MAY • 1956
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PF REPORTER

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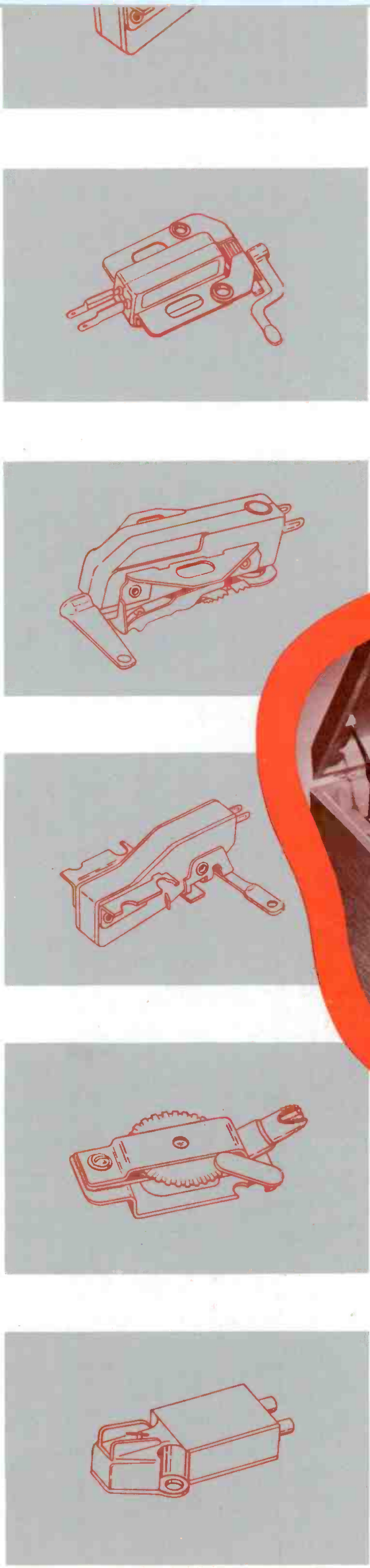
for the Electronic Service Industry



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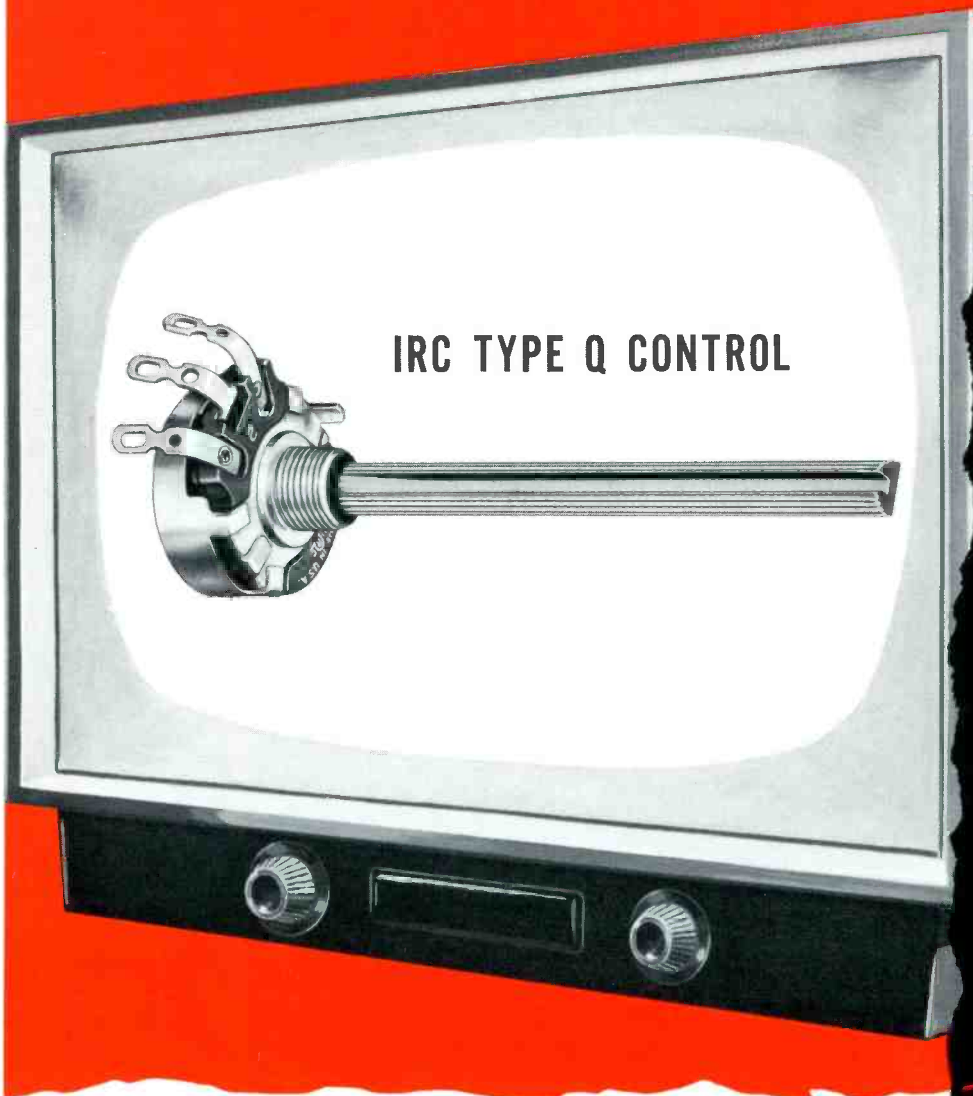

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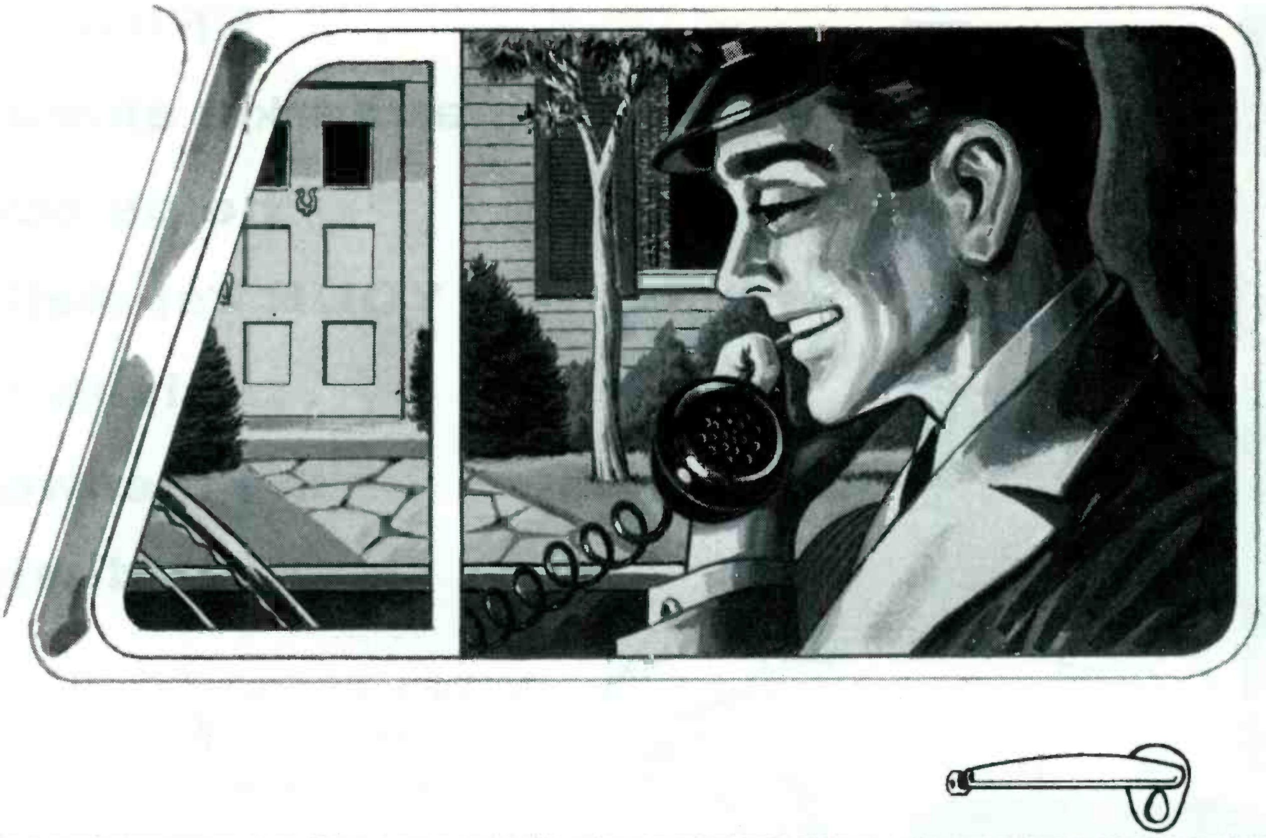

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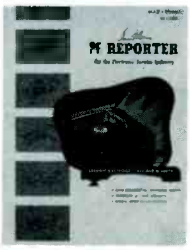

ABOUT THE COVER

Line drawings of some ceramic cartridges that are currently available are shown on the cover. For information about these cartridges, see "Audio Facts" by Robert B. Dunham on page 26. Cover design by Glenn R. Smith

PUBLICATION INFORMATION

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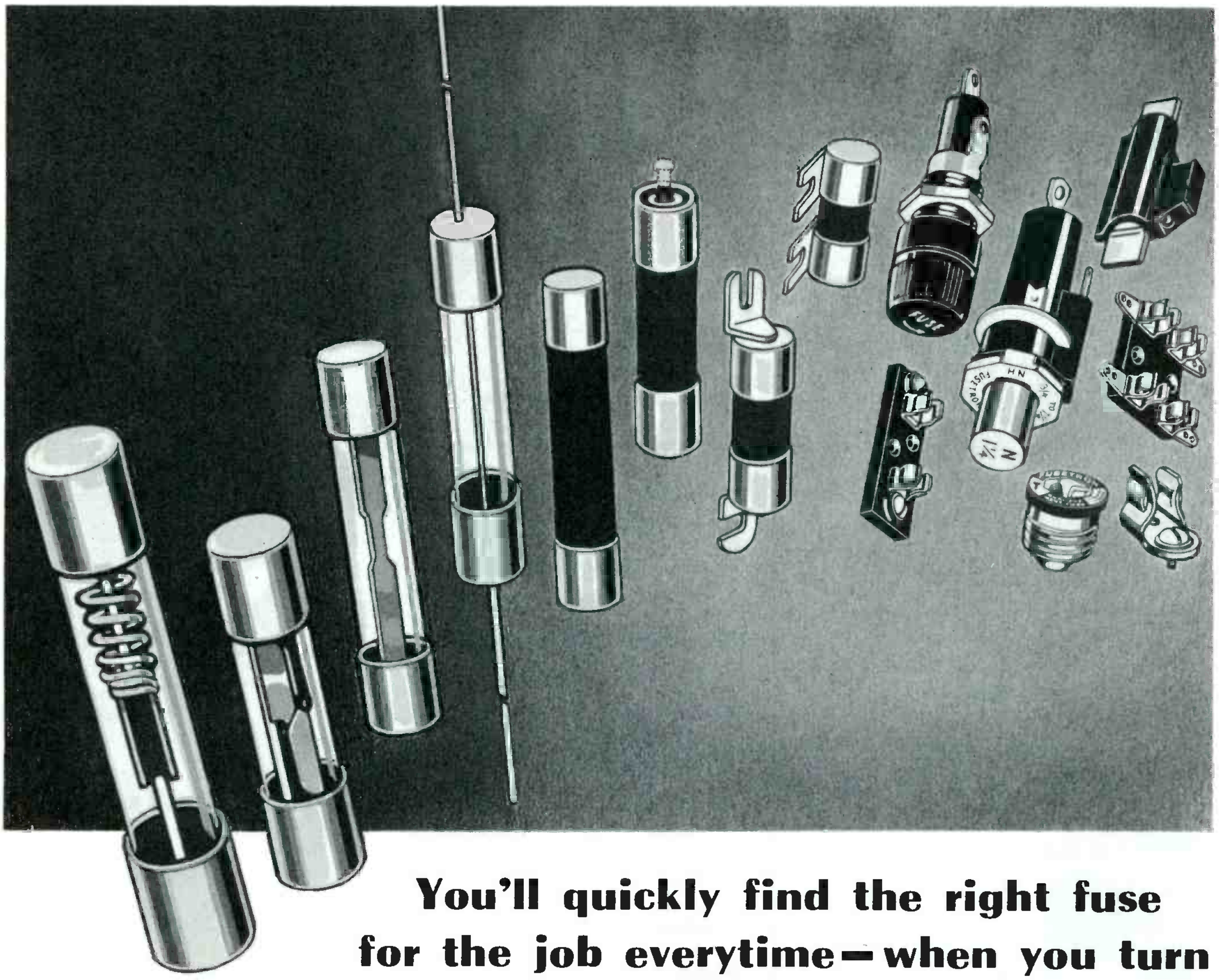

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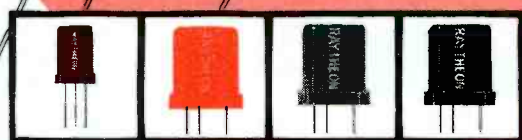
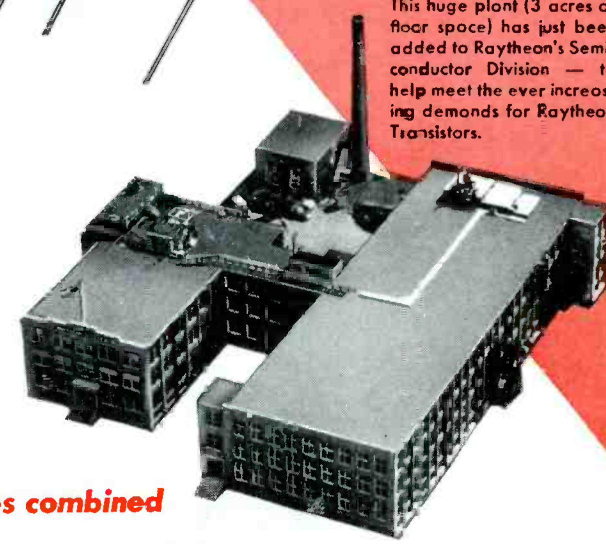


ACTUAL SIZE



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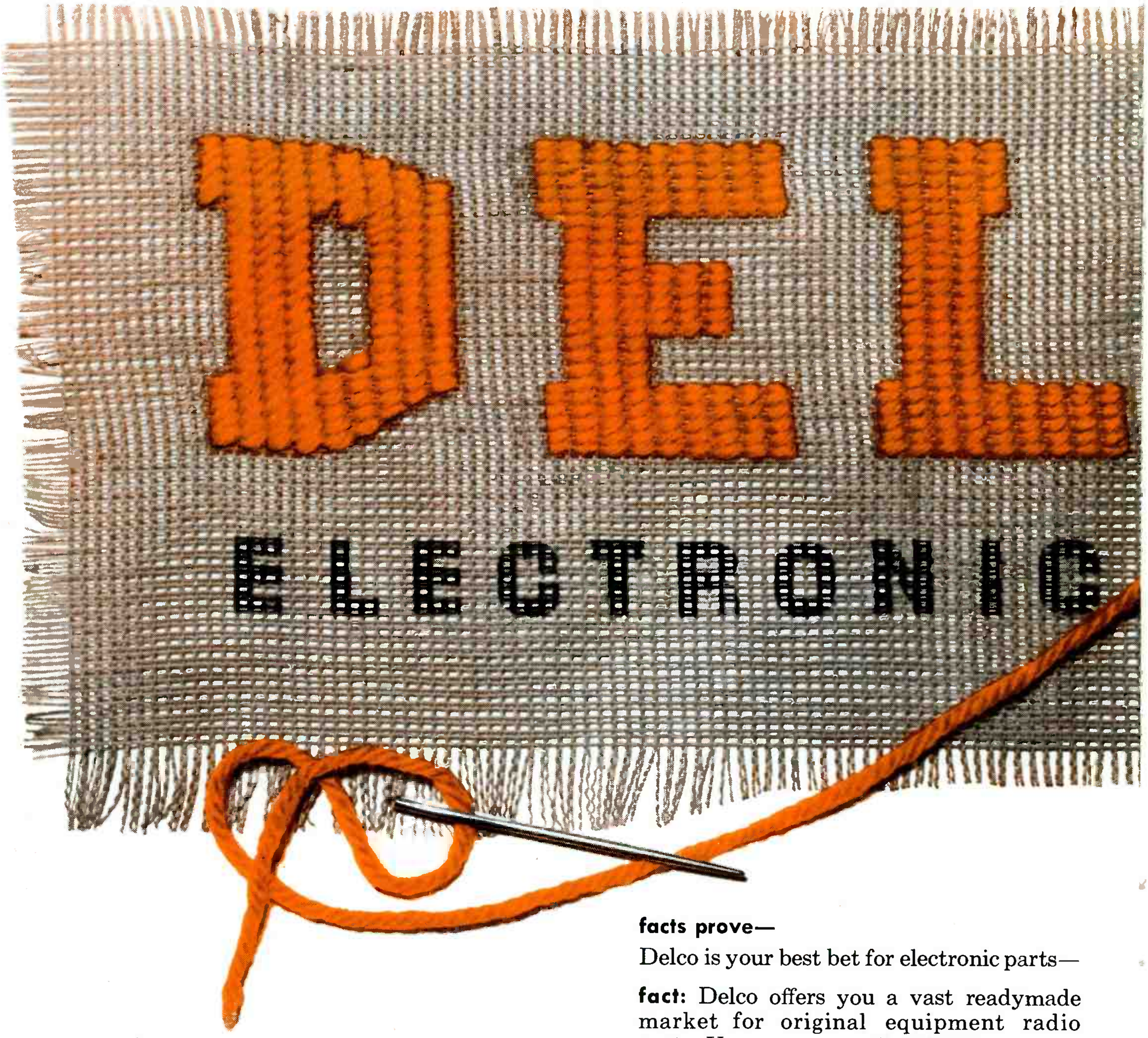

