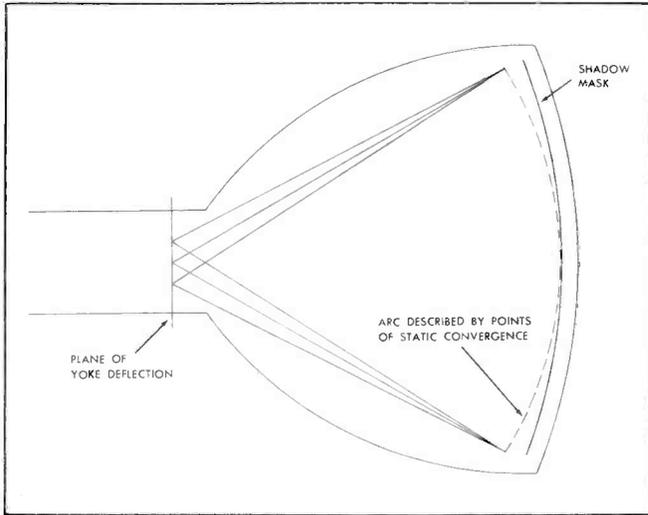


Fig. 9-30. A Curved Mask-and-Screen Assembly Reduces the Need for Dynamic Control of the Beams.

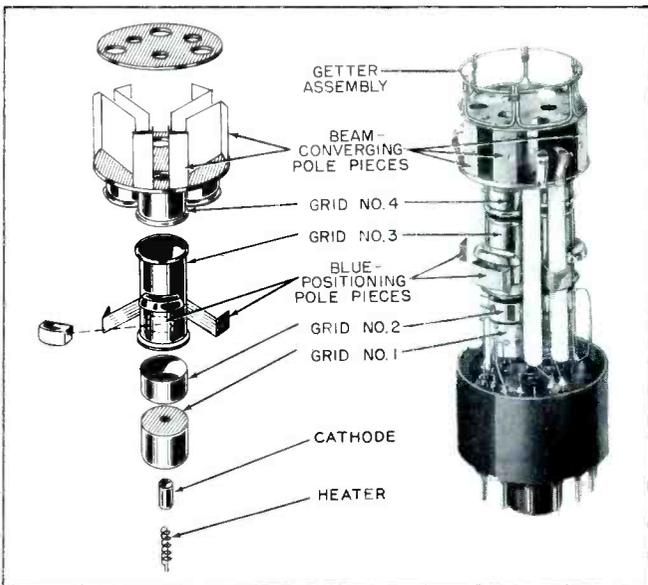


Fig. 9-31. Electron-Gun Assembly Used in a Tube Which Employs the Principle of Magnetic Convergence. (Photograph Courtesy of RCA.)

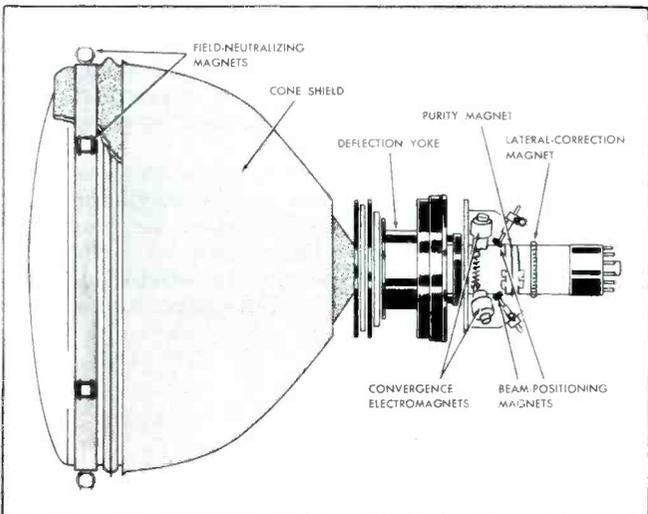


Fig. 9-32. Auxiliary Components Used With a Tube Which Employs the Principle of Magnetic Convergence.

This is done to provide a method of positioning each beam so that proper convergence will be achieved.

A special set of pole pieces associated with the source of the blue beam is also shown in Fig. 9-31. These pole pieces are constructed from magnetic material and are mounted on the focus electrode of the blue gun. A magnetic field from an external source is used with this set of pole pieces to aid in obtaining proper beam convergence.

AUXILIARY COMPONENTS

This section concerns auxiliary components as they are used with the three-beam tube that employs the magnetic method of convergence.

As pointed out in Part IX of this Color TV Training Series, an exacting relationship between the electron beams and the mask and screen must be maintained to obtain optimum performance from the three-beam tube. Even though close tolerances are observed in the manufacturing process, some variations exist. One such condition will result if the guns are not positioned properly in the gun assembly. A second variation exists when the axis of the gun assembly does not coincide with the central axis of the tube. Another kind of variation is caused when the gun assembly is turned slightly in the neck of the tube.

In order to minimize the errors which are produced by these variations, it is necessary to use certain auxiliary corrective devices to control the position of each beam with respect to the shadow mask and viewing screen. Other auxiliary components are used as a precaution against the effects of stray magnetic fields on the electron beams. Fig. 9-32 is a drawing that shows the outline of a three-beam tube which employs the magnetic method of obtaining beam convergence, and it also shows the auxiliary components used with a tube of this type. In the order of their positions starting from the tube base, the external components are the lateral-correction magnet, the purity magnet, the beam-positioning magnets, the convergence electromagnets, the deflection-yoke assembly, the cone shield, and the field-neutralizing magnets.

Color purity is achieved when each beam strikes only its respective set of color dots. The adjustment of the purity magnet, the position of the deflection yoke, the presence of the cone shield, and the setting of the field-neutralizing magnets play an important part in obtaining color purity.

The beam-positioning magnets and the lateral-correction magnet are used in conjunction with the convergence electromagnets to obtain beam convergence at all points on the shadow mask. By making the proper adjustment to the beam-positioning magnets and to the lateral-correction magnet and by applying the proper voltages to the convergence electromagnets, the points at which the three beams strike the shadow mask will coincide throughout the scanning process. Under these conditions, optimum convergence is obtained.

The Color-Purity Magnet.

The photograph in Fig. 9-33 shows that the purity magnet is similar to the centering device used with some types of monochrome picture tubes. Actually, this device uses two rings which are composed of magnetic material. The arrangement of the molecules in each ring is such that one half of each ring is a north pole and the opposite

* * Please turn to page 33 * *



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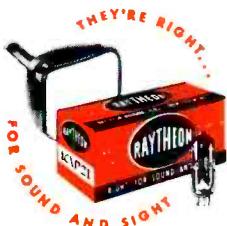
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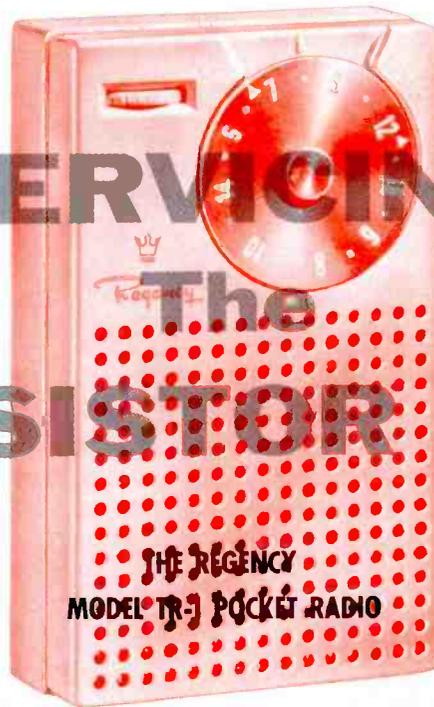


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SERVICING The TRANSISTOR RADIO



The introduction of the first transistor radio presents to the service technician new problems such as:

1. Will the printed wiring board need repairing?
2. How can transistors be tested?
3. Does normal servicing procedure apply to this receiver?

Because of the extremely small size of the receiver and because of the use of transistors, the technician is in "strange territory" as soon as he opens the case. A look at the back of the Regency Model TR-1 (with the cover removed) will reveal that the components are very closely spaced and that apparently no wiring points are accessible. With this article, we hope to present to the service technician

BY WILLIAM E. BURKE

a method of trouble shooting this receiver with the least expenditure of time and effort as well as methods of repair and replacement of components with the least possibility of damage to the delicate miniature components.

Battery Replacement

As with any piece of battery-operated equipment, the first suspect

when the receiver is inoperative is the battery. A voltage check of the battery is easy when the rear cover of the receiver is removed, since the battery clips are readily accessible. This measurement should be made with the receiver turned on and should read more than 15 volts. Any reading below this value indicates a defective battery which should be replaced.

Since it is usually not known whether the battery deteriorated through normal usage or through a defect in the receiver, an ohmmeter check should be made across the battery clips before a new battery is installed but after the old one is removed.

* * Please turn to page 52 * *

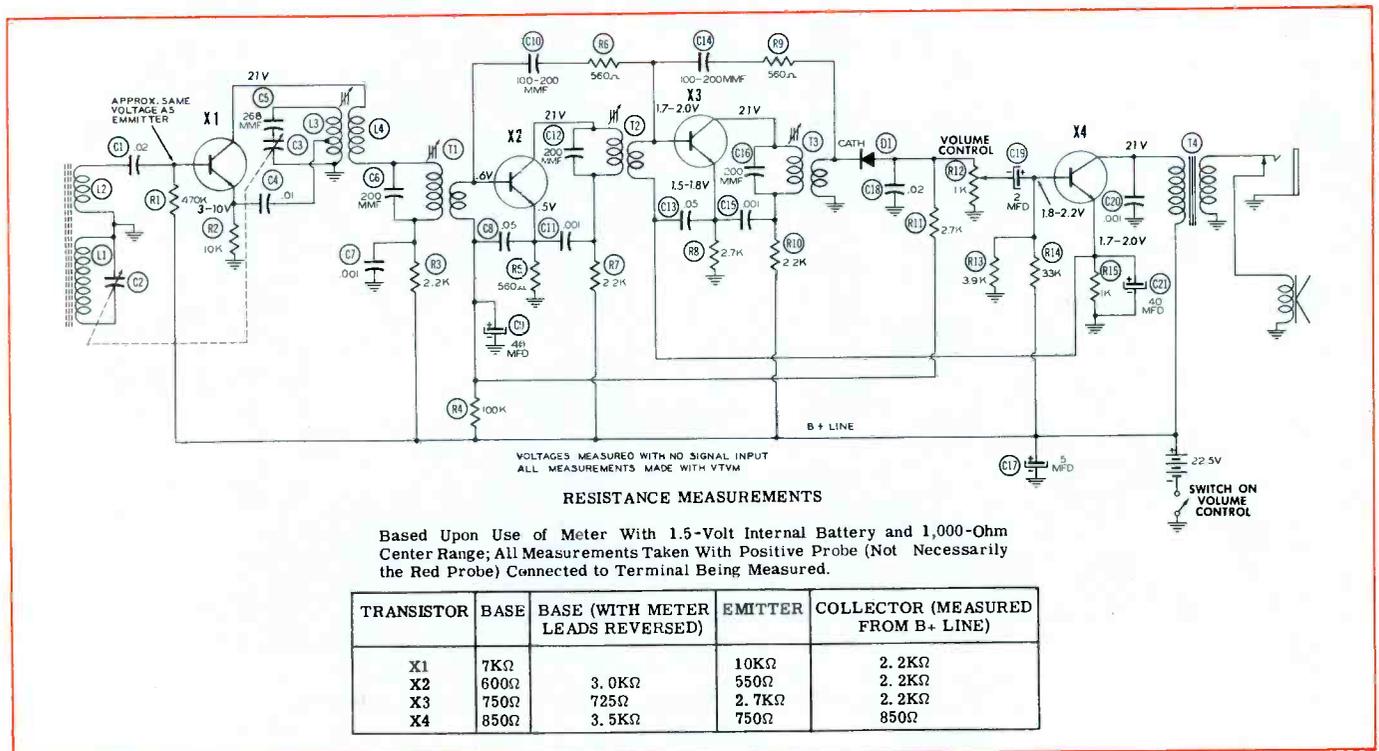


Fig. 1. Schematic Diagram of the Regency Model TR-1 Receiver.

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FREQUENCY RESPONSE

IN

MAGNETIC RECORDING



The Fourth in a Series
of Articles Devoted to
the Principles of
Magnetic Recording

BY ROBERT B. DUNHAM

The smooth wide-range frequency response featured by most late-model tape recorders is one of the important reasons why most high quality recordings are recorded originally on tape. Advances in design and construction of tape recording and playback equipment, particularly of the recording and playback heads, and the improvements made in the tape have resulted in extended frequency response at comparatively slow tape speeds.

In common with other methods of recording and playback, some inherent characteristics of the magnetic tape recording and playback processes discriminate against certain frequency ranges. Consequently, compensation such as pre-emphasizing the high frequencies during the recording process and then boosting the low frequencies during playback must be employed because of these characteristics.

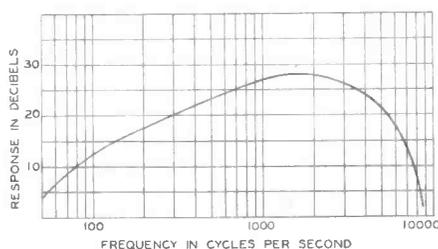


Fig. 1. Typical Response Curve Obtained When Signal Is Recorded and Played Back and There Is No Compensation.

A frequency response similar to the typical curve shown in Fig. 1 is obtained when a signal that is held at a constant current level throughout the frequency run is recorded without pre-emphasis and is played back without low-frequency boost. The subject of the compensation required to level out the response and how this compensation is obtained will not be discussed at this time. It will be taken up later when circuits are considered. Instead, we will look into the characteristics of magnetic recording to see why and how a response like that shown in Fig. 1 comes about.

The frequency response obtained with a tape recorder depends chiefly upon the width of the gap in the recording and playback heads, the magnetic characteristics of the tape used, and the speed at which the tape moves across the recording and playback heads. Of course, many things such as the amplifier circuits can affect frequency response; and correct mechanical and electrical adjustments must be maintained. But the important basic factors which influence frequency response are speed and the properties of the heads and the tape.

Recording and Playback Heads

The width of the gap in the playback head has more effect upon frequency response than does the width of the gap in the recording head. Output is reduced when the wavelength of the recorded signal is equal in size or smaller than the width of the gap in the playback head. Consequently, to extend the high-frequency response, the gap in the playback head is made very narrow. Gaps of .001 to .0005 inch or smaller are used in playback

heads; whereas, recording heads can and do use gaps measuring .001 to .002 inch in width. In any case, the effective width of the gap is wider than its physical size because the magnetic flux cannot be confined completely within the gap.

One reason for the playback gap being critical is that the signal output depends upon the time rate of change in magnetic flux as the recorded tape moves across the gap in the playback head. Remember, a playback head operates like a generator, and current flows when the magnetic lines of force cut through its coils. Output increases as frequency increases, at least in theory. Actually, during playback, the output increases at the rate of 6 db per octave at the lower frequencies; but at the higher frequencies, this increase in output is not achieved. The high frequencies suffer increasing loss, as frequency increases, because a narrower gap and a higher tape speed would be required to reproduce them properly.

This discussion of the effect of gap width upon frequency response would not be complete without directing attention to the importance of maintaining constant and uniform contact of the tape with the gap. Any change in pressure or in tension exerted upon the tape while it is moving across the head will cause the distance between the tape and the gap to vary and will cause variations in the frequency response.

The gap in the recording head need not be so narrow as that in the playback head, because the tape is magnetized as it leaves the gap during

* * Please turn to page 70 * *

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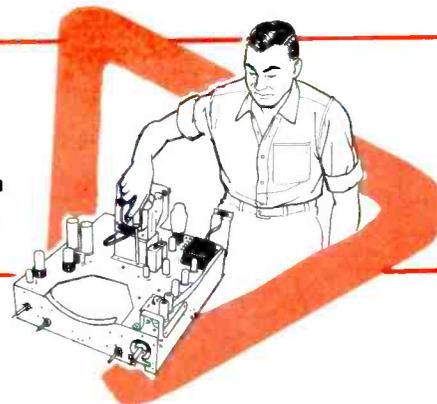
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In the Interest of . . . Quicker Servicing



by Henry A. Carter and Calvin C. Young, Jr.

IN THE HOME

New Antenna Developments

Since the freeze on construction permits for new television stations was removed by the Federal Communications Commission (FCC) in April of 1952, a great many of the larger cities over the country have acquired additional VHF television stations. This means that many cities which formerly had only one now have two or more in operation.

In most of these cities, the stations have their transmitting antennas located in different places in the city or in outlying areas. The city of Indianapolis, Indiana is a good example of this situation. The relative locations of three VHF stations which provide local reception are shown in Fig. 1. It can be seen from this illustration that it is very difficult within the city to orient a single antenna so that reception may be obtained from all three stations without ghosts or distortion.

To combat this problem in the residential areas, technicians have in many cases installed a DPDT

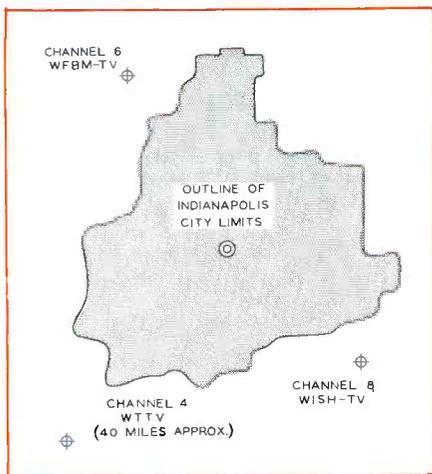


Fig. 1. Relative Locations of TV Transmitting Towers in Indianapolis, Indiana.

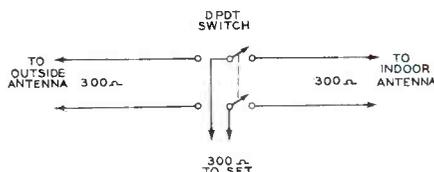


Fig. 2. Antenna-Switch Arrangement.

switch in the antenna lead, as illustrated in Fig. 2. In using this hookup, the outside antenna is turned for best reception on channel 4 and the indoor antenna provides a usable signal on channels 6 and 8. This method has proved to be very satisfactory where there is acceptable reception on channels 6 and 8 by means of indoor V-type antennas (rabbit ears).

There are other methods which may be employed in residential areas to receive all channels without ghosts or without other types of distortion caused by the antenna. A good grade of all-channel outdoor antenna may be used in conjunction with an antenna rotator. The antenna used in this type of installation should have a high front-to-back ratio and a sharp directivity pattern. Another method is to install an outdoor antenna for each channel to be received.

The Clear Beam Antenna Company has recently introduced in the Indianapolis area an antenna system which consists of a three-element Yagi for channel 4, another three-element Yagi for channel 6, a folded dipole with reflector for channel 8, a matching transformer, and a harness for connecting the two Yagis to the transformer. The harness is made up of 450-ohm open-wire line. A sketch of this antenna system is illustrated in Fig. 3. The matching transformer is mounted on the mast, the channel-4 and channel-6 Yagis are connected to the low-channel input of the transformer by means of the harness, and the channel-8 folded dipole is connected to the high channel input. The output of the transformer is connected to the receiver

through a single 300-ohm ribbon lead-in wire. Reception in this area with the Clear Beam unit just described has proved to be very satisfactory.

There will be cases, however, when reception problems will be a function of the location of the receiver and antenna system. Such may be the case in downtown areas, in large apartment buildings, in areas behind a hill or mountain, or even in areas directly behind a large building. If the reception problem in a downtown area consists of ghosts or multiple images, the installation of an antenna having very sharp directivity and a high front-to-back ratio will do much toward improving reception. For an installation in such a downtown area, an antenna which has no minor lobes in its directivity pattern is almost a necessity because ghost pickup may be a problem on an antenna which has several pickup lobes. See Fig. 4 for examples of a single-lobe directional pattern and a multiple-lobe pattern.

There will be occasions when ignition interference, interference from neon signs, and interference present on the AC power line may cause reception problems in the downtown area. Installing a high-pass filter in the antenna input circuit, twisting the antenna lead-in wire, and routing the lead-in wire as far away

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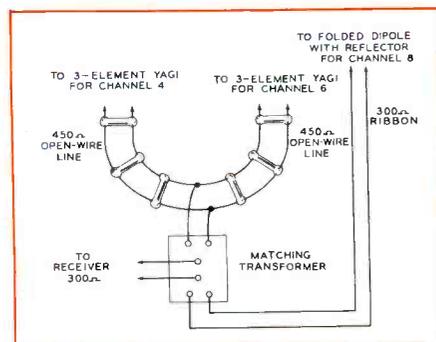
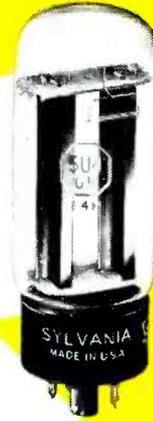


Fig. 3. Clear Beam Antenna System Designed for Indianapolis Area.



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MILTON S. KIVER

President, Television Communications Institute

Uses for the RF Generator

Normally, an RF generator is associated with alignment work, and that is its chief application; however, the RF generator also serves as a very fine localizer of defects, and those men who have never thought of using it in this way will be interested in the following discussion.

In last month's column, mention was made of an RF generator that was successfully used in locating an intermittent defect. Briefly, here is the procedure that was followed. The receiver was placed on the bench and tuned to one of the local channels. Then a VTVM was placed across the load resistor of the video detector. At the same time, an RF generator was loosely connected between grid and ground of the second video IF stage. The generator was set to the mid-frequency of the video IF range, and the amplitude of its output signal was modulated by its own 400-cycle audio note. Then its output control was slowly advanced until alternate black and white horizontal bars were just barely visible on the screen.

The set was left to operate. In time, the intermittent condition appeared and removed the picture and the sound; but it did not affect the horizontal bars produced by the RF generator. This meant that the cause of the intermittent condition was situated between the antenna terminals and the second video IF stage.

For the next step, the RF generator was shifted to the grid of the mixer tube. When the intermittent symptom once again appeared, all the signals left the screen. The inescapable conclusion was that the trouble was located between the mixer grid and the grid of the second video IF amplifier. By tapping the various capacitors, resistors, and tubes in these two stages, the technician found the defective component to be a bypass capacitor.

Fortunately for the health and welfare of the service technician, comparatively few of his jobs involve

intermittent receivers, but whether the trouble is persistent or elusive, an RF generator can be of great assistance in tracking it down. Here are some additional examples.

Stages which are completely dead are readily checked by an RF generator. In the video system following the second detector, only the audio modulating voltage of the generator is used. The signal is applied across the load resistor of the second detector, and the picture tube screen is observed for horizontal black and white stripes. See Fig. 1. Appearance of these stripes indicates that the audio signal is passing through the various video amplifier stages.

If there are several video amplifiers and you wish to obtain a relative indication of their amplifying power, the foregoing procedure can be modified as follows. Inject the audio signal at the signal element of the picture tube. Then reduce the level of the audio signal until the black and white bars are just barely visible on the screen. Shift the generator to the control grid of the final video amplifier. The bars, as seen on the screen, should appear considerably darker, indicating that the video stage has amplified them. If there is still another video amplifier, again the audio signal can be reduced until the bars are just visible on the screen. Then the input point is shifted from the grid of the final video amplifier to the grid of the preceding stage.



Fig. 1. Horizontal-Bar Pattern Produced on Screen Is Caused by Audio Modulation of RF Generator.

The increase in bar intensity is an indication that the video amplifier is amplifying the signal.

If desired, the actual numerical stage gain can be determined. Place the audio signal at the grid of a video amplifier, and increase the generator output until one volt of signal at the grid is indicated on the AC scale of a VTVM. Then move the meter to the plate of the tube, and note the value of the audio signal at that point. The ratio between the signal at the plate and the signal at the grid represents the gain of the video amplifier. The test can be carried out over the entire video amplifier section or any part of it; moreover, the gain checks which can be done in the video amplifier with the foregoing tests can also be carried out in the audio amplifier system.

In the IF system, all the tests are performed with the generator set to an appropriate IF frequency. If your instrument only goes up to 30 mc and the video IF in the receiver is in the 40-mc range, it is almost always possible to use the second harmonic of some frequency in the 20-mc range. The method of testing is similar to that described in the foregoing, with the exception that a modulated RF signal is used instead of an audio signal. Horizontal bars will again appear on the screen; and by their relative intensity, you will be able to judge whether or not a certain stage is amplifying the signal. At any point where the signal path is broken, the signal will disappear; and this will practically pinpoint the source of trouble. You can proceed stage by stage or jump several stages at a time. Either method is carried out readily with approximately the same service time.

Checking the gains of the video IF stages by means of an RF generator may seem a little involved at first, but it actually offers very little additional difficulty. There are two ways of making the measurements — one is by using an unmodulated RF

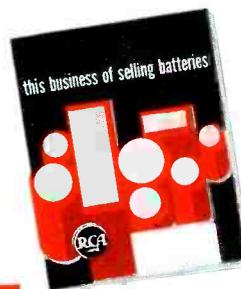
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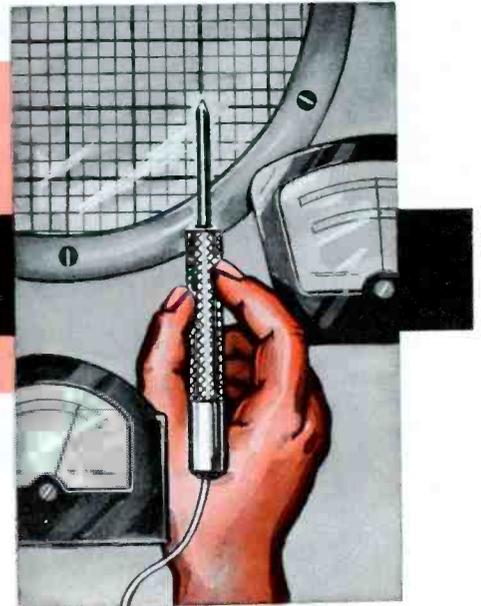
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Notes On

TEST EQUIPMENT

Presenting Information on Application, Maintenance, and Adaptability of Service Instruments



by Paul C. Smith

CAPACITANCE CHECKERS

The service technician is interested in many characteristics of capacitors. The foremost of these characteristics is capacitance, but others also have a direct influence on the behavior of the capacitor. The technician may wish to know whether a capacitor is open, shorted, leaky, or intermittent; or he may be interested in the insulation resistance, power factor, or RF impedance. All this information can be obtained through the use of present-day capacitance checkers.

One of the simplest capacity checks may be performed with the use of an AC voltmeter. The capacitor is connected in series with a known resistance, and this series network is placed across an AC voltage source of known voltage and frequency. A part of this applied voltage will be developed across the capacitor in direct proportion to the reactance of the capacitor. A chart could be prepared to show capacitance corresponding to reactance at the frequency used, and the value of capacitance can be obtained directly from such a chart. Some VTVM's may include a circuit for this type of capacity checking, in which case the chart would be unnecessary because the VTVM is calibrated so that capacity may be read on the meter scale.

More accurate checks can be obtained with the use of a bridge, and the majority of capacitance checkers will be found to use any one of several types of bridge circuits. These types may range in complexity from the very simple general-purpose bridge

circuits to the more complex laboratory bridge circuits. The ones commonly encountered in capacitance checkers are kept fairly simple in operation.

Bridge Theory

A schematic diagram of an AC bridge circuit is shown in Fig. 1A. The bridge circuit consists of four arms and a detecting device connected at two opposite junctions. A source of AC signal is connected to the two remaining junctions. The detector may be an oscilloscope, a pair of earphones, an electron-eye tube, or some other device which will indicate the relative magnitude of the AC signal present across the detecting device. The arms are labeled as impedances because they may represent resistances, capacitances, inductances, or any combination thereof. The bridge is balanced when:

$$\frac{Z_a}{Z_b} = \frac{Z_c}{Z_d}$$

where

$Z_a, Z_b, Z_c,$ and Z_d = the impedances designated.

There will be no potential difference between the junction points y and z for this condition.

The bridge circuit of Fig. 1A can be modified to the form of Fig. 1B in which it is shown as a general-purpose bridge. Z_x is an unknown impedance, and Z_s is a standard impedance with which it is to be compared. Three conditions are

necessary in order for the bridge of Fig. 1B to be in balance:

$$Z_x = \frac{R_a}{R_b} (Z_s),$$

$$X_x = \frac{R_a}{R_b} (X_s),$$

$$R_x = \frac{R_a}{R_b} (R_s),$$

where

X = reactance,

x = unknown value,

Z_x = impedance of unknown,

R_a, R_b = resistances,

Z_s = standard impedance,

X_x = reactive component of Z_x ,

X_s = reactive component of the standard impedance,

R_x = resistive component of the unknown impedance,

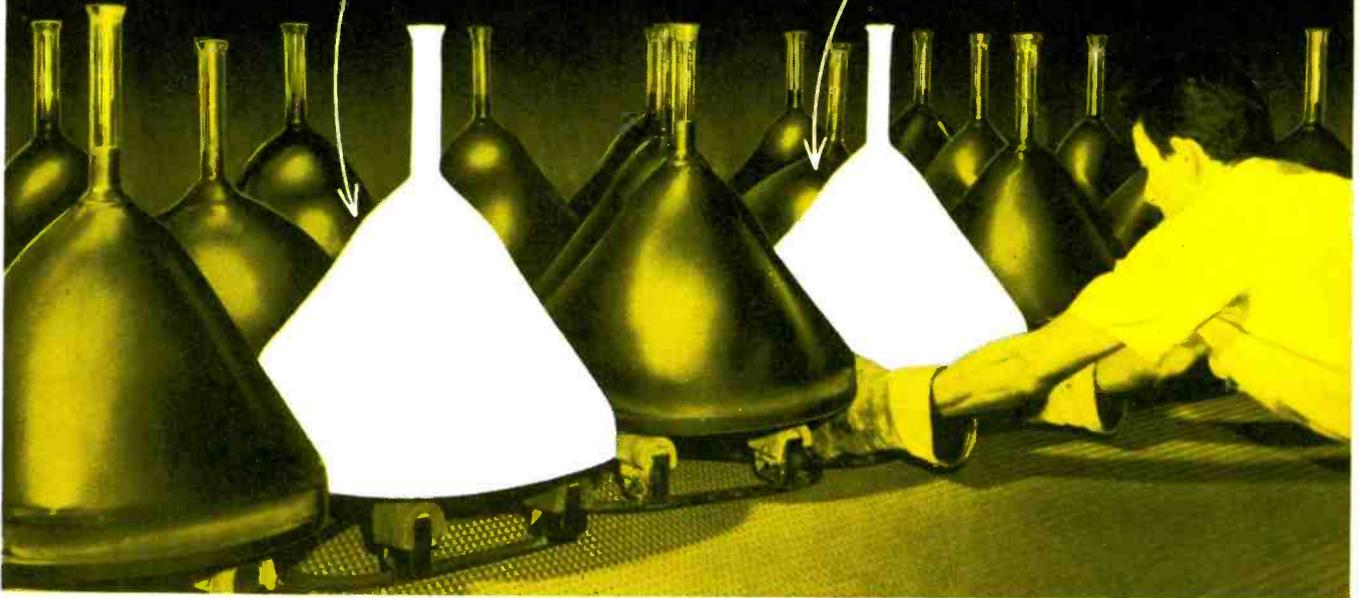
R_s = resistive component of the standard impedance.

Both resistance and reactance, which are impedance components, must be considered in order to reach a balance. This fact is the basis for

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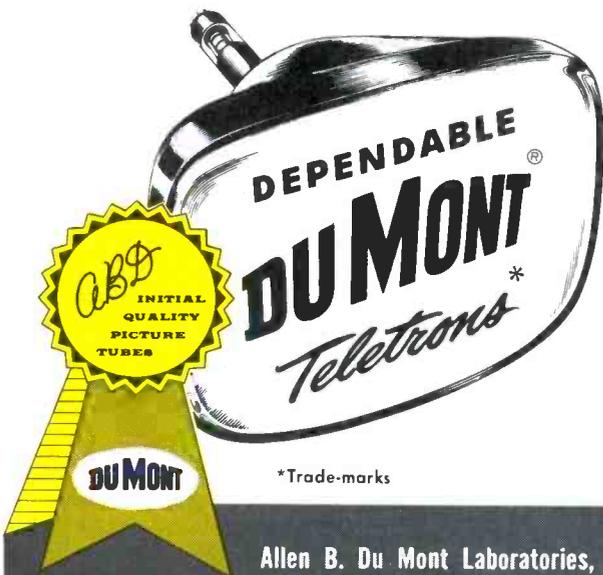
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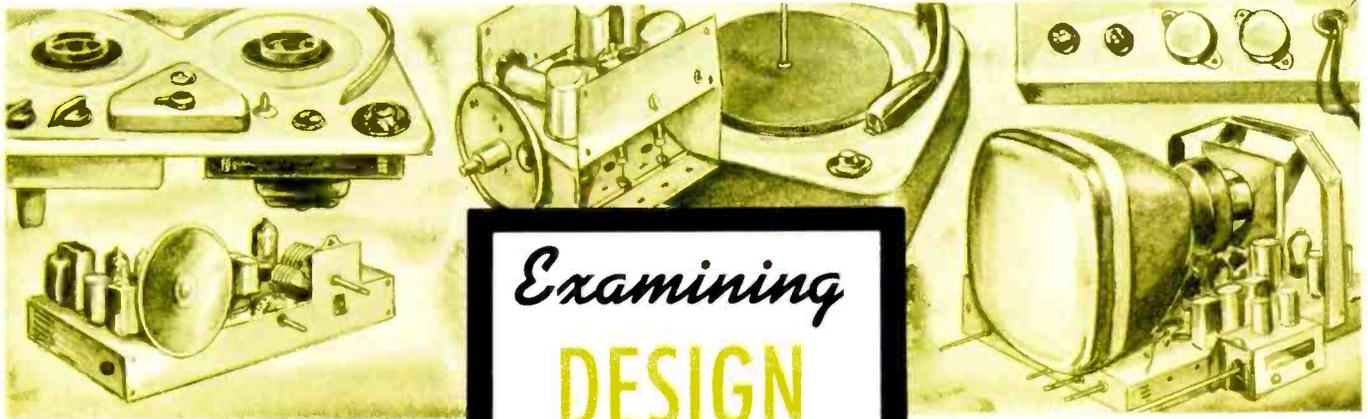


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Examining DESIGN Features

BY WILLIAM E. BURKE
and JAMES M. FOY

MUNTZ CHASSIS 47A4

The Muntz Chassis 47A4 shown in Fig. 1 is an example of the Muntz Industries' new line of TV receivers. The chassis has the newly popular vertical construction, and the receiver uses 14 tubes plus the 21-inch picture tube. The intermediate frequency is in the 40-mc range; the picture carrier is at 45.75 mc, and the sound carrier at 41.25 mc.