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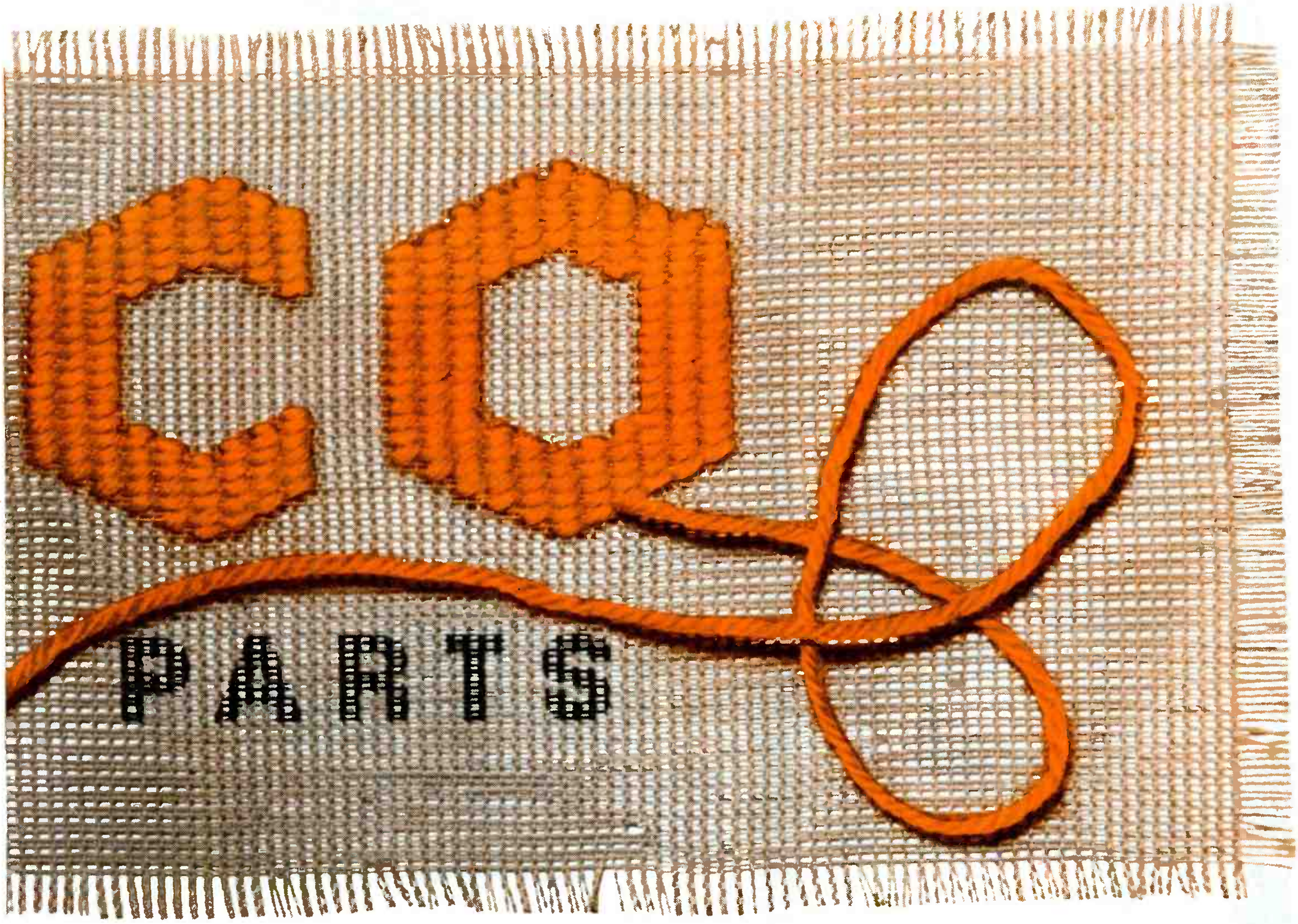

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LETTERS *to the* EDITOR

Dear Editor:

With reference to your item in the January *PF REPORTER* concerning water on the floor behind the TV set, this is an experience that might be of interest to you.

Our location is such that rotators are necessary for good reception. Many of our installations were put in with four-wire round cable. Soon we had complaints that the control boxes were "leaking." Naturally, we discounted this and tried to place the blame on vases or lamp planters used for decorations on the TV set. On one call, however, we found the doily under the control box completely saturated and no vase or planter in existence. Keeping a careful check on this case revealed that water was seeping down the tube which encased the control leads. It proved to be a result of capillary action; and in some later cases, it was due not only to water at the open ends but also to condensation that formed within the plastic tube.

Since we had carefully made drip loops in the wire, we assumed that this was not a complete cure. So, in each succeeding installation, we put a small hole in the tubing at the lowest part of the drip loop. Using this method or using flat wire cures the "leaking" control boxes.

J. H. Larry, Mgr.,
Home Electronics
St. Albans, Vermont

Previous articles in the PF REPORTER have presented information on the proper installation of tubular lead-in, including the sealing of the tube end and the punching of a hole in the lowest part of the drip loop. The item in the January issue and reader Larry's experience illustrate the importance of these measures.—Editor

Dear Editor:

We wish to take serious exception to the conclusions reached in the article "Interference Rejection" in your January issue. For the most part, the statements in the article are essentially correct in theory. However, we believe that this article is extremely misleading to any serviceman who may attempt to solve interference problems with the technique you described, for these reasons:

1. No mention is made of the loss in gain which occurs when this system is used. It can be calculated that when two antennas are pointed in different directions and connected by a stacking harness, the gain or sensitivity is reduced to at least 6 db *below* the gain of properly stacked antennas. Since the usual stacking gain is near 3 db, this means that the gain of the arrangement recommended in the article is 3 db lower than one of the antennas used alone. To put it another way, 6 db is a loss of 75% of the signal power. It can be seen that such a system is highly inadequate for any area except a very strong signal area.

2. It was emphasized that this system is effective in eliminating adjacent-channel interference. However, a better way to attack this particular problem is by proper adjustment of the adjacent-channel traps in the IF circuitry of the TV receiver. A much greater problem today is co-channel interference. And since such interference is encountered only in fringe areas, the system you describe, because of its extremely low gain, is a very poor solution for the problem.

3. What happens when two antennas are connected in this unorthodox manner? The antenna bay receiving the desired signal is actually feeding both the set and the other antenna. Therefore, half of the received signal is being re-radiated by the antenna which is not oriented to the transmitter. It is possible that this re-radiated signal may in itself become the source of interference for the other TV owners in the neighborhood.

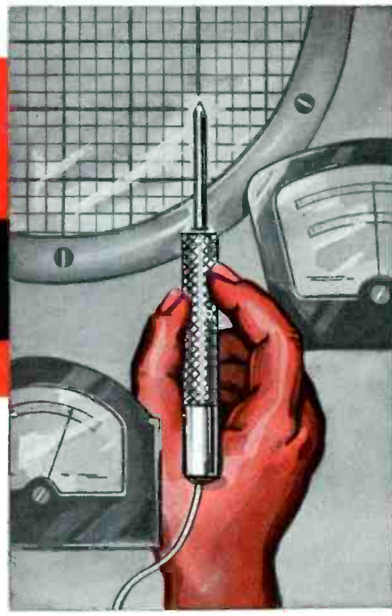
We sincerely feel that servicemen in these areas looking for a solution to this problem will be severely disappointed in their results if they use the system described in this article.

Any system that attempts to eliminate interference by substantially reducing gain is, to say the least, impractical. Nearly all problems of interference and "ghosting" can be solved by the selection of one of the many specialized and high power television antennas commercially made today.

Julius Green, *Project Engineer*
Channel Master Corp.
Ellenville, N. Y.

As Mr. Green states and as noted in the article, different products and systems are available and may be used to solve specific interference problems. The article in the January issue was intended only to present information on one recently developed system.—Editor

Notes On TEST EQUIPMENT



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

by Paul C. Smith

Fig. 1. EICO Model 232 VTVM.

EICO MODEL 232 VTVM

The Electronic Instrument Company, Inc., (EICO) manufactures the Model 232 VTVM shown in Fig. 1. This VTVM has many features which make it suitable for TV servicing. One is its ability to measure high voltages and the peak-to-peak value of complex waveforms.

The instrument employs a 6AL5 dual diode as a full-wave, peak-to-peak rectifier for measuring AC voltages and a 12AU7 dual triode in a balanced bridge circuit to operate the meter movement. The power supply employs a transformer and selenium rectifier.

The Model 232 can measure DC voltages up to 1500 volts, of either positive or negative polarity. The input resistance for DC voltage measurements is 11 megohms. This includes 1 megohm in the probe. With an accessory high-voltage probe, the range of DC voltage measurements can be extended to 30,000 volts. There are 6 DC voltage ranges, with the lowest range from 0 to 1.5 volts. Accuracy on DC voltage ranges is stated as being ±3 per cent of full scale or better.

The Model 232 will give accurate indications of the peak-to-peak values of AC voltages, as was stated in the first paragraph; however, it will not indicate the correct rms values of waveforms other than sine waves. The technician is seldom interested in rms values of other waveforms. Most measurements of this type will be confined to AC filament voltages and AC power line voltages having a sine waveform.

There are 7 rms ranges up to 1500 volts and 7 peak-to-peak ranges up to 4200 volts. The lowest rms range is from 0 to 1.5 volts, and the lowest peak-to-peak range is from 0 to 4 volts. These latter two ranges are on separate meter scales from the other AC voltage ranges.

The accuracy on all AC voltage ranges is stated as ±5 per cent of full scale or better. The frequency response is from 30 cycles to 3 megacycles when the voltage source has an impedance of 100 ohms or less. With the use of an accessory RF probe, the frequency response is extended to 250 megacycles with an accuracy of ±10 per cent. The AC input impedance is 1 megohm shunted by approximately 60 micromicrofarads.

Seven resistance ranges are provided from 0 to 1000 megohms. The center of the scale indicates 10 ohms when the VTVM is set to the Rxl range.

All measurements other than RF measurements are made using one probe. A rotating tip on the probe is used to switch from DC operation to AC-OHMS operation.

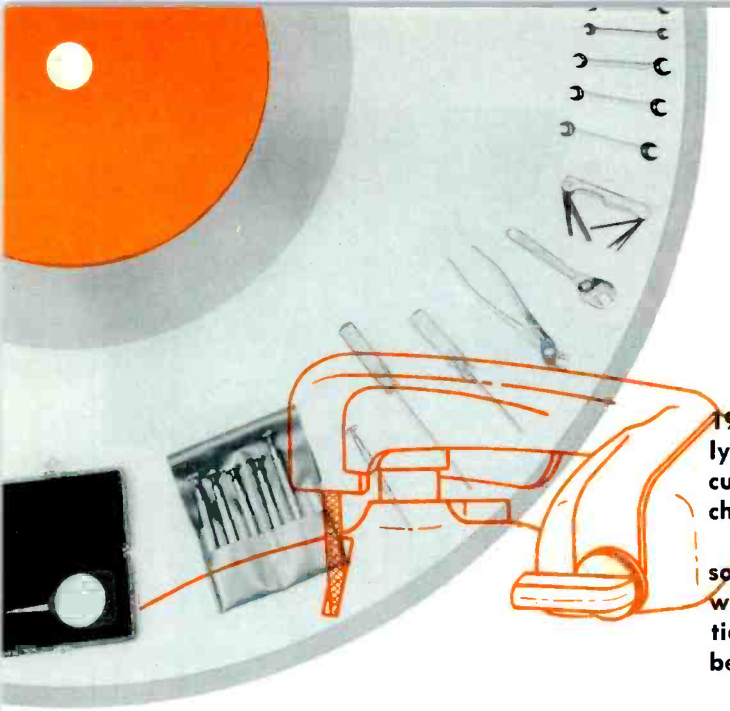
The Model 232 VTVM uses a 4½-inch meter mounted in a metal case 8½ by 5 by 5 inches.

EICO MODEL 324 SIGNAL GENERATOR

The Electronic Instrument Company, Inc., (EICO) makes the Model 324 signal generator which is designed to provide a signal suitable for general radio and television servicing as well as for other applications requiring a modulated or unmodulated RF signal of sine waveform from 175 kilocycles to 420 megacycles. The instrument is shown in Fig. 2.

The frequency range mentioned is covered in 7 ranges. The lowest 6 are at fundamental frequencies, and the seventh range is

· *Please turn to page 46*



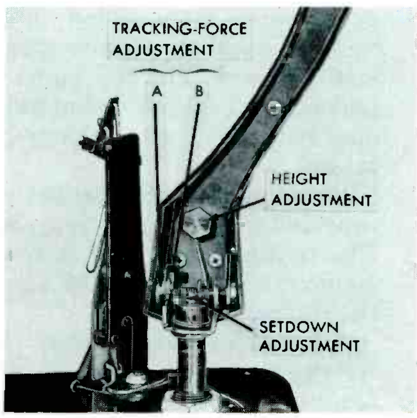
RECORD-CHANGER ADJUSTMENTS

PART II

This is the second of a two-part series that began in the April 1956 issue. In the first part, the basic adjustments that can normally be made in the home and those of a general nature were discussed. Specific adjustments required for the Admiral and V-M changers were also covered.

In this second part, the basic adjustments will be given for some additional record changers. The more complex adjustments will not be covered; therefore, for any required work not mentioned in these articles, consult a service manual for the changer being serviced.

by **Calvin C. Young, Jr.**

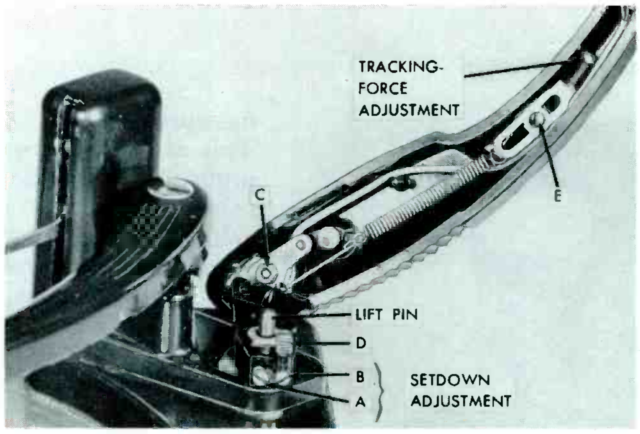


Adjustments for Crescent Changers

SETDOWN. Pull the power plug from the AC socket. Place a 7-inch record on the turntable. Operate the reject knob, and then release it. Rotate the turntable by hand until the tip of the needle is about ¼ inch from the record. Adjust the setdown screw so that the needle will land approximately ⅛ inch from the outer edge of the record.

HEIGHT. The height screw should be adjusted so that the tone arm just clears a record resting on the spindle shelf. In this position, the needle should also clear a stack of twelve 10-inch records on the turntable. Clockwise rotation of the height screw causes the tone arm to rise.

TRACKING FORCE. The needle pressure should be between 8 and 12 grams. To adjust the pressure, loosen screw A and adjust the lever B; then tighten screw A.

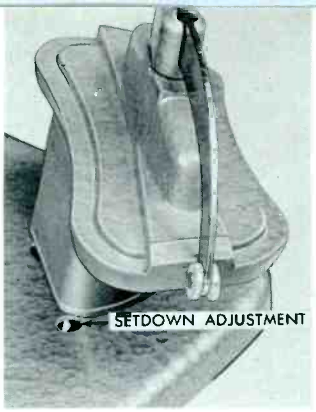


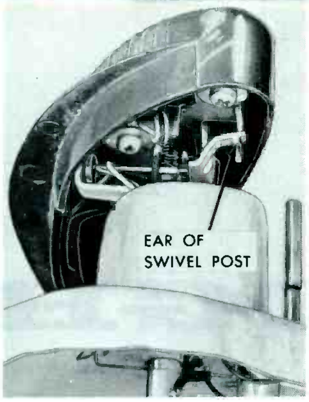
Adjustments for Collaro Changers

SETDOWN. If the setdown positions are erratic, first make sure that nut C is securely tightened. Pull the power plug from the AC socket. Place a 7-inch record on the turntable. Turn the control knob to the REJECT position and then release it. Operate the turntable by hand until the needle is about ¼ inch above the record. The needle should set down approximately ⅛ inch inside the outer edge of the record. If the setdown point is not correct, it may be corrected by means of screws A and B. To move the setdown point toward the center of the record, loosen screw A and tighten screw B. This adjustment is very sensitive, and therefore the screws should be turned by only a small amount (approximately ⅛ turn) each time until the correct setdown position is obtained.

HEIGHT. The height to which the pickup arm is lifted during the change cycle is controlled by the lift pin. To adjust the height, switch off the power when the pickup arm has just swung outward over its rest. The lift pin may then be screwed up or down to the point where the pickup arm will clear its rest by ⅛ inch. The depth to which the pickup arm may be lowered is controlled by screw D. With the changer out of cycle, adjust the screw D so that the underside of the arm will be level with the top of the turntable.

TRACKING FORCE. The tracking force should be adjusted according to the specifications of the cartridge manufacturer. To reduce the tracking force, loosen screw E and turn the adjustment screw.



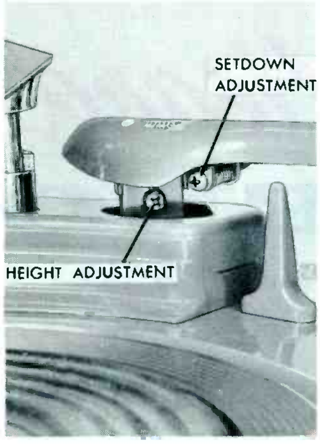


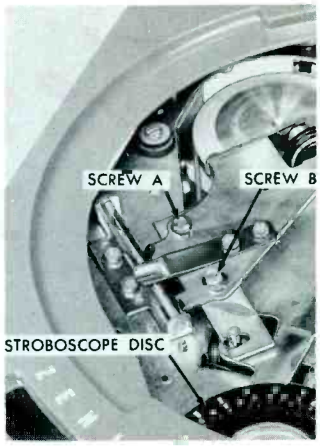
Adjustments for Philco Changers

SETDOWN. Pull the power cord from the AC socket. Put the record shelf in the 12-inch position. Place a 12-inch record on the turntable. Actuate the control knob to the REJECT position, and then release it. Operate the turntable by hand until the needle is about $\frac{1}{4}$ inch above the record. Adjust the setdown eccentric screw so that the needle will land approximately $\frac{1}{8}$ inch inside the outer edge of the record. Check the setdown position on 7- and 10-inch records. If the setdown position varies, then it will be necessary to consult the service manual for a complete adjustment procedure.

HEIGHT. Bending the protruding ear on the swivel post causes the height of the arm to change. With the changer out of cycle, check the clearance between the needle and the base plate. The correct clearance is $\frac{1}{8}$ inch plus or minus $\frac{1}{16}$ inch. Bending the ear upward will decrease the clearance. When the correct clearance between the base plate and the needle has been obtained, then raise the tone arm to its maximum height and place it against the arm rest. There should be a clearance of approximately $\frac{3}{32}$ inch between the lower edge of the tone arm and the top of the hook of the arm rest.

TRACKING FORCE. No provision is made for adjustment of the tracking force.





Adjustments for Zenith Changers

SETDOWN. Place a 7-inch record on the turntable, and move the setdown selector to the 7-inch position. Move the speed selector to the 45-rpm position. Depress the RECORD CHANGE button, and immediately unplug the power cord from the AC socket. Operate the turntable by hand until the needle is about $\frac{1}{4}$ inch above the record. Adjust the setdown screw so that the needle will land approximately $\frac{1}{8}$ inch inside the outer edge of the record. The setdown position should then be correct for all sizes of records.

HEIGHT. Adjust the height screw so that the tone arm will clear a stack of 12 unwarped records on the turntable as well as the underside of a record resting on the spindle shelf.

TRACKING FORCE. No provisions are made for adjustment of the tracking force.

SPEED INDICATOR. Adjust the speed-selector lever until the turntable is turning at exactly 78 rpm. Stop the changer by pulling out the AC plug. Loosen the adjustment screws A and B, and move the speed-selector until it indicates 78 rpm. Carefully tighten screws A and B, and replace the turntable. Check with a stroboscopic disc or the built-in stroboscope to make sure that the speed is exactly right.

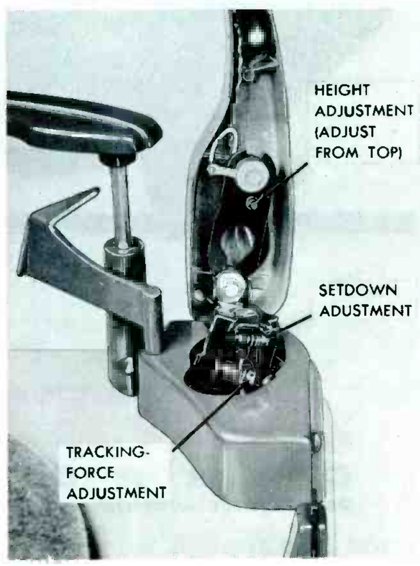
Adjustments for Webcor Changers

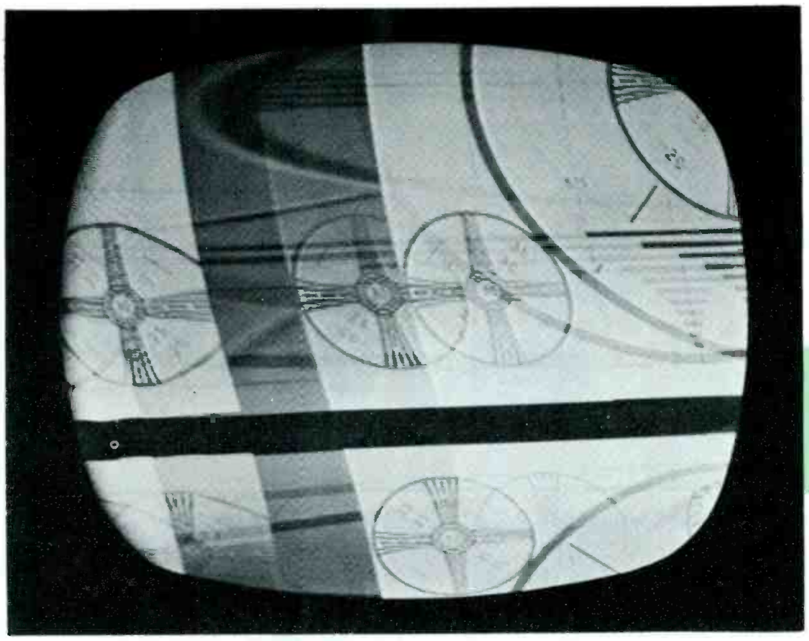
SETDOWN. With the control knob in the neutral (N) position, put a 7-inch record on the turntable and depress the control knob. Operate the turntable by hand, and note the setdown point of the needle. Adjust the setdown screw so that the needle will land in the lead-in groove (about $\frac{1}{8}$ inch inside the edge of the record). Turning the adjustment screw counterclockwise will cause the needle to move toward the spindle.

HEIGHT. With a one-inch stack of records on the turntable, set the control knob to the N position. Depress the knob, and rotate the turntable by hand. The needle should clear the one-inch stack of records by no more than $\frac{1}{8}$ inch. Turning the adjustment screw clockwise will cause the arm to rise. *Caution!!* Never turn the height screw more than two turns clockwise, or other troubles will result.

TRACKING FORCE. The tracking force should be set for 8 to 11 grams unless otherwise specified by the cartridge manufacturer. To adjust the tracking force, insert a small steel rod in the hole of the mounting stud. Turning the stud toward the arm decreases the pressure.

Photographs: Robert W. Reed





TROUBLES in SYNC CIRCUITS

A Servicing Guide Arranged by Symptoms

BY LESLIE D. DEANE
and **CALVIN C. YOUNG, JR.**

The service technician has undoubtedly encountered numerous synchronization troubles in the daily task of repairing television receivers. Many of these could become difficult servicing problems which would consume a great deal of time and effort in solving. It is the objective of this article to aid the technician in the solution of some of these problems by presentation of a number of trouble symptoms, suggested methods of isolation, and possible causes of poor synchronization.

In the television receiver, there are a number of circuits which will affect the stability of picture synchronization; however, this coverage will deal primarily with troubles resulting from defective components in the sync section. The sync circuits to be discussed will include limiters, clippers, separators, inverters, amplifiers, and some of the associated noise-eliminating circuits.

When the sync section is not operating properly, certain trouble symptoms will show on the screen. The symptoms usually vary from a slight horizontal bending or an occasional vertical roll to a complete loss of both vertical and horizontal synchronization. A clear interpretation of the symptom will often help the technician to isolate the defective stage.

Some of the more common trouble symptoms resulting from poor operation of the sync circuit are listed as follows:

1. Loss of vertical and horizontal synchronization.
2. Loss of vertical synchronization.
3. Loss of horizontal synchronization.
4. Horizontal pulling in the picture.
5. Vertical jitter.

These common symptoms will be more thoroughly discussed later in the article. Photographs illustrating each individual trouble as it appears on the picture tube screen will be presented. The normal test pattern shown in Fig. 1 is for reference purposes only.

General Discussion

Let us review the functions of television sync circuits and discuss a few of the typical stages employed in modern receivers.

One of the basic requirements for proper reproduction of a television picture is that the vertical and horizontal sweep oscillators in the receiver should be in synchronization with the scanning frequencies of the television camera. For this reason, the transmitted signal contains, in addition to the video signal, vertical and horizontal sync pulses which are intended to trigger the respective sweep oscillators at the receiver and therefore synchronize the entire system.

In order for the sync pulses to control the frequencies of the oscillators, the video portion of the signal must first be removed and the remaining pulses must be clipped, amplified, and separated from each other.

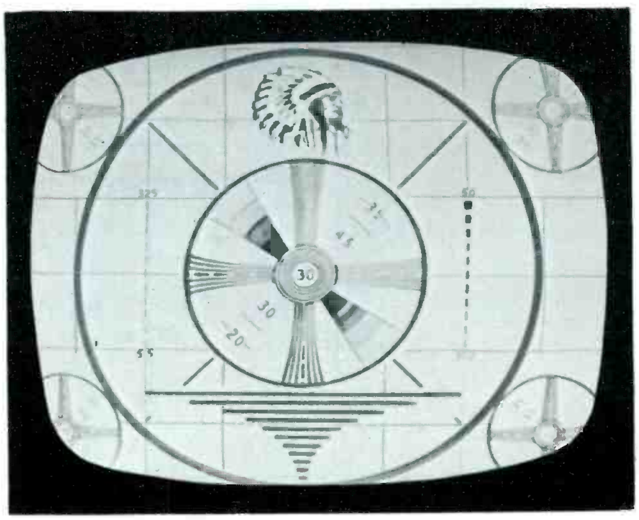


Fig. 1. Normal Test Pattern.

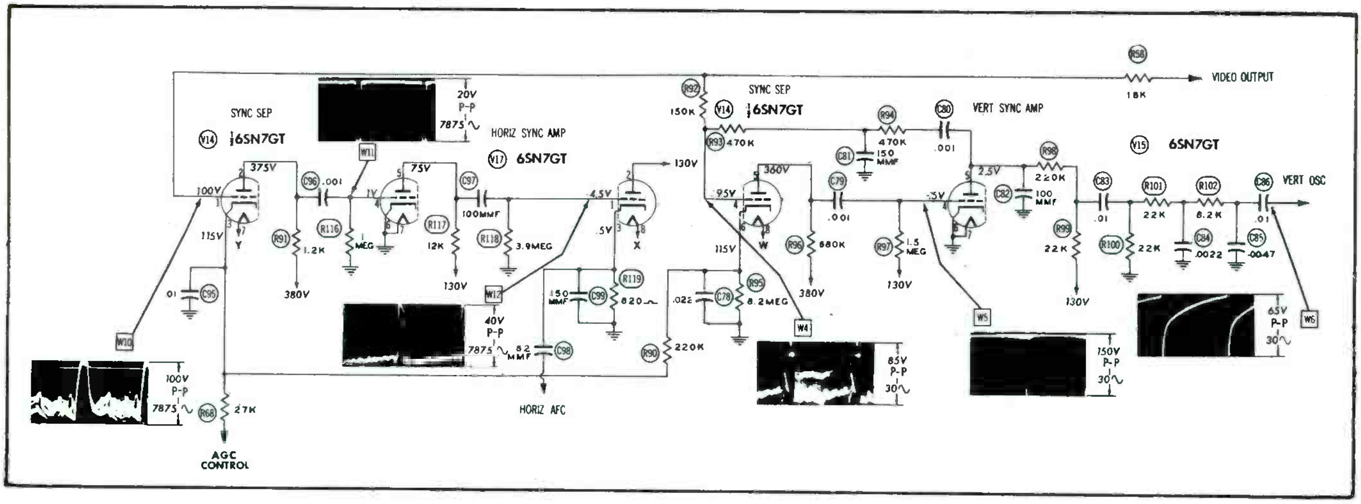


Fig. 2. Schematic Diagram of the Sync Circuit Employed in the RCA Victor Chassis KCS68F.

Sync circuitry is perhaps the least commercially standardized section of the television receiver. Other sections of the receiver usually fall into two or three design categories, but the sync section may vary considerably.

Sync stages make use of a number of different tube characteristics to accomplish their purpose. They may use cutoff bias, plate saturation, diode limiting, grid-current flow, cathode-follower action, cathode driving, and others. Regardless of the different names applied to the individual sync stages in commercial receivers, all of them accomplish amplification and clipping of the sync pulses. Some receivers employ separate tubes for the different sync functions, but others may use only one tube to perform all of the necessary requirements. A sample of the composite signal must be obtained from a circuit following the video detector and fed to the sync section. The source of this signal is commonly referred to as the sync take-off point; and it is usually located at the video detector load, video output plate, or DC restorer load.

If the signal is taken off at the video detector load, an additional sync amplifier will often precede the sync separator. This stage is necessary because of the low amplitude of the signal at the video detector. When the sync signal is obtained from the video output plate, it has already been amplified a sufficient amount and there is no need for a separate amplifier. The only disadvantage in obtaining the signal from the plate circuit of the video output tube is that there may be a loading effect on this stage and a tendency toward distortion of the response of the amplifier.

In the past few years, DC restorers have become obsolete in TV receivers. You may find in many of the older receivers, however, that the DC restorer load resistor is used as a sync take-off point. The value of the resistor used in the sync take-off network is usually critical. If the resistance decreases, it may load the video output stage; and if it increases, the signal reaching the sync circuit may be of insufficient amplitude. A defective coupling capacitor in the sync take-off network can also result in loss of both horizontal and vertical synchronization.