One side of the AC line is connected directly to the chassis; consequently, an isolation transformer is particularly recommended when servicing this receiver. The circuits employed in the receiver have some unusual features which will be covered in the following discussion.



Fig. 1. Muntz Chassis 47A4 Mounted in Cabinet.

A circuit of this type has the advantage that a tube change, with its accompanying capacity change, cannot alter the IF alignment because the small change in tube capacity is masked by the relatively large capacity of the trimmers.

Two 6AU6 tubes provide amplification in the first two IF stages, and the pentode section of a 6AM8 is used in the third IF stage. AGC voltage is applied to the control grids of the first two IF stages, and it is derived from the output of the video detector. The video detector and output stages use conventional circuitry, and the functions are provided by the diode section of a 6AM8 and the pentode section of a 6AU8 respectively.

Tuner.

The tuner is a turret type with 12 positions covering VHF channels 2 through 13. (UHF reception can be added to this receiver through the use of UHF turret strips, or an optional UHF tuner can be installed.) The RF signal is first amplified by a conventional pentode RF stage and is converted to the intermediate frequency by the pentode and triode sections of a 6AT8. These sections operate as the mixer and oscillator respectively. AGC voltage is applied to the grid of the RF tube.

Video IF.

The IF signal from the tuner is coupled to the grid of the first IF stage through a pi-network composed of coil L6 and capacitors C101 and C17. This network can be seen in the schematic of Fig. 2. The coil L6 and the plate coils of the three IF stages are tubular, impregnated with plastic, and have fixed inductance values. The necessary adjustments for the correct IF response are made by means of small, variable, ceramic trimmers. The coils and trimmer capacitors are identified in the photograph of the IF section in Fig. 3.

Sound.

The 4.5-mc sound IF signal is derived from the video output stage and is amplified by the pentode section of a 6U8 before being applied to the 6BN6 gated-beam detector. Since the detector provides amplification of the audio signal, that signal is fed from the detector through the volume control to the 25L6GT output tube. Filtering of the B+ voltage is supplied by a part of the primary of the audio output transformer.

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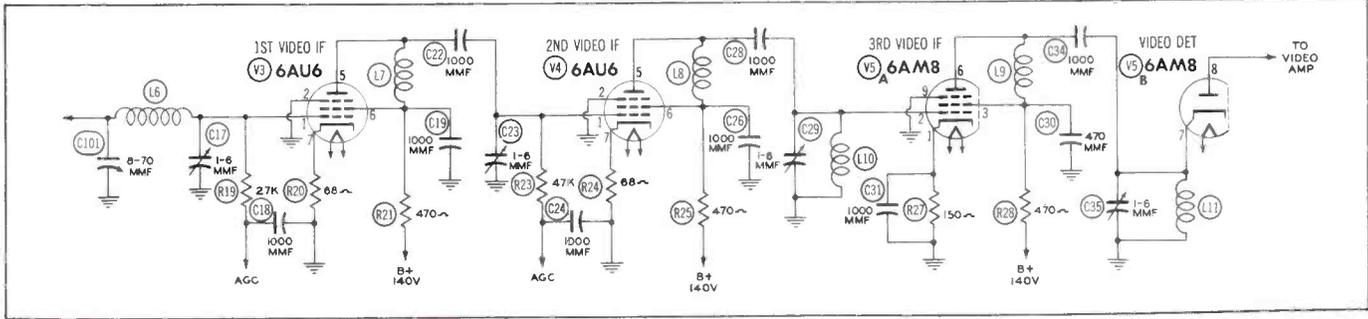


Fig. 2. Schematic Diagram of Video IF Strip in Muntz Chassis 47A4.

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The alignment of a small radio is much simpler than that of a TV receiver. The latter involves video IF alignment (often accompanied by many trap adjustments), sound IF and sound detector alignment, and in some cases adjustment of the oscillator and RF stages. The radio alignment quite often consists of only three or four steps. With this great difference in the two alignments, it is probably a temptation for the service technician to view the radio alignment as something of much less importance — perhaps as something to be hurried over with the idea that almost any sort of alignment will do. The truth of the matter is that an excellent radio alignment takes very little or no more time than an indifferent one, and the improvement effected in some cases is quite easily noted by the owner when the receiver is returned.

If a technician has a receiver on the shop bench for a routine repair such as replacement of a filter capacitor or of an open or shorted bypass capacitor, it takes only a little more time for a quick check of the alignment; and he may feel justified in completing the alignment and charging for the added service if he sees that considerable improvement can be made. The very process of checking the alignment puts him partially through the alignment procedure so that not much extra time is involved. Quite often there will be sets which do not receive stations falling near the extremes of the broadcast band or which do so only at greatly reduced volume compared to the rest of the band. Another common occurrence is to find that a set will tune just to the edge of a station frequency that is at one extreme of the band, and the hiss and distortion which are characteristic of a mistuned superheterodyne receiver will result.

The symptoms or shortcomings just mentioned must be considered to be the result of poor tracking or misalignment, inasmuch as all standard AM receivers of recent design provide ample coverage of the broadcast band. Poor tracking and misalignment may be the result of gradual changes in component values over a period of time; they may come about because of vibration or rough handling during shipment; or they may even be the result of amateur "slug twisting." (A slug twister is the next step beyond a "knob twirler.")

A step-by-step alignment of a radio may range from something that is extremely simple in the case of small 4- or 5-tube AC-DC sets to a more complicated alignment for larger sets, for sets having several tuning ranges, and for sets having an

RADIO

ALIGNMENT

A DISCUSSION OF TRACKING, ALIGNMENT POINTS, IMAGE FREQUENCIES, AND OTHER FACTORS

BY PAUL C. SMITH

FM band. Alignment of auto radios also tends to be a little more elaborate than that of the simpler table-top model radios. A typical alignment procedure for a small radio is outlined in Chart I. Step 1 consists of peaking

the IF transformers for maximum response at the intermediate frequency. Step 2 calls for setting the tuning range at the high-frequency end of the band by means of the oscillator trimmer. Step 3 is a tracking operation to adjust for greatest response at a tracking point (1400 kc in this case). For this last operation, the antenna circuit is tuned by means of a trimmer on the antenna section of the tuning capacitor. The alignment procedure of Chart I is about as simple as any the technician is likely to encounter. Occasionally, a receiver which uses only one IF transformer is found; and in that case, fewer adjustments would be necessary. Normally, however, the set employs two or more IF transformers. Sometimes, an RF stage is added ahead of the converter, thus increasing the sensitivity and selectivity of the set.

Superheterodyne Theory

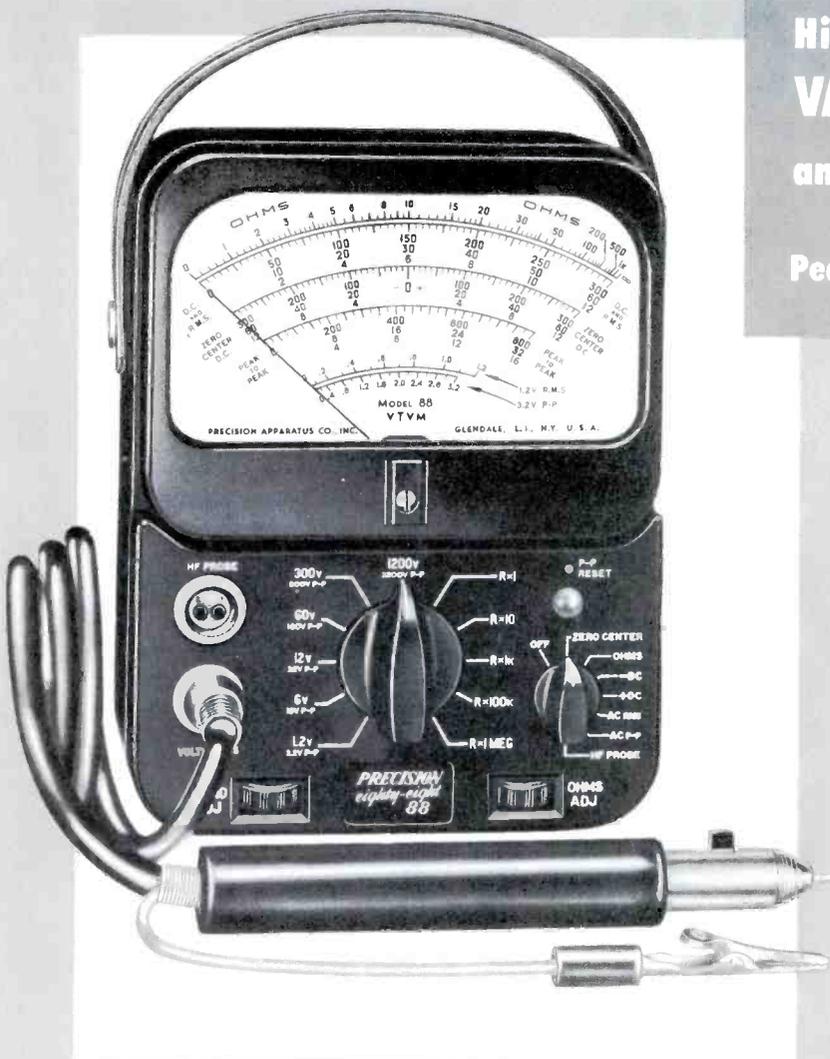
A brief review of the principles of operation of superheterodyne receivers may lead to a better understanding of some of the points to be made in the paragraphs which follow. The modulated carrier signal from the radio station is intercepted by the antenna system of the receiver; then this RF signal is applied to an RF stage for amplification, or it is passed directly to the converter stage of the receiver. A tuned circuit between the antenna and the converter stage provides for a certain amount of attenuation to all signals except the desired one. The RF signal is combined or heterodyned in the converter stage with an oscillator signal, and the result is a combination signal made up of each original signal plus the sum and difference frequencies.

Consider a case in which the RF or antenna circuits are tuned to accept a signal at 1000 kc and in which the oscillator is operating at 1455 kc. Frequencies of 1000 kc, 1455 kc, 2455 kc, and 455 kc will be present in the output of the converter. The IF stages are tuned to accept and pass only one of these signals and to reject the others. The accepted signal, which is 455 kc in this case, contains all the audio information impressed upon the RF carrier at the broadcasting station; but the carrier has been effectively changed from 1000 kc to 455 kc.

This system has several advantages not found in tuned radio frequency (TRF) receivers. The IF stages do not need to be designed for amplification at frequencies other than the intermediate frequency, and this permits simpler design and greater amplification. Because the IF signal is lower than the RF signal, the selectivity is improved and there

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CHART I

AN EXAMPLE OF ALIGNMENT INSTRUCTIONS FOR A SMALL AM RADIO

Volume control should be at maximum position. Output of signal generator should be no higher than necessary to obtain an output reading. Use an insulated alignment screwdriver for adjusting.
 Loop should be maintained in same relative position to chassis as when receiver is in cabinet.
 To set pointer, turn tuning capacitor fully closed and set pointer parallel with base of dial.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
1. .05MFD	High side to pin 7 (grid) of 12BE6 (V1). Low side to B-.	455KC (400%Mod)	Tuning gang fully open	Across voice coil	A1, A2, A3, A4	Adjust for maximum output. If isolation transformer is not used, reduce dummy antenna to .001MFD to reduce hum modulation.
2. "	"	1640KC	"	"	A5	"
3.	Loop	1400KC	Tune to 1400KC signal	"	A6	Fashion loop of several turns of wire and radiate signal into loop of receiver. Adjust for maximum output.

is less danger of feedback trouble between stages.

The amplified IF signal is applied to a conventional detector circuit for detection of the audio modulation. This is often called the second detector, since the action of the converter stage involves a detection process; therefore, the converter stage can be considered as the first detector. After any necessary amplification, the audio signal is applied to the speaker system of the receiver.

Tracking Principles

The IF stages are permanently tuned to the intermediate frequency during alignment, and the intermediate frequency should not be changed while the set is being operated; therefore, in order to make sure that this intermediate frequency will be obtained at the output of the converter stage whenever a signal is being received, the design of the receiver is such that the frequency of the oscillator can be maintained at a constant difference from the RF signal being tuned. The difference was 455 kc in the example described previously. To establish the 455-kc difference, the oscillator

and RF circuits are both tuned by separate sections of a ganged tuning capacitor. Both sections cannot have the same tuning effect, however. While the RF section is tuned from 535 to 1620 kc, the frequency of the oscillator section must vary from 990 to 2075 kc in order to maintain the intermediate frequency constantly at 455 kc.

The formula for the resonant frequency of a tuned circuit is:

$$f = \frac{1}{2\pi\sqrt{LC}}, \quad (1)$$

where

L = inductance in henrys,

C = capacitance in farads,

f = frequency in cycles per second.

By squaring both sides of equation 1, we obtain:

$$f^2 = \frac{1}{4\pi^2 LC}$$

where

L, C, and f are the only variables. If we double L or C, then f^2 will be halved. With a given value of inductance L, it is possible to calculate the capacitance range which we must have in order to tune through a given frequency range. For example, with the frequencies chosen in the preceding paragraph, the RF range from 1620 to 535 kc represents a frequency ratio of 3.03 to 1. To tune this range, capacitance C must vary through this ratio squared, which is about 9.2 to 1. In other words, the maximum capacity of C must be 9.2 times its minimum capacity. At the same time, the oscillator varies according to a frequency

ratio of 2.1 to 1, requiring a capacity ratio of 4.4 to 1.

Obviously, we cannot tune through capacity ratios of 9.2 to 1 and 4.4 to 1 by rotating the common tuning shaft unless the operation of one of the sections in the dual capacitor is modified. Some early radio receivers utilized a padder capacitor in series with the oscillator section, and this altered the tuning ratio in the proper manner. Theoretically, perfect tracking was obtained at two or three points of the range, and the tracking at other points was close enough to be satisfactory.

More recent models use what is termed a "cut rotor" in the oscillator section. This method accomplishes the same results and also saves materials, since no padder is needed and since the oscillator section of the capacitor is reduced in size. With proper design, this arrangement should track very closely across the entire tuning range. As a result of the advantages just mentioned, cut-rotor tuning is used almost exclusively in present-day superheterodynes.

Several circuit components may be made variable to permit the service technician to make necessary tracking adjustments. These include the small trimmer capacitors usually mounted on the ends of the stator plates of each section of the tuning gang; and in some cases, they include slug-tuned coils to obtain variable inductance.

Fig. 1 illustrates one type of loop antenna with a few turns which have been moved out of line at the factory for tracking purposes. Thus, the inductance of the loop as a whole has been lowered.

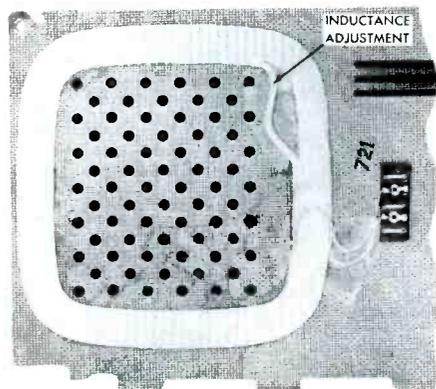


Fig. 1. Loop Antenna with Turns Moved in Order to Change Its Inductance.

* * Please turn to page 82 * *



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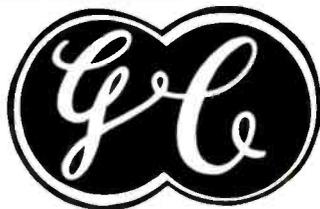


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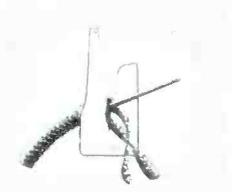
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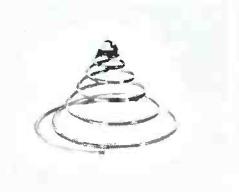
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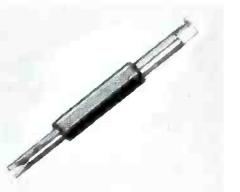
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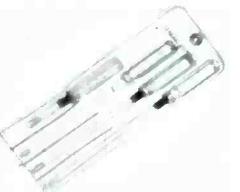
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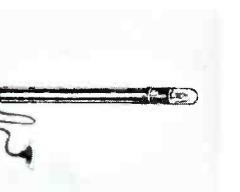
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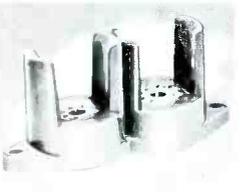
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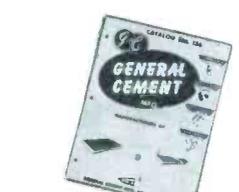
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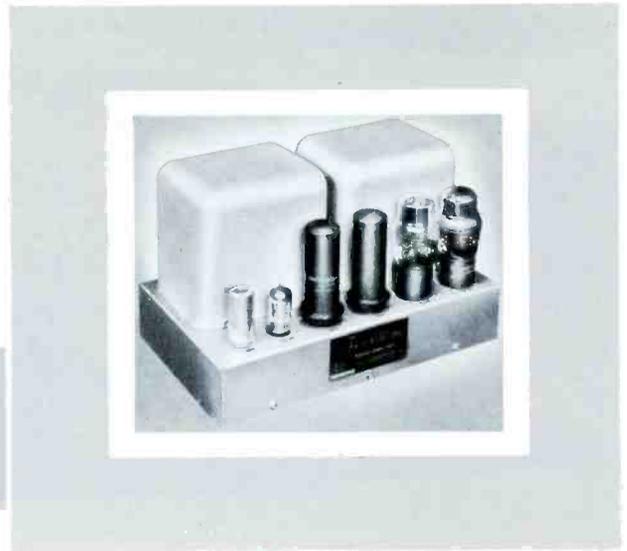


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Audio-Facts

A 50-Watt Power Amplifier Fairchild Model 260



The large number of amplifiers now available permits a prospective user to select one that will prove to be suitable for most any application. Although they are made in many shapes and sizes and most of them possess some special features, probably no amplifier is ever chosen without some consideration being given to whether or not its power capabilities will be adequate.

It is understood that the amplifier must develop enough power to drive the loudspeaker to reproduce the signal (music in most cases) properly. Just how varied and critical the power demands can be and how much power the amplifier must actually handle at times might surprise some users.

We discussed power requirements briefly in the article "A Small High Quality Amplifier" in the July-August 1953 issue of the PF INDEX. We mentioned how well the small

4-watt (maximum) amplifier, which was the subject of the article, performed under conditions found in the average home.

It is true that a small low-powered amplifier can provide very satisfactory results. The pleasing music that can be obtained from one of the many small high quality record players now available illustrates this fact. If the listening is done at low or very moderate levels, and if reproduction is good otherwise, the fact that extreme power output is not available does not detract from the pleasure of the average listener.

The subject of power capabilities of power amplifiers was brought to our attention at this time by some tests we have been making on the Fairchild Model 260 power amplifier. The Model 260 shown in Figs. 1, 2, and 3 is a 50-watt amplifier. Tests

were made with instruments to check specific ratings, and many listening tests were also made in an effort to form an opinion on the value and desirability of an amplifier with a power rating of 50 watts. These tests and experiments proved to be very interesting from several angles.

Before examining the circuit and features of the Model 260, we will continue the discussion about the amount of power which is required to reproduce music satisfactorily.

Most audio enthusiasts would probably voice the opinion at this point that there is no reason for having a 50-watt amplifier in a home. It is true that a sustained level of 50 watts will never be used when operating the typical home music system, but it is surprising how often peaks in the sound being reproduced can call for outputs approaching that amount.

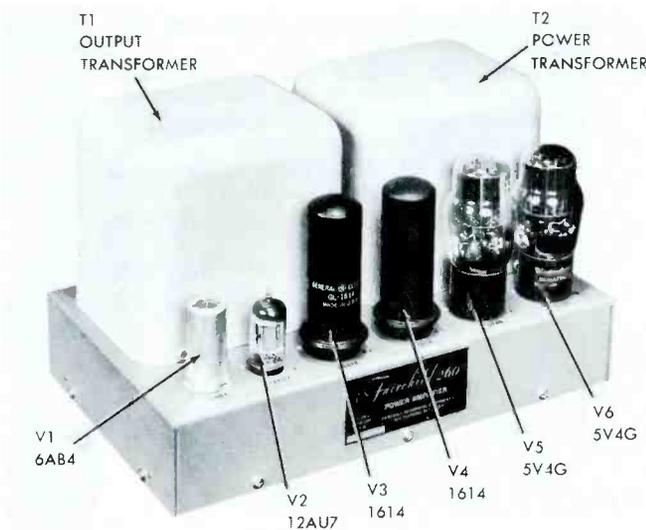


Fig. 1. Front View of Fairchild Model 260 Power Amplifier.

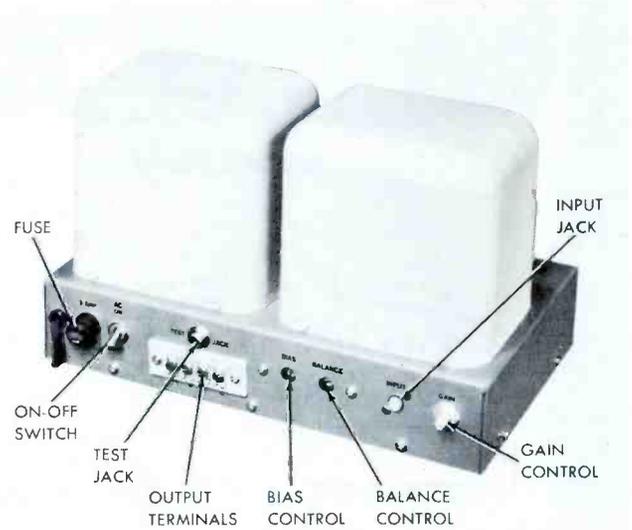


Fig. 2. Rear View of Fairchild Model 260.



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When mentioning audio enthusiasts, we should not overlook the group that prefers high-powered amplifiers (and probably high-powered cars); because they derive a great deal of satisfaction from knowing that they possess an outfit which can cope with any situation they are likely to encounter. In homes where music is used for background and consequently is not played at a high level, low power output is sufficient in most cases. This was particularly true not so long ago when radio broadcasts and recordings were subjected to much compressing. This caused the level to remain fairly constant with very little difference in volume between the softest and loudest passages of reproduced music.

Very little if any compression is used during most present-day FM broadcasts and during a recording process, since both processes now feature wide dynamic range. This wide range in signal level can be seen when an oscilloscope is connected across the output (speaker) terminals of the amplifier while a record is being played. It is not at all unusual to observe peaks 20 times the level which would be considered normal for the music being played.

An odd thing about the peaks is that the highest ones occur so often

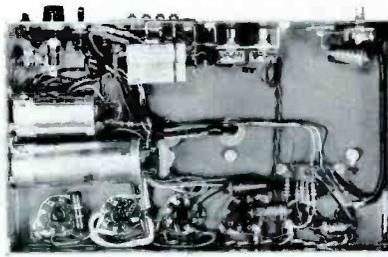


Fig. 3. Bottom View of Fairchild Model 260.

in passages in the music that do not sound so loud as other portions which the listener would judge to be the loudest. Such things fool the listener and can account for some baffling effects. Considerable power is required to reproduce the peaks properly and effectively.

To increase the output 3 db, the power must be doubled. For example, if the listening is being done at a level using one watt of power and the level is increased 3 db, the power output will have to be raised to 2 watts. Increasing the output 12 db above the original one-watt level would require 16 watts. A 15-db level would require 32 watts, and an 18-db level would call for 64 watts.

The increase from 15 db to 18 db might even pass unnoticed because

the sound level is already so high that the ear may not notice the difference. To increase the power output from 32 to 64 watts is really asking a lot from the equipment, thus it can be seen that power requirements pile up.

Of course, the value of a high-powered amplifier is unquestioned when sound is being reproduced in auditoriums, theaters, or for PA work. Driving a large speaker system for high quality reproduction of music for a large audience does require power, particularly for handling the peaks, and calls for a large margin of reserve.

Another application which requires power in excess of that furnished by the usual 20- or 25-watt amplifier is the cutting of disc recordings. Plenty of power is needed to drive a cutting head. This is especially true when cutting micro-groove recordings because of the pre-emphasis employed.

To return to the tests made on the Model 260, it was found that when some recent recordings of very high quality were played the reproduction of all high-level passages and sudden heavy chords was very clean and un-

* * Please turn to page 64 * *

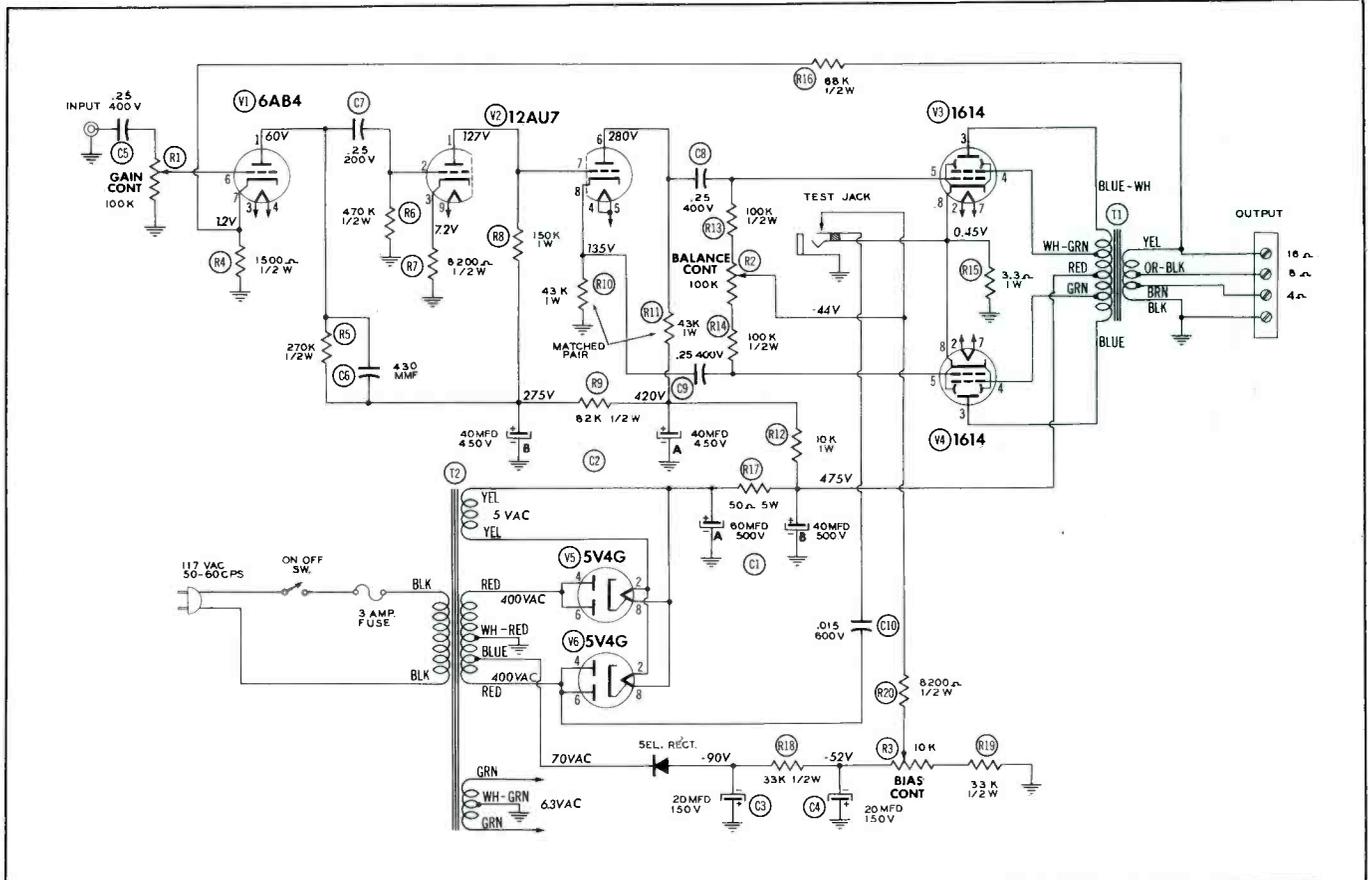
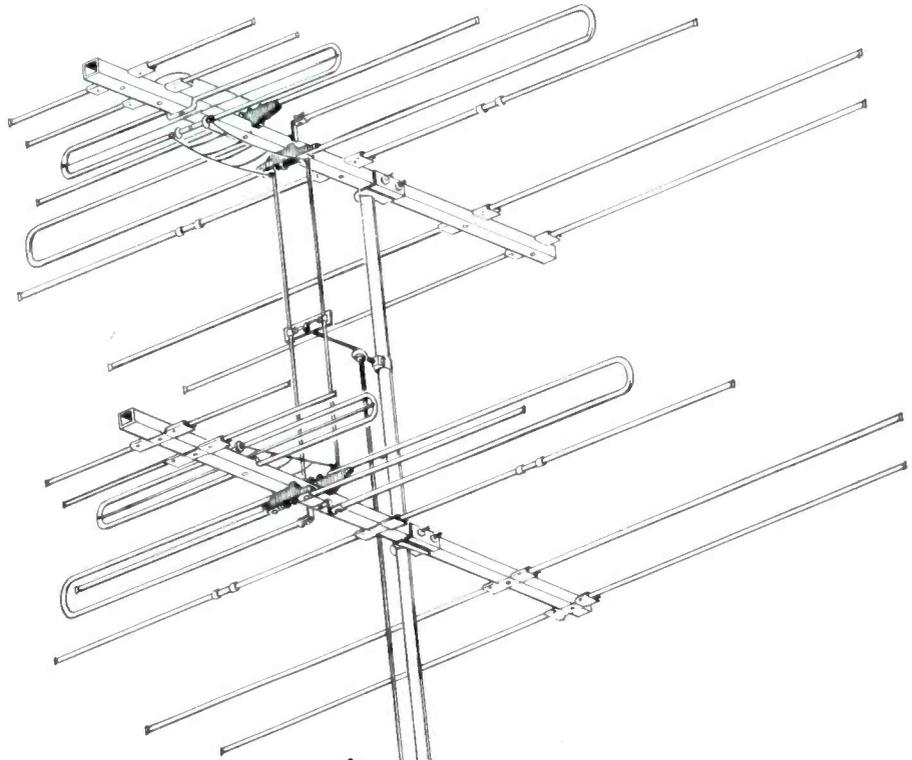


Fig. 4. Schematic of Fairchild Model 260.

150 field tests have proved to WARD jobbers:

- * Good VHF picture at as far as 200 miles on several channels
- * Excellent results at 100 miles
- * Good results in areas where no other antenna was able to bring in a picture
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- * Channel 2-13 response as much as 40% better than any comparable antenna
- * Unique superior snap-lock bracket
- * Original WARD design all aluminum supplemented spring pressure bracket—eliminates possibility of intermittent contact



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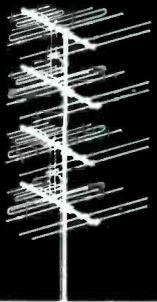
WARD Model TVS 356 2 bay and stacking harness \$39.95 list

WARD Model TVS 357 4 bay stacking kit (feed harness only) \$3.95

THE INVADER* CONQUERS

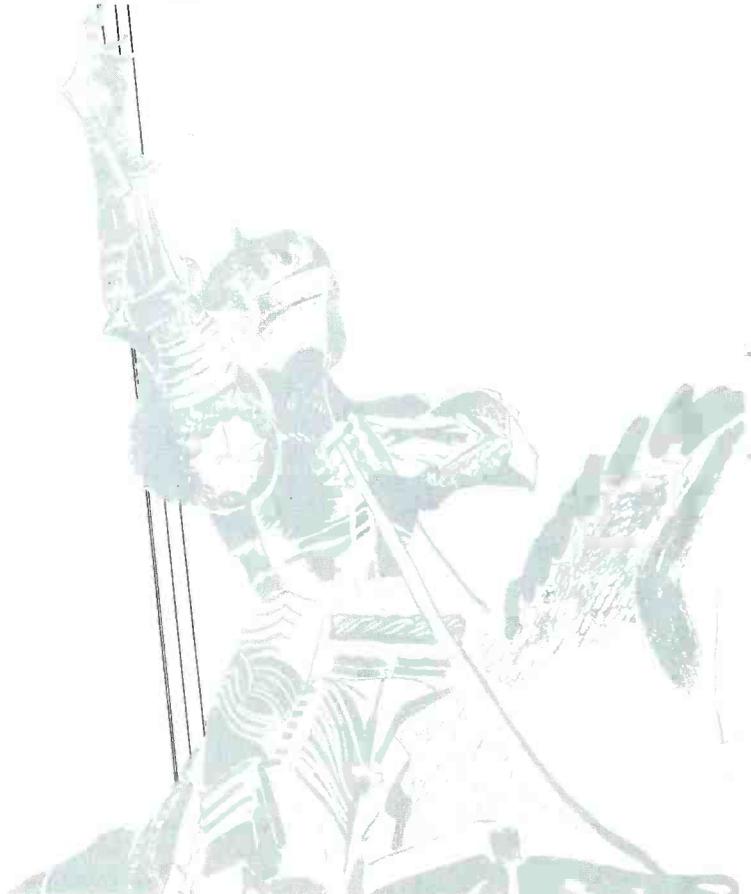
sweeps all other fringe and super-fringe antennas before it

* an original WARD design



flat type Uni-plane Yagi for fringe area VHF and primary signal area UHF.

*Documental testimonials in our files



WARD PRODUCTS CORP., Cleveland 15, Ohio



Dollar and Sense Servicing

by *John Markus*

Editor-in-Chief, McGraw-Hill Radio Servicing Library

CALL BOX. When Clancy goes to a call box in Baltimore for his hourly check-in with police headquarters, he hears the latest information on robberies, stolen cars, and fugitives wanted. It's all done with Magnecord tape recorders at headquarters. The dispatcher acknowledges Clancy's call, then switches him over to a recorder that's continuously repeating the latest police news.

When new information comes in, it is recorded on a second machine and then added to the tape currently in use. After a message has been on the tape for about an hour so that it has been heard by every officer on duty, it is erased. Use of two machines eliminates any silent periods while adding or removing messages.

By eliminating time-consuming human repetition of this vital information, the electronic system has permitted cutting the police switchboard staff in half. The equipment has thus paid for itself in a matter of weeks and has already saved the department over \$50,000.

For tape-recorder salesmen, this is a dream setup — assuming they can coax the headquarters' staff to go pound the beats again so the saving can be realized.