The stage responsible for removing the video portion from the composite signal is generally referred to as the sync separator. The majority of sync separators now in use employ a combination of low plate voltage and grid-leak bias to obtain the desired limit-

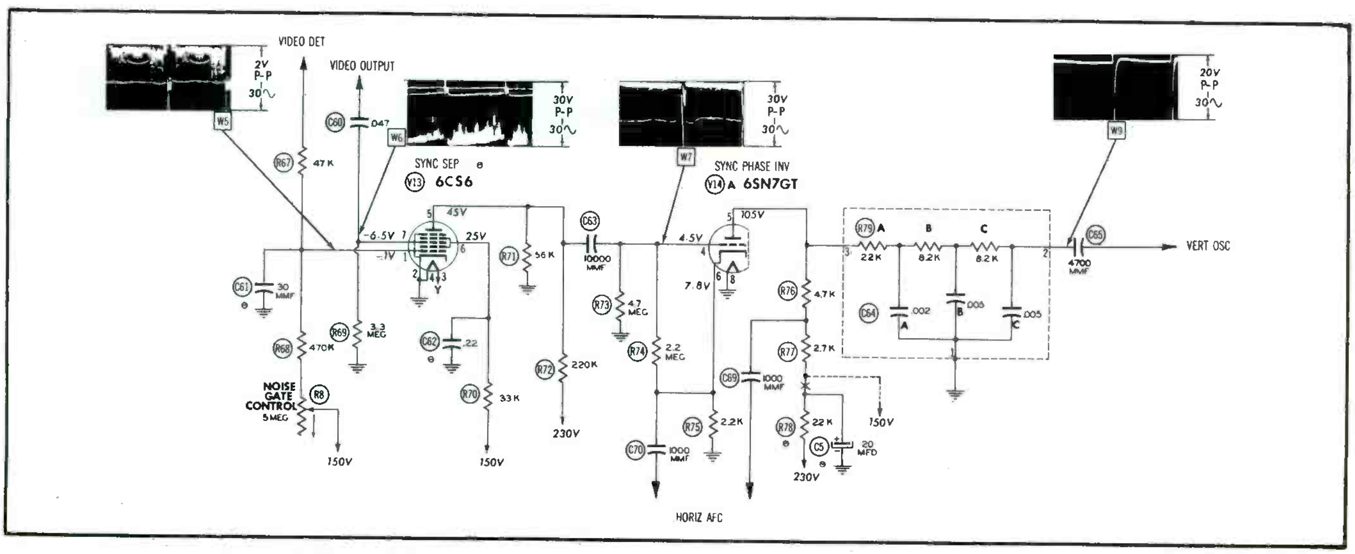


Fig. 3. Schematic Diagram of the Sync Circuit Employed in the Admiral Chassis 22A3AZ.

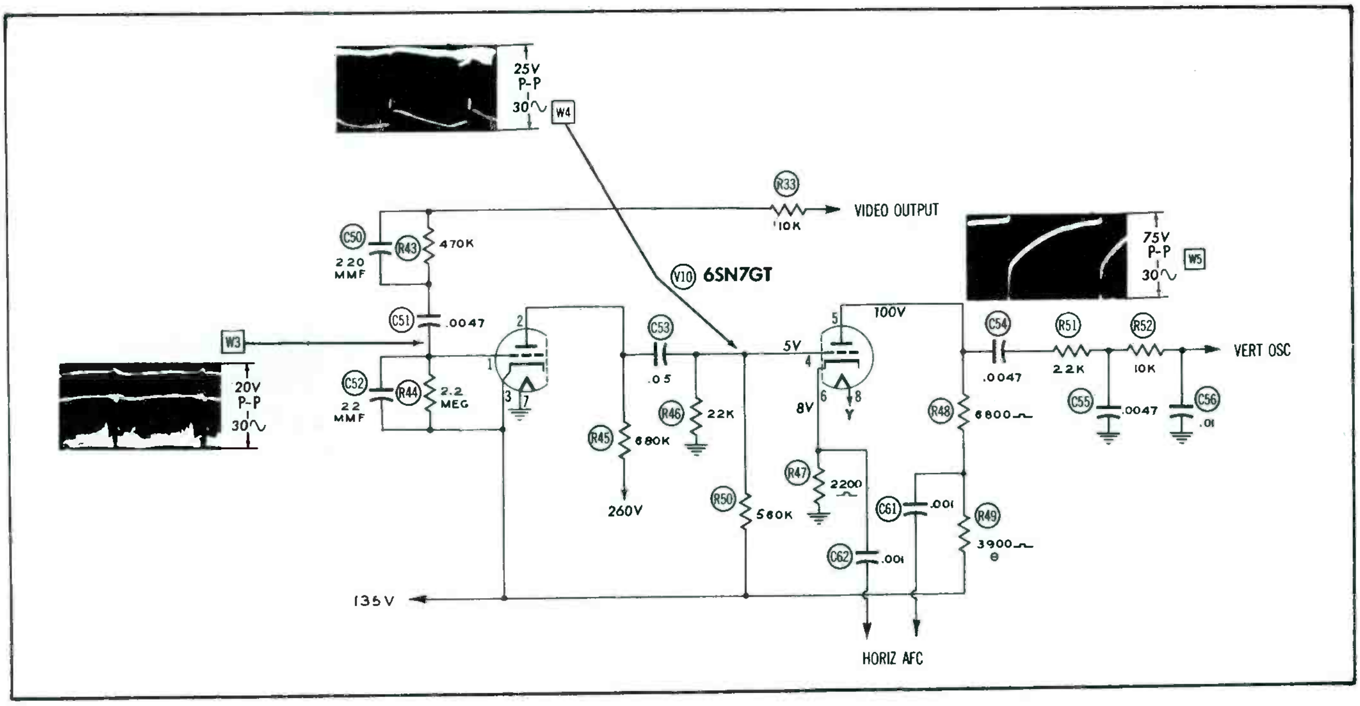


Fig. 4. Schematic Diagram of the Sync Circuit Employed in the Motorola Chassis TS-307.

ing action. If any component fails in the plate or grid circuits of this stage, an excessive amount of video signal in the output may result or the sync pulse amplitude may be seriously reduced. In either case, synchronization of the sweep oscillators will be affected.

The low plate voltage applied to the separator tube not only aids in clipping the signal for uniform amplitude but eliminates any noise appearing on top of the sync pulses. This action is not always performed in the separator circuit but may take place in one of the sync stages which follow the separator.

The bias applied to the sync separator is often made a direct function of the level of the input signal to the separator so that the amplitude of the sync pulses leaving the separator will be fairly constant. Since the AGC voltage is in effect a measure of the signal strength, some sync separators are biased by the AGC network. In other receivers, this process is reversed and the AGC tube is biased by a voltage from the sync separator. In either case, a trouble that develops in the AGC or in the sync circuits will usually affect both.

A wide variety of amplifier, clipper, phase-inverter, and noise-eliminator circuits may precede or follow the sync separator stage. These circuits are far too numerous to discuss in detail at this time; however, typical sync circuits employed in four modern receivers are illustrated in Figs. 2 through 5. These schematic diagrams will be referred to later in connection with each individual trouble symptom.

The actual separation of the vertical and horizontal sync pulses is not performed by the tubes but by the high- and low-pass filter networks at each oscillator input circuit. The filter networks separate the two sync pulses accord-

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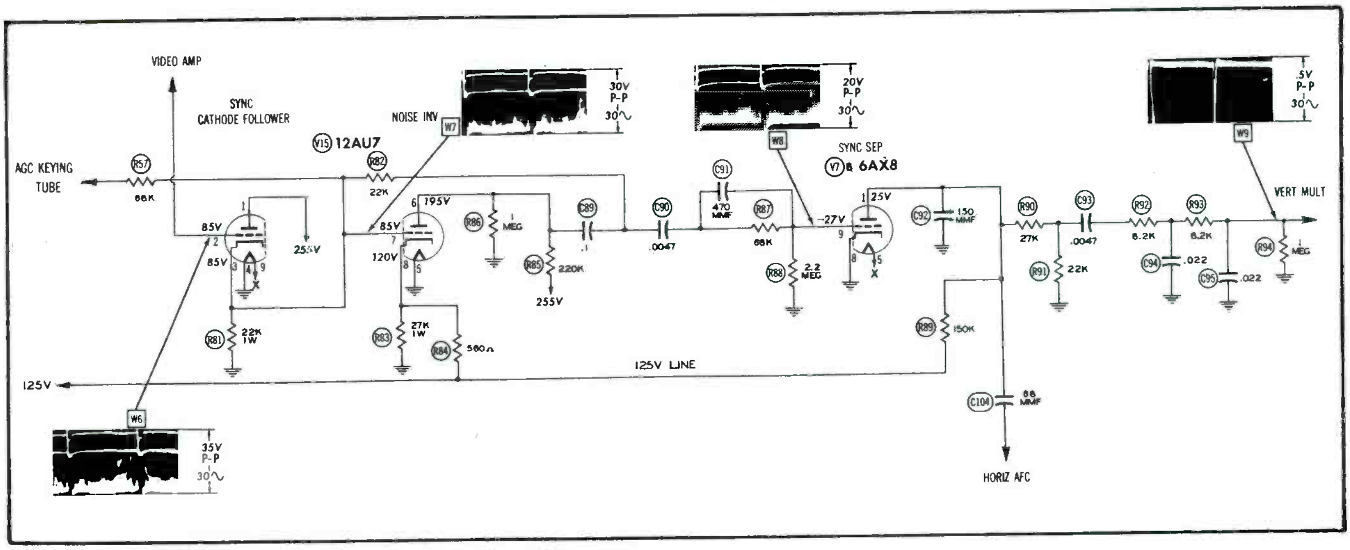
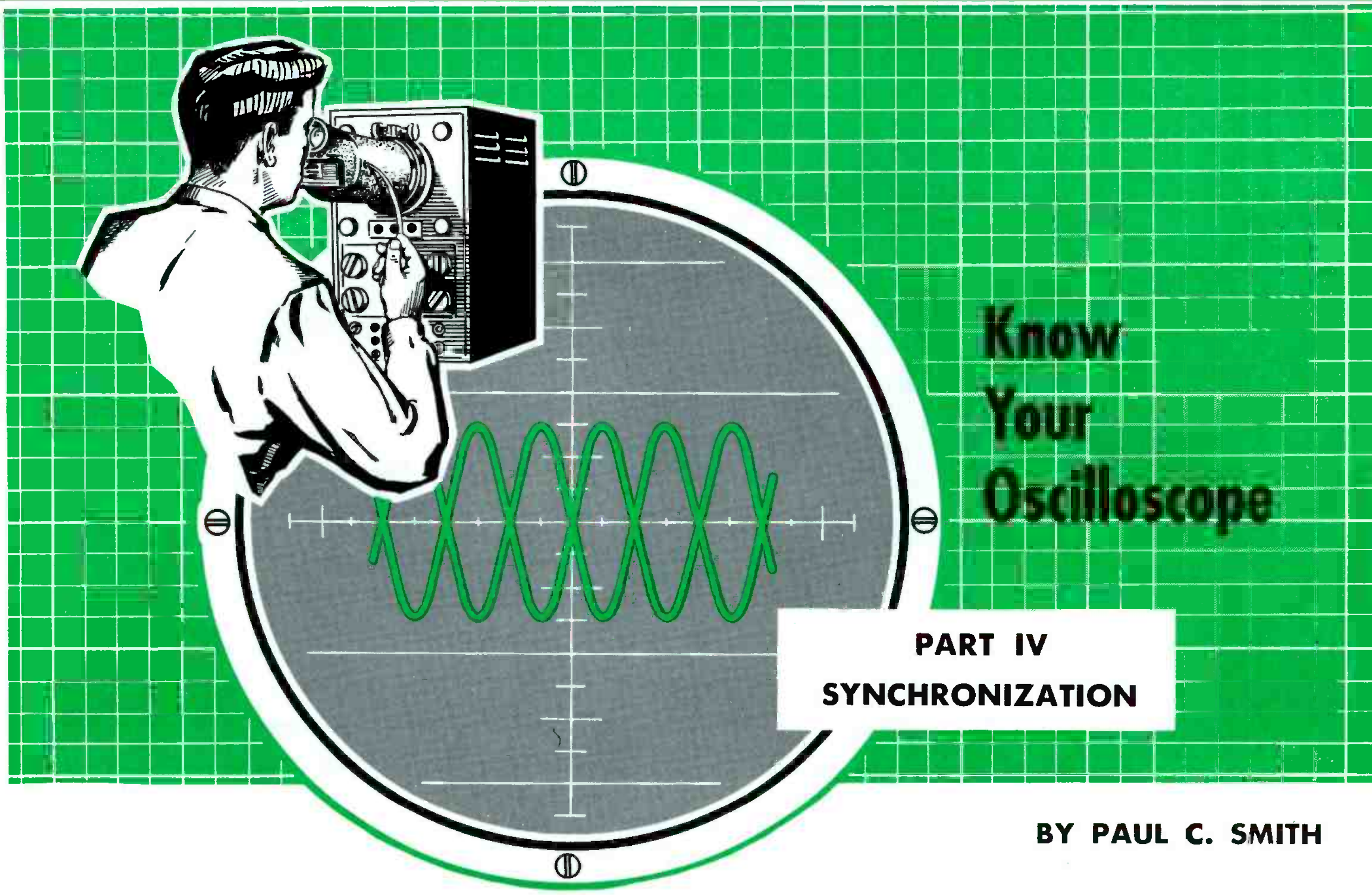


Fig. 5. Schematic Diagram of the Sync Circuit Employed in the Philco Chassis TV-400.



Know Your Oscilloscope

PART IV SYNCHRONIZATION

BY PAUL C. SMITH

SYNCHRONIZATION

Synchronization can be defined as the timing of two or more events so that they will occur simultaneously or in step with each other. As applied to oscilloscopes, such timing would be between the signal to be viewed and the sweep system of the oscilloscope. In the majority of cases, the technician will be observing a signal that has some regularly recurring peak or dip in its amplitude. In other words, it is made up of cycles that repeat regularly and can therefore by synchronized with the trace of the oscilloscope as the trace sweeps across the oscilloscope screen.

When an oscilloscope has been properly synchronized with a signal, this signal will appear to be stationary on the screen and one or more cycles of the signal can be seen. If the oscilloscope is slightly out of synchronization, the waveform will appear to move slowly across the screen either to the right or to the left.

Certain types of signals will be more difficult to synchronize than others. These include signals that have little information of a recurring or repeating nature and signals that have few pronounced peaks or dips. As the frequencies of both the signal being viewed and the oscilloscope sweep are increased, synchronization will also become more difficult. The reason for these difficulties will become more apparent later when we consider the process of synchronization.

If a signal does not cycle or repeat at regular intervals, it can still be viewed on certain oscilloscopes of laboratory type. These oscilloscopes use a system whereby the signal is made to initiate or trigger the sweep, which is a "one-shot" or nonrepeating sweep. A cathode-ray tube of long persistence is used so that the waveform developed by the single sweep will not fade immediately but will persist long enough to be useful to the operator.

As was just mentioned, this type of sweep will normally be found only on oscilloscopes of special or laboratory design; but a modification of this sweep may be found in some general-purpose oscilloscopes and is called a "driven sweep."

The Hickok Model 650 is one oscilloscope that provides a driven sweep. When this model is adjusted for the use of this feature, the beam will be at rest at the right-hand side of the screen until a signal is applied to the input of the oscilloscope. The applied signal triggers the sweep into operation. The retrace or movement of the beam from right to left occurs first, followed by the sweep of the beam from left to right at a constant rate determined by the settings of the sweep frequency controls.

Synchronization of Thyratron Sweeps

A previous article, No. III of this series in the February 1956 issue, mentioned the two types of sweep generators most often used in present-day oscilloscopes, the thyratron and the multivibrator types. The thyratron sweep generator will be used as the basis for an explanation of the way synchronization can be accomplished, and then comparisons can be made between the two systems.

Fig. 1 shows the sawtooth waveform developed by the thyratron generator. This represents the voltage developed between the plate and the cathode of the thyratron tube or between the plate and ground. The zero DC reference level is shown. The sweep generator in this case is shown as free running—that is, no synchronization voltage is applied; and the sweep operates at a frequency determined by the time constants and the voltages present in the sweep circuits. It is also assumed that the sweep generator has been operating for a short period so that the first cycle of operation does not appear in Fig. 1.

One cycle of operation consists of one sweep and one retrace. The plate potential of the thyratron rises from the deionization potential E_d until it reaches the ionization potential E_i. This rise in potential sweeps the beam across the screen of the cathode-ray tube. When the plate potential reaches the potential of E_i, the thyratron fires and discharges the capacitor in its plate circuit. The discharge is very abrupt and continues until the deionization potential E_d is reached, at which point another cycle is started. The discharge period corresponds to the retrace period of the beam.

The ionization potential of the thyratron is governed by the voltage between its cathode and grid at any particular instant. If this voltage is constant (as it will be if there is no signal present at the grid), the ionization potential will remain constant, as in Fig. 1. To synchronize a sweep generator of this type, a synchronization signal is applied to the grid of the thyratron. The signal can be taken from some point in the vertical amplifiers of the oscilloscope, from a 60-cycle or 120-cycle source within the oscilloscope, or from some external source of the operator's choice.

In Fig. 2, we have used a sine-wave signal in order to simplify the explanation. The signal is assumed to be taken from a point in the vertical amplifiers and is therefore exactly like the signal which is to be viewed on the oscilloscope screen, except for amplitude.

Fig. 2 is not an actual waveform such as could be obtained by connecting another oscilloscope at a certain point in the thyratron sweep generator, but it is a graphical representation of the action which takes place when a sine-wave signal is applied to the grid of the thyratron. This AC signal at the grid results in a similar but greater variation of the ionization potential of the thyratron. This variation is shown as starting at A in Fig. 2 and has a 180-degree phase shift from the grid signal. It is of greater amplitude than the grid signal because of the grid-control characteristics of the thyratron. The dotted portion of the E_i line represents the ionization potential that would result if no synchronization signal were present, and the dotted sawtooth waveform represents the sweep signal that would be obtained under the same circumstances. In this case, the sweep would operate at its free-running or natural frequency; and the firing points for the thyratron would be at F, G, H, and I. For simplification, the retrace is pictured as occurring instantaneously.

The progress of the synchronized sweep is shown by the continuous sawtooth line which represents both the varying plate potential of the thyratron and the sweep voltage applied to the horizontal deflection system of the oscilloscope. The plate potential rises from E_d to point F, at which point the thyratron would normally fire if the sweep generator were free running; but the firing potential has been changed by application of a synchronization signal, and so the plate potential continues rising to point B. The thyratron fires at point B, retrace occurs, and the sweep repeats. This time the sweep reaches a firing point at C; and thereafter, the sweep repeats at regular intervals, with firing points at D, E, and so on. The sweep and the incoming signal are in synchronization from point C on.

Several interesting observations can be made on the basis of the action shown in Fig. 2. The sawtooth waveform has been changed from the free-running frequency to the frequency of the applied synchronization signal. Its amplitude has also been changed somewhat. The free-running frequency was lower than the synchronized frequency. Synchronization is shown as taking place on the negative slope of the ionization curve.

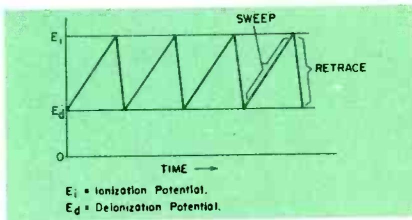


Fig. 1. Free-Running Operation of a Thyratron Sweep Generator.

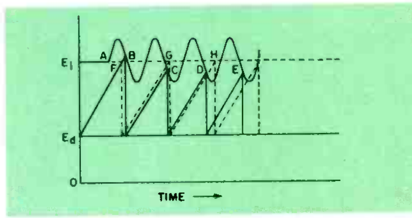


Fig. 2. Synchronization of a Thyratron Sweep Generator by Means of a Sine-Wave Signal.

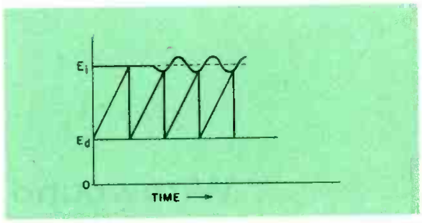


Fig. 3. Synchronization on the Positive Slope of the Ionization Curve.

Fig. 3 shows that it is possible to have synchronization take place on the positive slope of the ionization curve. Such synchronization would be very unstable and easily disturbed by a slight drift of frequency of either the sawtooth signal or the synchronization signal. It can easily be seen that, if the amplitude of the applied sync signal is increased much above that shown in Fig. 3, the sawtooth waveform will not strike the positive slope of the ionization curve at any point because it will then strike the negative slope first.

In Fig. 2, one cycle of sawtooth sweep has been synchronized with each cycle of the applied signal. Under these circumstances, one cycle of the applied signal will be displayed on the oscilloscope screen. If the sweep frequency controls are properly adjusted to sweep frequencies lower than the

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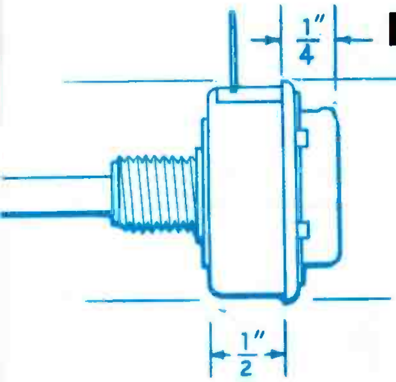

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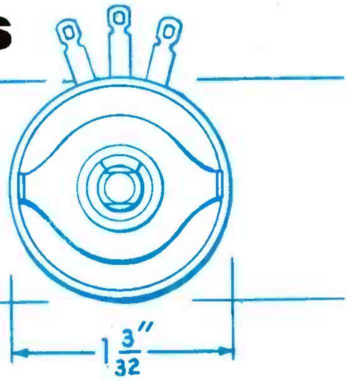

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B-3055

Examining DESIGN Features

by THOMAS A. LESH

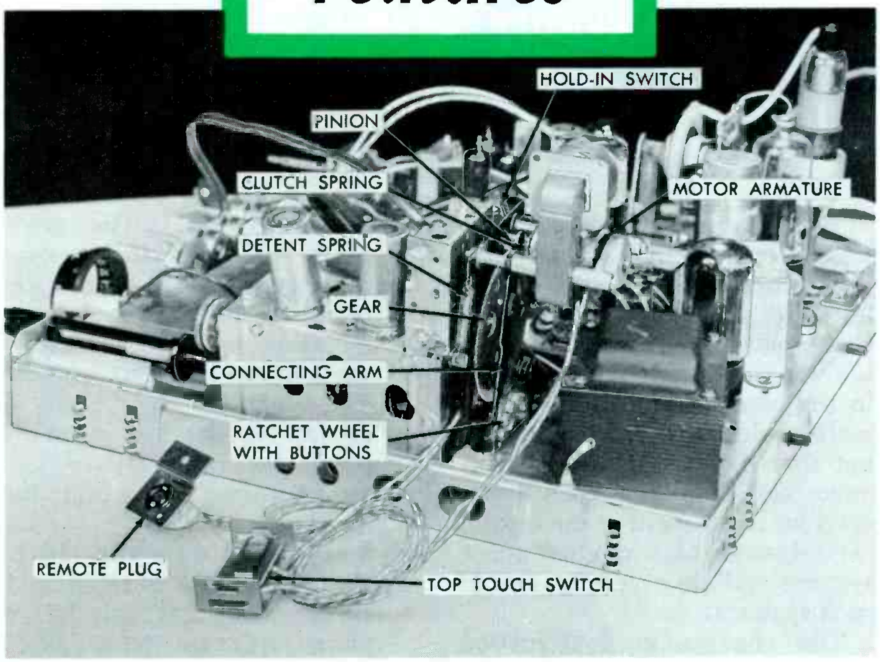

Fig. 1. Automatic Tuning Mechanism Mounted on Philco Chassis TV-394.

Philco Automatic Tuning

Some of the new Philco television receivers are equipped with an automatic tuning device called "top touch tuning." This system is composed of a mechanical stepper unit driven by a small motor. Each time a button on the top of the cabinet is momentarily pressed, the motor is energized and the stepper unit rotates the shaft of the tuner to the next higher channel position.

The button on top of the receiver serves only to start the tuning cycle. As soon as the stepper unit begins to operate, an internal hold-in switch is automatically closed. Power is then supplied to the motor through the circuit of the hold-in switch, and this circuit is not broken until the tuner shaft has come to rest in the next channel position. The top button must be touched again before the tuning system will begin another cycle. If the top button is held down, the motor circuit will remain closed and the mechanism will operate continuously at a rate of approximately five channels per second. The stepper unit turns in only one direction and proceeds from low to high channels.

A switch type of tuner having 13 positions is connected to the automatic tuning system. The 13th or U position is used in conjunction with a separate UHF tuner. Any of the VHF channels plus a single preset UHF channel can be tuned in automatically. Entirely automatic tuning cannot be accomplished if reception of two or more UHF channels is desired. The mechanism can be adjusted so that it will skip unwanted VHF positions. A remote switch is an optional accessory. This can be plugged into a socket that is already wired into the motor circuit.

Setup Procedure

The tuner must be carefully adjusted before the set owner can enjoy all the convenience that is afforded by the automatic tuning system. The owner should not have to reset the fine-tuning control at any time in order to get a good picture, but he will be forced to do so if the oscillator slugs are not correctly adjusted.

The procedure for setting up the tuning system of a VHF receiver is as follows. Let the receiver warm up thoroughly so that the local oscillator will be stabilized. Turn the fine-tuning control to the center of its range. Set the channel selector to the highest channel on which reception is desired, and adjust the oscillator slug for best reception. Then check the oscillator adjustments of the other active channels in descending order. Be careful not to move the fine-tuning control during this process.

If a UHF/VHF receiver is being adjusted, the procedure is slightly different. Continuous tuning of UHF channels is accomplished by rotation of the fine-tuning control. While the automatic system is being set up, the control should be set and then left in the position at which a desired UHF channel is properly tuned in. This channel will then be automatically selected whenever the channel selector is placed in the U position. After the UHF channel has been chosen, the fine-tuning control should be left alone and the VHF oscillator slugs should be adjusted until the VHF channels are all correctly tuned.

It was mentioned that the tuning system can be adjusted so that it will pass some of the channel positions without stopping. To accomplish this adjustment, the technician simply removes some of the plastic buttons which are set into the ratchet wheel. This subject will be discussed in greater detail in another part of this article.

Operation of Stepper Unit

A photograph of the automatic tuning mechanism mounted on the Philco Chassis TV-394 appears in Fig. 1. This mechanism is also used in the newer vertical chassis of the TV-440 and TV-444 series. The motor and the stepper unit are mounted on the upper

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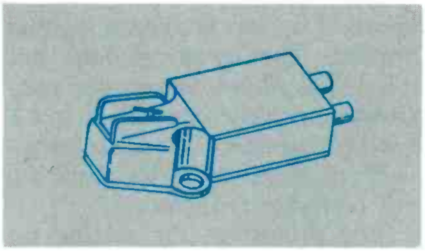
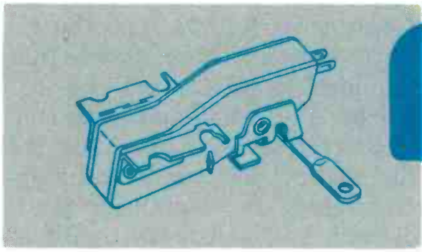
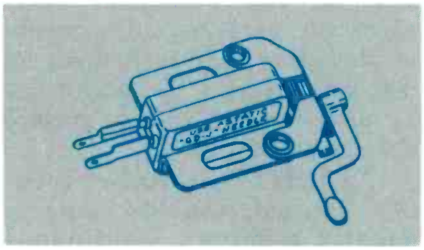
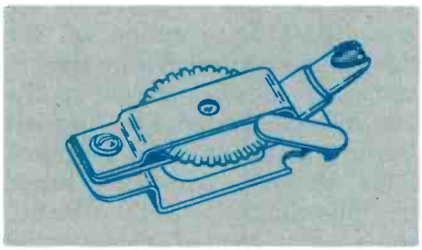
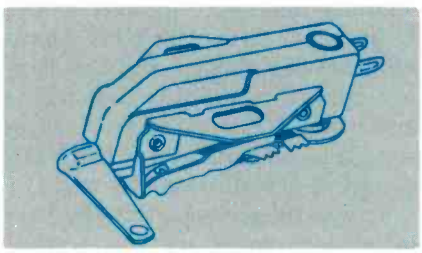










Audio-Facts

SOME HIGH-QUALITY CERAMIC CARTRIDGES

by ROBERT B. DUNHAM

If the curious individual who took a crystal cartridge apart a few years ago to see how it was made would do the same with a new type ceramic cartridge, he would find practically no similarity between the two units. The design of cartridges has changed so much in the past few years that he might not be able to recognize the ceramic element or be able to find the needle. The construction and size of most cartridges have been changed and modified to such an extent that one manufacturer does not even use the term cartridge when referring to his latest ceramic unit.

Both crystal and ceramic cartridges operate on the piezoelectric principle. The signal is produced by a Rochelle salt crystal in the crystal cartridge and by a barium titanate ceramic element in the ceramic units. Because of certain desirable characteristics not shared by crystal units, ceramic cartridges have been developed for use instead of the crystal cartridges in high quality music systems and are generally used in such systems.

The changes in construction and appearance mentioned in the first paragraph resulted from the efforts made to develop a ceramic cartridge which would provide the best possible reproduction from records. Certain qualities and characteristics had to be built into the cartridge to make it a practical and satisfactory unit. We can list a few examples of the requirements to be met as follows.

1. The cartridge should feature a smooth wide-range frequency response with no disturbing peaks or other distortion.
2. The cartridge should have high lateral compliance and low effective mass to permit proper tracking of the stylus in the fine grooves of microgroove records. Tracking should be accomplished with a stylus pressure of not more than 4 to 8 grams so that record and stylus wear will be minimized.
3. The cartridge should be so constructed that it can be mounted in standard arms with turntables of the transcription type and with record changers.
4. The cartridge should be sufficiently rugged to operate in a record changer. The stylus must withstand the pressure sometimes exerted by the tripping mechanism and must maintain proper tracking on a stack of one or several records.
5. The cartridge should not be subject to damage when exposed to comparatively high temperatures or to high humidity.
6. The cartridge should be equipped with a replaceable stylus—one that can be replaced with ease and a high degree of precision by most anyone.

These are only a few of the things that have to be considered. We could elaborate on them and discuss additional ones, but these should give some idea of what a satisfactory cartridge must do.

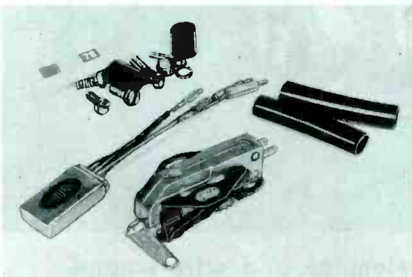
Before discussing some specific models of ceramic cartridges for high quality reproduction of recordings, we should say something about certain advantages that ceramic cartridges possess over some other types.

Ceramic cartridges are not sensitive to hum picked up from the AC fields which are always present to some extent around a turntable and other associated audio equipment. Some magnetic cartridges are very sensitive to hum; consequently ceramic and crystal cartridges are usually used with turntables or changers which use two-pole motors because such motors produce a heavy hum field.

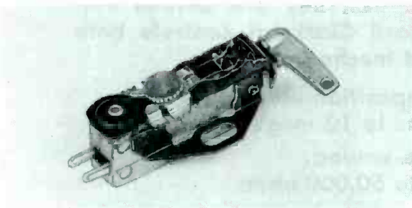
Since ceramic cartridges do not use magnets, no added weight is placed on the stylus because the cartridge is not magnetically attracted to a steel or iron turntable.

This is an advantage when the cartridge is used on a record changer because practically all changers employ steel or iron turntables.

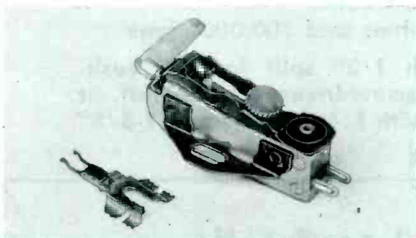
The ceramic elements used in ceramic cartridges are not affected by relatively high temperatures or by high humidity. Most crystal (Rochelle salt) cartridges are permanently damaged if subjected to temperatures above 120° Fahrenheit or to high humidity.



(A) Cartridge With Adapter Network and Accessories.



(B) The 3-Mil Stylus in Playing Position.



(C) With the Stylus Assembly Removed.

Fig. 1. Shure ML44 Series Music Lovers' Cartridge.

The signal output developed by a ceramic cartridge is much higher than that developed by a magnetic cartridge. An output of 0.5 volt at 1000 cps is about average for most of the recent ceramic cartridges. This output is high enough that the cartridge can be connected directly to the input jack of most amplifiers, and satisfactory results can be obtained without the use of a preamplifier. In addition, very little if any equalization is required for playing records because a ceramic cartridge is a constant-amplitude device.

Some recent ceramic cartridges have been designed specifically for connection to constant-velocity inputs intended for use with magnetic cartridges. In this way, all of the equalization and compensation usually provided for magnetic cartridges are made available for these ceramic cartridges.

It is interesting to examine some of the new ceramic cartridges to see how the different manufacturers have incorporated certain ingenious features in their cartridges in order to produce units suitable for use in high quality music systems. In the following discussion, we will describe some cartridges made by different manufacturers.

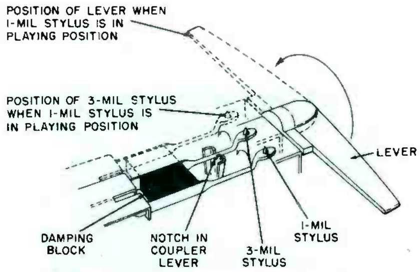
Shure ML44 Series Cartridges

The Shure ML44 Series, Music Lovers' cartridge (Fig. 1) is a ceramic cartridge designed to produce results similar to those obtained with high quality magnetic cartridges. An adapter is supplied for matching the cartridge to the magnetic input of the music system. The ML44 can be mounted easily in standard pickup arms.