FIRE DETECTION. In place of the forest ranger high up on those steel towers that dominate mountaintops in forest country, Raytheon proposes a rotating TV camera feeding a microwave relay transmitter aimed at a distant central location where a ranger can sit in comfort in front of a battery of monitor receivers yet see the first sign of smoke or fire just as quickly as if actually up in a tower.

TV ANTIQUES. Only 1.5 per cent of the TV sets now in use were made before July 1948, according to a nationwide spot-check survey by American Research Bureau Inc. This amounts to about 400,000 sets; therefore, you can just about let your tube stock run out on those special early TV tubes which had dropped out of use by mid-'48.



PICTUROLA. In the place where the speaker ought to be in one new phonograph, you see a brightly colored kaleidoscopic pattern that changes formations in time to music. It's called the Picturola, was built to order for Liberty Music Shop in New York City, sells for \$59.95 in console cabinet with 3-speed player, and is intended chiefly as a musical novelty for children.

A small projection lamp and lens throw a beam of light through a tiny kaleidoscope onto a frosted plastic screen. A small PM-speaker movement without cone is mounted alongside the kaleidoscope and connected in parallel with the voice coil of the regular speaker. A metal strip links the dust cap of this extra voice coil to the inch-cube kaleidoscope; consequently, the cube gets gently shaken on loud passages to produce a change of pattern. On soft steady music, the pattern quivers much like the needle of an output meter without changing color or shape.

The same idea can be used in other ways, such as for giving action to a grass-skirted cardboard hula dancer atop a radio (a sure traffic stopper for your shop window if you perch her atop a table radio to which she's connected), for jiggling the arms or legs of other cardboard figures, or for putting a wiggle into a furry toy mouse atop the radio. For the last, you might put up a price card: WALTZING MICE, \$9.95 each.

GETTING ACQUAINTED. After each orchestral selection at a recent concert in huge Constitution Hall in Washington, the audience heard the same number played back on high-fidelity equipment by a magnetic tape recorder. Purpose was to acquaint music fans with high-fidelity and to acquaint high-fidelity fans with good music, according to promotion by the sponsoring sound-equipment manufacturers and local radio station WGMS. To us, a still more important result would be acquainting high-fidelity fans with high fidelity; some get so familiar with screechy, improperly equalized hi-fi systems that live music sounds distorted to them.



SWEET MUSIC. Former radio service technician Burton Minshall of London, Ontario now heads a million-dollar business because his wife wanted an organ in 1935 and he couldn't afford such things on a \$25-a-week salary. Working in spare time for three years with around \$40 worth of radio parts, he produced an electronic organ that delighted Mrs. Minshall and brought demands for more. The second was sold to a funeral parlor for \$400 and the third to another funeral parlor for \$625. From that point, the business built up to the extent that his two firms — Minshall Organ Ltd., of Canada and Minshall Organ, Inc., of Brattleboro Vt. — built some 2,500 organs priced from \$995 to \$3,000.

Your own future may likewise lie in what you do in your spare time, evenings and weekends. As a suggestion, there's still a demand and need for a really good radio type of metal detector — one that's reliable, light in weight, has wide coverage and deep penetration (or an adjustment for attaining varying degrees of each), and can be waterproofed for working under water. Transistors may be the answer.

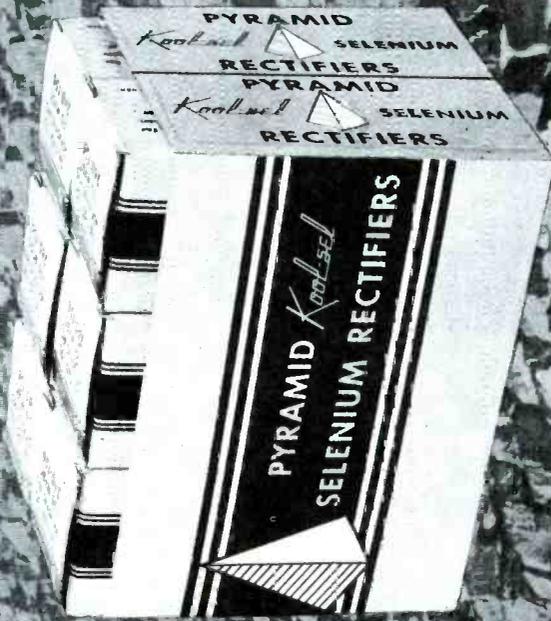
* * Please turn to page 49 * *

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A giant in black and white performance. Flat microwave type helical section composed of individual non-linear additive collectors, each tuned separately for highest gain and sharpest directivity on one high band channel.

Revolutionary new Hi-Plex folded dipole design transforms low band collector into 3 half wave length antennas that develop highest in-phase current on high band. Result: sustained high signal magnitude on all low and high band channels — plus sharp forward unidirectional response.

A giant in color performance! Possesses consistently flat gain across the spectrum, uniformly high signal to noise ratio, narrow beam width, and close 300 ohm impedance match essential for fidelity color reception.

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Inline designed for physically streamlined appearance. Maximum eye-appeal. Minimum wind resistance.

Completely preassembled. Just flip elements into place. New "Hi-Tension" aluminum brackets lock elements permanently in place. No tools. No screws.

Built for permanence — constructed of matchless aluminum by ALCOA.

300 ohm impedance for 100% signal transfer.

COMPARE THE PERFORMANCE OF THE STAR HELIX WITH ANY VHF ANTENNA YOU ARE NOW USING!

ANTENNA	CHANNELS												
	2	3	4	5	6	7	8	9	10	11	12	13	
"STAR-HELIX" SX711	4.75	5.	6.25	7.25	7.	14.5	14.	13.25	13.5	13.75	13.75	14.5	
"STAR-HELIX" SX711S	8.	8.5	9.	10.5	10.5	17.5	17.	15.75	16.	16.	16.	17.5	
"DODO" Screen Type REFLECTOR	4.75	4.5	7.2	7.1	7.	11.	11.2	11.8	11.5	11.1	12.1	12.	
"SUPER DODO" Screen Type REFLECTOR	6.3	6.8	8.8	7.8	7.5	9.5	11.2	11.8	12.	11.1	12.1	12.	
Broad Band Yagi with Phasing Stubs	4.3	5.7	4.5	7.1	9.	13.	14.	13.5	14.	13.	14.	15.	
Inline Yagi with Phasing Stubs	5.2	5.5	6.	8.	8.	11.5	9.5	10.	9.	11.	11.5	11.8	
Inline Yagi with Triple Dipole	5.25	6.25	7.	7.5	7.75	10.5	10.25	8.75	9.5	10.25	11.	11.75	
Super-Inline Yagi with Triple Dipole	6.75	7.	9.2	9.	10.	11.5	12.2	12.8	13.5	13.1	14.6	15.5	

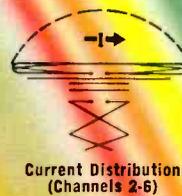
Highest Front-to-Back Ratio ever in Broad Band design

Chan.	DB	Rel. Volt.
2	17.	7:1
3	22.	12.5:1
4	21.	11.5:1
5	20.	10:1
6	20.	10:1
7	10.5	3.5:1

Chan.	DB	Rel. Volt.
8	18.	8:1
9	19.	9:1
10	25.	18:1
11	22.	12.5:1
12	25.	18:1
13	13.	4.5:1

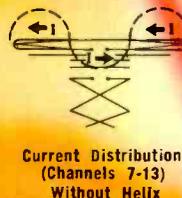
HERE'S HOW THE JFD HI-PLEX SYSTEM WORKS!

ON LOW BAND



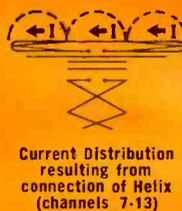
Full sized low band half wave folded dipole develops maximum in-phase current across its length on low band channels 2 to 6. Entire dipole length acts as effective capturing device because it operates totally on fundamental frequency unimpeded by additional radiating devices used in other broad band systems to raise high band gain.

ON HIGH BAND



When operating on high band frequencies, JFD Hi-Plex phasers transform each low-band collector extremity into separate high band dipoles. These electrically isolated elements function as independent collectors operating on their fundamental frequency, each developing maximum in-phase current on channels 7 to 13. Out-of-phase voltage of center section of folded dipole is minimized and isolated from other high band dipoles by blocking action of two anterior high band phasing elements.

ON BOTH LOW AND HIGH BANDS



Special phasing harness feeds channel 7 to 13 energy produced by flat plane helix into Hi-Plex collector in same phase and magnitude of other 2 high band dipoles. Result in in-phase additive operation of 3 half-wave antennas balanced for increased high band gain and unlimited signal strength on low band channels — Plus 300 ohm impedance to assure 100% energy transfer.

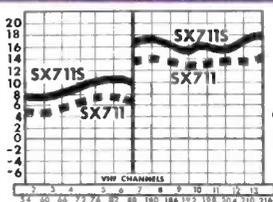
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*The S/N Figure of Merit sums up the major individual characteristics of an antenna in one concise value. Write for S/N Figure of Merit engineering folder No. 315 for complete details.

Gain Represents That Over 1/2 Wave Reference Folded Dipole

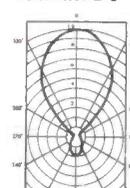
Up to 18 db on High Band*

*Tested in strict accordance with RETMA antenna measuring standards



Up to 11 db on Low Band*

Horizontal Pattern (Relative Voltage) Channel 2-6



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Color TV Training Series

(Continued from page 9)

half is a south pole. The alignment of the molecules in the ring can be seen in Fig. 9-34.

Each of the magnetic rings in the color-purity device may be rotated 360 degrees. In this manner, the unlike poles of each ring may be placed adjacent to each other so that no appreciable field exists in the space at the center of the rings. By rotating one magnet slightly, a weak magnetic field is produced. This field becomes increasingly stronger as one ring is rotated with respect to the other, and the field reaches maximum strength when the like poles of the two rings are adjacent to each other.

The drawing in Fig. 9-35 shows the magnetic field produced in the space at the center of the purity device. This field is fairly uniform and exerts an equal force on all three beams. The force is at right angles to the direction of the magnetic field.

By adjusting the strength and direction of the purity field, the beams can be caused to enter the deflection field at the proper points. Fig. 9-36 shows a beam entering at the proper point as well as at an improper point in the deflection field. Only the red beam is shown in order to simplify the drawing. When the beam enters the deflection plane at point A, it will pass through the shadow mask at the proper angle throughout the scanning process and will produce a pure red raster.

If the beam enters the deflection plane at any other point, color impurity will result. Such a condition would occur if the red beam were to enter the deflection plane at point B in Fig. 9-36. Note that the dotted line from point B to the screen enters the shadow mask at a different angle than the line from point A to the screen. This condition can be corrected by the use of the purity magnet. The field of the magnet can be aligned so that the beam will enter the deflection plane at point A. The red beam is shown to be so aligned in the drawing.

The Deflection Yoke.

As previously stated, the position of the deflection yoke is a factor in obtaining color purity. This is also illustrated in Fig. 9-36. Assume that the position of the yoke along the neck of the tube is such that the red beam is deflected at point C. The dotted line from point C to the screen indicates the angle at which the beam would pass through the shadow mask. Since this angle is incorrect, color impurity would result. An improperly posi-



Fig. 9-33. Magnetic Rings Used in the Color-Purity Device. (Sample Courtesy of RCA.)

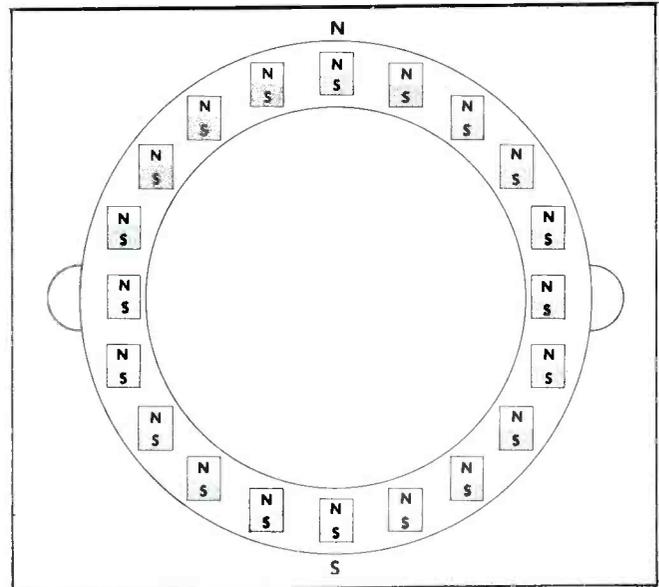


Fig. 9-34. Alignment of the Molecules in Either One of the Rings Used in the Purity Magnet.

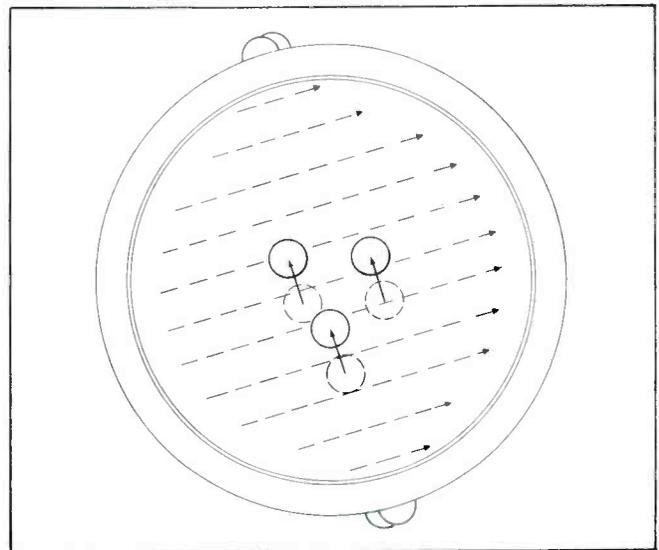


Fig. 9-35. The Field Produced by the Purity Magnet Exerts on Each Beam an Equal Force at Right Angles to the Direction of the Field.

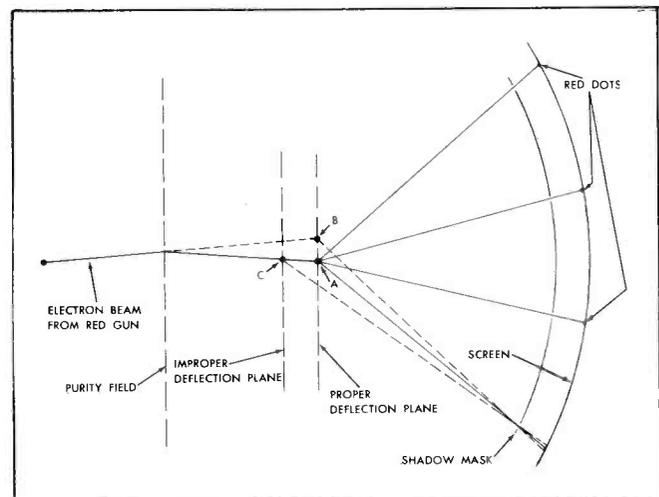


Fig. 9-36. Paths of the Red Beam As a Result of Proper and Improper Settings of the Purity Magnet and the Yoke Position.

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tioned deflection yoke will cause color impurity around the edges of the screen, since the error in the angle is greatest at those parts of the screen.

A discussion of the deflection yoke used with a three-beam picture tube was included in the data on tubes employing the electrostatic convergence principle. The yoke for a tube using magnetic convergence is different only in that special shielding techniques are required. These techniques are necessary to prevent the magnetic fields around the yoke from affecting the fields around the convergence assembly.

The photograph in Fig. 9-37 shows a yoke which employs special shields for this purpose. Note that a copper plate is placed directly behind the yoke assembly and that a ferrite ring is mounted a short distance behind the copper plate. These components prevent electrostatic and electromagnetic coupling between the yoke windings and the convergence magnets.

Field-Neutralizing Devices and Magnetic Shielding.

The earth's magnetic field and stray fields generated within the receiver can cause a severe misalignment of the three beams in the color picture tube. Unless certain precautions are taken to prevent this condition, poor image reproduction will result. For this reason, field-neutralizing components and magnetic shielding are commonly used as auxiliary devices for the three-beam tube.

The area in which the beams are most likely to be affected by stray fields extends from the plane of the deflection field to the viewing screen. A metal shield is placed around the bell of the tube to provide a path for the flux lines of these fields. The flux lines will follow the contour of the shield and are therefore prevented from extending into the beam paths.

The photograph in Fig. 9-38 shows that the cone shield does not extend beyond the welded joint between the main cone of the tube and the faceplate section. As a result, this shield does not protect the beams as they pass between the shadow mask and the viewing screen. The magnets shown around the rim of the faceplate section are used to counteract stray fields which would affect the positions of the beams in this area. In an earlier method of doing this, a field-neutralizing coil which encircled the faceplate section was employed. (The use of this device was described in Part IX of this Color TV Training Series.) Individual magnets for this application do the job better than a coil, since the strength and direction of the stray fields may not be the same at different points around the rim of the tube. Each magnet may be turned so that it neutralizes only the stray fields in its immediate area.

Another type of field-neutralizing magnet is shown in Fig. 9-39. The cylindrical magnet is polarized in a direction that is perpendicular to its axis. Several of these devices are mounted around the rim strap. Two adjustments can be made in conjunction with each magnet. One adjustment involves the movement of the magnet toward or away from the tube. The other adjustment is performed by rotation of the magnet so that the direction of its field is changed.

It was previously mentioned that beam-positioning magnets, a lateral-correction magnet, and convergence electromagnets were used to ensure beam convergence at all points on the shadow mask. The following discussion concerns these auxiliary components.

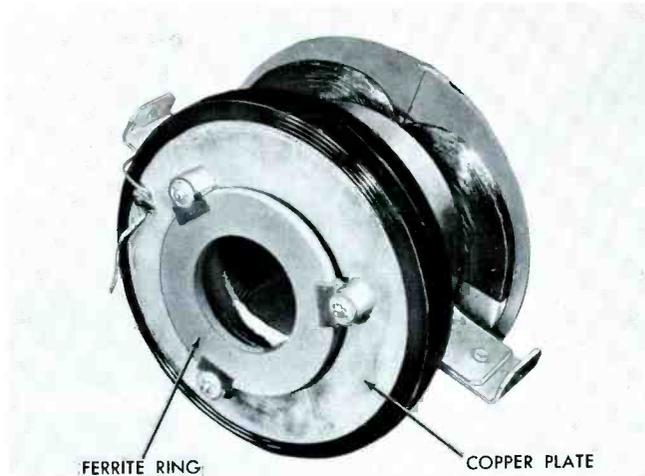


Fig. 9-37. Deflection Yoke Used With a Tube Which Employs the Principle of Magnetic Convergence. (Sample Courtesy of RCA.)

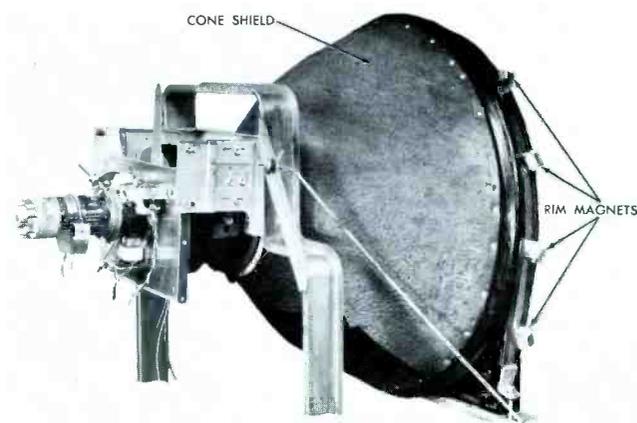


Fig. 9-38. Metal Shield and Rim Magnets Used in Motorola Model 19CT1.



Fig. 9-39. One of the Rim Magnets Used in the RCA Victor Model 21CT55.

Beam-Positioning Magnets.

The photograph in Fig. 9-40 shows the physical appearance of the beam-positioning magnets used in the Motorola Model 19CT1 color receiver. In the photograph, the magnets are spaced 120 degrees apart to correspond with the positions of the electron guns. These magnets are placed in a plane which is approximately perpendicular to the central axis of the picture tube and which intersects the three sets of pole pieces at the end of the gun assembly. The distance from any one of the magnets to the neck of the tube may be altered by loosening the thumbscrew and sliding the shaft through its mounting.

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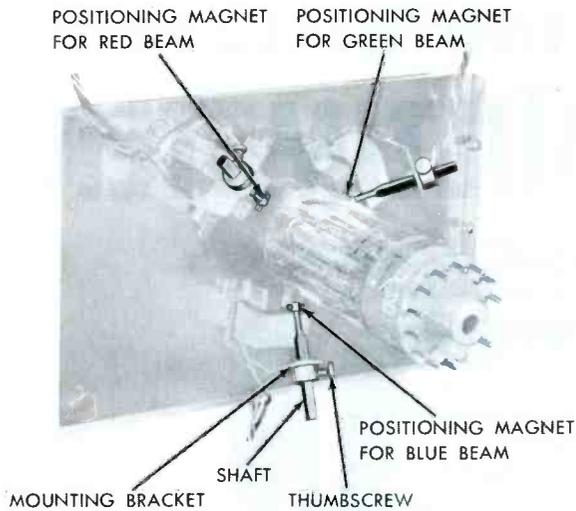


Fig. 9-40. Beam-Positioning Magnets Used in the Motorola Model 19CT1.

The drawing in Fig. 9-41 shows the three fields which are produced by the positioning magnets. The strengths of the fields produced between the pairs of pole pieces are dependent upon the settings of the magnets. The force exerted upon each beam is perpendicular to the direction of the magnetic field between the pole pieces associated with that beam. Thus, the beams are deflected in directions indicated by the solid arrows in Fig. 9-41. The amount of deflection on each beam is a function of the strength of the magnetic field between its associated pole pieces. Let us assume for the moment that the beams strike the shadow mask of a particular tube in the pattern shown in Fig. 9-42. The dots represent the centers of the beams. The arrows indicate the directions that the beams can be moved by the fields between the pole pieces. Note that any two of the three beams in this tube can be converged but that all three beams cannot be converged. This is an undesirable condition. In order to correct the error in convergence, a lateral-correction magnet is used.

The Lateral-Correction Magnet.

The lateral-correction magnet is used to provide a field which will move the blue beam in a horizontal direction. This device is placed on the neck of the picture tube so that its field intersects the special pole pieces mounted on the focus element of the blue gun. The magnetic field produced between these pole pieces and the direction of beam movement caused by this field can be seen in Fig. 9-43. Let us see how the lateral-correction device aids in obtaining convergence of all three beams.

Consider a condition in which the blue beam cannot be made to converge at the same point at which the red and green beams converge. Such a condition was described in connection with Fig. 9-42. Fig. 9-44 shows the points at which the beams can be made to strike the shadow mask by means of the positioning magnets. The dotted arrow shows the direction in which the blue beam can be moved through the use of the lateral-correction magnet. Note that a movement of the blue beam in a lateral direction will cause all three beams to be converged.

Two different types of lateral-correction devices are shown in Fig. 9-45. Both of these components will produce the same effect; therefore, either type may be used to obtain the desired result. The magnet in the device labeled A in Fig. 9-45 is contained in a circular plastic piece which can be revolved 360 degrees; thus, a means is provided for varying the strength and revers -

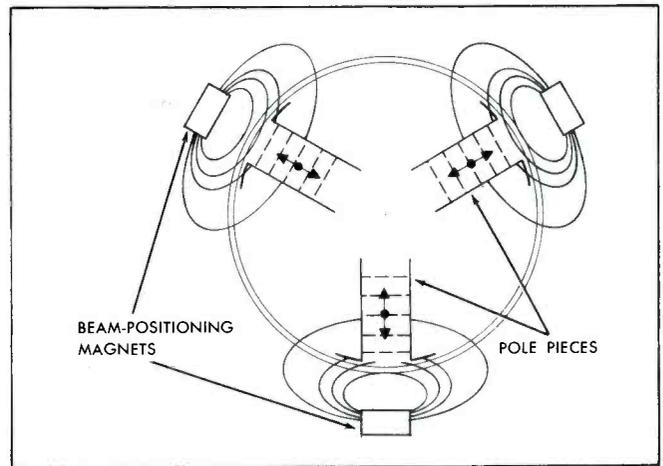


Fig. 9-41. Possible Directions of the Force Exerted Upon Each Beam by the Field of Its Associated Positioning Magnet.

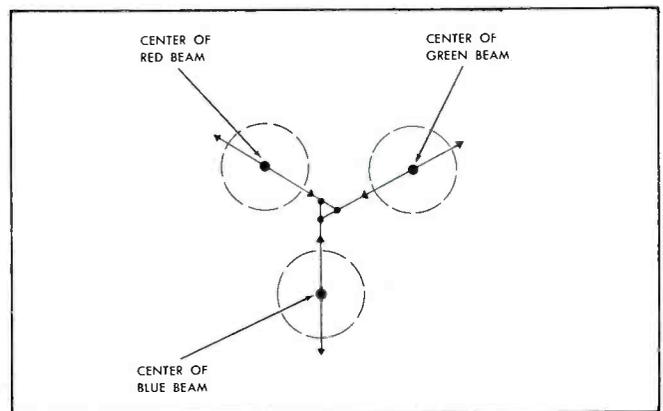


Fig. 9-42. Beams on the Shadow Mask and Possible Directions They Can Be Moved by Means of the Positioning Magnets.

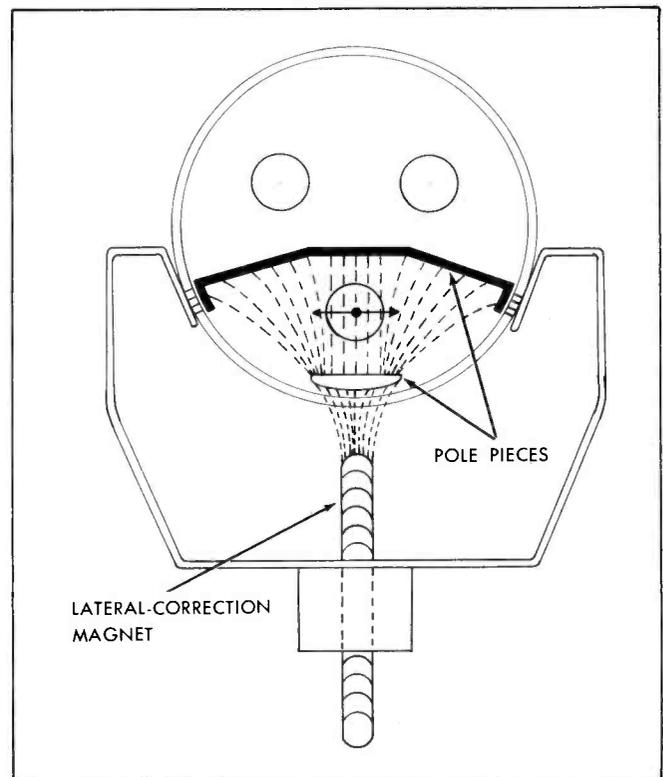


Fig. 9-43. The Field of the Lateral-Correction Magnet Deflects the Blue Beam in a Horizontal Direction.

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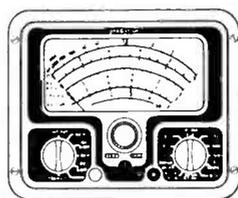
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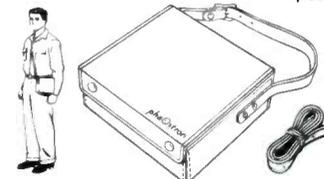


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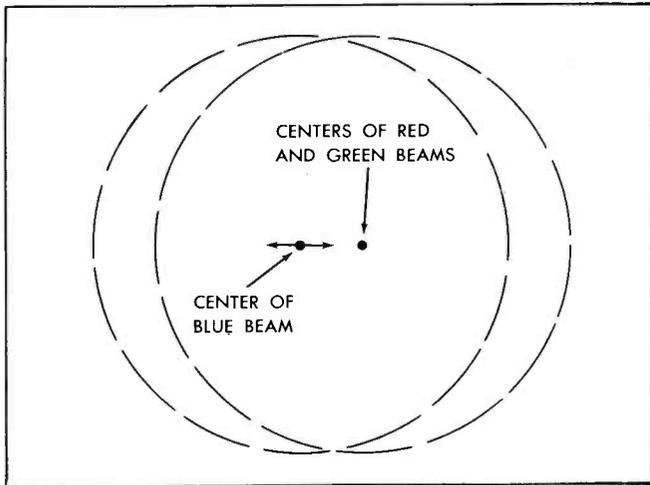


Fig. 9-44. Beams on the Shadow Mask and Possible Directions the Blue Beam Can Be Moved by Means of the Lateral-Correction Magnet.

ing the direction of the magnetic field. The magnet used in the device labeled B is threaded over its entire length so that the distance between the magnet and the neck of the tube may be varied as needed. If a reverse field is required, the magnet can be reversed in the assembly.

Dynamic-Convergence Electromagnets.

It has been pointed out that the distance the beams must travel from the plane of deflection to the shadow mask is greater at the edges than at the center of the screen. The convergence force must be varied during the scanning process if the beams are to converge at all points on the shadow mask. On the type of tube under discussion, an assembly of electromagnets is used to supply the dynamic convergence force. This assembly is positioned on the neck of the tube so that the field from each one of the electromagnets is coupled to the pair of pole pieces at the end of each electron gun.

As shown in Fig. 9-46, the forces exerted upon the beams are radial with respect to the axis of the tube. It may be recalled that this description also applies to the forces produced by the beam-positioning magnets; therefore, it can be said that the fields produced by the electromagnets aid or oppose the fields produced by the positioning magnets. Dynamic voltages at the horizontal and vertical-scanning frequencies are applied to each of the electromagnets. As a result, the field produced by a positioning magnet and the field produced by the associated electromagnet will aid each other when current through the electromagnet flows in one direction and will oppose each other when the current flow is reversed. This being the case, the beams can be independently di-



Fig. 9-45. Lateral-Correction Devices Used in (A) RCA Victor Model 21CT55 and (B) Motorola Model 19CT1.

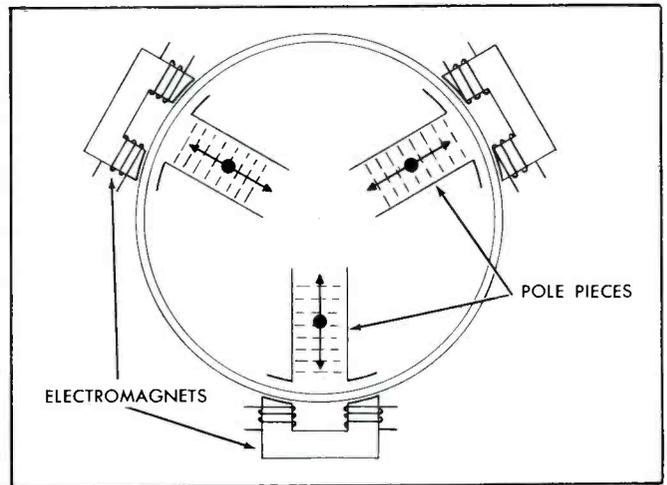


Fig. 9-46. Possible Directions of the Force Exerted Upon Each Beam by the Field of Its Associated Electromagnet.

rected so that they converge on the shadow mask at all times during the scanning process. Although earlier versions of color picture tubes employed a single element to provide dynamic convergence of all three beams simultaneously, it was found that a tube on which individual convergence adjustments could be made for each beam provided better over-all convergence. The tube under discussion is such a tube.

Again referring to Fig. 9-46, the reader will note that the electromagnets have horseshoe-shaped cores. These cores are constructed so that they can be aligned with the pole pieces in the tube. Two separate windings are found on each core. It is to these windings that the dynamic convergence voltages are applied. The nature of these voltages and their derivation will be discussed later in this section.

The photograph in Fig. 9-47 shows the electromagnets and their method of mounting in the Motorola Model 19CT1. This arrangement is typical in receivers which employ this type of picture tube.

DYNAMIC-CONVERGENCE CIRCUITS

Motorola Model 19CT1.

A schematic diagram of the dynamic-convergence circuits used in the Motorola Model 19CT1 color receiver

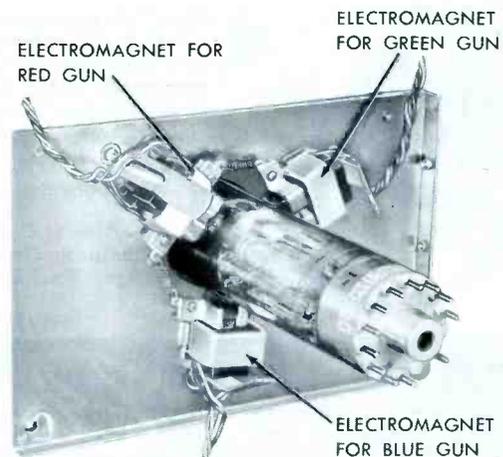


Fig. 9-47. Dynamic-Convergence Electromagnets Used in the Motorola Model 19CT1.

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is shown in Fig. 9-48. The coils in the assembly of electromagnets are designated as T10, T11, and T12. The diagram shows that a convergence coil and a tilt coil are used with each electromagnet. Generally speaking, it can be said that the field produced by the convergence coil on the electromagnet determines the maximum amount of dynamic-convergence correction obtained. The field produced by the tilt coil determines the time during vertical scanning when maximum correction is obtained. The term "tilt" is used because the action of the tilt coil produces an effect which makes a vertical row of colored dots slant to the right or left on a picture-tube screen as the amplitude of the voltage applied to the tilt coil is varied.

Let us first consider the action of the circuits with respect to the convergence coils. The horizontal-phase coil and the .01-mfd capacitor associated with each of the convergence coils form resonant circuits at the horizontal-oscillator frequency. A sine wave at the horizontal-scanning rate is developed across each of these resonant circuits by a pulse from a winding on the horizontal-output transformer. The convergence-coil circuits which are effective at the horizontal frequency are shown in Fig. 9-49. The .047-mfd capacitors and the vertical-amplitude controls in Fig. 9-48 have been eliminated in Fig. 9-49 because the reactances of the capacitors are negligible at the horizontal frequency.

The sine wave at the horizontal frequency is applied to each of the convergence coils through the horizontal-amplitude controls. Each control provides the means for changing the voltage across its associated convergence coil so that the strength of the field at the horizontal frequency around the convergence coil may be varied as needed. The core in each of the phase coils can be adjusted to shape the current waveform as required to obtain the best convergence in the horizontal plane.

Further examination of the circuit drawing in Fig. 9-48 will show that the saw-tooth current from the vertical-output stage passes through the three vertical-phase controls and through the 2-henry choke L56 to a B+ point at the junction of R148 and C3D. This saw-tooth current causes a parabolic voltage at the vertical-oscillator frequency to be developed across the parallel circuit formed by C14A and L56. This voltage is coupled to the convergence coils through C14B, the horizontal-phase coils, and the vertical-amplitude controls.