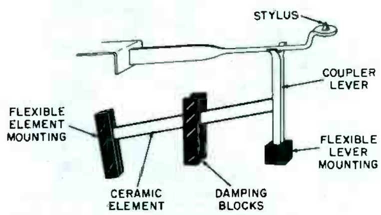
Some specifications as supplied by the manufacturer are as follows:

Frequency Response—30 to 15,000 cps with a gradual roll-off between 10,000 and 15,000 cps.
Output Voltage—0.4 volt at 1,000 cps without network; 25 millivolts at 1,000 cps with network.
Recommended Load Impedance—network designed for 22,000 ohms to 1 megohm.
Compliance—1.5×10^{-6} cm per dyne.
Tracking Force—5 to 8 grams.
Cartridge Capacitance—525 micromicrofarads.
Cartridge Weight—approximately 14 grams with network. It is equivalent to most magnetic cartridges.
Mounting Dimensions—standard ½-inch mounting centers.
Mounting Accessories—complete set of mounting hardware and accessories.

Different views of the ML44 cartridge can be seen in the photographs of Fig. 1. The magnetic-input adapter and other accessories that are included with the cartridge are shown in Fig. 1A. The dual-stylus assembly is held in place on the cartridge by a knurled screw, as shown in Fig. 1B. No tools are required when the stylus assembly is being removed and replaced. The knurled screw is loosened with the fingers, and the stylus assembly (Fig. 1C) is removed. The assembly can be replaced easily and with adequate precision because this assembly and the body of the cartridge are formed in such a manner that the assembly is properly seated when the knurled screw is tightened.



(A) Stylus Shifting Mechanism.



(B) Working Parts.

Fig. 2. Parts in the Shure ML44 Series Cartridge.

The assembly has separate 1-mil and 3-mil styli. This arrangement provides independent operation of each stylus and isolates them so the idle one does not interfere with the one in operation. Fig. 2A shows that each stylus is moved in and out of playing position by the shifting mechanism.

When in playing position, the stylus rests in the notch at the end of the coupler lever, as shown in Fig. 2B. The other end of the coupler lever is held in an elastic pivot. The coupler lever must move from side to side when the stylus is moved by the modulated groove of a record. The movement of the coupler lever causes the ceramic element (which is connected to the lever, as shown in

• *Please turn to page 88*

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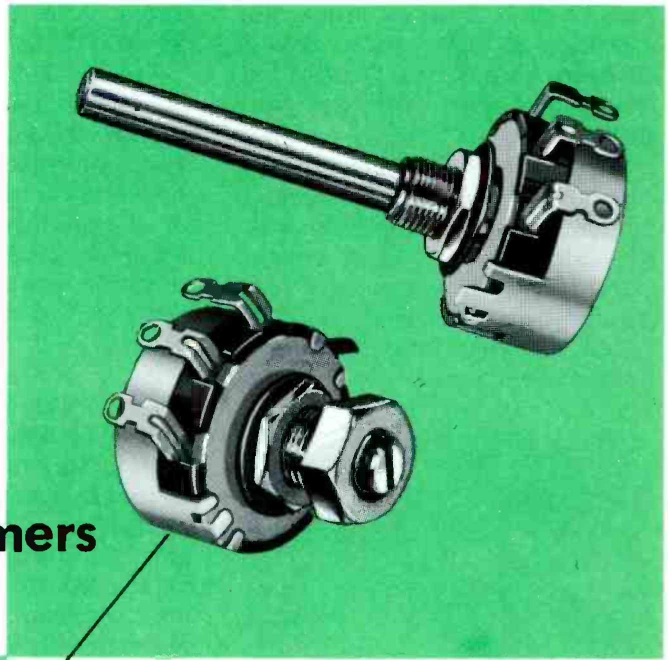

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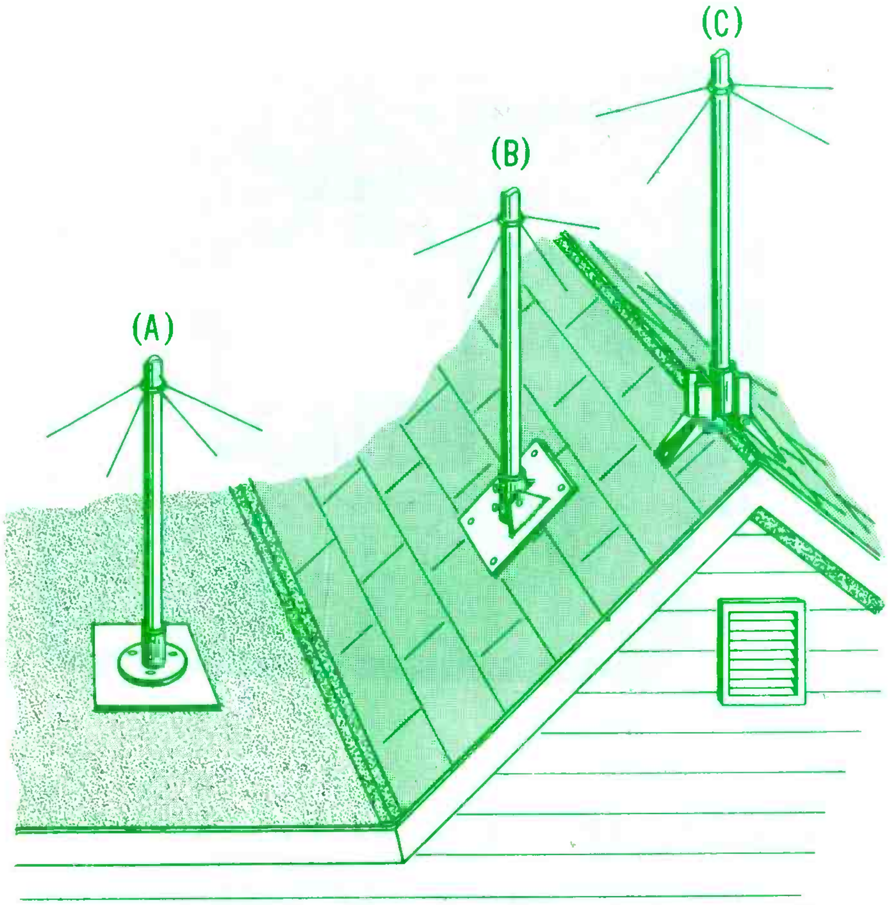

Fig. 1. House Roof with Three Types of Base Mounts. (A) Plate Mount. (B) Slope Mount. (C) Peak Mount.

BASE MOUNTS for ANTENNA MASTS

by GEORGE B. MANN

Two fundamental problems that are encountered in every antenna installation are where to place the antenna and how to support the base of the structure. Actually, the antenna and mast can be erected at any location that might be chosen by the customer or installer. It is then up to the installer to devise or locate a suitable base mounting for the antenna structure.

Few service shops are equipped to fabricate antenna base mounts, and therefore the installer must depend upon the manufacturer of metal products for antenna mounting brackets and base mounts. It is possible to purchase a base mount for nearly any location that might be decided upon.

Roof Mounts

In many instances when an outdoor antenna is to be installed, it is important that as much height as possible be obtained with the least cost. Mounting the antenna on the roof of the building is probably one of the simplest methods of achieving this.

The mounting bases for roof installations are designed for three types of roof construction. Antenna mountings on these three roof types are shown in Fig. 1. The antenna in Fig. 1A is supported on a flat roof by a single plate of metal which has a clamp attached to its surface to hold the base of the mast in place. Such a plate must be large enough so that the weight of the antenna installation will be evenly distributed over a large area and so that damage to the roof surface will not occur. The plate should be held in place by roof cement or tar so that it will not slip. An antenna having two sets of guy wires will be held rigidly in a vertical position, and the only thrust on the base will be in a downward direction. If the antenna has only one set of guy wires, it is a good policy to fasten the plate to the roof with nails or screws because the wind pressure against the antenna will produce a side thrust on the base plate.

The base mounting used on a sloped roof is shown in Fig. 1B. The mast clamp is set on a swivel or hinge which allows the mounting plate to be adjusted to various roof slopes. The mounting plate must be fastened securely to one of the rafters supporting the roof to prevent the base from pulling loose and damaging the surface of the roof.

The use of a peak mount consisting of two mounting plates hinged to a single mast clamp will permit the mast to be installed over the peak of the roof. Such a mount is shown in Fig. 1C. The peak mount can sometimes be used on a sloping or a flat roof. Whenever a peak mount is installed, it should be positioned over one of the supporting members of the roof. This precaution is very important when the antenna structure is fairly heavy.

Heavy towers installed on roofs should have rigid base plates which will span at least two rafters, and the base plate should be securely bolted to these rafters.

Roofs covered with tile, slate, or other materials which are easily damaged should not have antennas installed upon them. In many

· *Please turn to page 78*

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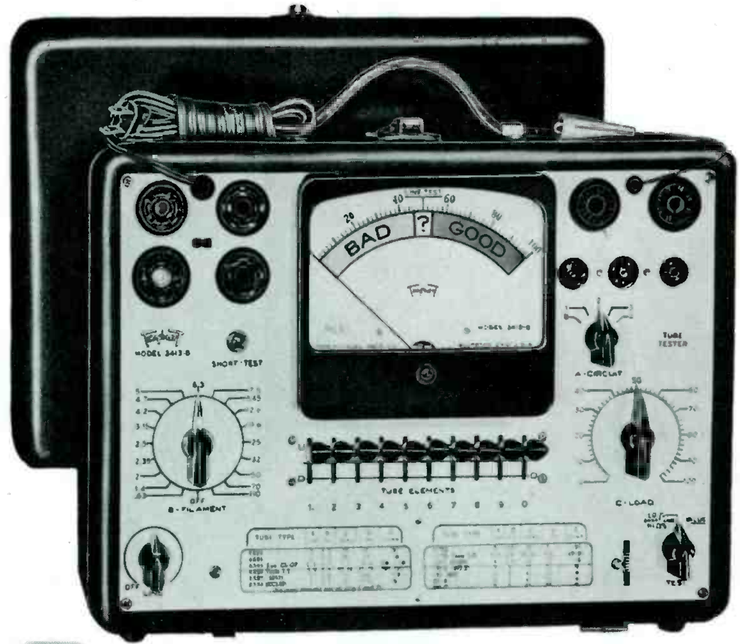

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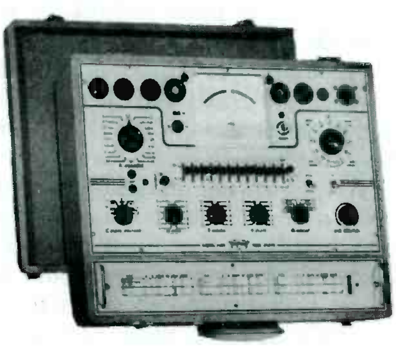

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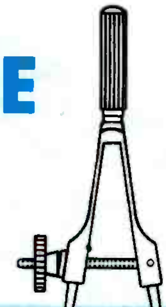

by THOMAS A. LESH

Defects that produce incorrect DC operating voltages in television circuits are easier to locate if the technician is familiar with the part that voltage-divider action plays in furnishing the normal operating voltages. Since the voltage divider is basically an extremely simple circuit, the theory of its operation is not hard to understand. To be able to recognize one wherever it may appear in a schematic diagram is a more difficult matter because it is not always obvious that a given circuit is functioning as a voltage divider.

The reader should recall from his study of basic electricity that the voltage drop across a series of two or more resistors is divided between the resistors in proportion to their ohmic values. See the schematic diagram in Fig. 1A. In this figure, a 2,500-ohm resistor and a 7,500-ohm resistor are connected in series across a supply voltage of 100 volts. The values of the resistors are in a 1 to 3 ratio, and the voltages of 25 and 75 volts measured across the individual resistors are in the same ratio.

Power-Supply Bleeder

A classic example of a voltage divider is the bleeder network that is connected across the output terminals of a rectifier type of power supply. This network converts the single output voltage of the rectifier into several B+ voltages that are furnished to the external circuits. It also improves the voltage regulation of the power supply by placing a load on the supply at all times. Finally, the bleeder network provides a safety feature by serving as a discharge path for the filter capacitors of the power supply after the receiver has been turned off. A simple bleeder network connected across the output terminals of a 300-volt B+ supply is shown in Fig. 1B.

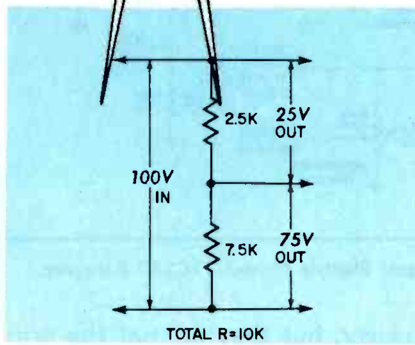

Fig. 1A. Basic Resistive Voltage Divider.

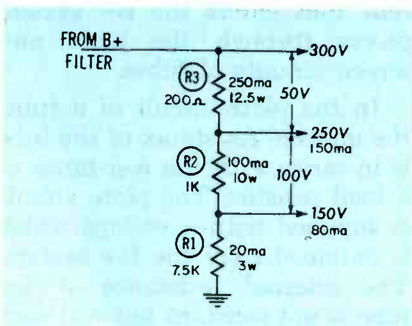

Fig. 1B. Simple Power-Supply Bleeder Network.

When a bleeder network is designed, the requirements for output voltage and current determine the resistance and power ratings of the bleeder resistors. The bleeder in Fig. 1B is designed to furnish 150 milliamperes at 250 volts and 80 milliamperes at 150 volts to the external circuits. In addition, a small current of 20 milliamperes is allowed to flow internally through the bleeder, and a minimum load is therefore maintained upon the power supply.

Resistor R1 carries only the 20 milliamperes of bleeder current. Resistor R2 carries the bleeder current plus the current for the external 150-volt circuit. Resistor R3 carries the foregoing currents in addition to the current for the external 250-volt circuit. If the reader will use the formulas

$$R = \frac{E}{I} \text{ and}$$

$$P = EI$$

to calculate the resistance and power dissipation of the three resistors, he will see how the values which are marked on the diagram in Fig. 1B were determined.

If the bleeder is composed of three separate resistors, the wattage rating of each resistor can be selected to fulfill the power requirements of a particular section

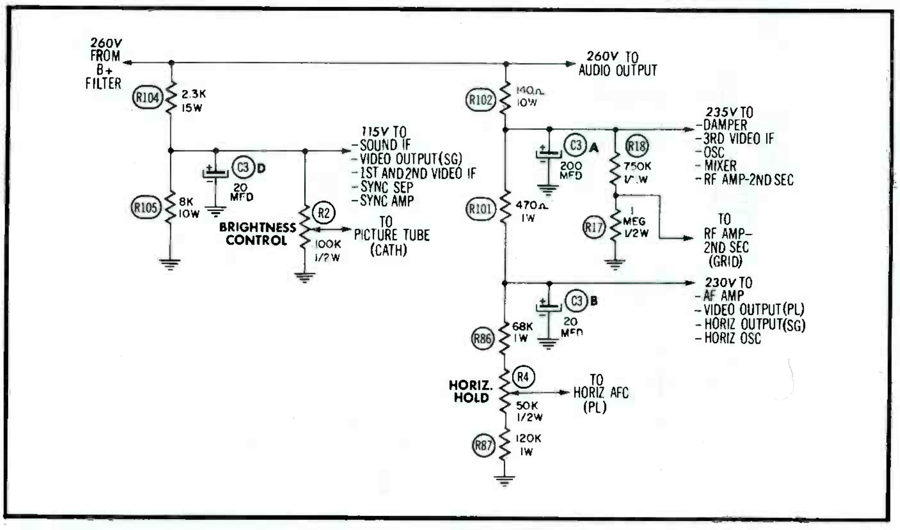

Fig. 2. B+ Distribution System in Silvertone Model 5132A Receiver.

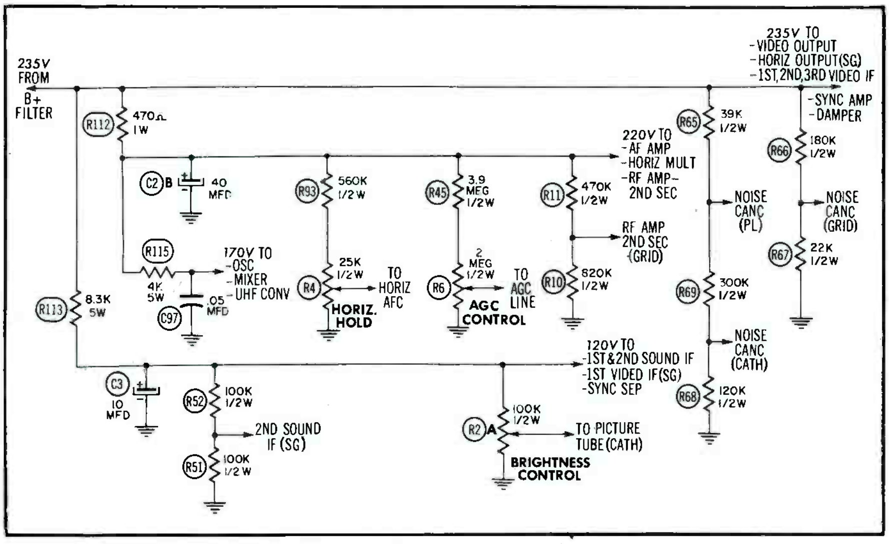

Fig. 3. B+ Distribution System in General Electric Model 21C240 Receiver.

of the bleeder. Assuming that the ratings should allow for protection against a 100-per-cent overload, a 6-watt resistor would be adequate for use as R1 even though R3 should be rated at 25 watts.