The equivalent convergence-coil circuit at the vertical frequency is shown in Fig. 9-50. The 100-mfd capacitor C14B and the horizontal-phase coils are not shown because the reactances of these components are negligible at 60 cycles. A parabolic voltage at the vertical-oscillator frequency is applied to each of the convergence coils through its respective amplitude control. Each control provides the means for changing the voltage at the vertical frequency across its associated coil so that the strength of the field around each coil may be varied as needed.

A saw-tooth voltage is developed across each of the vertical-phase controls as a result of the current from the plate of the vertical-output stage. The drawing in Fig. 9-50 shows that the center tap and rotor arm of each control are connected to opposite ends of an associated tilt coil. The amplitude and polarity of the saw-tooth voltage which is applied across any one of the tilt coils depend upon the relative position of the rotor arm on the associated phase control with respect to the center tap on that control.

Since the convergence and tilt coils are wound on the same core, the fields generated by these coils are

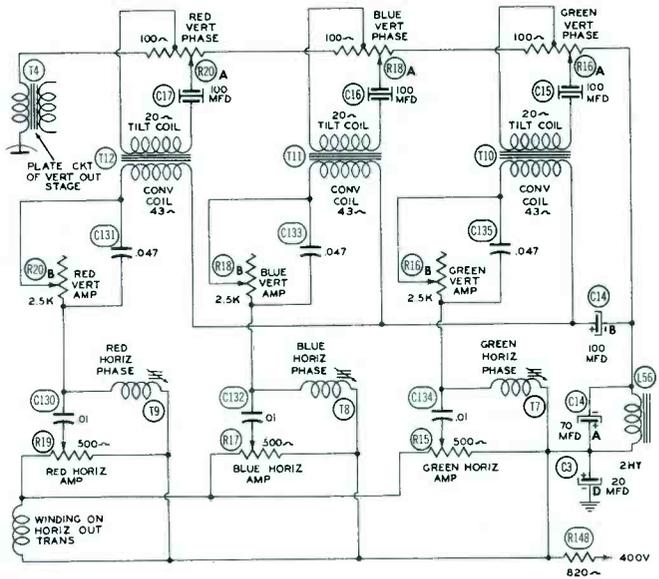


Fig. 9-48. Dynamic-Convergence Circuits Used in the Motorola Model 19CT1.

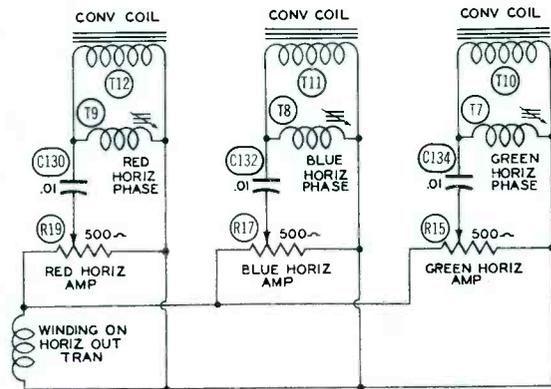


Fig. 9-49. Simplified Schematic of the Dynamic-Convergence Circuit at the Horizontal Frequency. (Motorola Model 19CT1.)

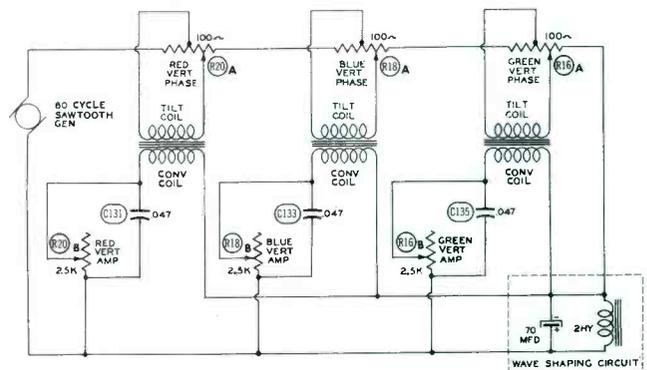


Fig. 9-50. Simplified Schematic of the Dynamic-Convergence Circuit at the Vertical Frequency. (Motorola Model 19CT1.)

combined and produce a resultant field. In order to obtain the best convergence in the vertical plane, the vertical-amplitude and vertical-phase controls can be adjusted as needed to control this resultant field.

Before analyzing the current waveforms in the convergence and tilt coils, let us investigate the circuitry of another color receiver which uses electromagnetic convergence.

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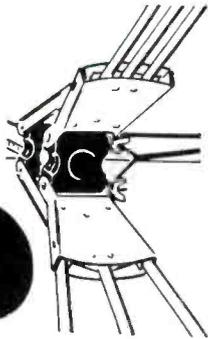


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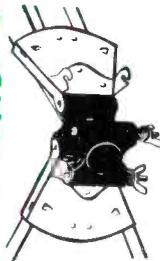
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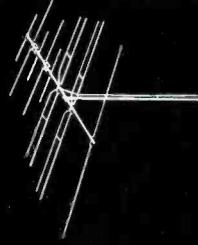
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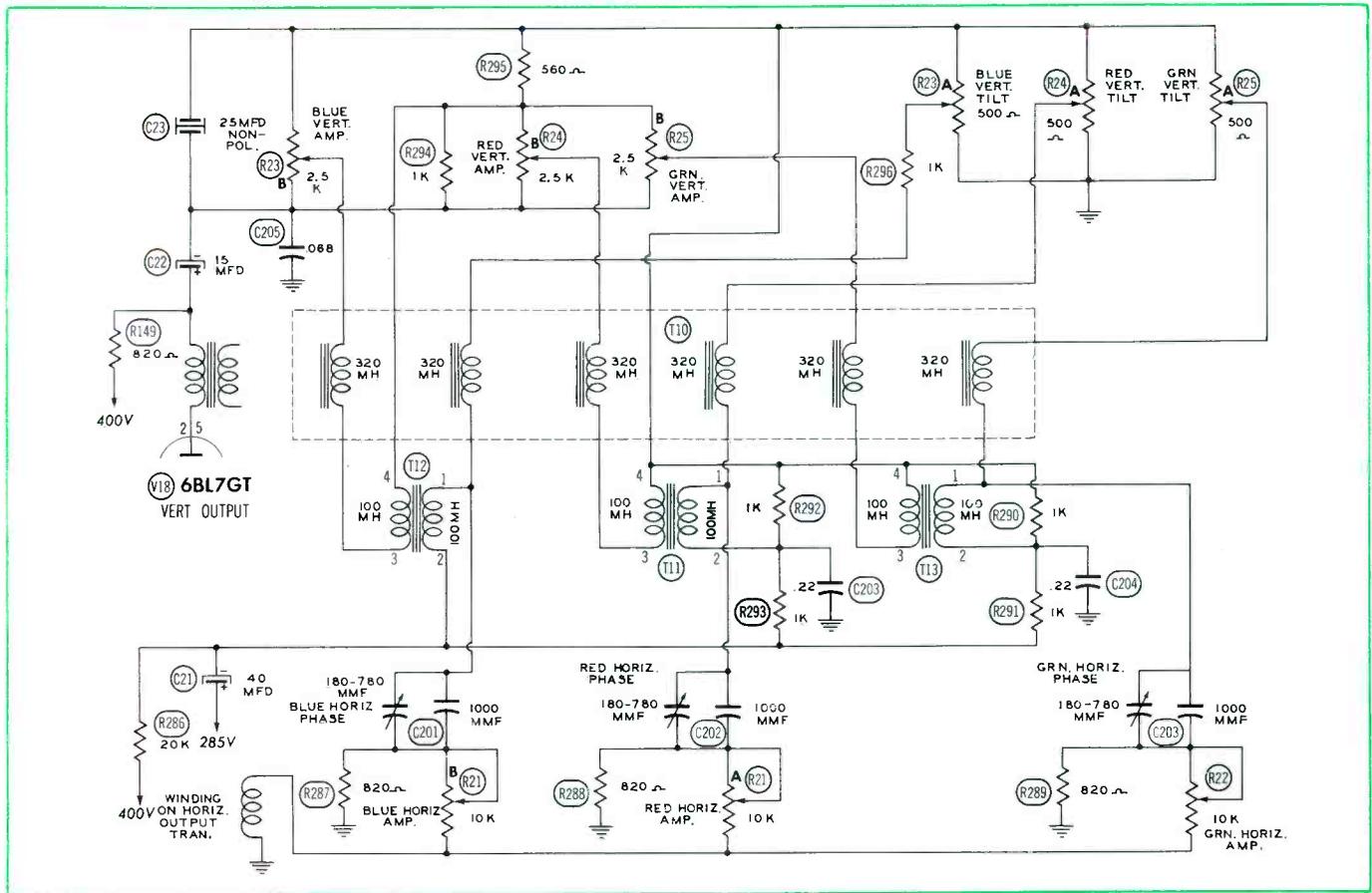


Fig. 9-51. Dynamic-Convergence Circuits Used in the RCA Victor Model 21CT55.

RCA Victor Model 21CT55.

The schematic diagram in Fig. 9-51 shows the dynamic-convergence circuits used in the RCA Victor Model 21CT55 color receiver. As in the circuit just discussed, two coils are used with each of the three electromagnets T11, T12, and T13. According to the schematic one might conclude that each pair of coils is connected to provide transformer action by which coupling is provided from one winding to another; but in the case of convergence electromagnets, energy is applied to both coils in order to produce a resultant field. The two coils are wound around adjoining sections of a ferrite core. As shown in Fig. 9-52, a horseshoe-shaped core is formed by the two sections. Since the core is common to both coils, the fields of the two coils will be combined.

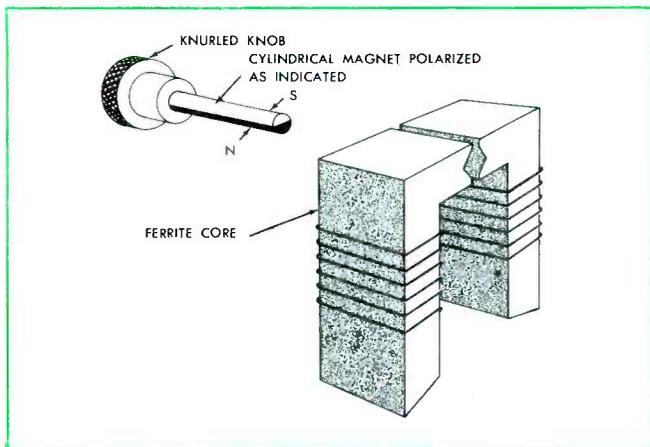


Fig. 9-52. Parts of an Electromagnet Used in the RCA Victor Model 21CT55.

Fig. 9-52 also shows that the beam-positioning magnets used in this receiver are cylindrical in shape and are mounted in the groove between the two sections of the ferrite core. Each magnet is polarized as indicated in the drawing and produces a static field within its associated electromagnet. The magnet may be rotated so that a static field of either polarity and of the desired strength will be produced.

In order to understand clearly the operation of the dynamic-convergence circuits in this receiver, let us use a simplified schematic for each individual circuit.

The simplified schematic in Fig. 9-53 shows the dynamic-convergence circuit which is effective at the horizontal frequency. The operation of this circuit is almost identical to the one used in the Motorola receiver. The main difference between the two is that in this circuit, trimmer capacitors are used to vary the phase of the sinusoidal voltages; whereas, in the other circuit, variable inductances are used for this purpose.

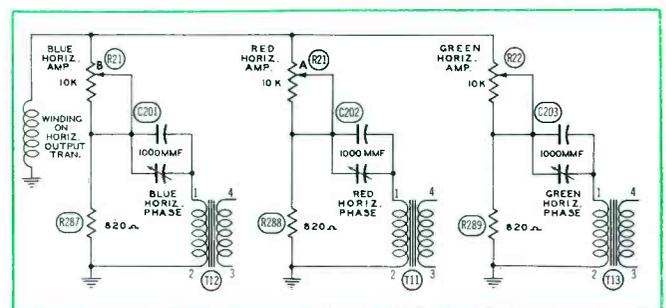
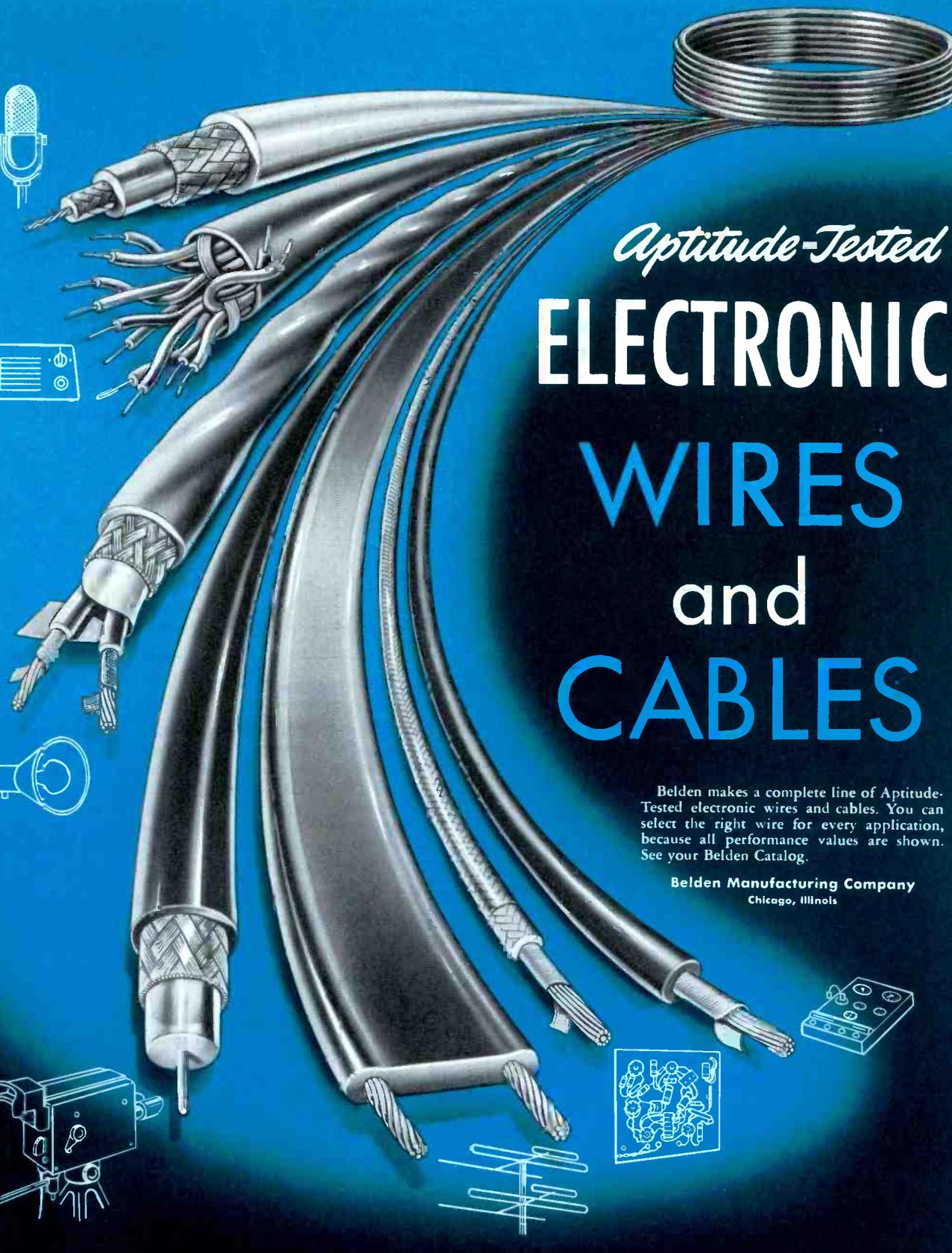


Fig. 9-53. Simplified Schematic of the Dynamic-Convergence Circuit at the Horizontal Frequency. (RCA Victor Model 21CT55.)



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Fig. 9-54 is a simplified schematic which shows the source for the dynamic convergence voltage at the vertical frequency. R1 represents the total resistance of the network (in Fig. 9-51) composed of R294, R295, and the three vertical-amplitude controls. R2 in Fig. 9-54 represents the total resistance of the three tilt controls shown in Fig. 9-51. A saw-tooth waveform of current flows from the vertical-output stage through the primary winding of the output transformer; however, the current waveform through R149 is parabolic because of the bypassing action of the parallel RC network composed of C22, R1, C23, and R2. See waveform W1 which represents the voltage waveform across R149.

The 15-mfd capacitor C22 blocks the DC component of waveform W1 and aids in shaping the voltage waveform across the remainder of the network. The voltage across the RC network formed by R1, R2, and C23 is shown by waveform W2. These components comprise a voltage-divider network. Capacitor C23 presents a low impedance to the high frequencies represented by the sharp voltage rise, but it presents considerable impedance to the low frequencies represented by the parabolic curve. The result is that the parabolic voltage shown by waveform W3 appears across R1 (which represents the vertical-amplitude controls in Fig. 9-51). The saw-tooth waveform of voltage shown by W4 appears across R2 (which represents the vertical-tilt controls in Fig. 9-51).

The simplified schematic in Fig. 9-55 represents only that portion of the circuit which supplies the vertical parabolic voltage to the convergence coil associated with the blue gun. R3 represents the total resistance afforded by the red- and green-amplitude controls and the 1K-ohm resistor R294 in Fig. 9-51. Keep in mind that the voltage waveform across C23 is W3 in Fig. 9-54. The amplitudes of the parabolic voltages developed across R295 and R3 in Fig. 9-55 are approximately the same, because the voltage division is approximately one to one.

When the rotor arm of the blue-amplitude control R23B is moved to a point somewhere near the center of the control, no voltage will be applied across the coil. Thus, no current will flow through the coil and no magnetic field will be produced. When the rotor arm of R23B is moved to the upper end of the control, the coil will be connected across R3. When the rotor arm of R23B is moved to the lower end of the control, the coil will be connected across R295. In the first case, point 4 of the coil will be connected to the lower side of R3; and in the second case, this point will be connected to the upper side of R295. The polarity of the voltage applied to the coil can be reversed by moving the arm of the control from one side of center to the other. The amplitude of the applied voltage will increase as the arm of R23B is moved farther from the center of the control.

The simplified schematic in Fig. 9-56 represents only that portion of the circuit which supplies the vertical parabolic voltage to the convergence coil associated with the red gun. R4 represents the combined resistance of the green-amplitude control and the 1K-ohm resistor R294 in Fig. 9-51. When the rotor arm of R24B in Fig. 9-56 is moved to the lower end of the control, the voltage drop across the coil will be at a minimum. Very little current will flow through the coil, and a weak magnetic field will be produced. As the rotor arm is moved toward the upper end of the control, the voltage applied to the coil will increase; consequently, the current flow through the coil and the strength of the electromagnetic field around the coil will increase. The field strength will be at its maximum when the rotor arm reaches the upper end of the control.

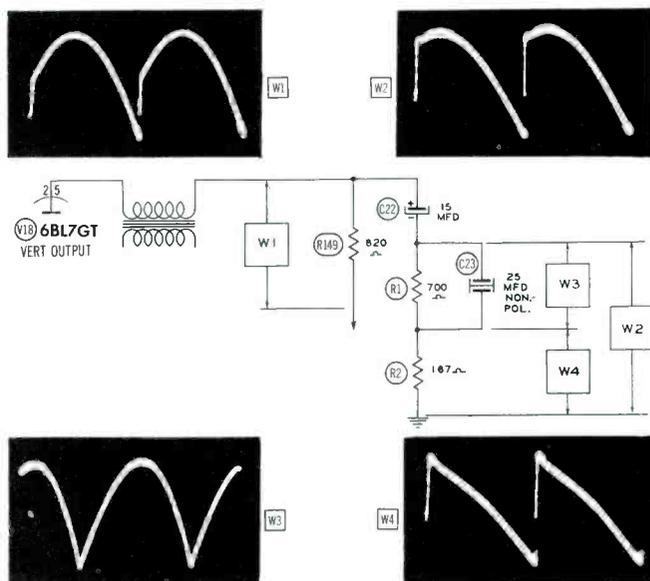


Fig. 9-54. Simplified Schematic of the Dynamic-Convergence Circuit at the Vertical Frequency. (RCA Victor Model 21CT55.)

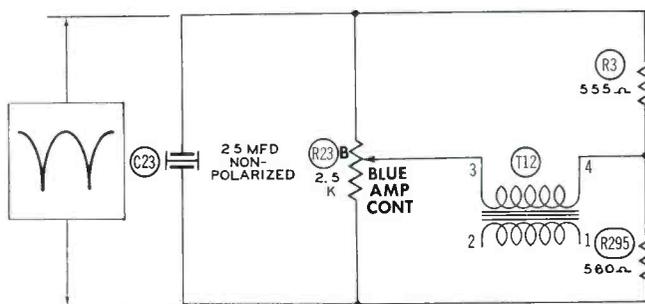


Fig. 9-55. Simplified Schematic of the Circuit Which Supplies the Voltage to the Convergence Coil for the Blue Gun. (RCA Victor Model 21CT55.)

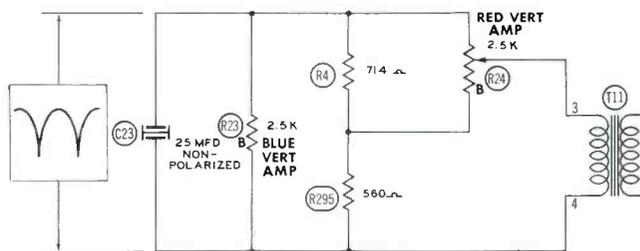
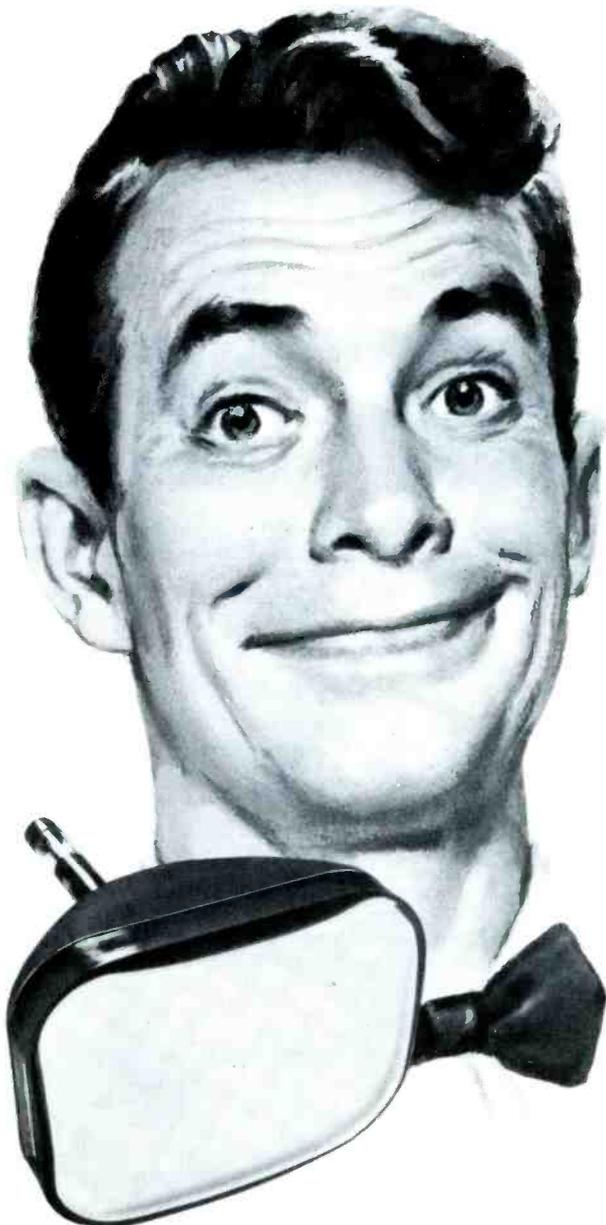


Fig. 9-56. Simplified Schematic of the Circuit Which Supplies the Voltage to the Convergence Coil for the Red Gun. (RCA Victor Model 21CT55.)

The operation of the circuit which supplies the vertical parabolic voltage to the convergence coil associated with the green gun is the same as the operation of the circuit shown in Fig. 9-56. It is interesting to note that the polarity of the parabolic voltages applied to the red- and green-convergence coils cannot be reversed in the same manner that the parabolic voltage applied to the blue-convergence coil can be reversed.

The circuits which supply the saw-tooth voltages to the electromagnets are shown in the simplified schematic diagrams in Fig. 9-57. Schematic A represents the blue-tilt circuit, and schematic B represents the red-tilt circuit. The coil shown in each of these circuits is the tilt coil and should not be confused with the convergence

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coils shown in the previous simplified circuits. The input signal is that shown as waveform W4 in Fig. 9-54. Note that direct current flows through each of the coils in Fig. 9-57 from point 1 to point 2. This current flow results from the fact that each coil is connected across the power supply through a voltage-divider network. Direct current through the coils was provided in order to compensate for any slight misconvergence caused by variations in the line voltage. The green-tilt circuit is not shown in simplified form because it is identical to the red-tilt circuit.

The polarity of the saw-tooth voltage applied to the blue-tilt coil cannot be reversed; whereas, a saw-tooth voltage of either polarity may be applied to the other two tilt coils.

Summarizing the discussions that concern the circuits which supply the dynamic voltages at the vertical frequency, we can state that the voltage applied to the blue-tilt coil cannot be reversed in polarity but that the voltage applied to the blue-convergence coil can be reversed in polarity. In addition, we can state that the voltages applied to the red- and green-tilt coils can be reversed in polarity but that the voltages applied to the red- and green-convergence coils cannot be.

Now let us consider the function of a few components which are used in the circuit shown in Fig. 9-51 but which were not included in the simplified drawings. Refer back to Fig. 9-51, and note that T10 is comprised of six 320-millihenry chokes. The reactance of each choke is about 120 ohms at the vertical frequency and about 31.5K ohms at the horizontal frequency. As a result, the chokes can be considered as short circuits to the parabolic and saw-tooth voltages; however, these chokes present a considerable impedance to the sinusoidal voltages at the horizontal frequency and prevent these voltages from appearing across the vertical amplitude and tilt controls. The .068-mfd capacitor C205 in Fig. 9-51 presents a high impedance at the vertical frequency and a very low impedance at the horizontal frequency. That portion of the horizontal-frequency voltage which appears across the convergence coils because of transformer action will be bypassed to ground. This prevents a voltage at the horizontal fre-

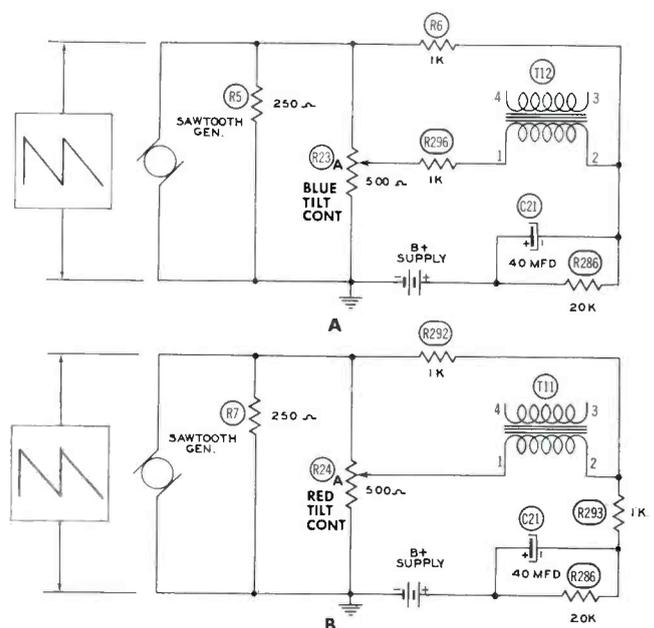


Fig. 9-57. Simplified Schematics of the Circuits Which Supply the Voltages to the Tilt Coils (A) for the Blue Gun; (B) for the Red Gun. (RCA Victor Model 21CT55.)

quency from appearing in the circuits which supply the parabolic and saw-tooth voltages at the vertical frequency. The .22-mfd capacitors C203 and C204 which are connected respectively at terminal 2 of T11 and at terminal 2 of T13 provide bypasses to ground at the horizontal frequency. C21 provides a bypass at this frequency from terminal 2 of T12 to a B+ source.

Currents in the Convergence and Tilt Coils.

At this point in the discussion of convergence circuits, let us consider the nature of the currents through the coils of each of the electromagnets. In both the RCA Victor Model 21CT55 and the Motorola Model 19CT1 receivers, a parabolic voltage at the vertical frequency is applied to one coil of each electromagnet, and a saw-tooth voltage at the same frequency is applied to the other coil. A sinusoidal voltage at the horizontal frequency is also applied across one of these coils. The parabolic voltage produces a parabolic current, the saw-tooth voltage produces a modified saw-tooth current, and the sinusoidal voltage produces a sinusoidal current.

It has been mentioned that the magnetic fields of the two coils used with each electromagnet will be combined because the coils have a common core. The resultant field of any one electromagnet is approximately the same as that which would be produced if the three voltages were combined and then applied across a single coil. If the waveforms of the parabolic and saw-tooth currents are plotted graphically, the algebraic sum of their values can be plotted to show the variation in the field strength during a vertical-scanning period. Then when the field produced by the sinusoidal current at the horizontal frequency is considered, it can be said that the vertical field is modulated by a sine wave at the horizontal frequency.

The waveforms of the parabolic and saw-tooth currents through the coils of the electromagnets and the resultant fields are shown in the drawings of Fig. 9-58. The circuits for all three electromagnets used in the Motorola Model 19CT1 receiver are identical, and only parts A and B of this figure are needed to illustrate the currents and resultant fields associated with this receiver. Parts A and B also illustrate the currents and fields which are associated with the electromagnets used with the red and green guns in the RCA Victor Model 21CT55 receiver. Parts C and D of the same figure pertain only to the currents and resultant fields for the elec-

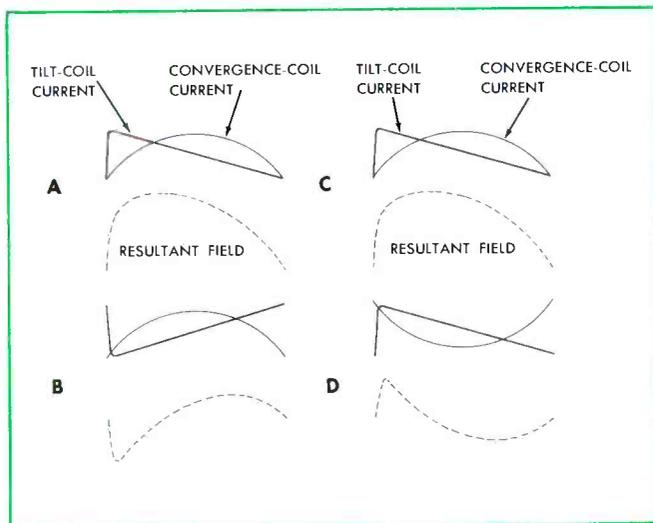


Fig. 9-58. Current Waveforms Through the Two Coils of an Electromagnet and the Resultant Fields Produced.

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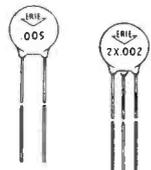
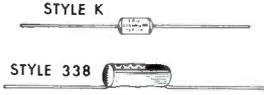
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tromagnet used with the blue gun in the RCA Victor Model 21CT55.

The resultant fields shown in parts A and B of Fig. 9-58 represent the possible extremes obtainable through adjustment of the tilt control, with the amplitude control set for maximum current in both cases. The tilt-coil current represented in part A is obtained with the tilt control set at one end of its rotation, and the tilt-coil current represented in part B is obtained with the tilt control set at the opposite end of its rotation. Note the difference in the shapes of the waveforms of the two resultant fields.

The difference in the waveforms of the resultant fields shown in parts C and D are obtainable by setting the amplitude control for maximum current and by setting the tilt control first at one extreme of its rotation and then at the other.

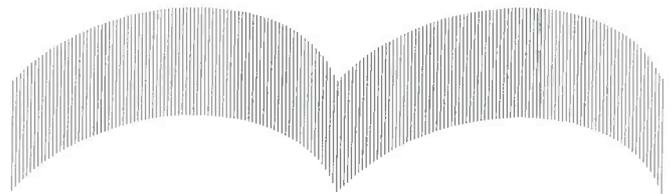


Fig. 9-59. The Strength of the Magnetic Convergence Field Varies at Both the Vertical and Horizontal Frequencies.

An infinite number of variations of waveforms of the resultant fields could be plotted, because the amplitudes of the currents through the convergence coil and tilt coil can be reduced individually or together. If the amplitude of the current of the convergence coil is reduced, the curvature of the waveform which represents the resultant field will decrease. As the amplitude of the current of the tilt coil is reduced, the waveform which represents the resultant field will approach the symmetry of the waveform of the convergence-coil current. These factors provide an infinite number of variations in the phase and amplitude of the vertical-convergence force applied to each of the electron beams.

When the dynamic voltages at both the horizontal and vertical frequencies are applied across the coils of each electromagnet, it may be stated that the dynamic-convergence field developed at the vertical rate will be modulated by the field developed at the horizontal rate. Fig. 9-59 shows a waveform which follows the variations of the strength of such an electromagnetic field over an interval of two vertical-scanning periods. By individually adjusting the controls which determine the amplitude and phase of each voltage applied to the coils of each electromagnet, the rasters of the three electron beams can be made to coincide on the shadow mask of the picture tube.

The next part of the Color TV Training Series will present the setup procedure for a receiver which uses a color picture tube of the electrostatic type.

In order to give the reader an opportunity to test himself on the material in this issue, we are including on the insert a few questions that are answered in this discussion.

C. P. OLIPHANT

and

VERNE M. RAY

Dollar and Sense Servicing

(Continued from page 31)

GUMPTION. Here's an old-fashioned word meaning what you have to have to get somewhere in life. The man who stands still or slips backward doesn't have it; however, without "gumption" he may well be a lot happier and healthier than those who're pushing their career like a wheelbarrow.

As we grow older and notice more closely the "big shots" who baby their ulcers with a milk diet, who land in the hospital with a nervous breakdown, or who just simply drop dead at their desk from an overworked heart, common sense begins to look much more desirable than gumption. Call it slipping or call it laziness if you will, but what good is gumption to you and your family when you're six feet under?



ELECTROFORMED WIRE. The wire that runs from the street telephone line to your house has two requirements - enough steel to hold when branches fall on it and enough copper to give the required conductivity. Western Electric formerly had to use copper-clad steel wire in which the copper was rolled around the steel by an intricate mechanical process. Now it has its own plant for putting the copper on the steel by plating, sometimes called electroforming. Some 25 wires at a time run through block-long plating baths, with electronic controls measuring the conductivity of each wire in turn and changing plating speed accordingly so that each wire gets the essential amount of copper.

In wartime, the same wire can be used for telephone lines strung over treetops by airplane or helicopter, to maintain jam proof and secret communication with advancing troops. Development of the electroforming process gives the needed second source of supply for this essential military requirement of strong conductive wire, so that if one plant is knocked out there'll still be wire for war.

Publication of details on how these new production techniques work means we can set up new plants quickly anywhere, no matter what an enemy does. That's why we get such a feeling of pride in our country and security in our future when going through little-known plants having terrific military value.

TRAPS. Practically all picture-tube manufacturers have gone to aluminized tubes now. Automatic equipment puts a layer of aluminum only a few molecules thick on the screen inside the tube.

The first aluminized coatings were heavy enough to stop ions, making ion traps unnecessary; with electronically controlled thin coatings currently being produced, ion traps are back again in many sets for added insurance against ion trouble.



PROP. When you're the boss of your own business, in effect you're president of the company. Traditionally, though, this title is used only for large businesses, chiefly those that are incorporated. The title of proprietor, abbreviated Prop., or Propr., has been widely used on business cards and in advertising to indicate who's head of a servicing business; but somehow this title sounds antiquated. How about just putting Owner after your name?



TRANSISTOR RADIO. The little Regency radio, first all-transistor design to hit the market in volume, is selling fine at \$49.95 list price at Liberty Music Shop in New York City, with no discounts given. People are amazed at its performance in the shop and even more so when they get it home in quieter surroundings where its tone quality can be appreciated.

Service manager Norman Platner at this shop says there've been very few troubles with these little sets. Practically 100 per cent of them work on arrival, and the occasional troublemaker has invariably had only a rosin joint due to trouble in dip-soldering. If the bad joint can't readily be localized, a quick dab at each joint with a small hot soldering iron will clear up the trouble.

It's hard to realize that bad joints can occur when all are soldered at once by dunking the chassis in liquid flux first, then in molten solder. Apparently some component leads acquire a grease or oxide film that doesn't come off in the flux. Be assured that all manufacturers are working on this dip-soldering problem. In the meantime, condition yourself to suspect joints first when a dip-soldered set acts up. Leave the transistors alone; they're the least likely to be the cause of trouble.

INCOME TAX. For real help in preparing your Federal income tax return, see pages 75 to 107 of "Successful Service Management," a book that is available from GE tube distributors. Among other things, this tells how to make out your deductions from your gross income in order to get credit if part of your residence is used for such business as keeping the books, handling correspondence, and handling business phone calls. Automobile expenses are also deductible to whatever extent the car is used for business, and the book gives detailed instructions for keeping the necessary logs and records to substantiate your claims if challenged.

An example is given for a five-room house in which one room is used for business; therefore, 20 per cent of the residence expense is deductible. The telephone is estimated to be used 50 per cent for business, and the automobile is estimated at 25 per cent for business. In this particular case then, the permissible deductions for adjusted gross income to report on your Federal tax return are:

	Total Cost	Business Deduction
Depreciation on house	\$250.00	\$ 50.00
Repairs to house	500.00	100.00
Interest on mortgage	450.00	90.00
Real estate taxes	400.00	80.00
Light and heat	200.00	40.00
Telephone	96.00	48.00
Auto depreciation cost $\left[\begin{array}{l} \$2,000 \\ 5 \text{ yrs.} \end{array} \right]$	400.00	100.00
Auto repairs, gas, oil	325.00	81.25
State gasoline taxes	8.00	2.00
Driver's license	5.00	<u>1.25</u>
Total		\$592.50

The book cautions that these percentage figures should not be used in your own return just because they are given in this example and gives specific instructions for figuring out your own values and percentages.

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TAPE RECORDERS. Year-end estimate by Electrical Merchandising magazine says 470,000 magnetic tape recorders were sold in 1954, as compared to 275,000 in 1953. They say three factors kept the sales from going still higher:

1. Production slowdowns due to lack of needed special components such as recording heads.

2. Failure of many recorder manufacturers to achieve mass distribution of their models.

3. Lack of merchandising. Too few dealers try as hard to sell recorders as they do other merchandise, and most of the manufacturers give their dealers little sales help other than through national advertising.

As a venture into a new branch of selling, service organizations might well consider taking on a good line of magnetic recorders and using service technicians to give on-the-spot demonstrations right in homes during service calls. Just plug in the machine loaded with the latest pre-recorded reel of taped background music, and let it run while working on the TV set. Even just one sale a week may put a decided boost in a service technician's take-home pay and in shop income.



FAR-SEEING EYES. Here are two interesting new uses for industrial television systems. On the West Virginia Turnpike, cameras are mounted on the ceiling of a tunnel to replace the guards formerly stationed at intervals in the tunnel to detect traffic jams. And out West, a parking lot operator mounted a camera high atop a post and put the monitor receiver in his shack to show at all times where the empty spaces were, if any, on the lot.



TRENDS OF THE TIMES. Console radios are fast vanishing these days, with universal AC-DC table-model radios taking over. Straight AC receivers with power transformers are also pretty much a thing of the past, along with tuning indicators and push-button tuning. Bets are still being taken on the battle between loop antennas and ferrite sticks for radios. But all bets are off on the TV-radio battle; it's evident to all now that these two will live happily together for many years to come.

UNDERWATER TV. The new United States supercarrier "Forrestal" will have underwater TV cameras designed to swing over the side to inspect the hull for battle damage. The new high-sensitivity camera tubes are even better than frogmen in the murky depths, because the cameras can see more than human eyes and bring the picture right up to the experts who must make the decisions in connection with the damage.

Another innovation on this carrier is a system of fixed cameras on the flight deck and at other key stations, with monitoring screens in below-deck control centers. This can well mean that the Navy will be looking for TV service technicians soon.



DISGUISE. A complete hearing aid concealed inside the frame of horn-rimmed glasses has been announced as ready for the market early this year, and it will sell at about \$265 plus the cost of the lenses. The three transistors used, each about the size of a match head, are made by CBS-Hytron especially for hearing aids. The battery is about the size of a dime, and all other parts are proportionally subminiature in size to fit inside the hollow earpieces. Manufacturer is Otarion Inc., Dobbs Ferry, New York.



FLUORESCENTS. For just about fifty bucks today, you can get a bench light that will serve every corner of a ten-foot bench, will ease eye strain, and will give the entire shop a new and modern look. Just order a plain white-enamel 8-foot fixture holding four 8-foot instant-starting fluorescent lights, and put it up against the ceiling right over the bench. It's worth every cent of the price.

Modern fluorescents radiate very little interference, but we know one service technician who prefers the noisy older fluorescents as an aid to high-speed servicing. He uses his as a handy noise generator for providing an indication of receiver sensitivity and AVC action. At the high end of the broadcast band, the noise can be used for peaking the high-frequency trimmers. At the low end of the band, a finger touching the stator of the antenna tuning section will furnish noise to indicate a dead oscillator.

CHOICE. Is it better to be a well man with a sick business — or a sick man with a well business?

All too often, those of us who are seldom sick forget that good health is a real blessing to be enjoyed and treasured. What good are business success and money when they are achieved by destroying your health?

Work hard when you work, but work just as hard at enjoying life. Spring is coming soon; make plans now for those early-morning fishing trips, for hikes in the woods, for going to ball games now and then, or for following whatever other hobby you have. This planning chiefly involves organizing your business to run itself while you're away for the half-day, day, or even week.

For a small business, part-time help may be the answer — chiefly for tending the shop and answering the phone so that customers won't think you're just ignoring them while you're having fun. Many a young wife, missing the excitement of her before-marriage job, would jump at the chance to work a half day now and then for the minimum legal wage rate per hour. Just run a small help-wanted classified ad in your local paper, and take your pick. In between handling customers, a part-time girl can also take care of correspondence, if you pick one who has been a stenographer. Even larger service organizations can profitably use part-time stenographers now and then.



TRADE-INS. What happens to the old TV sets that are traded in on new models? A recent survey made by Electrical Merchandising magazine gives the answer: 9.7 per cent of the trade-ins are junked, 16.0 per cent are resold as is, 62.7 per cent are rebuilt and resold, and 11.6 per cent are still on hand. These percentages are based on a study of records for about 18,000 sales which involved 4,000 trade-ins; this is an amply large sampling to justify use in future planning.

Assuming that the sets still on hand will eventually be disposed of, chiefly by junking, here are the rounded-off percentages you can apply to the trade-in picture in 1955: plan on junking 15 per cent, selling 20 per cent as is, and rebuilding 65 per cent for resale.

FLORIDA. In one Florida locality, it's a common sight to see people watering their TV antennas with the garden hose, according to Reader's Digest. Off-sea winds coat the antennas with salt, bridging across the insulators with a conductive coating and thus impairing reception — hence the need for washing off the antenna.

To tourists, the procedure is quite startling and generally results in questions that become a bit monotonous after the first few dozen tourists have asked them. At Pompano Beach, one housewife turned the tables on one group of tourists who'd just stopped, by turning toward them first and placing her hand palm down at the height of her knee. "Only used to be that big," she said; then she went on with her antenna watering.



SWAPPING TUBES. When things tighten up businesswise, be on the lookout for an epidemic of radios and even TV sets that have been tinkered with before reaching your shop. One of the favorite stunts of the home handyman is interchanging tubes. A few of these sets may come in during seasonal periods when owners are "broke," such as right after Christmas or right after vacation. It's hard to believe anyone would switch tubes around blindly, but they surely do.

For TV, the old paper bag is coming into use, just as for radio, even by those set owners who should know better. One chap we know had a set that had sound but no picture, so he "yanked" all the tubes, put them in a paper bag, and took them into a shop for testing. All checked good except the damper, for which he considerably bought a new tube from the shop owner. But putting the tubes back into the receiver just made things worse; the sound went out, and the picture was hopelessly out of sync. The service technician who was finally called had to replace two tubes that had somehow been ruined. In addition, he had difficulty with a few other things before the set was finally put in order again.

Anyway, the current do-it-yourself fad has one advantage — when people try to fix their own TV sets and fail, they appreciate the abilities of their service technicians more and pay the bill more cheerfully.

* * Please turn to page 64 * *



HIGH PASS FILTER eliminates TV interference

The model 114-330 High Pass Filter is an inexpensive accessory providing clearer, sharper pictures for any tv set.

It effectively rejects all signals at frequencies below 50 mc, including communication-type, diathermy and heat-transmitting interference, and industrial or ignition interference • Circuits are double-shielded in the 114-330 to prevent pick-ups of signals by the Filter itself. Mounting/grounding strap bleeds off rf interference direct to chassis ground.

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Servicing the Transistor Radio

(Continued from page 11)

Meter Precautions

It is important to point out at this time that some service ohmmeters utilize circuitry which necessitates an other-than-normal battery polarity inside the meter. With meters of this type, the red test lead has a negative potential and the black lead has a positive potential. The technician should investigate his meter to determine its polarity. This can easily be done by connecting a voltmeter across the ohmmeter test prods. When measuring circuits which are critical with regard to polarity (such as those containing electrolytic capacitors), the technician should keep in mind the polarity of the meter leads and should connect them accordingly. The positive lead, whether it is red or black, should be connected to the positive lead of the electrolytic capacitor. The transistors in this receiver would not be ruined if an ohmmeter were to be connected into the circuit in the reversed polarity, but the electrolytic capacitors would give incorrect readings because they would be measured backwards. It is also imperative not to use an ohms range which utilizes a battery of more than three volts (or two cells), because the transistors can be ruined if too much voltage is applied to them.

The resistance between the battery clips (with the battery removed and the receiver turned on) should be between 6K and 15K ohms for a normal receiver, as read by an ohmmeter with an internal battery of not more than three volts. A reading lower than 6K ohms will usually indicate a defective receiver which should be checked before the new battery is installed.

Checking Battery Current

Probably the easiest method of checking a receiver which has a low B+ resistance reading is to measure the battery current. This can be done very easily by holding the battery vertically with the negative terminal resting on the negative clip. The negative lead of a milliammeter is attached to the positive battery clip, and then the positive meter lead is touched to the positive terminal of the battery. Normal battery current should be between 3.5 and 4.8 milliamperes.

Trouble Shooting

The new battery can be inserted into the clips if the reading of the

CHART I

TROUBLE-SHOOTING PROCEDURE FOR THE REGENCY MODEL TR-1 RECEIVER

DEAD RECEIVER

A. Absolutely No Output.

1. Remove the battery and turn on the switch. Measure the resistance between the battery clips. (Make sure the positive meter lead is on the positive clip.) If the resistance is:

- a. Approximately 10K ohms, the B+ circuit is normal.
- b. Less than 2500 ohms, check the leads of capacitors C17 and C21, and make sure that they are not touching the battery clips or the frame of the output transformer. Check for a shorted condition in either C17 or C21. Measure the resistances from the top ends of R3 and R7 to ground. These should be 2200 ohms more than the reading across the battery clips.
- c. Infinity, check for an open switch.

2. Turn the volume control to maximum, and insert the battery. If a click or noise is heard from the speaker, check X4 by shorting its base to the frame of the output transformer. The audio stage is operating if a click is heard. If no click or noise is heard, proceed as follows:

- a. Check for an open or shorted jack. Indicative readings can be obtained by measuring the resistance from the fixed contact of the jack to ground. These readings are:

0 ohms	— Shorted jack.
2 ohms	— Normal.
15 ohms	— Jack is open, or the ground between the wiring board and chassis is open.

- b. Check for an open condition in the speaker or in the output transformer.
- c. Voltage at the base of X4 (about +2 volts normal).
- d. Voltage at the emitter of X4 (should measure approximately .15 volt less than the base voltage).

3. Check capacitor C19 by paralleling it with a capacitor known to be good.

4. Measure the voltage at the output of the diode D1 (should be approximately +.1 volt).

- a. If voltage is zero, check the resistance to ground with the positive meter lead on the output. This resistance should measure between 20 and 100 ohms. If the resistance is zero, check for a shorted condition in the diode circuit. If the resistance is 200 ohms or greater, check for an open in the diode circuit or for an open diode.
- b. If voltage is negative when the receiver is tuned to a station, move the tuning dial so that no station is received. The negative voltage should decrease.
- c. If voltage is negative by one volt or more and does not drop when the receiver is tuned off the station, the receiver is oscillating. Proceed to the section entitled "Oscillating Receiver."

5. Make voltage and resistance measurements in the IF stages.

B. Noise But No Signal.

1. Check the local oscillator in the receiver as follows: Tune another receiver to any station above 850 kc. On the receiver being serviced, rock the dial above and below a setting that is approximately 262 kc below the frequency of the station being received by the other receiver. If the local oscillator in the receiver being serviced is operating, a whistle will be heard from the other receiver

as the radiation from the oscillator beats with the station frequency.

- a. If the oscillator is dead, proceed as follows:

(1) Check the voltage at the base of X1. This should be between 3 and 10 volts.

(2) Check the voltage at the emitter of X1. This voltage should be within .1 volt of the base voltage.

(3) Check the voltage at the top end of R3. This should be measured from the B+ line, and it should be between .6 volt and 2 volts.

(4) If any of the voltages measured in the three preceding steps are incorrect, check for an open oscillator-coil primary or an open first IF transformer.

- (5) Check resistances of:

(a) The high side of the antenna coupling coil to ground (should be less than 1 ohm).

(b) The secondary of the oscillator coil (should be approximately 10 ohms).

(c) Stator of oscillator section of the tuning capacitor to ground (should be infinity).

WEAK OR DISTORTED OUTPUT

1. Turn volume control to maximum. Check capacitors C19 and C21 by paralleling a good capacitor across each.

2. Perform step 5 under section entitled "Dead Receiver."

3. Measure voltages at:

a. Base of X4 (should be approximately +2 volts).

b. Emitter of X4 (should be approximately .15 volt less than the base voltage).

c. Emitter of X3 (should be approximately .15 volt less than the voltage at the emitter of X4).

d. Top end of R11 (should be approximately -.5 volt when receiving a signal of average strength).

e. AVC line (should be from approximately 0 volts with signal to .5 volt with no signal).

f. Emitter of X2 (should be approximately .15 volt less than the AVC line).

4. Check the alignment of the receiver.

OSCILLATING RECEIVER

1. Measure the battery voltage. If it is below 15 volts, the battery should be replaced.

2. Check the local oscillator as in step 1 under the section entitled "Noise But No Signal."

3. Check capacitors C17, C9, and C21 by paralleling a good capacitor across each.

4. Check ground connection between wiring board and chassis. This connection is the twisted lug near the negative battery clip and is the only lug which has been soldered to the board. Measure between an IF transformer can and the metal chassis. These readings are:

0 ohms — Normal.

15 ohms — Ground lead is open.

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battery current is within the normal range. If the dead battery were the only trouble, the receiver should operate satisfactorily; however, there will presumably be many cases in which a new battery will not return the receiver to operating condition. For these receivers, a troubleshooting procedure is outlined in Chart I. This chart covers the basic methods of isolating and identifying the causes of the most common troubles.

Oscillations

There is one receiver condition which is not fully covered in Chart I. This is the condition wherein the receiver is oscillating and normal reception is impossible. As in most battery-operated receivers, the battery in the Model TR-1 is bypassed with an electrolytic capacitor C17 in order to present a low-impedance circuit for signal currents. Consult the schematic in Fig. 1 for the location of these components in the circuit. If this capacitor were to develop an open circuit, there would be a considerable amount of feedback along the B+ line to all stages; and the receiver would have general oscillations over the entire tuning range. A similar condition of general oscillations will exist when and if capacitor C9 develops an open circuit. Since C9 bypasses the audio voltages on the AVC line, its failure will allow the gain of the IF stages to vary at an audio rate; and oscillations will result.

An electrolytic capacitor of almost any value can be used to check an electrolytic capacitor that is suspected as being open. This can be accomplished by momentarily bridging the external capacitor across the suspected one while the receiver is turned on. The capacitor polarity should be observed when making this check.

Failure of capacitor C19 in the audio stage will cause a complete loss of audio output. An open condition in capacitor C21 will cause extreme degeneration in the audio stage. This will in turn cause the output of the receiver to be weak and distorted, and some IF oscillation will be encountered.

The information in Chart I lists most of the possible troubles in this receiver. Actually, the replacement of the battery and the electrolytic capacitors is expected to constitute the great majority of service operations in the field.

Circuit Checks

At first glance, it may seem that no points are available for volt-

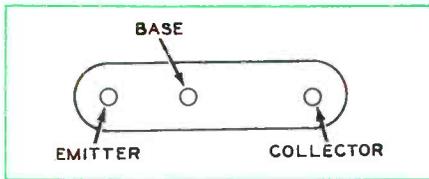


Fig. 2. Basing Diagram for the Transistors Used in the Regency Model TR-1 Receiver.

age or resistance checks of the circuit. Actually, the top end of each resistor in the receiver provides an important circuit point at which to make measurements. All but three of the transistor elements can be measured very easily from the rear, and those three (the collectors of X2, X3, and X4) could be checked by using some ingenuity. The transistors in this receiver use the basing illustrated in Fig. 2; and X2, X3, and X4 are mounted so that their collector leads are toward the outer edges of the circuit board. A small wire probe could be attached to the conventional meter probe and could be bent to reach under the transistor in order to touch the collector lead.

The voltage readings of an average receiver are shown on the schematic diagram. All of the readings were obtained from the rear of the receiver, and the receiver was not disassembled in any way. The photograph in Fig. 3 identifies each of the points at which these measurements were taken. The polarities of the leads of the electrolytic capacitors are also shown in Fig. 3.

Checking Transistors

The transistors are soldered onto the circuit board and must be checked in the circuit. Transistors are low-impedance devices; and unlike vacuum tubes, the input and output resistances can be measured directly with an ohmmeter. When checking the transistors, care must

be taken to ensure the correct polarity of the ohmmeter leads. The positive lead, whether it is red or black, must be connected to the base terminal for these transistors which are of the NPN type. The negative lead is then used to measure resistance at the emitter and collector terminals.

The transistor is a nonlinear device; therefore, different types of ohmmeters will give different values of resistance between the terminals of the transistor. The reading given by any one ohmmeter will depend upon the circuit in that meter, the range that is selected, and the voltage of the internal battery. Ohmmeters using an internal battery of 1.5 or 3 volts and having a 10-ohm midscale range will give the following resistance values:

Base to emitter — 2 to 10 ohms,

Base to collector — 5 to 200 ohms.

The junction transistor is a very stable device having exceptionally long life. Mishandling, mechanical damage, or application of improper voltages are the usual causes of transistor failure. Improper voltage and resistance measurements which are encountered at the transistor leads are in all probability the result of a fault in a component other than the transistor. Before any component (especially the transistor) is changed, the entire associated circuit should be checked thoroughly to determine which component is faulty.

Component Replacement

The replacement of small components such as resistors and capacitors can be accomplished without disassembling the receiver. The leads of a faulty capacitor can be cut close to the body of the component, thus leaving leads long enough to solder to the new component. Faulty resistors can be crushed with a pair

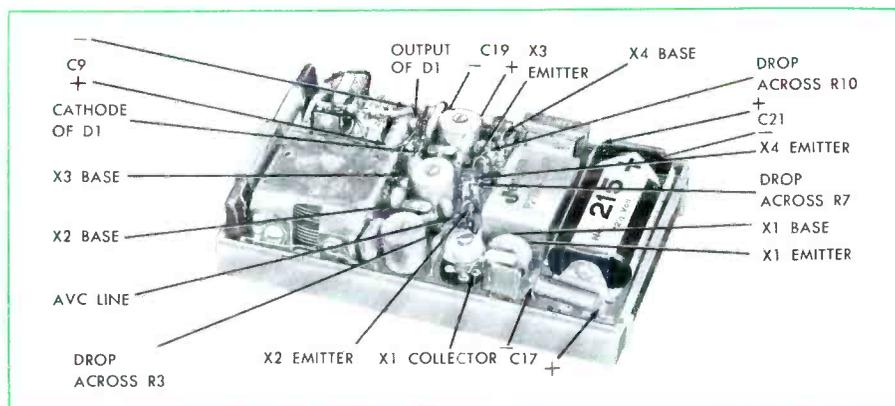


Fig. 3. Photograph Showing the Measuring Points in the Circuits of the Regency Model TR-1 Receiver.

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JACKSON CRO-2 FIVE-INCH OSCILLOSCOPE

And, this Jackson scope has been good for color even before color standards were approved. For Jackson "Service-Engineering" wisely provided four years ago this wide-band, high sensitivity oscilloscope to answer the need for a good television instrument that would not become obsolete. Now provided with new probes (easily attached to older models) the Jackson CRO-2 is the ideal service oscilloscope, used by servicemen and manufacturers. If you're thinking of buying a 'scope, check these features.

Wide Band Amplifier—Flat within 1 db from 20 cycles thru 4.5 MC. This feature is absolutely essential for evaluating color burst signal and Chrominance signal.

Vertical Deflection Sensitivity—Two ranges with three positions for each range. Has fully compensated attenuators. Excellent transient response. Each unit completely tested for "tilt" and "overshoot."

Sensitivity Ranges—With a band width of 20 cycles thru 100 KC, the sensitivity ranges are .018, .18, 1.8 RMS volts per inch. The wide band position 20 cycles thru 4.5 MC has sensitivity ranges of .25, 2.5, 25 RMS volts per inch.

Internal Horizontal Sync.—Positive or negative signal is available to provide excellent stability due to using the best available component of the waveform, such as the leading edge of the horizontal sync. pulse of the standard TV signal. Reversing pattern vertically will not interfere with sync.

Horizontal Sweep Expansion—Four times screen width—up to 20 inches of equivalent width. This feature is excellent for enlarging any small portion of the total waveform. For example, the color TV sync. pulse can be spread to easily observe the 3.58 MC color burst signal so that the individual cycles can be clearly viewed.

Horizontal Deflection Sensitivity—Push-

pull horizontal amplifiers have a sensitivity for all applications of 0.40 RMS volts per inch.

Vertical Input Impedance—1.5 megohms, shunted by 20 mmf. Direct to plates balanced 6 megohms, shunted by 11 mmf.

Horizontal Input Impedance—1.1 meg. **Linear Sweep Oscillator**—Sawtooth wave 20 cycles thru 50 KC per second in 5 steps. Sine wave sweep of 60 cycles also available. Provision for external sync.

Input Calibration—A standard voltage is provided to determine unknown voltages. Permits peak-to-peak measurements.

Vertical Polarity Reversal—By merely flipping a switch you can reverse the polarity of voltage to the vertical plates.

Return Trace Blanking—A new amplifier-timer combination for blanking return traces, providing a clearer, sharper image at all times. Prevents confusion in analysis.

Synchronizing Input Control—Four input control positions, Internal Positive—Internal Negative—External—60 cycle.

Deflection Plate Connections—Direct connections thru capacitors for AC only to deflection plates of CR tube by means of terminal block at back of instrument.

Intensity Modulation—Either 60 cycle internal intensity modulation or external intensity modulation through binding posts.

Accessories—Demodulation Probe, Model CR-P available for using scope as signal tracing instrument. Low Capacity Cathode Follower Probe, Model 10LCP with 2 to 1 attenuation ratio and not more than 8 mmf effective input capacitance. High Voltage Low Capacity Probe Model 3LCP with 10 to 1 attenuation ratio for use up to 1,000 volts.

Model CRO-2 Oscilloscope . . . \$225.00, net
 Model CR-P Probe . . . \$ 9.95, net
 Model 10LCP Probe . . . \$ 19.95, net
 Model 3LCP Probe . . . \$ 7.95, net

of pliers and the resistive material can be removed, again leaving leads long enough to solder to the new components. Access to the wiring side of the circuit board is not necessary for these replacements. A small 20- to 25-watt soldering iron is recommended for any repairs that have to be done. Repairs on the wiring board itself should not be attempted unless the technician has some general knowledge of printed-wiring repairs.

Disassembly of Receiver

The larger components, including the transistors, will have to be unsoldered before they can be removed from the board. To do this, the circuit board must be disassembled from the chassis. Disassembly should proceed as follows:

1. Rotate the tuning dial to the extreme counterclockwise position.

2. Loosen the knurled screw in the center of the dial, and remove the screw and dial.

3. Loosen and remove the one flat-head screw.

4. Remove the chassis from the receiver case.

5. Straighten the twisted lugs at three corners of the circuit board.

6. Unsolder the connections to the stator of the tuning capacitor and to the twisted lug projecting from the chassis.

7. Move the circuit board to a right-angle position with the chassis.

Alignment

The alignment of this receiver is very simple. Signal injection is accomplished by connecting the signal generator to a loop formed of several turns of wire and situated close to the antenna coil of the receiver. Set the generator to 262 kilocycles with 400-cycle modulation, and reduce the output to as low a value as is usable. Connect an output meter (with a .1-volt scale) across the voice-coil connections. (The high side of the voice coil is easily accessible at the spring of the phone jack.) Set the volume control in the receiver to maximum. Adjust each of the cores of the IF transformers for maximum indication on the output meter. Set the receiver dial to its maximum counterclockwise position, tune the generator to 535 kilocycles, and adjust the core of the oscillator coil for maximum output. Tune the generator to 1630 kilocycles, set the receiver dial to its maximum clock-

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wise position and adjust the oscillator trimmer capacitor for maximum output. Repeat these last two adjustments alternately until no further improvement can be made. Then tune the generator to 1500 kilocycles, tune in this signal with the receiver dial, and adjust the antenna trimmer capacitor for maximum output. Turn the receiver dial to the high-frequency end, and determine whether or not the range extends to 1630 kilocycles. If not, the oscillator trimmer capacitor must be readjusted, and the alignment at 1500 kc must be repeated.

Transistor Replacement

The transistors in the two IF stages of this receiver have been carefully selected and matched so that the IF gain is held at an average value for all receivers. To accomplish this, there are three types of transistors that are used in these stages. These types are identifiable by the body (or top) color.

In addition, the transistors in the IF amplifier stages have been divided into several classifications according to their internal capacitances. The neutralizing capacitors C10 and C14 are selected during manufacture to neutralize effectively the specific internal capacitances of the transistors used.

To eliminate the confusion which could arise from this situation, the manufacturer has color-coded each transistor for internal capacity. When available, each replacement transistor will be supplied with its proper neutralizing capacitor. The neutralizing capacitor (either C10 or C14) must be replaced when X2 or X3 are changed, unless the new one is of the same value as the old.

Since the Regency TR-1 transistor receiver has been on the market only a short time, the special components are not yet available through parts distributors. Distribution of these components is planned by the manufacturer for a future date. Until such distribution has been made, the service technician should contact the manufacturer for information regarding the contemplated plan for factory service at a fixed price before attempting any component replacement; or the faulty receiver should be returned to the manufacturer for service.

EDITOR'S NOTE: For a discussion on the repair of printed wiring boards, refer to pages 70 to 72 in the January 1955 issue of the PF REPORTER.

WILLIAM E. BURKE

March, 1955 - PF REPORTER

TWO NEW COLOR BAR GENERATORS



For All Color
Circuit Checks in
Color TV Receivers

"Ideal for
COLOR"

Specifications—Model 700

Signal Outputs

1. Composite video of either polarity, adjustable amplitude to 1-volt across 90 ohms. Either luminance or chrominance can be eliminated from the composite signal.
2. Modulated R.F., channels 3, 4, or 5 of .1 volt across 300 ohms.
3. Horizontal sync., positive polarity, 1 volt across 200 ohms.
4. Crystal controlled color subcarrier (3.5795 MC), 40 Millivolts across 200 ohms at burst phase.

Synchronizing Signals

1. Color burst, crystal controlled (NTSC standards).
2. Standard horizontal sync. and blanking signals.

Color Bar Signals

1. Simultaneous bar display with luminance and chrominance levels held to plus or minus 10 percent, phase angles to plus or minus 5 degrees as follows:

Color	Relative Luminance	Chrominance
White	1.0	0
Yellow	0.89	0.44
Cyan	0.70	0.63
Green	0.59	0.59
Magenta	0.41	0.59
Red	0.30	0.63
Blue	0.11	0.44
Black	0	0

2. Color Difference Displays. Bars of zero luminance selectivity available as follows: (Phase angles within plus or minus 2 degrees):

Signal	Type of Display	Relative Chrominance
I	single bar	0.25
Q	single bar	0.25
I & Q	simultaneously	0.25
R-Y	single bar	0.25
B-Y	single bar	0.25
R-Y & B-Y	simultaneously	0.25

(Background for all color difference bars in black—relative chrominance zero)

3. Single Bars — Primary colors — red, green and blue—selectively available. Each bar is approximately 60% of screen width. Luminance 0.3, chrominance 0.5.

Crystal Controlled Sound Carrier—approximately 25% of peak picture carrier, placed 4.5 megacycles from picture carrier. Sound carrier may be turned off or on by panel control switch.

Panel Controls

1. R.F. Carrier Tuning—channels 3, 4 or 5.
2. Video Output Amplitude.
3. Horizontal Lock.
4. Sound On—Sound Off Switch.
5. Video Output Polarity Switch.
6. Power Switch.
7. Color Bar Selector Switch.
8. Horizontal Centering Control.
9. R.F. Attenuator.
10. Luminance-Chrominance Selector.

Internal Adjustments

1. Burst amplitude.
2. Color Sub-Carrier.
3. Modulation percentage.

Circuit Operation

1. Color sub-carrier and sound frequencies are determined by crystal oscillators.
2. All six color bars—yellow, cyan, green, magenta, red, blue, plus black and white are independently generated. No color mixing or matrixing is required.
3. Color phase angles are determined by an accurate, low impedance delay line.
4. Direct gating of proper chrominance phase is employed for each color bar to attain maximum stability and reliability rather than the usual methods which utilize quadrature encoders.
5. Luminance and Chrominance levels are reliable and stable. No multi-vibrators are employed in generating any bars.
6. No internal or external adjustments are required for proper phase angles, bar widths, luminance, or chrominance levels.

Specifications—Model 712

Provides similar signal outputs and Color Selection to model 700. Also includes crosshatch and white dot generators for convergence checks on 3-gun tubes. Cross-hatch pattern may also be used for linearity and tilt adjustments. Small dot size—about 1/4" on a 19" tube permits more positive convergence adjustment.

Accessories

Model 75C—Attractive Leatherette Covered Carrying Case with Velvet interior lining. For either Model 700 or 712.

Model 700—Shipping weight

30 pounds\$295.00 net

Model 712—Shipping weight

32 pounds\$395.00 net

Model 75C—Carrying Case—Shipping weight

12 pounds\$24.95 net

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(Continued from page 15)

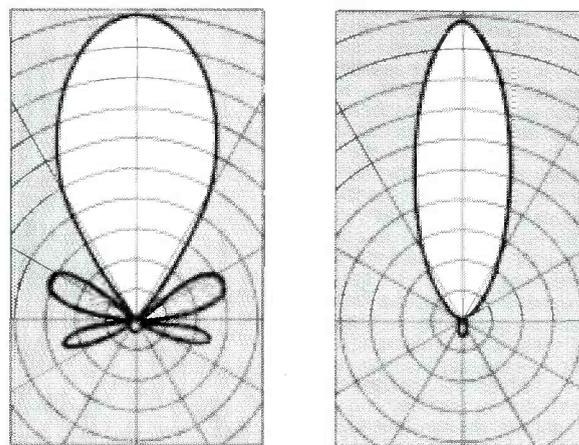


Fig. 4. Antenna Directivity Patterns.

(A) Single Lobe.

(B) Multiple Lobes.

as possible from the interference sources will do much toward minimizing ignition interference and other similar types of interference. The installation of a line filter of good quality between the TV receiver and the AC outlet will tend to eliminate such interference. The installation of a line filter will also prove to be of great value in large apartments, since

receivers will in some cases radiate spurious signals back through the AC power line. If this condition is suspected in an apartment, a line filter should be installed. These units are relatively inexpensive and are advisable to have in stock.

In an area behind an obstruction such as a large building or mountain, the signal may be very poor; in fact, there may not be sufficient signal to obtain a measurement with a field-strength meter. The only method to combat difficulties with dead spots in areas behind such obstructions is to locate the antenna so that satisfactory clearance of the obstruction is obtained. Feed the signal to the receiver with a suitable feed wire and install a booster amplifier if required. Good examples of this method are the community antenna systems which are located throughout the country.

The reception in large apartment buildings, especially those of concrete and steel construction, is often somewhat of a problem. Some of the recently built units have antenna distribution systems which were installed as the buildings were being built. When the distribution system is properly operating and the customers have their receivers connected to it, there is usually excellent reception on those channels for which the system is set up to operate.