Television B+ Circuits

The output circuits of B+ power supplies in television receivers are far more complicated than the basic bleeder circuit which has been described. A simple bleeder composed of a few resistors with high wattage ratings is not often found. Instead, several parallel resistive circuits, each carrying a fairly small current, take the place of the simple bleeder. These parallel strings of resistors all serve as voltage dividers. They are important to the operation of the receiver, but they are not the principal current paths to ground in the B+ system. Most of the current that enters the B+ system passes through the plate and screen circuits of tubes.

In the plate circuit of a tube, the internal resistance of the tube is in series with the resistance of a load resistor. The plate circuit is supplied with a voltage which is obtained from the B+ system. The internal resistance of the tube is not constant but will vary in response to changes in the grid voltage of the tube. The load resistance is constant, however. The resistance ratio between the tube and its load resistor will be constantly changing; therefore, the combination of a tube and its load resistor might be called a dynamically variable voltage divider. The total B+ voltage across the tube and the resistor in series will not change, but the voltage which is developed across the load resistor will change in step with the variations in the internal resistance of the tube. The voltage-divider action that has just been described is fundamental to the operation of nearly all vacuum-tube circuits because the voltage which is developed across the load resistor is normally used as an output voltage.

Diagrams of Actual Circuits

In the usual schematic diagram of a television receiver, the parallel resistive paths from B+ to ground are widely scattered throughout the various circuits. The connections that are made to the outputs of the power supply are often indicated only by arrows. In the diagrams of Figs. 2, 3, and 4, three typical television B+ circuits have been presented in order that the extent and the nature of the B+ system will be readily apparent.

All the DC paths through resistors from the output of the rectifier to ground have been shown in each diagram because these paths function as parts of a bleeder network. Arrows mark the points at which voltages are taken from the B+ system for application to external circuits. Certain arrows which are labeled with values of output voltage are the take-off points for the major B+ lines that supply operating voltages to most of the tubes in the receiver. The arrows that are not marked with output voltages indicate connections that supply special DC voltages to single external circuits.

The load circuits which are served by each supply are listed in the diagrams. If the name of a stage appears next to an arrow, that stage receives B+ voltage from the point which is marked by that arrow. Inclusion of the letters in parentheses following the name of a stage indicates that the B+ voltage is supplied only to the circuit of the plate (PL), screen grid (SG), control grid (GRID), or cathode (CATH), respectively. A lack of such notation indicates that the B+ voltage is applied only to the plate of

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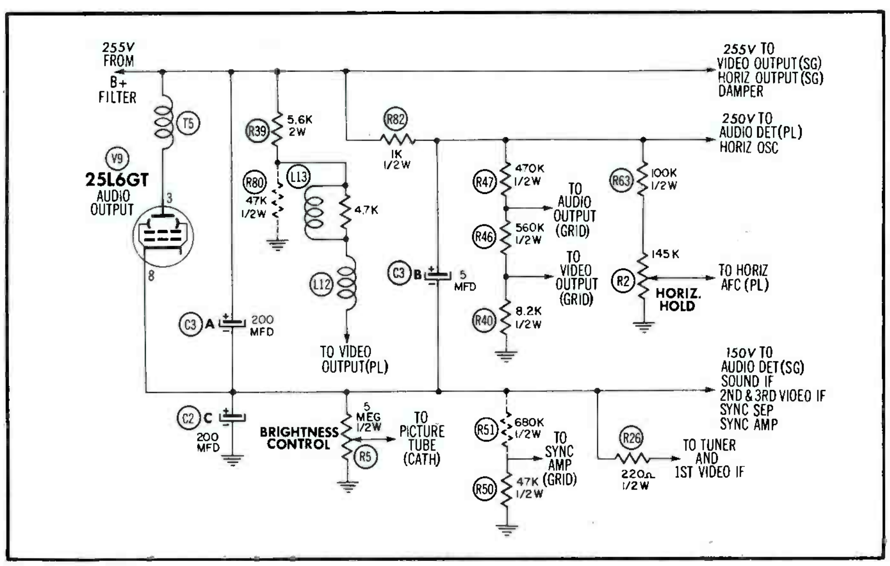

Fig. 4. B+ Distribution System in Crosley Chassis 431.

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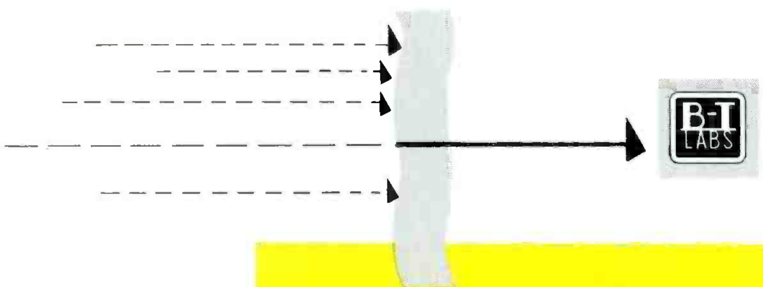

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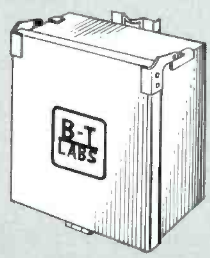

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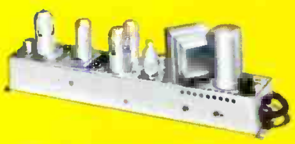

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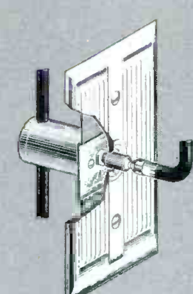

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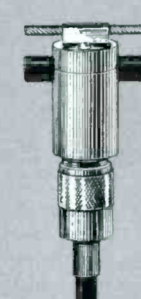

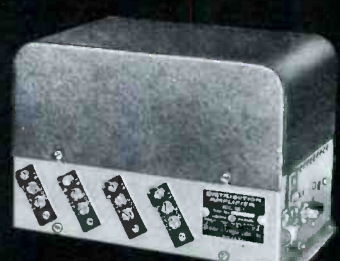

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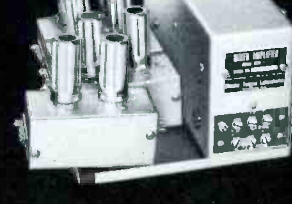

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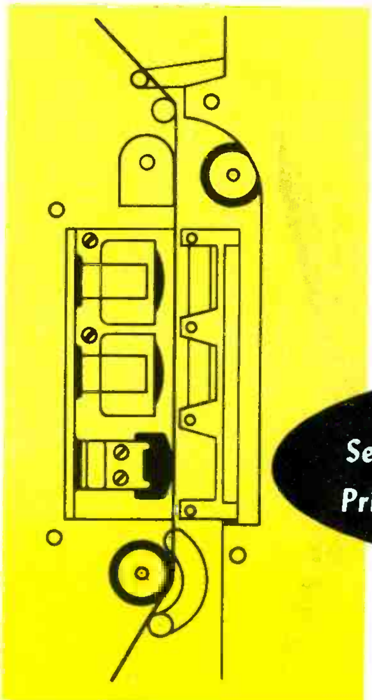
MAINTENANCE of TAPE RECORDERS

the Eleventh in a Series of Articles Devoted to the Principles of Magnetic Recording



by ROBERT B. DUNHAM

This month, we will conclude this series of articles that started in the November 1954 issue. Since then, we have covered the subject of magnetic recording from several angles and have given some comments on the maintenance and adjustments required to keep a tape recorder in good operating condition. Maintenance pointers concerning brakes, motors, and tape tension have been covered. If certain things that were mentioned previously are mentioned again in this article, it will be because they are closely connected with the procedure or adjustment being discussed.

Preventive maintenance of a tape recorder (or the process of correcting an undesirable condition before it can become critical) pays off in better recording and playback quality. The routine cleaning of all parts with which the tape makes contact during the various operating modes comes under this category.

Foreign Matter on Heads and Other Parts

The erase, record, and playback heads; tape guides; capstan; capstan pressure roller; idlers; tension levers or rollers; and any other parts over which the tape passes can become contaminated with an accumulation of magnetic coating, tape lubricant, and foreign matter from the tape. The heads are probably the most affected by this accumulation. Frequency response will be disturbed and distortion can be produced if enough foreign particles are deposited on the faces of the heads to hold the tape away from the gaps.

A clean cloth moistened with a small amount of carbon tetrachloride can be used to clean the heads and other parts mentioned in the preceding paragraph. This should be done carefully, and any specific instructions supplied by the manufacturer of the machine in question should be followed. Some manufacturers caution against the use of carbon tetrachloride on certain parts and recommend the use of alcohol instead. The important thing is to recognize the fact that the heads and other parts do require cleaning and that the cleaning should be done carefully and according to recommended procedures.

The need for adjustment or service to eliminate an undesirable condition in a tape recorder can be indicated by symptoms present in inferior recording and playback. Noise, distortion, and a loss of high frequencies can be caused by a magnetized head. Capstans and tape guides can also become magnetized and can exert a deteriorating influence on the signal recorded on the tape.

Effects of Magnetized Heads and Parts

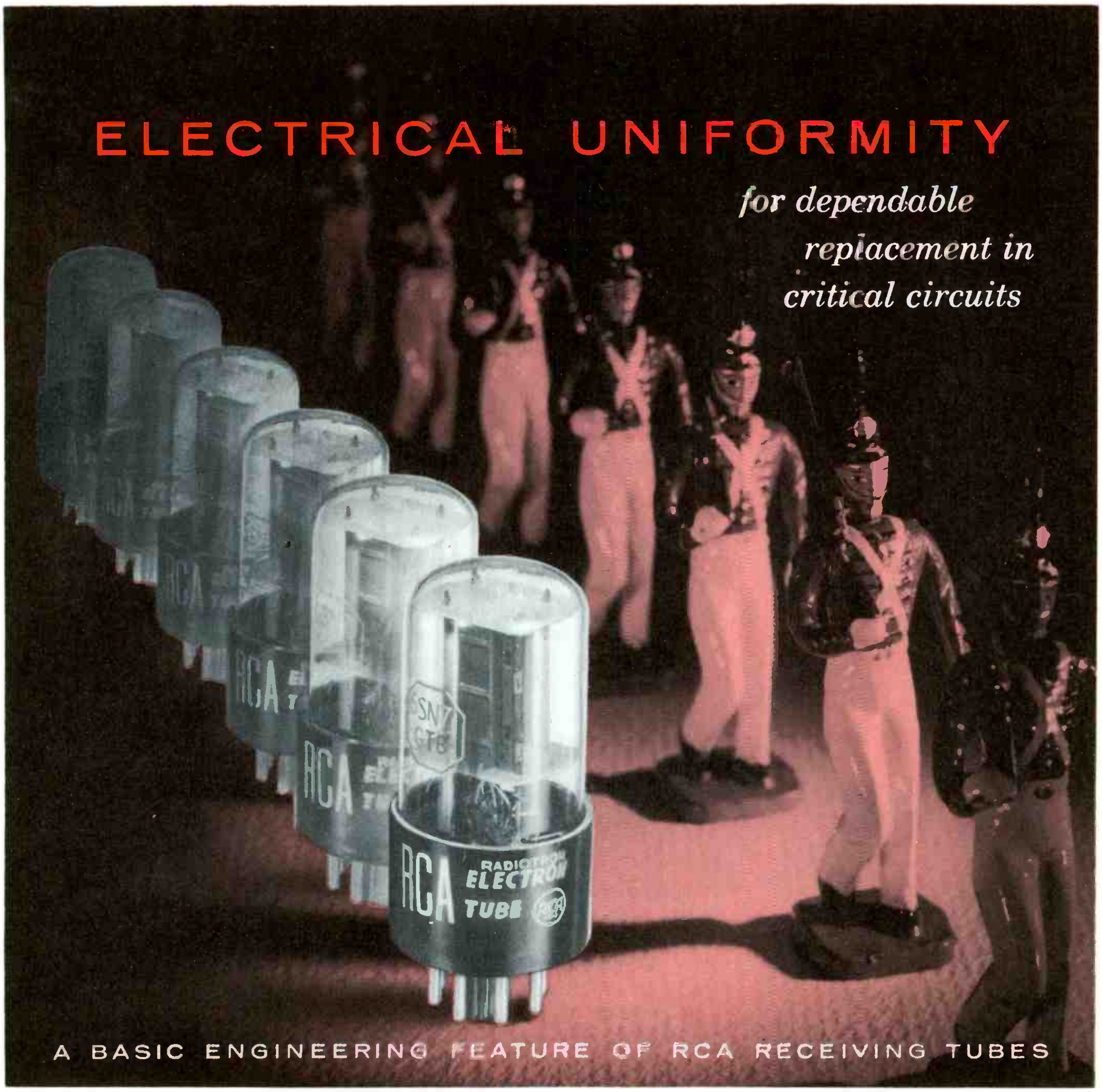
If noise is to be kept down to a minimum amount in a tape recording, the tape must be in a neutral or unmagnetized state when the signal is recorded on the tape by the recording head. The signal is the only magnetic pattern that can be allowed on the tape because any polarized state caused by the tape moving through a polarized magnetic field will increase noise and distortion. This point was discussed in some detail in preceding articles on the basic principles of magnetic recording.

If a playback head becomes magnetized, it can have very much the same detrimental effect upon the tape as when the tape passes through a polarized magnetic field while being recorded. Any magnetized head or part with which the tape makes direct contact while being played back can partially erase the signal on the tape and can increase noise. The high frequencies suffer most from this erasing action. A recorded tape can be partially erased and damaged by magnetized heads and parts each time it is played back.

How Heads Become Magnetized

Care should be taken to avoid and prevent the situations that cause the magnetizing of the heads and other parts. A very strong signal can overload the recorder to the extent that DC components will flow through the heads and magnetize them. For this reason, a "live" low-level input jack should not be touched or opened and a tube should not be removed from its socket while the recorder

· *Please turn to page 80*



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Shop Talk

MILTON S. KIVER

Author of . . .
How to Understand and Use TV Test Instruments
and Analyzing and Tracing TV Circuits

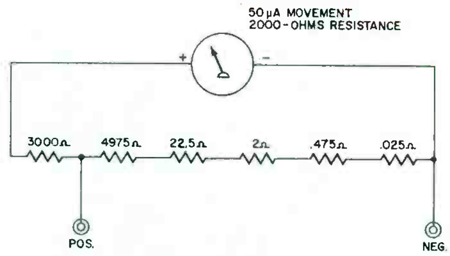
Extra Uses for Test Instruments

No matter how well you get to know the characteristics and applications of a certain test instrument, there is always one more facet that crops up to show you there is still more to be learned. For example, we have had occasion to mention in a previous column that, although an RF signal generator is designed primarily for circuit alignment, it can also help to locate defective components in many sections of radio and television receivers. There are many such side functions for other instruments, and some of these will be discussed in this article. Perhaps these can aid you in some current work you are doing; if not, just file them away for future reference.

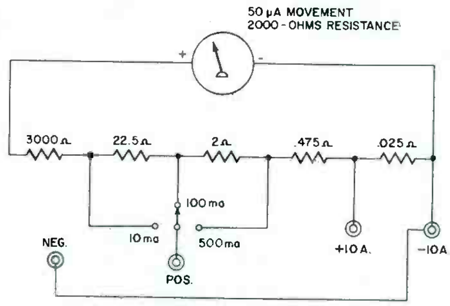
Low-Voltage Measurements with Current Meters

One of the first rules that every budding technician learns is that current meters are never connected across a circuit. When such instruments are used, they are placed in series with the circuit so that the current in that circuit will flow through the meter; but if you stop and dig into this subject, you will find that there can be exceptions to this rule if the meter has a particular design.

The current-measuring circuits of the Simpson Model 260 VOM are shown in Fig. 1. A 50-microampere, 2,000-ohm meter movement is combined with a group of resistors. On the whole, the function of this group is to alter the resistance in parallel with the meter so that the proper amount of current will pass through the meter movement. The maximum safe value of meter current is 50 microamperes, and this is true whether the meter is set at the 101-microampere or at the 10-ampere range. The current which is the difference between the 50-microampere current that flows through the meter movement and the actual current that enters the instrument is diverted away from the meter by the shunt path.