In the older apartments or in ones which have no TV antenna distribution system, there are some problems which are difficult to overcome. The easiest method of securing satisfactory reception is to install a suitable outside antenna. This may not be possible in all cases because of the height of the building or the refusal of the property owner to grant permission to install an outside antenna. To overcome this problem, many technicians have installed folded



Fig. 5. RMS Model CL-2 Indoor Antenna.

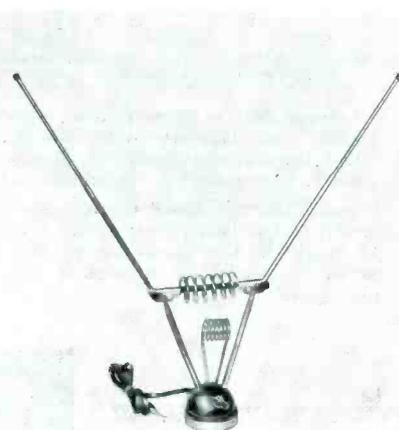


Fig. 6. K-G Model 6A Delta-Beam Antenna.



Fig. 7. Spico Model 501 Indoor Antenna.

dipoles made of 300-ohm ribbon lead-in wire under the rug or behind curtains, have constructed matching stubs of 300-ohm twin lead by using a cut-and-try method, or have gone to other elaborate and time-consuming means to secure a usable picture in these apartment buildings.

During the last few months, there have been placed on the market several indoor antennas which feature tuning stubs or other methods of tuning the antenna to provide proper impedance match between the antenna and receiver. Three of these antennas are illustrated in Figs. 5, 6, and 7. The RMS Model CL-2 shown in Fig. 5 is the deluxe model, and a similar unit without the clock assembly is available as RMS Model K-38. The internal switching arrangement of the RMS Model CL-2 antenna is shown in Fig. 8.

On the switch there are six different positions to enable the operator to select a variety of circuit connections from the two ears and the center stub to the output lead-in wire. It has been found that very good reception may be achieved by selecting the length of the ears, the angle at which they are spread, the correct switch position, and the proper orientation of the antenna.

The internal connections in the Delta-Beam indoor antenna produced by the K-G Electronics Corporation are very similar to those shown in

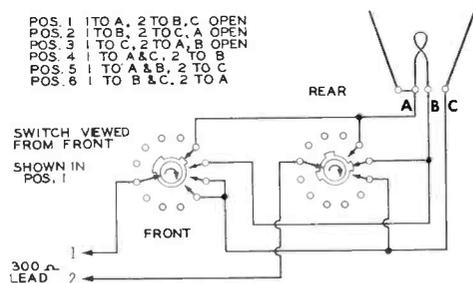


Fig. 8. Switch Connections in the RMS Model CL-2 Indoor Antenna.

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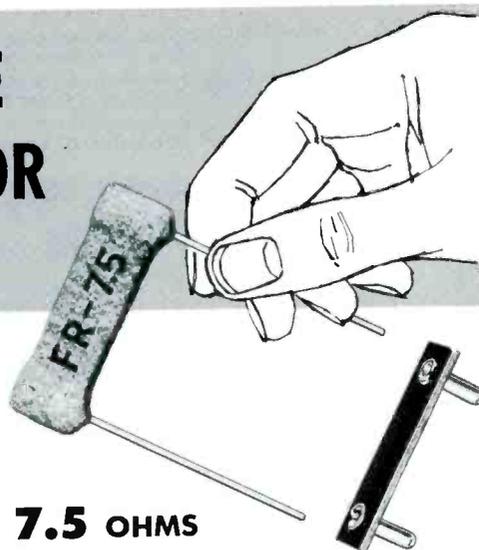
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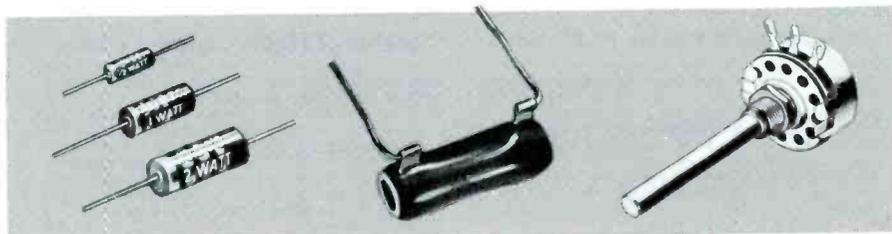
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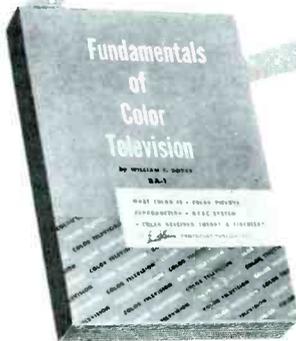
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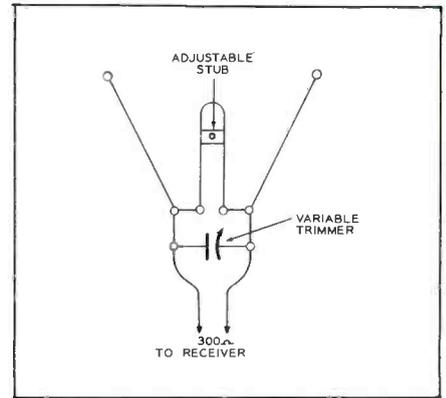


Fig. 9. Connections in the Spico Model 501 Indoor Antenna.

Fig. 8. The connections in the Spico Model 501 antenna are shown in Fig. 9. There are many more of these improved indoor antennas which cannot be shown here because of limited space; but it will be found that all of the indoor models which feature some method of tuning will provide improved reception almost without exception. This is not only true of installations in apartment buildings but also in residential areas, since the impedance match between antenna and receiver is of prime importance in achieving satisfactory reception.

CBS-Hytron Four-Way Tool

The CBS-Hytron four-way tool shown in Fig. 10 is a pocket tool which was designed to contain in one unit all of the tools normally needed to remove the back cover and the high-voltage cover of a receiver.

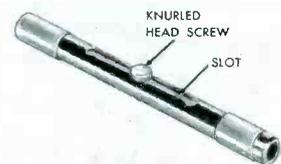


Fig. 10. CBS Four-Way Tool.

To those who like multipurpose tools, this small handy unit should be of interest. The tool has 1/4-inch and 5/16-inch hexagonal sockets at opposite ends. Inside, it has a standard screwdriver and a Phillips-head screwdriver. Either can be used by first loosening the knurled thumb-screw, then by slipping the assembly to one end or the other of the slot, and by tightening the knurled thumb-screw.

IN THE SHOP

Tuner Troubles

Many technicians find that the TV tuner is the most difficult portion

of a receiver to service. This is understandable for three principal reasons.

The first and foremost of these reasons is brought about by the fact that there is a risk of throwing the tuner completely out of alignment when probing around the components or when moving them to get to other parts hidden beneath. Care should most certainly be taken when probing in the tuner.

Secondly, the signal level in the tuner is so weak that most test equipment will detune the circuit to such a degree that the signal is completely lost.

Third, but not least, is the fact that tuners are usually so crowded that the parts are very difficult to change without practically dismantling the tuner. This crowded condition also makes voltage and resistance checks difficult to do.

The favorite method of many technicians when servicing tuners is to attempt to align the tuner after substituting tubes. If there are any troubles in the tuner, such troubles will probably show up during alignment. The portion of the circuit in which the trouble lies can usually be detected by noting the adjustments which fail to provide the proper response. If the tuner will not pass a signal at all, there are two other methods which may be used for testing. Measuring the operating voltages will sometimes disclose a lot, as is true in any other part of the receiver. Since the voltage readings are difficult to obtain because of the crowded condition of the tuner circuits, a test-socket adapter can be used. The use of such an adapter permits the measurement of the voltages from the top of the chassis during operation. These adapters were discussed in the June 1954 issue of the PF INDEX on page 65.

In some tuners, however, test-socket adapters cannot be used for measuring the voltages of the oscillator because the added capacity, small as it may be, will sometimes throw the oscillator completely out of operation. If the oscillator voltages cannot be read from the underside of the chassis in such cases, the technician must rely upon resistance checks. These checks may be done from the top of the chassis at the tube sockets. It must be kept in mind when making measurements of any kind from the top of the chassis that the socket pins are numbered in a counterclockwise direction.

One of the most common troubles encountered in TV tuners using a cas-

code circuit is a cathode-to-heater short in the RF amplifier. This trouble very often causes much more damage to the set than is normally caused by a bad tube. A study of the partial and simplified schematic shown in Fig. 11 will indicate what happens when the second section of the RF amplifier becomes shorted between the cathode (pin 3) and filament (pin 5). Since one side of the filament is connected directly to ground, any element which touches the filament will naturally become grounded. If a heater-to-cathode short exists, the cathode which normally has a potential of approximately 105 volts with respect to ground will lose this voltage. The grid, which normally has a voltage of slightly under 105 volts, immediately starts to draw current. The grid voltage drops so that it is very close to the cathode voltage which is zero under these conditions. At the same time, the effective plate voltage on the second section of the tube is practically doubled; and much more than normal plate current is drawn. It was found by actual tests that the plate current increases to approximately 35 milliamperes when the cathode is shorted to ground. This current is three to four times the normal plate current for this tube.

If the receiver is allowed to operate for any length of time in this condition, the result will be burned-out resistors in the plate circuit. In the case of the tuner shown in Fig. 12, the resistors that would be damaged are R8 and R52. The plate current of the RF amplifier must pass through both of these resistors. With zero bias on the stage, R52 would have to withstand a dissipation of five and one-half watts. Since a one-watt resistor is usually used for R52, it naturally burns out. Since R8 is usually a one-watt resistor but of a much smaller resistance (470 ohms), it normally only becomes charred and increases in value instead of burning out.

It is sometimes rather comical (to a person not involved) the way we mortals jump to false conclusions at the slightest opportunity. These false

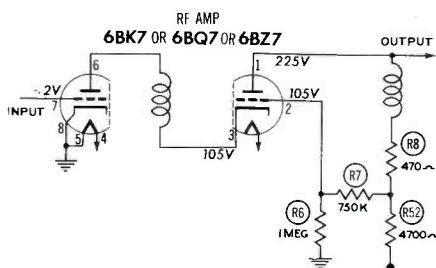


Fig. 11. Simplified Partial Schematic of Cascade-Coupled RF Amplifier.

conclusions are not funny, however, to those involved in the mistake; because all too often these mistakes cost us time, money, and loss of temper.

An example of this type of mistake is illustrated by the following incident. A television receiver was brought to a technician with the complaint from the customer that it had appeared to be on fire. Judging from the odor, it must have been.

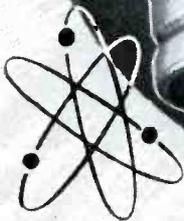
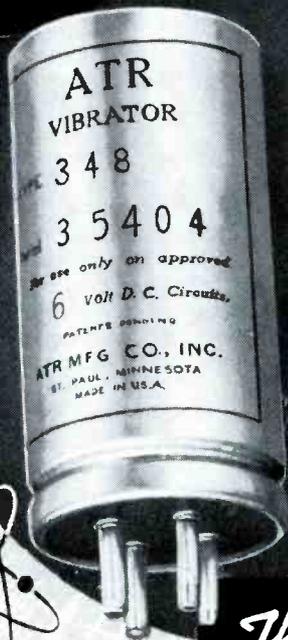
By use of his sense of smell, the technician was very quickly able to trace the odor to the tuner. When he pulled the shield off the bottom of the tuner, he noticed that two resistors were burned. The symptoms were identical to those encountered in a receiver that had been repaired the previous week and which had been found to have a heater-to-cathode short in the 6BZ7A. With this in mind, he made one check. Using the tube tester, he checked the 6BZ7A duo-triode for short circuits. The tester showed a heater-to-cathode short. That was all he needed to know. He went straight to work replacing the resistors and the 6BZ7A tube. He then put the set back together and turned it on for adjustment, confident that he had fixed it; but after about a minute of waiting for the picture to come on, he noticed smoke coming out of the tuner. He quickly turned off the set and removed the bottom shield of the tuner. The resistors were again badly burned. The next logical step was to check the new tube to see if by chance it was also shorted between the heater and cathode. It was not; however, thinking that perhaps the tube was breaking down under load, he tried another tube. The resistors again showed signs of overheating.

By this time, the technician was beginning to suspect that perhaps the old tube had not caused the trouble in the first place. He retrieved the old tube; and using an ohmmeter, he started measuring for shorts between pins. He found a heater-to-cathode short, but it was between pin No. 8 and the filament instead of between pin No. 3 and the filament. This meant that the short was in the first section instead of in the second. Thus, the short could not have caused the trouble, because pin No. 8 was connected to ground. This meant that the trouble had to be caused by some other component in the circuit.

After closely examining the schematic diagram in Fig. 12, the technician decided that the trouble had to be a short in the plate decoupler C12. His conclusion was brought

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about by the following manner of reasoning.

In order for R8 to become burned, the excessive current which had burned R52 would have to be passing through it, too. This meant that there had to be a short between ground and the junction of R8 and C12, or it meant that a high current had to be flowing through the tube. Therefore, the trouble could not be a short in either C28 or C81 because the high current which would have resulted, if either were shorted, would not flow through R8. C13 and C14 were also excluded as possibilities, because a short in one of them would probably have done damage to the mixer circuit instead of to the RF stage. If C11 became shorted, an increase in bias on the tube would result, and that would reduce the plate current rather than increase it. As a result, C11 was also eliminated.

On the other hand, if C12 were shorted, the full plate voltage would be placed on the grid and cause a very high plate current. This high current passing through R8 and R52 would surely burn them out.

The foregoing theory proved to give the solution to the problem; for when C12 was measured, it proved to be shorted. After C12 was replaced, operation returned to normal. Incidentally, the resistors R8 and R52 had to be replaced again because of the fact that the overheating caused by the high current resulted in an increase in their values.

Although this trouble with a shorted capacitor was rather difficult to locate and to eliminate, it need not have been if the technician had been more careful in his first tests. In other words, if he had noted which section of the tube had the heater-to-cathode short when he tested it, he would no doubt have found the trouble much sooner.

It is a recognized fact that in most instances, a dead tuner is much easier to repair than a tuner which is either intermittent or has low gain.

In the case of an intermittent condition, make sure that the trouble is in the tuner by first connecting a scope to the looker point which is provided on top of most tuners and by clamping the bias of the RF stage with an external battery. Then watch the scope to see if the amplitude of the signal changes during the intermittent operation. If it does, then you can be sure the tuner is at fault. Otherwise, it is probably not the tuner; and you can look elsewhere for the trouble in the receiver.

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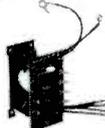
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Dollar and Sense Servicing

(Continued from page 51)

PEGBOARD. That new Sylvania tube and tool tender is a "honey" for home calls; be sure to look it over. Besides being a carrying case for tubes, it has pegboards and a supply of 100 special spring clips for holding the small tools used in servicing. The clips are far better than the wire inserts sold by lumber dealers for use in pegboards. There's even room for a multimeter, soldering gun, and mirror. The case opens up in such a way as to form a miniature equivalent of a workbench when placed on a chair or table. Wish we could buy those spring clips separately for use on our own workbench pegboard.



BILLIONS. This country paid out around \$1.7 billion to service technicians last year for replacing some 88 million receiving tubes; about 5 1/2 million picture tubes; and \$400 million worth of components, antennas, and accessories — according to an RCA estimate. This year should run a bit better, and by 1957 it is estimated that the servicing bill will hit an all-time high of \$2.7 billion. The rise is predicated on acceptance of color television with its increased servicing problems, because servicing income from radio and black-and-white TV is now well stabilized.



FINGERPRINTS. No matter how good a job you do on the roof, grimy fingerprints on the window sill near the TV lead-in are what the lady'll be thinking of when you present the bill. For just this situation, there's now a waterless on-the-job hand cleaner that comes in a squirt can of proper size to fit into the tool box. A touch of the button and out comes a blob of white foam that works like magic when rubbed over the hands. A cloth, paper towel, or piece of Kleenex completes the job. Distributors are now stocking this. Ask for a can of Handy at \$1.49, made by Planet Sales Corp., of Bloomfield, N. J.

JOHN MARKUS

Audio Facts

(Continued from page 29)

distorted. The conclusion was reached that on the many occasions when the loudspeaker had been overloaded, the breakup in sound had actually been due to distortion caused by peaks which exceeded the power capabilities of the inadequate amplifier being used at the time.

Tests verified the 50-watt rating of the Model 260. Our measurements revealed less than one per cent intermodulation distortion at 50-watt output.

The specifications supplied by the manufacturer are:

Power Output — 50 watts.

Controlled Frequency Response — within 0.5 db, 20 to 20,000 cps.

Input — full 50-watt output with input of 9.9 volts.

Intermodulation Distortion — under 0.5 per cent at 45 watts; under 2 per cent at 50 watts.

Harmonic Distortion — under 0.1 per cent at 45 watts; under 0.5 per cent at 50 watts.

Noise — in excess of 85 db below rated output.

Damping Factor — 9.

Dimensions — 12 inches wide by 7 inches deep by 7 1/4 inches high.

Weight — 27 pounds.

The specifications also state that the amplifier is guaranteed not to ring at any level because it is designed to be stable with a loudspeaker load. In our tests, no instability or ringing was detected at any time with a loudspeaker connected to the amplifier output, even when reproducing square waves. Ringing or oscillations at high or supersonic frequencies are prevented in the Model 260 by rolling off the high-frequency response, starting at about 20,000 cps.

The amplifier and its tube complement do not appear unusual, as can be seen in the illustrations (Figs. 1, 2, and 3) and in the schematic shown in Fig. 4. Much the same arrangement has been used in many amplifiers producing maximum outputs of only 15 to 25 watts; but the Model 260 makes use of an excellent output transformer tapped for screen connections, fixed bias, and an adequate power supply to achieve high power output.

The circuit, as mentioned previously, is conventional in most respects. The first stage using a 6AB4 tube designated as V1 is a voltage amplifier. Negative feedback is accomplished by connecting the feedback resistor R16 from the secondary of the output transformer to the cathode (pin 7) of V1. The 430-mmf capacitor C6 connected across the plate-load resistor R5 serves to roll off the extreme high frequencies and prevent oscillation (ringing) at super-sonic frequencies.

The first half of the 12AU7 tube designated as V2 is a voltage amplifier which is direct-coupled to the second section. This section is a split-load phase inverter. The screens of the 1614 tubes designated as V3 and V4 are connected to taps on the primary of the output transformer in a manner similar to that discussed in the article "The Williamson Amplifier, A Modified Design" in the February 1954 issue of the PF INDEX.

Fixed bias is employed in the output stage. The bias can be adjusted by plugging a DC voltmeter into the test jack by means of a phone plug and then by turning the bias control R3 until 0.45 volts are indicated on the meter.

The output stage can be balanced by inserting the phone plug (the meter need not be connected to the plug) into the test jack, with the 12AU7 tube V2 removed from its socket. The amplifier is then turned on, and the balance control R2 is turned until minimum hum is heard in the loudspeaker. This null indicates balance.

This convenient method of obtaining balance is made possible by the arrangement which places an AC voltage on the movable contact of the balance control R2. This voltage is fed to the control through C10 when the normally open contact of the test jack is closed by inserting the phone plug in the jack. The AC voltage is out of phase on the grids of the 1614 tubes and cancels out when perfect balance is reached.

The power supply, which uses two 5V4G rectifier tubes in the plate supply section and a selenium rectifier in the bias supply, is straightforward and needs no explanations.

The Model 260 is not large physically, but it is heavy for its size. Its 50 watts of power output make it a powerful performer but not beyond reason. This amplifier should satisfy the most critical listener. It has adequate reserve power and provides virtually distortion-free reproduction at normal as well as high levels.

ROBERT B. DUNHAM

March, 1955 - PF REPORTER

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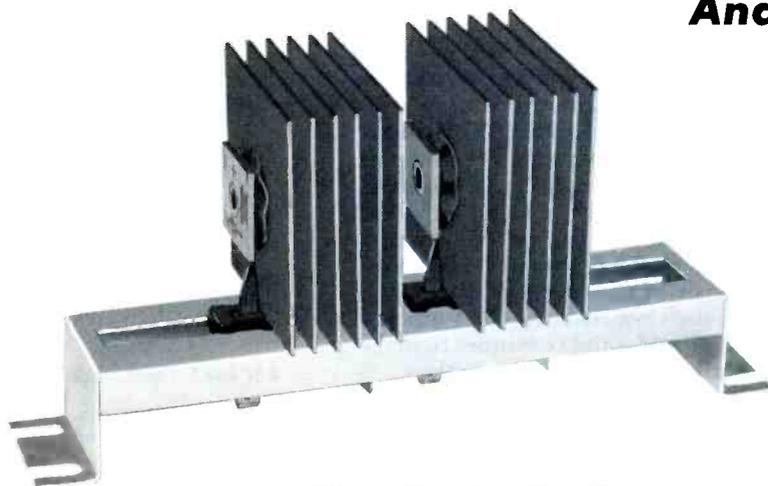
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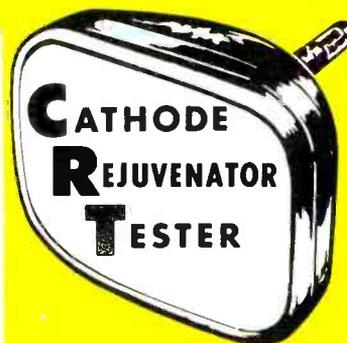
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Notes on Test Equipment

(Continued from page 19)

power-factor checks when the bridge is set up to check electrolytic capacitors. The power factor of a capacitor is the result of an internal resistance effectively in series with its capacitance. This resistance can be balanced by the proper value of resistance in another arm of the bridge circuit. The potentiometer used to obtain this balance is calibrated to indicate the value of the power factor.

In most capacitor checkers, the final form of bridge circuit used to check electrolytic capacitors will be similar to that of Fig. 1C. The unknown capacitance is to be connected across the terminals at C_X . C_S is a standard capacitance to which the unknown capacitance is to be compared and is selected internally by a certain position of the operating controls of the tester. C_S and R_f are in series to form one arm of the bridge circuit. The two ratio arms R_a and R_b are combined in one resistance in the form of a potentiometer, and this potentiometer is the main operating control for adjusting for bridge balance. Adjustment of this control varies the ratio between the bridge arms R_a and R_b ; and at the same time, the pointer will indicate the proper capacitance value on the instrument dial.

Certain modifications of the basic bridge circuit make it adaptable for special applications; thus, one variation may make the bridge more suitable for measuring small capacitances, another may make it more suitable for reading inductances, and so on. These modifications will not be covered in detail in this article; a great many variations may be found in textbooks dealing with electrical measurements.

Shorted or Open Capacitors

The bridge test furnishes information about the amount of capacity or resistance involved, but there are still several quality checks that must be performed to obtain a complete picture of the condition of the component being tested. A shorted or open condition renders a capacitor useless for all normal applications; therefore, it is important to provide a check for these conditions.

It is sometimes found that a capacitance bridge will give no indication of balance for a given capacitor except at the extreme end of its range. If this indication occurs at the low-capacitance end, the capacitor is considered to be open; and if this indication occurs at the high capacitance end, the capacitor may be considered to be shorted. Some bridges

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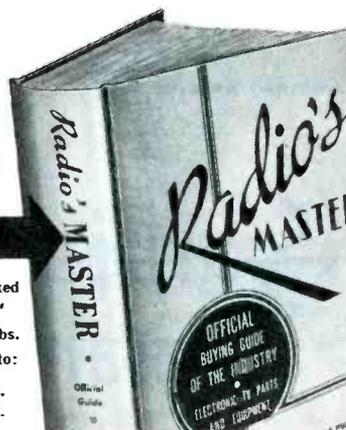
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have the extremes of the dial marked in that manner. Others have a separate test for opens and shorts, and this test may take the form of a quick check that may be performed without the necessity of disconnecting the component from the rest of the circuit. At least one manufacturer has made this feature the basis for a separate instrument. (See the PF REPORTER for November 1954, page 72.)

Within certain limitations, an ohmmeter may be used to check for an open or shorted condition of a capacitor. To perform this check, set the ohmmeter to a high-resistance range; and watch the meter needle closely while the ohmmeter leads are touched across the capacitor. A momentary "kick" of the meter needle indicates that the capacitor is not open. If the capacitor is of a low value, the charging current may be too small to be noticeable on the meter. Some shorts will be shown by the meter test, but others may require a higher voltage than that furnished by the ohmmeter and therefore will not be detected.

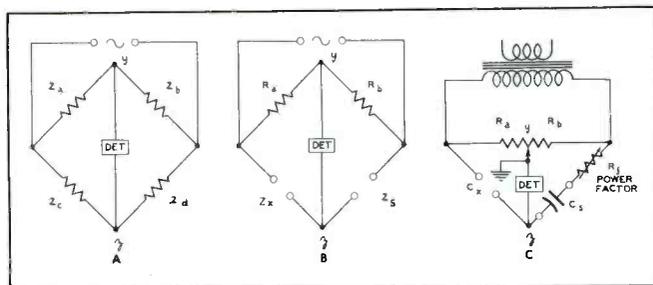
Leakage or Insulation Resistance

Leakage is usually thought of as applying to electrolytic capacitors, and insulation resistance is thought of as applying to other types; however, both can be measured by the amount of current that a given DC voltage will force through the capacitor in question. In the case of insulation resistance, the meter is calibrated to read in megohms instead of current.

In a leakage test, a voltage of the proper polarity and magnitude is applied to the electrolytic capacitor; and the leakage current is read directly on the meter. This current value can be compared with standard values for new capacitors of similar voltage rating and capacity. Thus, a relative indication of the condition of the capacitor is obtained. It is important that this leakage be below certain values to avoid excess loading of any circuit involved. An excess of current will also cause heating of the capacitor and subsequent deterioration. Some capacitor checkers use a neon indicator to show a leakage condition. A slight amount of leakage is shown by a slow rate of flashing of the neon lamp. More leakage results in a faster rate of flashing; and if the leakage is great enough, the lamp glows brightly and continuously.

The nature of an electrolytic capacitor is such that both its capacity and leakage may change considerably if it is allowed to remain

Fig. 1. Evolution of a Capacitance Bridge. (A) Simple Alternating-Current Bridge. (B) Modification of Alternating-Current Bridge. (C) Final Form of Capacitance Bridge.



idle for a long period of time. A re-forming period will usually restore the capacitor to its original condition. This re-forming action can be supplied by the capacitor tester. In fact, if the change has not been great, it is usually corrected by performing a leakage test. During this test, the leakage becomes less and less and finally tapers off to a steady value. Any improvement in the condition of the capacitor is indicated by the instrument. As the leakage becomes less and less, the applied test voltage will rise a little so that a slight readjustment of this voltage may be needed.

The insulation resistance of paper, mica, and ceramic capacitors is much greater than that of electrolytic capacitors and is measured in terms of hundreds or thousands of megohms. It might seem that a resistance of 500 megohms would be an adequate figure for a coupling capacitor, but the following reasoning will show that this is not necessarily true. Fig. 2 shows such a capacitor used as a coupling to the grid of an amplifier stage having a 10-megohm grid resistor. This is not an uncommon value where grid contact potential is used for bias. The preceding stage is shown as having a plate voltage of 100 volts DC. The 500-megohm resistance of the capacitor is in series with the 10-megohm grid resistor, and 100 volts is applied across the total resistance of 510 megohms. The voltage developed across the grid resistor is 1/51 of 100 or approximately 2 volts. Moreover, the polarity of this voltage will be positive at the grid with respect to ground; and so this voltage will be subtracted from any value of grid bias developed by contact potential in the amplifier tube. It can therefore be seen that very high insulation resistances are required for some applications and that an insulation test is helpful in selecting capacitors for these applications or in locating troubles caused by low insulation resistance.

The usual procedure in setting up such a test is to adjust the instrument, before connecting it to the capacitor, until infinite resistance is indicated. Then when the capacitor is connected, it will charge because

of current flow through the internal resistance of the instrument; and the final value of insulation resistance can be read on the meter. For large values of capacitance, the charging rate is slow; consequently, an added control feature is sometimes provided for a quick charging rate. The operation of this control momentarily shunts a part of the charging circuit, allowing the capacitor to charge quickly.

A safety feature is usually provided to discharge any capacitor before it is removed from the capacitor checker. This removes any shock hazard which might be present after a test.

Testing Intermittent Capacitors

An intermittent condition of a capacitor will be indicated, as the capacitor is tapped, by a fluttering of the electronic eye or of the indicating device used. As was true with the shorts check, sometimes an intermittent condition will not be apparent unless the capacitor is subjected to higher applied voltages like those encountered in actual use. An intermittent condition of this type may prove difficult to locate.

RF Impedance

RF impedance is an important factor when considering the use of a capacitor as an RF bypass. If the capacitive reactance were the only consideration, any capacitance above a certain value ought to work well as a bypass since the reactance decreases with an increase in frequency. Therefore, it would seem reasonable

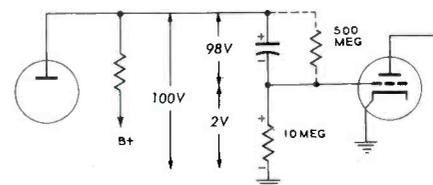


Fig. 2. Partial Schematic Showing Effect of Low Insulation Resistance. Contact Potential Is Reduced by Leakage Through the Capacitor.

to assume that all frequencies above a certain minimum would be effectively bypassed. Other factors enter into the case, however; and the RF impedance may actually increase at some higher frequencies. This increase in RF impedance of the electrolytic capacitor is due to such properties as: inductive value, characteristics of the electrolyte and film, and the disposition of the lead assembly. For this reason, we find circuit designs that use additional capacitors in parallel with some electrolytic bypass or filter

capacitors. These additional capacitors are nonelectrolytics of small value, and they serve to shunt the RF impedance of the electrolytic capacitor. A test of the RF impedance would be useful in selecting capacitors for special application or in tracing troubles caused by this RF impedance.

Most test-instrument manuals are well written and provide the service technician with complete instructions for operating a particular piece of equipment. A good

manual for a capacitor checker will probably contain, in addition to the operating instructions, several charts or tables giving pertinent information about capacitors. Normal insulation resistance and leakage, power factors of new electrolytic capacitors, and capacity tolerances are a few of the things these charts or tables may list. A good capacitance checker, together with a well-written manual, should make it easy for the technician to determine with speed and certainty the condition of any capacitor. This is more satisfactory than a cut-and-replace policy, as anyone will agree if he has struggled with a multi-section electrolytic only to find that the trouble was caused by some other component.

RECENT RELEASES

AUTHORIZED MULTIVOLTER MODEL 301



Fig. 3. Authorized Multivolter Power Supply.

The Authorized multivolter pictured in Fig. 3 is a product of Authorized Manufacturers Service Co., Inc., 919 Wyckoff Avenue, Brooklyn 27, N. Y. The instrument is a miniature power supply and is designed to furnish DC voltages from -135 volts through 0 to +135 volts and to furnish AC voltages from 0 to 135 volts. In addition, one ampere at 6.3 volts may be obtained for filaments from separate terminals. A neon-lamp indicator is lit during normal operation and is extinguished when an overload current of more than 20 ma is drawn.

The instrument is housed in a molded phenolic case of small size, 3 3/4 inches by 6 1/4 inches by 2 inches, and will fit easily into a tool box or tube caddy. The weight is 2 pounds. Other specifications include:

DC volts: no-load voltage is continuously variable from -135 to +135.

AC volts: no-load voltage is continuously variable from 0 to 135.

Output resistance: varies inversely as the output voltage varies.

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SIMPSON MIDGETESTER MODEL 355

The trend toward miniaturizing in the electronics field has spread to the design of test equipment. This fact is exemplified by the Simpson Midgetester Model 355 shown in Fig. 4. This meter measures 2 3/4 inches by 4 1/2 inches by 1 inch over-all and weighs just under 8 ounces complete with batteries and test leads.

Selection of the various ranges is made by inserting the test leads in the proper test sockets. Leads and sockets are threaded to fit so that once a lead has been properly inserted and good electrical contact is assured, there is no danger of the leads being accidentally removed. The act of inserting the black lead automatically closes a switch in the circuit for measuring DC volts, AC volts, or ohms, depending upon the function selected. The test lead does not make a direct connection between its tip and the switch, because a fiber insulator is interposed.

Measurement ranges offered by the instrument are: 0 to 3, 0 to 12, 0 to 60, 0 to 300, 0 to 1200 volts AC and DC. The total instrument resistance for both AC and DC voltage measurements is 10,000 ohms per volt. Meter-scale calibrations are 0 to 12, 0 to 60, and 0 to 300 volts.

DC resistance ranges are 0 to 10,000 ohms, 0 to 100,000 ohms, 0 to

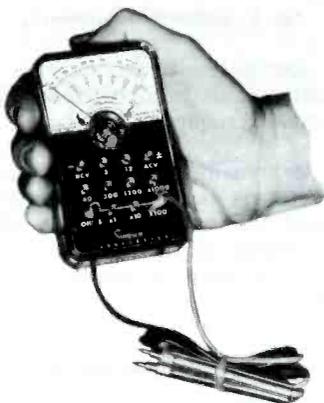


Fig. 4. Simpson Midgetester Model 355.

1 megohm, and 0 to 10 megohms. An adjusting knob labeled OHMS ZERO is provided at one side of the case in a small recessed opening which minimizes the possibility of accidental movement.

The test leads included with the instrument have an insulation rating of 5,000 volts. The probe ends of the leads have sharp conical tips to ensure good contact with the circuit under test. A shoulder on each tip permits the use of alligator clips, if this type of connection is desired.

The range of the instrument can be extended by the use of external multiplier resistors to measure high voltages. The Simpson Operator's Manual lists the values needed to extend the range to 6,000, 12,000, or 30,000 volts.

The Midgetester is housed in a smooth plastic case which surrounds the entire instrument. The face is of clear plastic, and the back cover is of black plastic.

PAUL C. SMITH

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Frequency Response in Magnetic Recording

(Continued from page 13)

the recording process. A recording head is an electromagnet, and its magnetic field varies with the signal current flowing through its coil. So, since the magnetic field of the head magnetizes the tape, the amount of signal current flowing through the coil of the recording head determines the strength of the magnetic patterns recorded on the tape. The magnetic

patterns are the recorded signal, and their strength is the level of the signal. This can be called constant-current recording because the level of the signal recorded on the tape is constant with respect to frequency.

Various things occur during the recording process to affect the frequency response. At high frequencies, the shunt capacity of the recording-head windings reduces the level of the recorded signal. Hysteresis and eddy-current losses in the core of the head can also cause the high-frequency response to fall off rapidly.

At high frequencies, the poles of the magnetic patterns formed on the tape are very close together and tend to demagnetize each other. This results in a loss of high-frequency response, and the loss increases with frequency and becomes very severe.

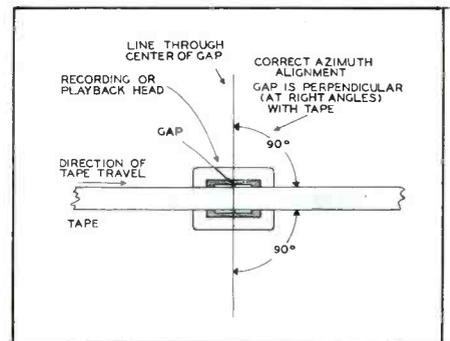
While discussing the influence that recording and playback heads have on frequency response, some things that have critical effects upon the operation of the heads should be mentioned.

Azimuth adjustment (the alignment of the gaps in the recording and playback heads so they are positioned at right angles to the direction of tape travel, as shown in Fig. 2) must be correct. Otherwise, the high frequency response will be reduced and excessive distortion will be produced.

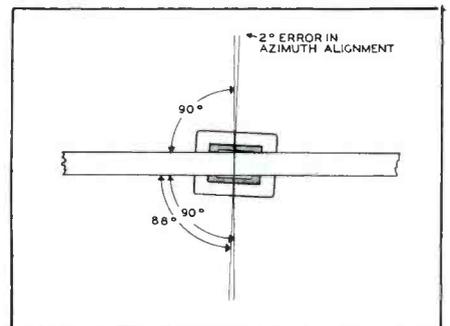
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(A) Correct.



(B) Incorrect.

Fig. 2. Azimuth Adjustment.

Excessive bias current can partially erase the higher frequencies and impair frequency response.

Overloading during recording will saturate the recording head and increase the effective width of the gap. Overloading disturbs the frequency response and produces distortion.

Characteristics of Tape

Two magnetic characteristics of tape, its remanence and coercive

force, influence frequency response. Remanence, the ability of the tape to become magnetized and retain its magnetism when the magnetizing force is reduced to zero, determines how well the low frequencies will be recorded on the tape. Coercive force, the opposition of the tape to a magnetic force which tries to reduce the magnetism of the tape to zero, has a definite effect upon high-frequency response.

As mentioned previously, at high frequencies the poles of the magnetic patterns in the tape are very close together and losses are high because of self-demagnetization. So, a tape with high coercive force to oppose this demagnetization is desirable. But a tape which has a high coercive force has a low remanence or flux density and does not record well at low frequencies.

High coercive force is not important at low frequencies, because wavelengths are long and the self-demagnetization is negligible.

Since the characteristic which aids in low-frequency response causes a loss to occur in high frequencies and since the one that increases high-frequency response produces a loss in low frequencies, a compromise must be reached.

Most improved tapes possess a high coercive force because, in most cases, an extended high frequency response is desired.

Tape Speed

High-frequency response is greatly affected by tape speed; whereas, low-frequency response is nearly independent of speed.

As the speed of the tape increases, the poles of the magnetic patterns recorded on the tape are spread farther apart, resulting in decreased self-demagnetization and reduced losses. Since demagnetization losses are negligible at low frequencies, tape speed has very little effect upon low-frequency response.

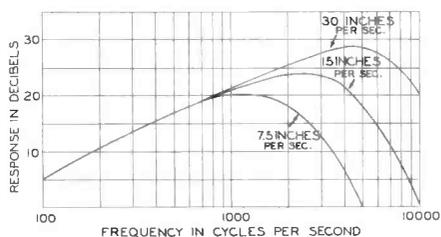


Fig. 3. Curves Showing the Effect of Tape Speed on Frequency Response.

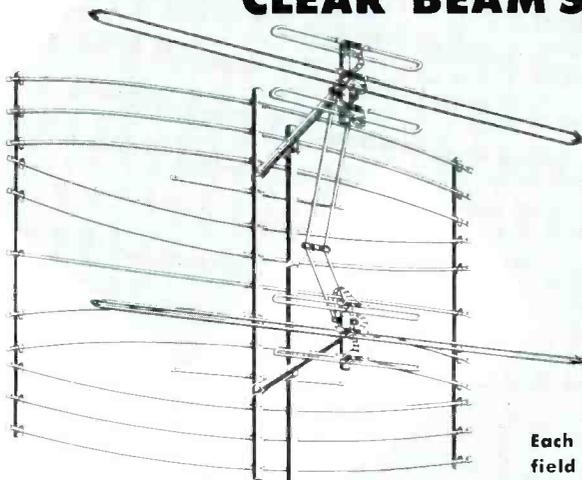
The frequency of maximum response increases with tape speed. If the speed is doubled, the frequency of maximum response will increase one octave. The curves in Fig. 3 illustrate the change in frequency response with increase in speed. Increased tape speed, besides increasing high-frequency response, also increases signal-to-noise ratio.

For most purposes, tape speed has become fairly well standardized -- 3 3/4, 7 1/2, and 15 inches per

second are the most commonly used speeds. Thirty inches per second and higher are used for extended high-frequency response when making certain types of high quality recordings. One and seven-eighths inches per second and no doubt slower speeds are sometimes used when recording voice or material for which wide-frequency response is not required.

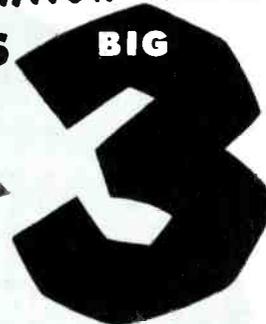
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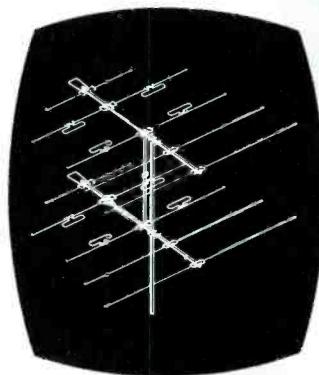
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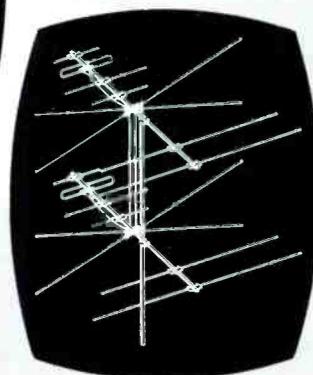
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Shop Talk

(Continued from page 17)

carrier, the other by modulating the carrier with a 400-cycle note.

Whichever method is employed, it is necessary to substitute fixed bias for any AGC bias that may be used. This can be achieved by connecting a source of bias voltage between the AGC line and ground. A suitable voltage to use is approximately -2 to -3 volts, unless the manufacturer specifies some other value in his alignment instructions. Or, with a station tuned in and the controls set for a normal picture, measure the AGC bias; then use this value in the gain measurements.

Considering the unmodulated-carrier method first, here is how to proceed. Apply the output of the signal generator to the control grid of the final video IF amplifier. Place a VTVM across the load resistor of the second detector. The VTVM is set to read DC, and the lowest scale is generally chosen. Next, adjust the generator output so that the meter reads some small value, possibly about .5 volt or less. Two things are important in this test. Do not drive any of the stages to saturation or cut-

off, and be sure to employ readings which can be accurately read.

(When a vacuum-tube detector is employed in the receiver, a preliminary voltage measurement across the load resistor should be made with no station or generator signal applied. Any voltage, such as contact potential, should be subtracted from all subsequent voltage measurements made across the load resistor.)

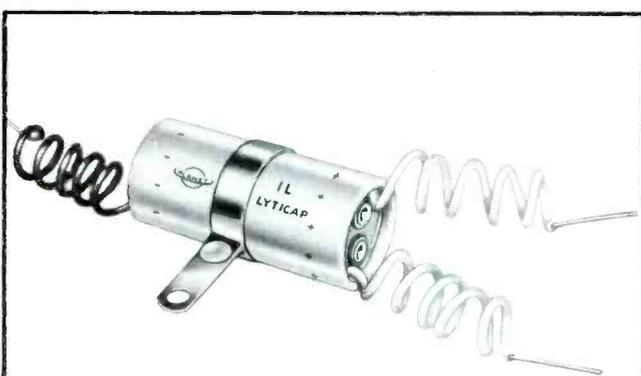
Next, shift the generator signal to the control grid of the preceding IF stage. The meter reading will increase; and if this new value is divided by the initial reading, the amplification of the next-to-last stage will be obtained.

To determine the gain of the second stage from the end, reduce the generator output until the VTVM reading is again .5 volt. Then move the generator back one stage, and note the VTVM reading. This new value divided by the initial .5 volt will be the gain of this stage.

The best video IF value to use is the mid-frequency of the passband. For example, in the 40-mc IF range, 43.75 mc is a good frequency. In the

20-mc range, use 23.75 mc. In stagger-tuned systems, the choice of the signal frequency may have some bearing upon the gain. This may be noted by rotating the dial frequency on either side of the chosen mid-frequency and by noting its effect upon the VTVM reading. If there is a marked rise in gain at some other frequency, that frequency may be used in the measurement.

The reader will note that by the foregoing method, we did not measure the gain of the final video IF amplifier. (We used this stage to set up the initial VTVM reading.) If the technician has a demodulator probe for his VTVM, then the following method will give him a fairly accurate indication of the gain in the last video IF amplifier. Apply the signal from the generator to the grid of the first IF amplifier. Then, with the demodulator probe, measure the signal voltages at the plate and grid of the final video IF amplifier. The ratio of plate-to-grid values will represent the gain of this stage. If you wish, you can check the accuracy of this method by using it to measure the gain of another video IF stage. Check this gain figure with the figure obtained by the previous method. If the two gain values are close, then the demodulator results can be accepted



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as obtained; however, if the demodulator value is higher or lower than the figure obtained by the other method, it should be corrected accordingly. For example, if you obtain a gain of 6 via the demodulator method, whereas the previous method indicated that the stage gain was 8, then any gain figures obtained using the probe should be multiplied by 8/6 or 4/3.

A second approach to video IF gain measurements is to use a modulated RF signal. In place of the VTVM, connect an oscilloscope across the load resistor of the second detector. By noting the changes in the peak-to-peak value of the 400-cycle wave as the input point of the RF signal is moved from plate to grid, we can determine the gain of an amplifier. This method requires some means of determining the peak-to-peak value of the 400-cycle wave developed on the scope screen.

In the RF stages, the signal generator can again provide a method of locating a stage with low gain or a break in the signal path. For convenience, a modulated RF signal is used and the horizontal-bar pattern is observed on the scope screen.

It might be supposed that there would be nothing that an RF generator could do in the sync-separator stages, but signal tracing is also possible in them. For this application, we resort to the 400-cycle note contained in the generator. This note will pass through the sync-separator stages and indicate whether a sync signal can get through these stages. For a detecting device, we can connect a jumper lead from the output of the sync-separator stages to the volume control. Any 400-cycle signal that passes through the sync-separator stage will then be heard from the loudspeaker. Absence of the signal indicates that it is not getting through the stage (or stages), and further point-by-point measurements are needed.

All in all, the RF generator is a very useful instrument to have around the shop; and the finer the instrument, the more reliable the results.

REVIEW

Commercial television is now in its ninth year, and many far-reaching advances have been made in design. For example, the average set of 1955 has fewer than 20 tubes, whereas the receivers of 1946 had 30 or more. Furthermore, over-all receiver sensitivity has increased considerably, and the equally important noise factor has gone down. Yet in spite of this substantial progress, antennas (par-

ticularly outside antennas) still are an important adjunct to the development of clear, noise-free pictures.

In a previous review (PF INDEX, June 1954), we discussed the corrective measures that should be taken after an antenna has been up for some time — generally about a year or so. Preceding this, however, is the initial problem of installing the antenna; and much of the subsequent maintenance which an array requires is directly related to the care taken when installation was first made.

An article containing an excellent summary of desirable installation practices appeared in the December 1954 issue of Radio & Television News magazine. The article is entitled "How Good Are Your TV Installations?" and was written by John B. Ledbetter.

Radio & Television News is published monthly by the Ziff-Davis Publishing Company, 366 Madison Ave., New York 17, N. Y. Subscription rates for the United States, its possessions, and Canada are \$4.00 per year. Single copies are priced at 35 cents.

Thirteen recommended installation pointers are discussed in the article. All are reviewed briefly in the following discussion, and it is suggested that the reader compare them with his own techniques to see whether there is any room for improvement.

1. Anchor the Mast Properly.

Do not use clamps or straps which will tend to rust or stretch. Pipe clamps and bracket mounts are suggested if the antenna mast is to be fastened to a wall or to one side of the house. For chimney mounting, straps or brackets may be employed, with brackets favored when the mast is heavy.

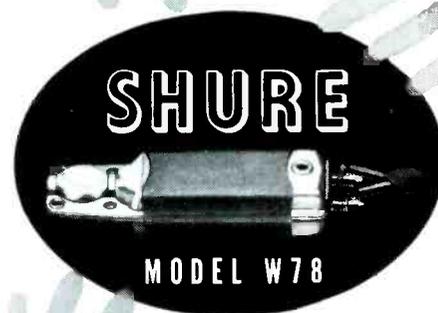
2. Use Guy Wires.

The damage which wind and snow storms have wrought on television antennas in recent months has emphasized the desirability of using guy wires when a mast extends higher than 5 to 8 feet. Mr. Ledbetter suggests three guy wires for masts 10 to 15 feet high, six for masts 15 to 25 feet high, and nine or more for greater heights.

In areas where the masts are subjected to high winds, self-supporting or guyed towers are suggested in place of the usual hollow mast. The initial cost is greater, but the former type of construction will give longer trouble-free life; and this is a factor

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†Dual-Weight, Dual-Volt Cartridge. Has weight slug secured by shrink-on band. With lead weight, net weight of cartridge is 25 grams. If 12 gram weight is desired, the shrink-on band can be cut off and the lead weight removed. In addition, Model W78 has capacitor, furnished as accessory. Without capacitor output is 4.0 volts; with capacitor output is 2.0 volts.

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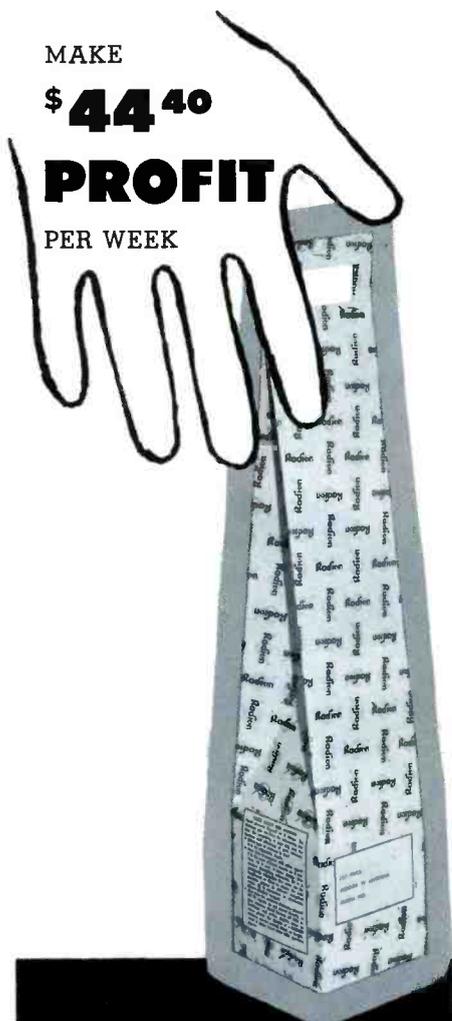
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which is beginning to carry greater weight with a good many customers.

For guy wires, the stranded type of No. 6 or No. 8 steel wire is recommended. It is frequently necessary to insert strain insulators in each guy wire to prevent the reradiation from these elements (which are, after all, equivalent to antennas) from producing ghost images on the receiver screen. There are those who recommend that the uninterrupted length of any guy wire should be made less than the shortest length of antenna; however, it is seldom necessary to break up a wire into this many sections. Your own experience will reveal how many insulators will be needed, but the number seldom exceeds one or two per wire.

3. Use Solid Anchor Points for the Guy Wires.

If the termination point is wood (such as beams or rafters), ordinary screw type anchors with an eye in one end will serve satisfactorily. For termination in brick, mortar, or concrete, some form of expansion bolt such as an Ackerman-Johnson is recommended. If the guy wire is terminated in the ground, specially constructed stakes having radiating spokes must be buried in the earth.

4. Use Ring Lugs.

Ring lugs, known also as solder or terminal lugs, should be clamped on the end of the lead-in wires before connecting the wires to the antenna terminals. This is a far more desirable practice than simply wrapping the lead-in wires around the antenna terminals and depending on the pressure of the terminal heads to hold the wires in place. Wires swing in the wind; and without a shake-free connection, they can be expected to work loose in a short time. By first clamping and then soldering a terminal lug onto the ends of the lead-in wires, the risk of the wires working loose is eliminated.

5. Secure the Lead-in.

A secure lead-in is a salient feature of every good installation and is one of the earmarks of a craftsman. Use a stand-off insulator every 4 or 5 feet on straight runs; use closer spacing, as required, when the direction of the lead-in is altered. The function of an insulator is to hold the line firmly in place. Do not crimp the line since this will alter its characteristics.

If separate lead-ins are employed for both UHF and VHF signals, use special stand-off insulators which act to prevent cross-coupling

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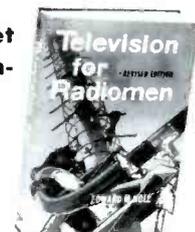
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TABLE I
TRANSMISSION-LINE LOSSES FOR VARIOUS
TEST FREQUENCIES AND LINE CONDITIONS

(In Decibels per 100 Feet)

TYPE OF LINE	100 MC		500 MC		1000 MC	
	Wet	Dry	Wet	Dry	Wet	Dry
	450-ohm open wire*	--	0.35	--	.78	--
300-ohm tubular wire	2.5	1.1	6.8	3.0	10.0	4.6
300-ohm flat wire	7.3	1.2	20.0	3.2	30.0	5.0
RF-59U cable	--	3.8	--	9.4	--	14.2
RF-11U cable	--	1.8	--	5.0	--	7.6

*Estimated values; unknown for wet conditions.

between lines. With UHF signals, it is particularly important that the line be kept as far away from building surfaces as possible.

6. Keep Twin-Lead Away From Metal.

Some metal surfaces most frequently encountered include drain pipes, downspouts, roof flashing, gutters, sheeting, vent pipes, and metal conduits. When a line is to be run over the edge of the roof, use enough insulators to prevent it from brushing up against the roof edge.

Also forbidden is the taping of twin lead-in lines to metal antenna posts. Finally, if shielding of the line is desirable, use coaxial cable. Do not run twin-lead through a pipe. The capacitance which the metal pipe shunts across the line may very well reduce signal strength below a usable level.

7. Protect Lead-in From the Weather.

In order to protect lead-ins from the weather, the following precautions should be taken:

a. Keep the horizontal runs in the lead-in as short as possible. A horizontal surface will permit rain or snow to collect, and the attenuation of a wet line is considerably higher than that of a dry line. A comparison of transmission-line losses in decibels per 100 feet is given in Table I. Note how sharply the attenuation of a 300-ohm flat line rises with moisture. The 300-ohm tubular line is considerably better in this respect and hence would be more desirable. Attenuation of open-wire lines is generally not appreciable, and shielded cables are

not affected at all by inclement weather.

b. Run transmission lines under eaves or straight down as much as possible.

c. If an antenna is mounted on a chimney and the chimney is never used, then the wire may be run down the center of the unit. Never do this when the chimney is to be used.

d. Mr. Ledbetter further suggests that if an antenna is chimney mounted, the array should be positioned so that it is least subject to the collection of soot, particularly across the antenna terminals.

8. Use a Good Ground.

For adequate protection, ground the antenna mast either to a cold-water pipe or by means of a wire to a ground. A rod with a diameter of 3/8 inch or more and a length of 4 to 6 feet will provide the proper low-resistance grounding if driven well into the earth. The grounding lead

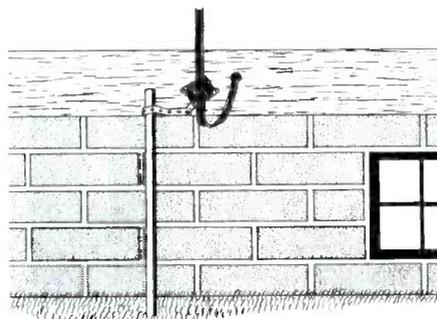


Fig. 2. The Best Position for a Lightning Arrester Is at the Point Where the Transmission Line Enters the House.

should be kept away from the building (if the construction is of wood or shingles). Use an insulated heavy wire, No. 10 or larger.

For those who ignore or pooh-poooh antenna grounding, reference should be made to the "Shop Talk" column in the February 1954 issue of the PF INDEX. The pictures there speak for themselves.

9. Use a Lightning Arrester With Twin-Lead.

In addition to the grounding protection afforded the antenna mast, similar protection in the form of a lightning arrester should be given the lead-in line and the receiver. The most common and the best place to install the arrester is the point where the lead-in line enters the house. See Fig. 2. The ground lead from the arrester may be run directly to its own earth ground, or it may be connected to the grounding lead of the antenna mast if the latter is convenient.

Coaxial transmission lines do not require special lightning arrestors so long as the precaution is taken to ground the outer shield securely. Doing this will afford adequate lightning protection and is sanctioned by the electrical code.

If more than one lead-in is used, install a separate lightning arrester for each line. Finally, clamp or bolt the ground-rod connections — never solder them.

10. Check Reception Before Securing Lead-in Permanently.

The reason for this pointer is so obvious that further discussion is unwarranted.

11. Check the Safety Features of the Antenna.

Safety features include the following: rigid mounting, keeping the antenna structure and lead-in lines away from power lines, and carefully inspecting the mounting surface (such as brick, concrete, or wood) to make certain the surface itself is secure.

The final two items in the article, Nos. 12 and 13, deal with special situations such as installing antennas on flat roofs, sun porches, or slate roofs. In all instances, be careful not to damage the roof. If mounting holes have to be made in the roof, cover these with pitch or caulking compound. On slate roofs, chimney mounting is your best bet.

MILTON S. KIVER

Deflection Yokes

(Continued from page 5)

is in proportion to the square of the cosine of the angle that is between the deflection axis of the coil and the radial position of the winding on the neck of the picture tube.

Service

Deflection yokes for the most part have the same general appear-

ance, size, and mounting feature; but there the similarity often stops. Deflection yokes come in different impedance combinations, deflection angles, insulation ratings, and have different damping networks. To provide sweep for the picture is only one function of the deflection yoke. The deflection yoke must also provide an accurate impedance match for the horizontal- and vertical-output stages so that no distortion will result from a mismatch. Troubles with deflection

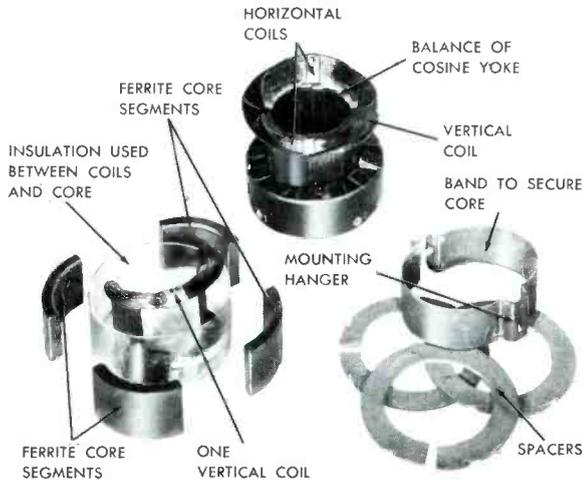


Fig. 4. Partially Disassembled View of a Cosine Yoke.

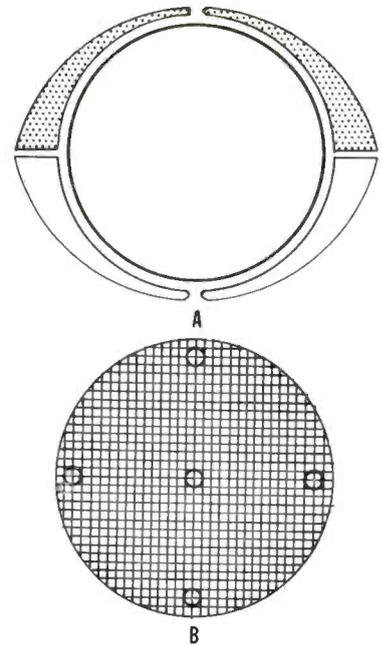


Fig. 5. (A) Cross-Sectional View of One Pair of the Deflection Coils of the Cosine Yoke. (B) Uniform Field Produced by a Cosine Yoke.

yokes will usually fall into one of five categories: (1) short circuits to the core, (2) shorted turns, (3) failure of the damping-network components, (4) open winding, and (5) short cir-

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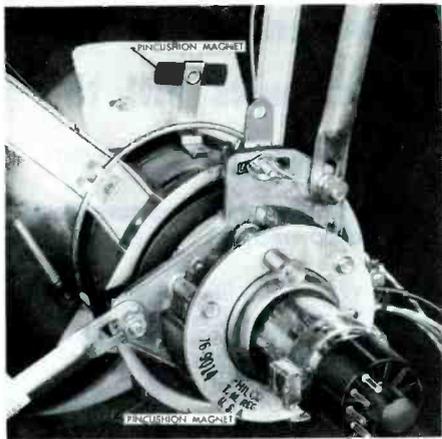


Fig. 6. Illustration Showing Installation of Magnets for Correcting Pincushion Effect.

uits between the horizontal and vertical coils.

Short circuits to the core and between the horizontal and vertical coils are usually characterized by excessive loading on the low-voltage power supply. Often, a shorted yoke will cause the plates of the low voltage rectifier tube to turn red or will cause the tube to fail completely. If the yoke connects to the receiver by a plug-in cable, the trouble may be quickly isolated by simply unplugging the yoke from its socket.

The location of faulty damping components requires that one end of each damping component should be unsoldered and checked with an ohm-meter or capacity checker as required. There are two methods of checking a deflection yoke for shorted turns: (1) substitution with a replacement yoke of known good quality, (2) checking the suspected yoke with one of the flyback and yoke testers such as the RCP Model 123 Flybacker which is manufactured by Radio City Products Company, Inc., Easton, Pa.

To locate an open coil in the vertical windings, it is necessary to disconnect one end of the deflection coil to be checked since the vertical coils are connected across the verti-

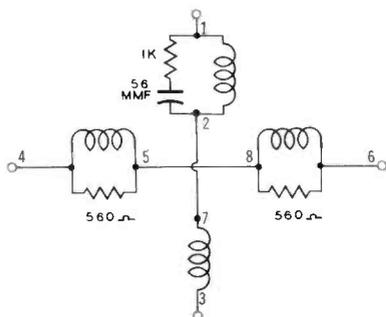


Fig. 7. Schematic of a Typical Deflection Yoke.

cal output transformer. The horizontal coils may be checked without disconnecting one end, provided that the receiver incorporates a coupling capacitor in the return lead from the horizontal coils. The schematic shown in Fig. 7 is representative of a good many of the deflection yokes now in use. The 1,000-ohm resistor in the horizontal-damping network is sometimes omitted.

Installation

Once it has been determined that the deflection yoke is defective, the next problem that arises is the proper installation and setup of the replacement yoke.

Replacement yokes of the different types may be supplied in one of three ways: (1) with the horizontal-damping components across either coil, (2) with the damping network components supplied but not connected, (3) without the damping network components. In order to make sure that the yoke will be installed properly, it should first be determined whether the horizontal-output transformer is of the isolated-secondary or autotransformer type. If the horizontal-output transformer is of the isolated-secondary type, the high side of the secondary winding should be connected to the horizontal coils of the deflection yoke at terminal 1, and the sweep-return lead should come from terminal 3. The damping network in this case should be connected across terminals 1 and 2 in the deflection windings.

If the horizontal-output transformer is of the autotransformer type, the high side of that portion of the autotransformer which serves as a source of deflection voltage should be connected to terminal 3 on the yoke, and the sweep-return lead should come from terminal 1. Again, the damping network should be connected from terminal 3 which is the point of highest AC potential to terminal 7 which is the center junction of the horizontal coils.

By using this procedure, the deflection yoke may be installed with the assurance that the picture will not be reversed in the horizontal plane and with the assurance also that the damping network will be located so that maximum reduction of ringing will be accomplished.

Since the damping resistor across each one of the vertical-deflection coils is the same, it is the usual procedure: (1) to connect the vertical coils temporarily; (2) to reverse the leads to the vertical coils, in case the picture should happen to be upside down; and (3) then to connect the vertical-deflection coils into the circuit permanently.



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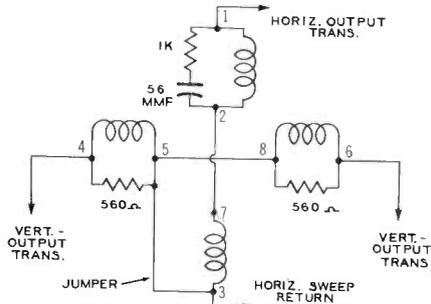


Fig. 8. Schematic of a Yoke in Which Boost Voltage Is Applied to the Vertical-Output Stage by Using Internal Connections in the Yoke.

In some direct-drive horizontal-output systems, high-impedance (30-millihenry) horizontal coils are used in combination with low impedance (3.5-millihenry) vertical coils in the deflection yoke. In this case, it is usually necessary to connect a 270-mmf or other small capacitor from a terminal at the center junction of the vertical coils to the one at the sweep-return end of the horizontal-deflection coils. The presence of this capacitor causes the center junction of the vertical coils to be at AC ground potential for horizontal-sweep frequencies and cancels the ringing which can be caused by inductive coupling between the horizontal and vertical coils.

In some late-model receivers, it has been the practice to apply boost B+ voltage to the vertical-output amplifier. This may be done by connecting the center junction of the vertical-deflection coils to the sweep-return end of the horizontal coils by means of a jumper within the yoke. This connection is shown in Fig. 8. When installing replacement yokes in receivers using this arrangement, always remember to add the jumper; otherwise, there will be no vertical sweep.

After the deflection yoke is properly installed so that the sweep is from left to right and from top to bottom, the yoke should be checked to see that it is as far forward on the neck of the picture tube as possible and that the scanning lines are exactly horizontal.

After replacing a deflection yoke, all the adjustments which are necessary for a proper picture should be made. These adjustment points include: the ion trap; the centering, focus, width, horizontal-linearity, and horizontal-drive devices; and the height and vertical-linearity controls. Careful adjustment of the receiver after any repair work has been done is very important because the customer is apt to be overly critical of the operation of the set after it has been repaired.

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Examining Design Features

(Continued from page 21)

Synchronization.

A composite video signal from the video output is coupled to the triode section of a 6AU8. The video is removed, and the sync pulses are further coupled to the sync clipper which is the triode section of a 6U8. The output from the cathode of this stage is applied to the vertical-sweep section; whereas, the output from the plate of the sync clipper is applied to the horizontal-sweep section.

Vertical Oscillator and Output Amplifier.

The Muntz Chassis 47A4 is unusual in that only one tube, a 25L6GT, is used for both the vertical-oscillator and vertical-output functions. A partial schematic and the waveforms in the circuit are shown in Fig. 4. The explanation of the operation of the circuit can best be made by following the sequence of events that take place in the circuit, beginning with the instant that the vertical sync pulse is applied.

Current is flowing through the tube until the negative sync pulse arrives from the cathode of the sync clipper. The sync pulse is applied to the screen of the 25L6GT and causes the plate current to decrease. The magnetic field which had been built up around the winding AB of transformer T2 suddenly begins to collapse, and a negative voltage is applied to the screen of the tube from winding CD. This voltage acts to decrease the plate current still further, and the action is cumulative until the tube is cut off. The cutoff of current through the tube takes place very rapidly; and immediately thereafter, ringing occurs in the circuits of the tube. A

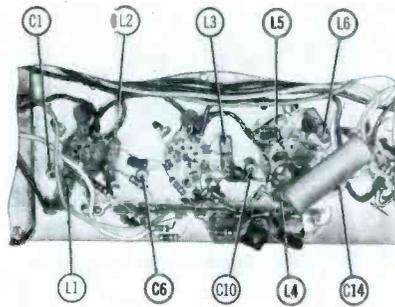


Fig. 3. Underchassis View of Video IF Strip in Muntz Chassis 47A4.

high positive pulse of voltage appears on the plate. This pulse is coupled to the grid of the tube through capacitors C57 and C56, but it is limited in amplitude by the flow of grid current which charges C56 to the polarity shown on the schematic of Fig. 4. Although the plate and control grid of the tube have positive voltages during this half cycle of ringing oscillation, the screen grid is highly negative; consequently, the tube cannot conduct, and ringing continues. The second half cycle of ringing causes a negative pulse on the plate and grid. When the grid voltage reaches the cutoff level at the conclusion of this pulse, the plate and screen are both positive; and the tube begins to conduct, and the next vertical scan begins. After conduction begins, ringing is immediately damped out; and the rate of rise in plate current is controlled by the rate of positive rise in control-grid voltage. The latter, in turn, is controlled by the discharge time of capacitor C56. Plate current flows until the next sync pulse arrives at the screen grid, and the sync pulse starts the cycle once again.

The vertical-linearity control R6 governs the amount of charge which is placed on C56 during retrace, and the vertical-hold control R5 fixes

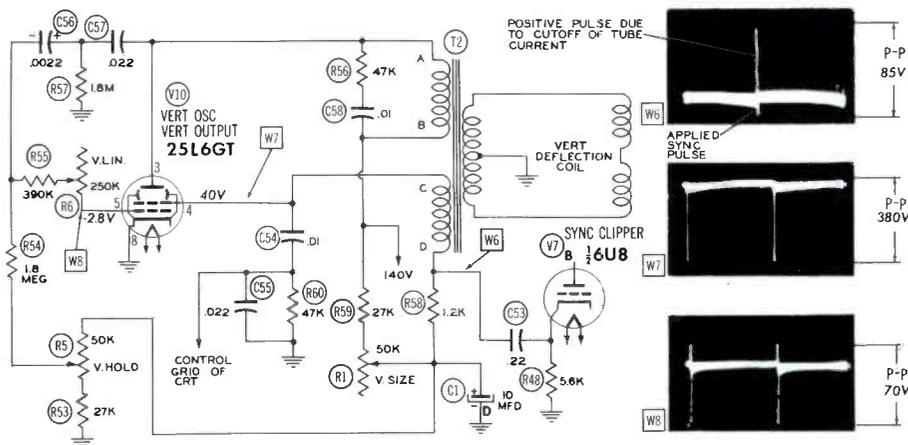


Fig. 4. Schematic Diagram of Vertical Oscillator and Output Circuit in Muntz Chassis 47A4.

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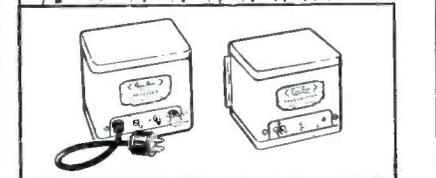
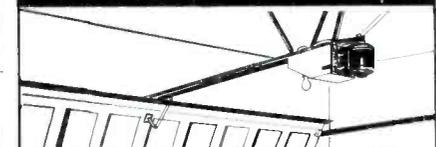
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the bias on the control grid. This bias level influences the frequency of the oscillator. Vertical size is determined by the setting of R1 in the screen circuit of the tube.

Horizontal Sweep.

Control of the horizontal sweeping rate is provided by a 12AU7 in a pulse-width type of AFC system. A 25BQ6GA supplies the output power for the sweep and for the high voltage. The high-voltage rectifier is a 1X2B, and damping action is provided by a 25AX4GT.

Power Supply.

An autotransformer is used to raise the line voltage slightly. A selenium rectifier provides the direct current, and a filter choke smooths this current. The output from this selenium rectifier is 140 volts DC, and this is reduced to approximately 125 volts by the time it reaches the plates of the tubes. Since this is a rather low plate voltage, it should be noted that any change in the selenium rectifier will have an effect greater than usual upon the performance of the set.



Fig. 5. Philco Electrostatic Speaker.

PHILCO ELECTROSTATIC SPEAKER

The development of high-fidelity sound reproduction has resulted in a number of different arrangements for reproducing the higher audio fre-

quencies. Philco has reintroduced the electrostatic speaker for this function. The original electrostatic speakers were used quite a few years ago, but they were not widely used nor perfected to a high degree because of the lack of suitable dielectric materials.

The Philco Model 1758 radio-phonograph combination uses the electrostatic speaker shown in Fig. 5 for reproducing the frequencies between 7,000 and 20,000 cycles. Its construction is similar to that of a capacitor in that each has two plates separated by a dielectric. In the speaker, one plate is fixed in position and the other is movable to a very slight degree. The movable plate has a large area in order to move a sufficient quantity of air. This plate consists of a layer of gold deposited on a polyester plastic film which serves as the dielectric.

The layer of gold and the plastic film have practically no mass so that only a small electrostatic force is necessary to move them. The force is provided by an AC voltage which is derived from the plate of one of the output tubes, as shown in the schematic of Fig. 6. The AC voltage is superimposed upon a DC voltage, and the strength of the electrostatic field

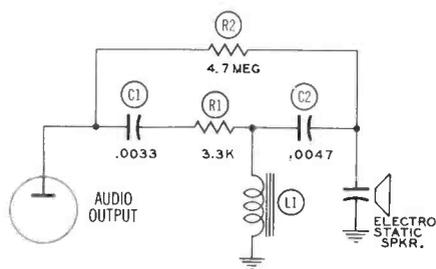


Fig. 6. Schematic diagram of Circuit Used With Electrostatic Speaker in Philco Receiver.

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Fig. 7. Zenith Model R512R Push-Button Radio.

between the two plates varies in direct proportion to the audio modulation. The movable plate or diaphragm follows the variations in electrostatic force and reproduces the audio signal.

The Zenith Model R512R, a photograph of which is shown in Fig. 7, is an AC-DC portable that utilizes push-button tuning to cover the broadcast band from 540 to 1700 kc. With the exception of the automatic push-button controls, it employs a conventional circuit composed of a 12BE6 converter, a 12BA6 IF amplifier, a 12AT6 detector and audio amplifier, a 50C5 power amplifier, and a 35W4 rectifier.

The automatic-tuning assembly is shown in the schematic in Fig. 8 and is composed of the oscillator coils L8, L9, L10, L11, L12, and oscillator shunt coil L7, along with the antenna

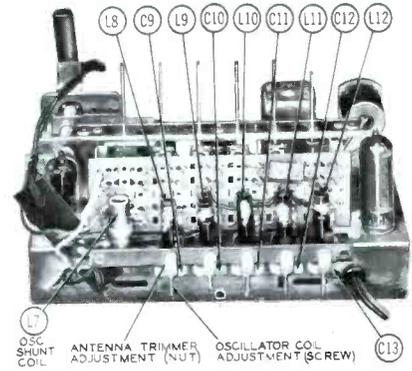


Fig. 9. Coils and Capacitors in Tuning Assembly of Zenith Model R512R.

trimmer capacitors C9, C10, C11, C12, and C13. The arrangement of these coils and capacitors on the chassis can be seen in the photograph shown in Fig. 9. For ease of identification, the coils are coded with colored dots. The dot on L8 (750 to 1700 kc) is white, on L9 (700 to 1500 kc) is blue, on L10 (650 to 1400 kc) is green, on L11 (600 to 1300 kc) is red, and that on L12 (540 to 1200 kc) is yellow. For push-button operation, a tuning-bar arrangement places the desired coil for the selected station in parallel with the oscillator coil L2. At the same time, the correct trimmer capacitor is placed in parallel with the antenna loop.

To adjust a particular automatic push button to the frequency of a specific station, first rotate the oscillator screw adjustment to the desired station, then rotate the antenna-trimmer adjustment for maximum sensitivity.

William E. Burke and James M. Foy

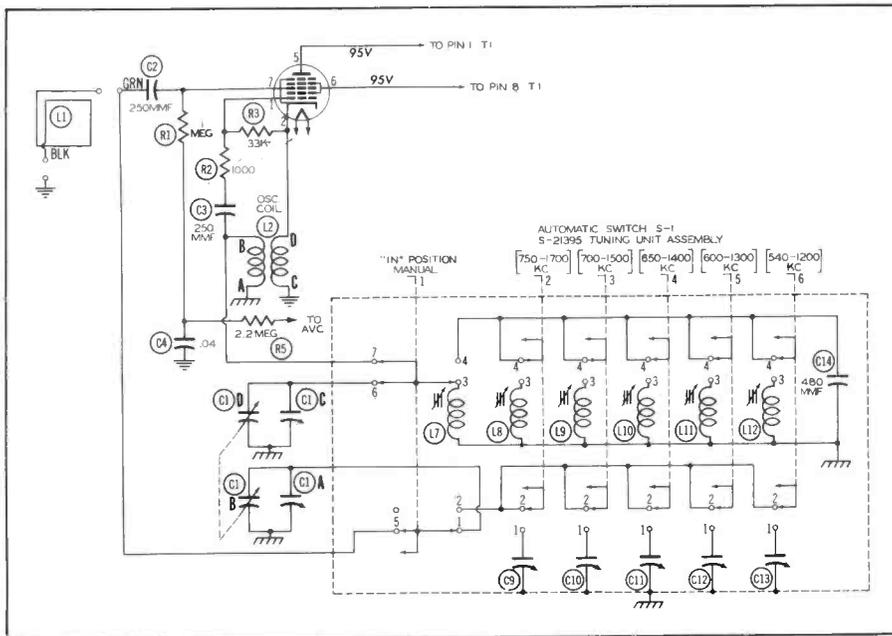


Fig. 8. Tuning Circuits in Zenith Model R512R.

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Radio Alignment

(Continued from page 25)

Another tracking feature is the use of slotted rotor plates in the tuning capacitor. The terms "slotted

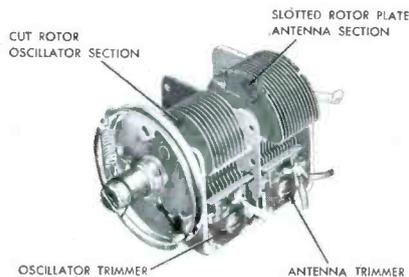


Fig. 2. Tuning Capacitor of a Small Radio Receiver. A Cut Rotor for the Oscillator Section and Slotted Plates for Antenna Tracking Adjustments Are Shown.

rotor" and "cut rotor" should not be confused. Both of these features are illustrated in Fig. 2. The cut rotor has already been mentioned and refers to rotor plates smaller than those used in the RF or antenna section of the tuning capacitor. The term slotted rotor describes the condition in which the outside plates of a rotor section are slotted to permit easy bending of portions of these plates. In this manner, the plates may be adjusted to give more or less capacity at certain parts of the tuning range.

General Alignment Procedure

Alignment of small radios usually assumes a more or less set procedure. The alignment technician attaches some measuring device to the receiver to indicate the relative strength of the detector output. This device may be an output meter or an AC meter across the voice coil. Some technicians like to use an oscilloscope as an AC indicator for the added sensitivity it affords, but it has a disadvantage in that difficulty is experienced in judging the point of maximum indication for small changes in amplitude.

A VTVM across the AVC line is favored by some as an indicating device; however, using a VTVM in this fashion also has its advantages and disadvantages. Among the advantages are: (1) no modulation is required for an indication and (2) the volume control may be turned down to eliminate the distraction caused by noise from the loudspeaker.

If the receiver employs delayed AVC, there is a disadvantage in using the VTVM across the AVC line. The input signal must be increased somewhat in order to overcome the delay in the AVC action; consequently, the



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alignment will not be made at the point of most sensitive receiver operation. Another disadvantage in using the VTVM in this way is that sometimes the AVC line is not so readily accessible as the voice-coil terminals on the speaker. In other instances, however, the AVC line may be returned to the rotor plates of the antenna-tuning capacitor or to one terminal of the loop antenna. Either of these test points can be reached easily.

When using an output meter across the voice coil of the speaker, the volume control should be fully advanced and only enough signal input to obtain an indication should be used. This will avoid driving the AVC into operation, and a maximum sensitivity of response to any adjustment which might be made will be assured. It is common practice to start adjustments at the last IF stage and work toward the front. The IF signal used for alignment is commonly fed to the converter tube at the same point that receives the station signal from the RF stage or from the antenna of the receiver. It is good practice to use a blocking capacitor with the signal generator and to use an isolation transformer for supplying power to the receiver.

The oscillator adjustment can be made next with the alignment signal applied at the same point as that just mentioned for the IF alignment. Often, all alignment signals are introduced at the antenna input of small sets; and this fact simplifies the alignment procedure considerably.

The alignment instructions in Chart I give a convenient method of coupling the signal generator to the loop without a direct connection. This method ensures a minimum of detuning in the receiver circuits. The trimmer capacitor for the oscillator is adjusted with the receiver tuned to the high-frequency end of the band. This is the normal thing to do because the effect of the trimmer is greater at the high-frequency end of the band than at the low-frequency end. At the high end, the trimmer capacitance is a large percentage of the total capacitance which consists of trimmer capacitance, oscillator-tuning capacitance, and the distributed capacitances of coils and other circuit components. At the low-frequency end of the range, trimmer capacitances and distributed capacitances contribute less to the total tuning effect; therefore, any tracking adjustments at the low end of the range are usually made by altering the amount of inductance. When provision for changing the amount of inductance is not made, bending of the slotted rotor plates may compensate for

tracking deficiencies at either end or at the middle of the range.

After the adjustment of the oscillator, adjustment of the antenna trimmer is made for best tracking at one of the higher frequencies. Common choices of the designers are around 1400 kc or 1500 kc. The setting of the antenna trimmer adjusts the receiver for maximum sensitivity at the chosen frequency. Then it is customary to check the tracking near the 600-kc tuning point and to make any slight adjustments that will increase the sensitivity at that point. Any adjustment made at this lower frequency will affect the tracking at the high end; therefore, alternate adjustments for maximum sensitivity are recommended first at the high end then at the low end until no further improvement can be made. These adjustments should end with the one made at the higher frequency, because a slight adjustment of capacity has a greater effect at the high-frequency end.

With receivers having an RF stage, tracking adjustments for this stage usually follow the oscillator adjustment and are made in a manner similar to the antenna adjustment just described. Both antenna and RF tracking adjustments are usually performed at the same points on the tuning range.

FM and Multiple-Band AM Receivers

Much of the alignment procedure mentioned also applies to FM receivers and to multiple-band AM receivers. Addition of other bands to an AM receiver increases the number of necessary tracking adjustments but does not affect the IF alignment. Alignment of the RF sections of an FM receiver resembles that of an AM receiver in principle. Alignment of the IF stages can also be similar, but the FM detector requires its own individual treatment.

Two methods of alignment of the IF stages of an FM receiver may be used, or sometimes a combination of both may be used. One method is the use of an RF signal generator and a VTVM, and the other is the use of an RF sweep generator and an oscilloscope. The latter is called a visual-alignment procedure and is especially suited to FM detector alignment and to alignment of wide-band IF systems. It is also used for aligning AM receivers having wide-band IF stages. The sweep generator furnishes a signal which varies in frequency over a certain range on each side of a center frequency which is adjusted to equal the intermediate frequency. This variation occurs at an audio rate which may be 60, 120, or 400 cycles

per second. Thus, all the frequencies to which the IF stages ordinarily respond are covered repeatedly at the sweep rate; and the response of the tuned stages to these frequencies can be viewed on the oscilloscope.

Some form of detector is required in order to view the IF response of the FM receiver, because the intermediate frequency of most of these receivers is above the response range of general-purpose oscilloscopes. The necessary detector action may be obtained at the grid of the last limiter stage or across the FM detector itself.

Fig. 3 shows the response curves obtained during an FM alignment. The curve of Fig. 3A may be obtained at either the limiter grid or across the detector load resistor. In Fig. 3B, the output of the detector as applied to the audio amplifier is shown. This waveform is obtained when the sweep rates of the generator and the scope are the same. If the scope rate is twice that of the generator, the butterfly waveform of Fig. 3C is obtained.

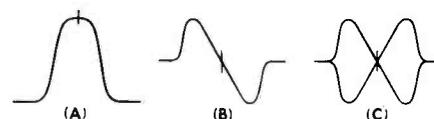


Fig. 3. Alignment Response Curves Obtained During the Alignment of FM Receivers. (A) At the Grid Load Resistor in the Limiter Stage. (B) At the Input to the Audio Stages with Scope Sweep Rate Equal to Generator Sweep Rate. (C) At the Input to the Audio Stages with Scope Sweep Rate Equal to Twice the Generator Sweep Rate.

The waveforms mentioned are really graphs traced by the oscilloscope, and they show the relative amplitude of the response of the circuit which is connected between the generator output and the scope input. The response is shown for all the frequencies covered by the sweeping action of the generator. These waveforms provide a means of checking the adjustments of the tuned circuits involved.

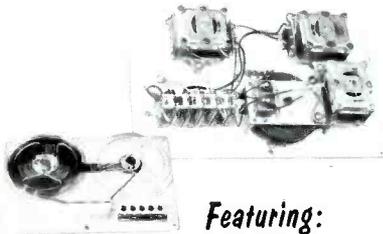
The use of markers enables the technician to pinpoint the response at any frequency on the response curve. The markers shown in Figs. 3A, 3B, and 3C indicate the intermediate frequency of the receiver. Typical alignment adjustments are made: (1) with the IF slugs in order to obtain at the last limiter stage the response of Fig. 3A, (2) with the slug in the primary of the discriminator transformer or in the primary of the ratio-detector transformer in order to obtain across the detector load the

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response of Fig. 3A, and (3) with the slug in the secondary of either the discriminator or ratio detector transformer in order to obtain at the input to the audio stages the waveforms of either Fig. 3B or 3C.

Instead of being obtained by these curves, the same sort of information — that is, the amplitude and symmetry of response, the straightness of the linear portion of the curve, and the crossover point — could be obtained by using a VTVM and an RF signal generator; but this would involve much time and many VTVM readings.

Special Cases

Alignment of any particular receiver should follow the alignment instructions for that receiver very closely. In special cases, however, the technician may be justified in taking some liberties in order to obtain a compromise which seems best to him under the circumstances.

In some locations, a strong local station may broadcast on a frequency which is the second harmonic of the intermediate frequency of the receiver; and in that case, one may hear an interfering squeal when listening to that station. One example would be that of a station that is broadcasting on 910 kc and is being received by a radio having an intermediate frequency of 455 kc. By shifting the intermediate frequency slightly from 455 kc, the technician should be able to reduce this type of interference. If the shift is too great, he may experience trouble in making the receiver track across the band.

Another type of interference similar to the one just mentioned is the reception of image frequencies. Such interference results from the fact that two different frequencies may beat with the local oscillator to produce the intermediate frequency. Assume that a receiver is tuned to a station operating on 600 kc. The local oscillator is tuned to 1055 kc, and the 455-kc intermediate frequency is obtained as the difference beat. If another signal of 1510-kc frequency should beat with the oscillator, this signal will also result in a 455-kc difference and will interfere with the first signal. This sometimes happens when the second signal is very strong. The tuned circuit of the antenna will greatly reduce the response of the receiver at 1510 kc; but if the signal is very strong, some of it may reach the converter to cause the interference just mentioned. An RF stage preceding the converter will do much to reduce this type of interference. The 1510-kc frequency is called an "image frequency" of the 600-kc

frequency of the desired station because both are separated from the oscillator frequency by an equal amount, one above and the other below.

A choice of a high intermediate frequency reduces the number of image frequencies that can occur over the broadcast range. If image frequencies are troublesome, the technician may try to eliminate the interference by shifting the intermediate frequency slightly.

Another liberty that may be taken, if there is considerable mis-tracking and if it defies correction, is to adjust the tracking to favor the stations of the owner's choice or to favor a weak station in preference to a strong one.

Little has been said in this article concerning alignment of auto radios; therefore, it might be well to call attention to at least one feature. Alignment of an auto radio is usually not complete until the radio has been replaced in the automobile and the antenna trimmer has been adjusted. These steps in service literature usually read somewhat as follows: "Replace the radio in the car, extend the antenna fully, and adjust the antenna trimmer for maximum sensitivity on a weak signal near 1400 kc." This procedure is necessary because the capacity of the car antenna affects the tracking at the high frequencies and because the capacity may be different with each individual antenna.

All the aspects of alignment have not been covered in the foregoing discussion, but it can be seen that there are many fine points to radio alignment and that it requires more than just a "lick and a promise." The conscientious technician has plenty of opportunity to exercise his skill on the "lowly" radio, and the result will be a job that he can view with pride.

PAUL C. SMITH

ADDENDUM

The WALSCO PC-9 TV chassis distributed by Walsco Electronics Corporation of Los Angeles and Chicago is identical to the CALTECH chassis T1 described in the article "Examining Design Features" in the January 1955 issue of the PF REPORTER. The information given therein is therefore also applicable to the WALSCO PC-9.

1C. B & K (B & K Manufacturing Co.)

Bulletin No. 102-P tells how servicemen can make money and retain customers with new low-cost, portable CRT Cathode Rejuvenator. *See advertisement page 66.*

2C. CHICAGO STANDARD (Chicago Standard Transformer Corp.)

TV Library. Auto-Radio Transformer Replacement Guide. *See advertisement page 8.*

3C. CLEAR BEAM (Clear Beam TV Antenna Co.)

Descriptive Literature on "Big 3" All Bank Fringe Antennas. *See advertisement page 71.*

4C. DUMONT (Allen B. DuMont Laboratories, Inc.)

Cathode-Ray Tube Data Chart. (1955 Edition) Complete technical data on all TV picture tubes. Ideal for replacement information. *See advertisement page 20.*

5C. EICO (Electronics Instrument Co., Inc.)

1955 12-page EICO Catalog describing the complete EICO line of 38 Kits and 42 Wired Instruments. Tells how to save 50% on your test equipment. *See advertisement pages 78, 82.*

6C. ERIE (Erie Resistor Corp.)

Bulletin on Erie Suppressors. *See advertisement page 48.*

7C. FENTON (Fenton Company)

Literature on Vortexion tape recorder; Motek transport mechanism; Rex Record Changer; Adaphone; Pillowphone; Miniature Earsets; TUF-GUY guy wire; Twistube; Fentube-Air-spaced. *See advertisement page 84.*

8C. IRC (International Resistance Company)

Form S-052—New Power Resistors. *See advertisement 2nd cover.*

9C. JACKSON (Jackson Electrical Instrument Co.)

Complete Line Folder—4 pages of complete information and specifications on all Jackson "Service-Engineered" Test Equipment. *See advertisement pages 56, 57.*

10C. JERRCLD (Jerrold Electronics Corp.)

Catalog, Jerrold Multi-Outlet System. *See advertisement page 76.*

11C. JFD (JFD Manufacturing Co., Inc.)

"Roto-King" Rotator Brochure and "Star-Helix" TV Antenna Brochure. *See advertisement insert.*

12C. MACMILLAN (The Macmillan Company)

New 1955 Catalog of Technical & Business Books on TV, Radio and Electronics. *See advertisement page 74.*

13C. MALLORY (P. R. Mallory & Co., Inc.)

FP and WP Electrolytic Capacitor Replacements. *See advertisement page 14.*

14C. OHMITE (Ohmite Manufacturing Company)

Bulletin No. 146—Brief description of Ohmite Fuse Resistor, Stock No. FR-7.5. *See advertisement page 59.*

15C. OXFORD (Oxford Electric Corp.)

Speaker Catalog. *See advertisement page 70.*

16C. PHAOSTRON (Phaostron Company)

Information on the New Model "555" pocket size Multimeter. *See advertisement page 38.*

17C. SAMS (Howard W. Sams & Co., Inc.)

Spring 1955 Book List. *See advertisement page 64.*

18C. SHURE (Shure Brothers, Inc.)

General Catalog No. 55. Microphones, phono cartridges and magnetic recording heads. *See advertisement page 73.*

19C. SPRAGUE (Sprague Products Company)

M-711 Descriptive circular on Ceramikit cabinet assortments of disc ceramic capacitors built like miniature letter files. *See advertisement page 2.*

20C. TRIAD (Triad Transformer Corp.)

Catalog TV-55, Replacement TV Guide, listing Triad Correct Replacement Television Transformers. *See advertisement page 60.*

21C. TRIO (Trio Manufacturing Co.)

Four color brochure on New Trio "Aristocrat" rotator control units. Ask for Form No. 101. *See advertisement page 42.*

22C. TRIPLETT (Triplett Electrical Instrument Co.)

Test Equipment Catalog Featuring Model 631 Volt-Ohm-Milliammeter and Vacuumtube Voltmeter. *See advertisement page 28.*

23C. TUNG-SOL (Tung-Sol Electric, Inc.)

Broadside, Form T-1, showing all sales promotion and service aids for Tube Distributors and Service Dealers. *See advertisement pages 46, 47.*

24C. TURNER (The Turner Company)

Bulletin No. 966 describing Turner Model 57 Slender Dynamic Microphone. *See advertisement page 50.*

25C. UCP (United Catalog Publishers, Inc.)

Descriptive literature on THE MASTER—the official buying guide of the Radio-TV-Electronic parts industry, with list of distributors. *See advertisement page 66.*

26C. XCELITE (Xcelite, Inc.)

Revised catalogs and supplementary literature on complete lines of screwdrivers, nut drivers, combination kits and pliers. *See advertisement page 72.*

27C. BOGEN (David Bogen Co., Inc.)

Complete New Public Address System Catalog. (NOTE: Bogen ad appeared in January PF REPORTER. Listing was omitted through error.)

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COLOR TV TRAINING SERIES

QUESTIONS ON PART X

James W. Adams



REPORTER

INDEX TO ADVERTISERS
March, 1955

Part X of the Color TV Training Series, appearing in this issue, should be studied prior to reading the following questions.

The questions are presented to give the reader an opportunity to test himself on the color-television material in this issue.

1. Into what two categories may three-beam color picture tubes be divided?
2. With respect to the electron-gun assembly used in the later type tube, how are the guns positioned to aid in obtaining static convergence of the beams at the shadow mask?
3. What advantage with respect to convergence is gained by using a curved instead of a flat mask and screen?
4. What auxiliary components used with a tube employing the magnetic principle can be adjusted to obtain optimum color purity?
5. What auxiliary components are used to obtain beam convergence at all points on the shadow mask of this tube?
6. The color-purity magnet directs the red beam so that it will converge with the blue and green beams. True or false?
7. What is the purpose of the lateral-correction magnet?
8. What special precautions are taken with respect to the deflection yoke used with a tube employing the magnetic principle?
9. What is the nature of the voltages applied to the coils of the convergence electromagnets that are used with a tube of this type?
10. Where do these voltages originate?

C. P. O. & V. M. R.

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Cumulative Index

No. 49
MARCH-APRIL 1955

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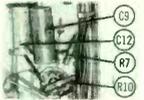
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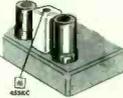
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7. Transformer winding resistances appear on the schematic.
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9. Exclusive photo coverage of all chassis views is provided for each receiver. 
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12. Photo coverage helps identify burned-out or missing parts.

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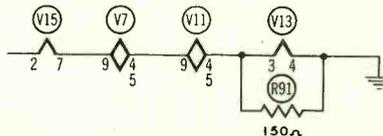
13. Complete, detailed alignment data is standard and uniformly presented in all Folders.
14. Alignment frequencies are shown on radio photos adjacent to adjustment number—all alignment adjustments are keyed to schematic and photos. 

TUBE PLACEMENT CHARTS

15. Top and bottom views are shown. Top view is positioned as chassis would be viewed from back of cabinet.
16. Blank pin or locating key on each tube is shown on placement chart. 
17. Tube charts include fuse location for quick service reference.

TUBE FAILURE CHECK CHARTS

18. Shows common trouble symptoms and indicates tubes generally responsible for such troubles.
19. Series filament strings are schematically presented for quick reference.



COMPLETE PARTS LISTS

20. A complete and detailed parts list is given for each receiver.
21. Proper replacement parts are listed, together with installation notes where required.
22. All parts are keyed to the photos and schematics for quick reference.

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23. Each Folder includes time-saving tips for servicing in the customer's home.
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Cumulative Index to PHOTOFACT FOLDERS

No. 49 • Covering Folder Sets Nos. 1 through 270 • World's Finest Electronic Service Data

HOW TO USE THIS INDEX

To find the PHOTOFACT Folder you need, first look for the name of the receiver (listed alphabetically below), and then find the required model number. Opposite the model, you will find the number of the PHOTOFACT Set in which the required Folder appears, and the number of that Folder. The PHOTOFACT Set number is shown in bold-face type; the Folder number is in the regular light-face type.

IMPORTANT—1. The letter "A" following a set number in the Index listing, indicates a "Preliminary Data Folder." These folders were designed to provide immediate basic data on TV receivers. Many of these were later superseded by regular Photofact Folders. In those cases where short production runs and/or limited distribution prevented availability of a sample chassis the "A" designation has been retained.

2. Models marked by an asterisk (*) have not yet been covered in a standard Folder. However, regular PHOTOFACT Subscribers may obtain Schematic, Alignment Data or other required information on these models without charge by supplying make, model or chassis number and serial number. (When requesting such data, mention the name of the Parts Distributor who supplies you with your PHOTOFACT Folder Sets.)

3. Production Change Bulletins contain data supplementary to certain models covered in previously issued PHOTOFACT Folders, and are listed in this Index immediately preceding the listing of the original coverage of the model or chassis. These Bulletins should be filed with the Folders covering the models to which the changes apply.

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NOTE: PCB Denotes Production Change Bulletin. Production Change Bulletin Nos. 1 Through 63 Are All Contained in Set No. A-200. * Denotes Television Receiver.

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(CM-1) indicates service data also available in Howard W. Sams 1947 Record Changer Manual. (CM-2) indicates service data available in Howard W. Sams 1948 Record Changer Manual. (CM-3) indicates service data available in Howard W. Sams 1949, 1950 Record Changer Manual. (CM-4) indicates service data available in Howard W. Sams 1951, 1952 Record Changer Manual. (CM-5) indicates service data available in Howard W. Sams 1953 Record Changer Manual.

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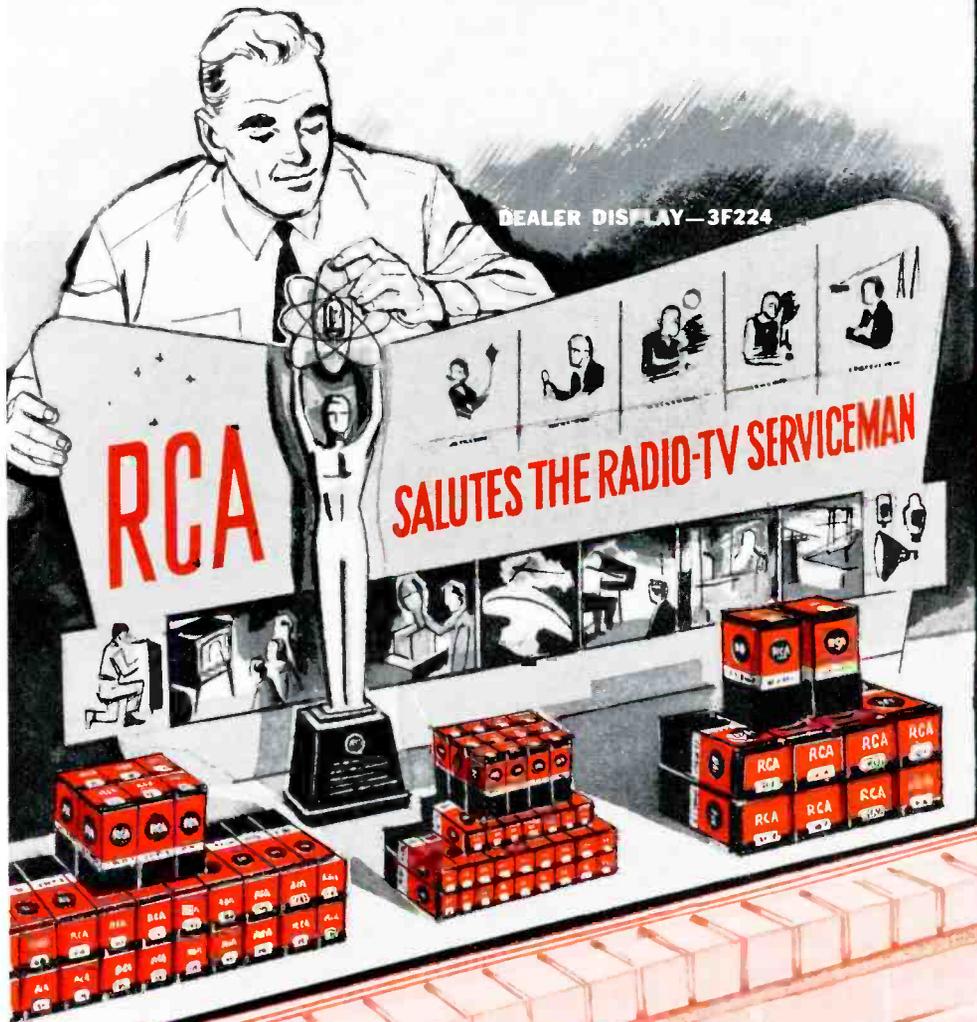
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 3C10 (CM-5) 215-17
 3F10 (CM-5) 220-11
 4A10 255-18
WIRE RECORDING CORP.
 WP (CM-2) 76-19

GET READY FOR . . . NATIONAL TELEVISION SERVICEMEN'S WEEK MARCH 7-12



DEALER DISPLAY—3F224

Television dealers and service technicians all over the country are preparing to tie-in with a great promotional event. It's National Television Servicemen's Week, March 7-12, sponsored by the RCA Tube Division and registered officially with the Chamber of Commerce of the United States.

You can use this unique merchandising plan right in your own neighborhood to meet and sell more television service prospects than ever before. Your RCA Tube Distributor offers you excellent promotional materials to help you identify yourself and your store with this nationwide consumer promotion.

Plan an active participation in National Television Servicemen's Week now. Act today! See your RCA Tube Distributor for full details.



RADIO CORPORATION of AMERICA
ELECTRON TUBES HARRISON, N.J.

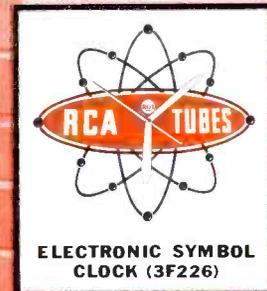
Use These Promotional
Materials



ELECTRONIC STATUETTE
(3F220)



PROMOTION KIT (3F223)



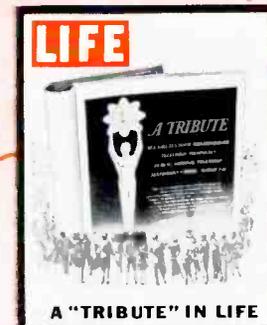
ELECTRONIC SYMBOL
CLOCK (3F226)



TV SERVICE SIGN
(3F230)



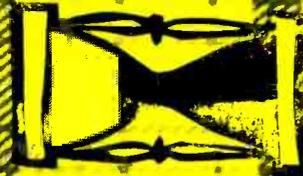
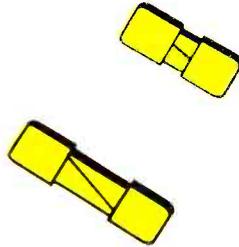
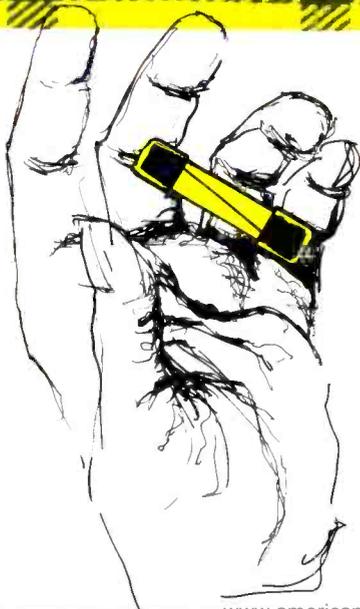
TEST EQUIPMENT
AWARDS



A "TRIBUTE" IN LIFE

THE RIGHT FUSE

AT HAND: TIME SAVED: YOUR PROFIT



LITTELFUSE



YOUR BENCH BOX

For the average TV-radio service operation this box provides the perfect container for the right number of fuses you should keep on hand. Supplied to you as a service by your distributor. The cover lists the fuses most widely used in TV, radio and communications service. You or your distributor salesman can replenish your stock quickly by checking what is in the box against the listing on the lid.

Ask your distributor today for full information on these time-saving money-making service aids. Littelfuse also provides illustrated price sheets, cross-reference sheets and fuse guides. For your convenience Littelfuse products are listed and cross-referenced in all Howard Sams Photofact folders.



FUSE DISPENSER

Ideal where your service turnover is greater. A revolving drum with self-dispensing channels to hold the individual boxes of fuses. No time lost in looking for the proper fuse—no time lost taking inventory of your stock—no time lost because you do not have the right fuse.



ONE CALL KIT

One call is all. This kit provides the fuse you need for 94% of all TV fuse service calls. A real service, the perfect assortment in the perfect container for your portable tool box.