(A) Microammeter Circuit.



(B) Milliammeter and Ammeter Circuit.

Fig. 1. Current-Measuring Circuits in the Simpson Model 260 VOM.

So far, we are on familiar ground. Now let us turn our attention to the 100-microampere range. With the switch in this position, we have the equivalent meter circuit shown in Fig. 2. The 3,000-ohm resistor and the 2,000-ohm meter movement are in series and form a 5,000-ohm path. Shunting this are five resistors with a total value that adds up to 5,000 ohms also.

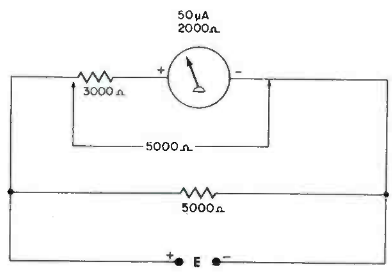


Fig. 2. Equivalent Circuit When the Range Switch Is Set for the 100-Microampere Range.

For full-scale deflection, 50 microamperes must flow through the meter movement; therefore, the total voltage drop across the 3,000-ohm resistor and the 2,000-ohm movement is equal to $50 \times 10^{-6} \times 5{,}000$, or 250 millivolts. In short, we can obtain full-scale deflection of the meter: (1) if we send 100 microamperes of current into the instrument and thereby cause 50 microamperes to pass through the meter movement, or (2) if we apply a voltage of 250 millivolts between the positive and negative terminals.

At this point, you might very well raise the question, "What happens if I apply less than 250 millivolts?" In that case, the meter will read proportionately less; therefore, if you apply 125 millivolts to the two input terminals, the meter needle will move to the mid-point of the scale. With this arrangement, you will be able to measure accurately voltages of 250 millivolts (¼ volt) or less.

· *Please turn to page 92*

E-V Power-Point actually gives you more working capital by cutting, drastically, the number of different cartridges and different needles you need in stock to do an adequate replacement business. Power-Point *alone* replaces over 90% of all popular phono cartridges. You save valuable time, troublesome service calls . . . you can replace Power-Point in less time than it takes to read this sentence! Remember too, almost a million Power-Points are now in use, and the number is growing fast. Additional millions will be demanded by the replacement market!

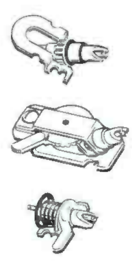
Four Power-Point Types, each $3.95 list

Model 51-1 (Red): two 1-mil sapphire tips.

Model 52-2 (Green): two 2-mil sapphire tips.

Model 53-3 (Black): two 3-mil sapphire tips.

Model 56 (Blue): turnover mounted 1-mil and 3-mil sapphire tips.



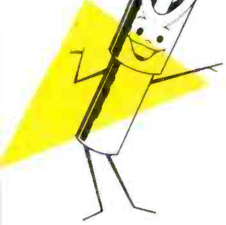
Three Mounting Mechanisms

Model PFT-1 Power-Point Fixed Mount, 50c list.

Model PT-1 Power-Point Turnover Mount, $1.00 list.

Model PT-2 Power-Point Turnunder Mount, $1.00 list.

What is Power-Point?



A nylon-encased unit combining ceramic cartridge and two jeweled* playing tips. A Power-Point cartridge can be changed in seconds, replaces virtually all popular phono cartridges, costs less than two needles alone. It has low inertia, superior tracking ability, wide range, low distortion, minimum needle noise and record wear. It is non-inductive, hum-free, unaffected by moisture or temperature. It actuates all changer mechanisms.

*Superior synthetic sapphire or natural diamond.

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ELECTRO-VOICE, INC., BUCHANAN, MICHIGAN

Dollar and Sense Servicing

by *John Markus*

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

ADVERTISING. Capitalizing on the current popularity of high-fidelity music, a Newark clothing store based an entire ad on this theme:

> "And now for '56 switch to Bond's lighter-tone Hi-Fi suits. Sweet music, isn't it? . . . And color does it! Not brassy bold—perish the thought. But not long-hair either. High Fidelity color, Bond calls it—clear and rich in good taste. . . . Tune to another 3-way triumph for Bond value. . . . Make the switch this week."

Original ideas like this get attention in advertising, particularly if changed frequently to attract new groups of readers each time. You can do the same, even in the smallest newspaper ads, just by changing the first few lines of copy each time. Here are a few suggestions:

Antique Collectors—Do you want your TV set to have the same care that you give your finest vases? Then call. . . .

Dog Lovers—Do you want your radio to have the same careful attention that you give your best friend? Then call. . . .

Gardeners—Do you want your radio-phonograph combination to receive the same thorough overhauling that you give your beautiful lawn each spring? Then call. . . .

GRACIAS. Had a room plastered the other day. To us, from an engineering viewpoint, it was a lousy job—no two corners square, no walls straight, faint cracks everywhere, and wall outlets thoroughly filled with plaster.

We made a list of 15 of the worst items for the plasterer to fix if he wanted his "dough." He fixed them, got his check, then made a nice little speech saying how much he had enjoyed working with us. Those few words will be remembered long after we forget the faults of his work.

Try this thank-you technique on every job—even the ones that didn't go sour. It's the best way in the world to ensure repeat business and to get recommendations, yet it takes just 30 seconds more time per call. If you forget or if you get tongue-tied when trying to say something like that, dash off a note on a postcard as soon as you get back to the shop.

The postcard technique is used in another way by Russell Hubbs Service in New York City, according to *Sylvania News*. This shop has a printed card which is sent as an expression of appreciation to a customer who has recommended the shop's service to a new customer.

CLOCK. Though priced in the luxury class now, the new GE electronic clock will definitely be another source of servicing income when it comes down in price. It runs off flashlight cells and keeps time by using 60-cps inductive pickup to synchronize a tuned oscillator that drives a low-friction, permanent-magnet motor. There are four stages, three using 2N43 transistors and the fourth a 1N67A germanium diode, on a printed wiring board. There is no line cord whatsoever. A ferrite antenna is sensitive enough so that the clock can be used in any room of the home.

COUNTERMAN. Just couldn't resist rewriting a poem we saw in *Electronic & Appliance Specialist* to make it apply to our own field. Here's the result:

LIFE OF A COUNTER MAN

I work behind a counter
In a TV jobber's store.
Sometimes I'm called a genius;
Sometimes I'm called much more.

I claim I'm no technician;
Yet when a job goes sick,
The technician comes and asks me,
"What makes the darn thing tick?"

I'm supposed to know the numbers
Of tubes and pots and gears
For every single radio made
In more than thirty years.

But life would be a pleasure
And I'd grin from ear to ear
If customers would only tell me
The model, make, and year.

MAN. On the Crosstalk page of *Electronics* magazine recently, man was defined as a 0.25-megohm, 1-watt resistor. At 1 milliampere, he just barely feels shock. At 10 milliamperes, he can't let go. At 100 milliamperes, his time is up. Remember these figures; good service technicians are in short enough supply as it is.

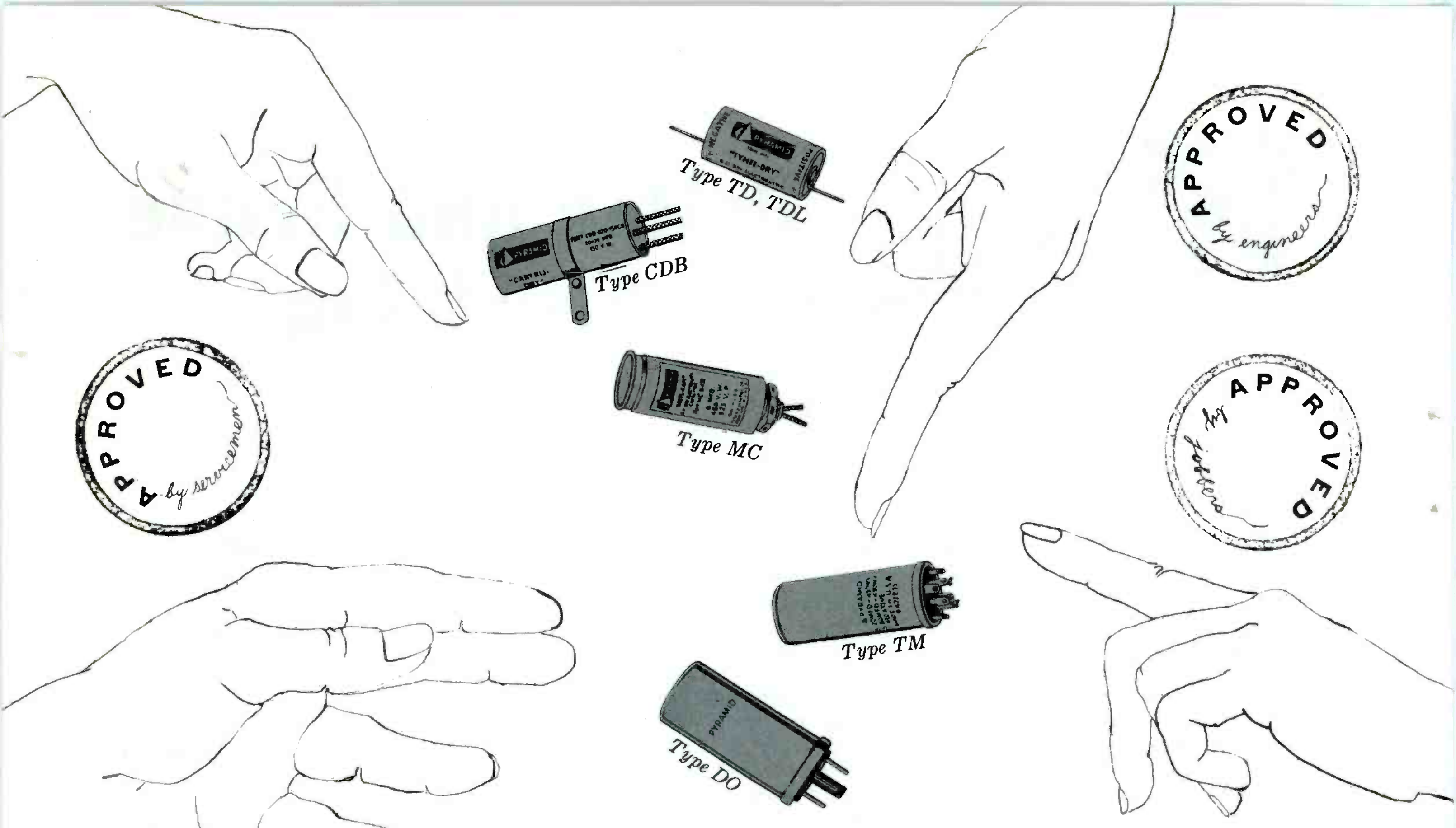
BABY SITTER. Somebody got to Walt Disney and sold him on color, judging from this conversation in a recent Donald Duck cartoon strip.

Girl: Good evening, sir! . . . I'm the baby sitter.

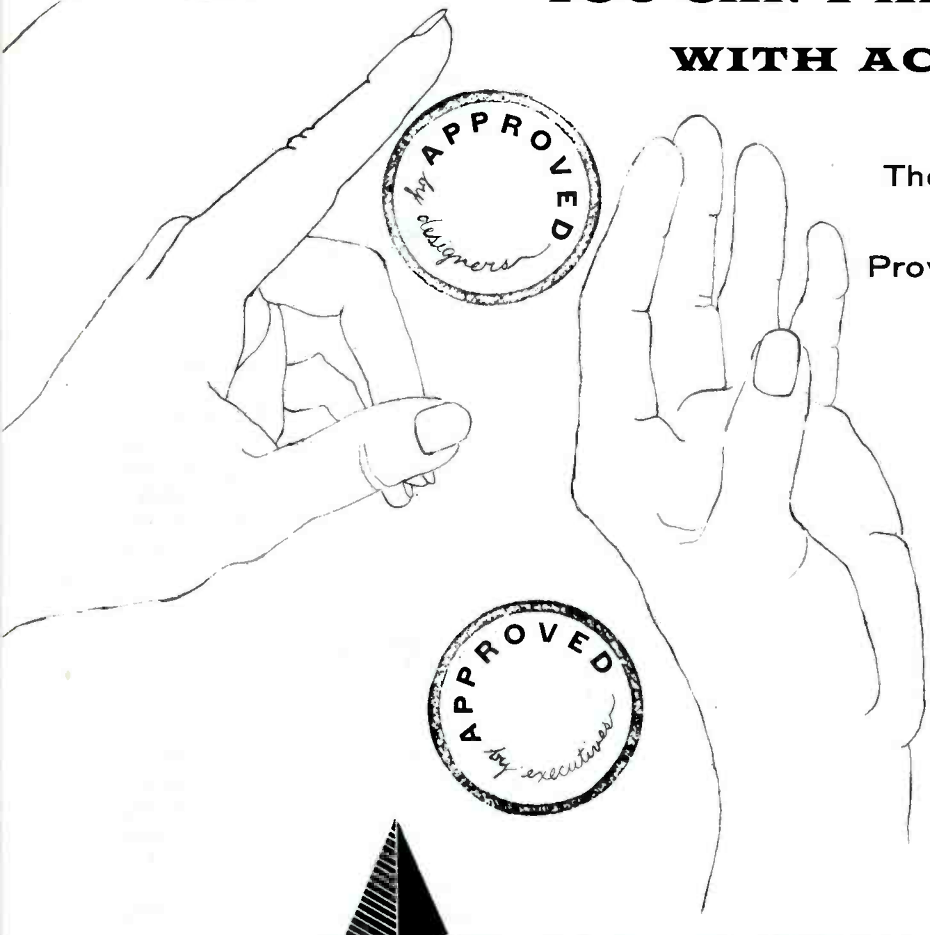
Donald: Oh, come right in! The boys are watching television!

Girl: Oh, fine, I . . . like to . . . Heavens! Black and white! Sorry, sir! . . . I sit only with a color set!

• *Please turn to page 69*



YOU CAN'T ARGUE WITH ACCEPTANCE



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Complete with metal and bakelite mounting plates.

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These features, plus an almost indestructible thermo-setting plastic encasement make Pyramid Imps your best molded paper tubular capacitor.

For full information on Pyramid capacitors and rectifiers, see your local distributor or write to

DISTRIBUTOR DIVISION
PYRAMID ELECTRIC COMPANY
1445 Hudson Blvd., North Bergen, N. J.

Know Your Oscilloscope

(Continued from page 21)

input signal, the oscilloscope can be synchronized so that two or more cycles of signal can be viewed. As was previously mentioned, if the frequency ratio between signal and sweep becomes very high, synchronization becomes more difficult.

A number of diagrams could be drawn to show the effects of varying the amplitude and frequency of both the waveforms shown in Fig. 2, but space does not permit this in an article of this length. We will suggest some of the possibilities, and the reader can verify them either by drawing diagrams or by actually experimenting with an oscilloscope, if he is so inclined. A few possibilities are:

1. With proper choice of the sweep frequency and amplitude of the synchronization signal, synchronization can be made to occur at any point on the negative slope of the deionization curve. This can be considered as the useful range of synchronization.

2. The synchronization range is decreased as the amplitude of the synchronization signal is increased.

3. It is possible to have too much synchronization signal. This will be illustrated in a later paragraph.

4. Synchronization will not be obtained with this type of sweep generator if the natural sweep frequency is greater than the frequency of the applied signal.

Synchronization of Multivibrators

Synchronization of multivibrator sweeps is similar in many respects to that of the thyratron sweep. A typical multivibrator circuit uses both sections of a twin triode with the signal from each plate coupled to the grid of the other section. Each section is alternately cut off while the other conducts. By proper choice of circuit constants, an unbalanced multivibrator is obtained with one section remaining cut off for a much greater time than its conduction period. The nonconduction period is used as the charging time for a capacitor, thus developing a sweep voltage; and the short

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The picture tube is your choice—and your reputation. Back that reputation with a reliable Du Mont picture tube.

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conduction period is used to discharge the capacitor, thus developing the retrace. A synchronizing signal can be used to influence the time at which the sweep section changes to a conductive or nonconductive state. Such a signal is usually introduced at the grid of one of the sections.

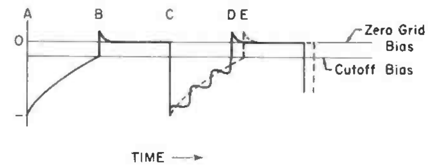

Fig. 4. Synchronization of a Multivibrator Sweep Circuit.

The waveforms obtained at various points in a typical multivibrator circuit are to be found in many textbooks. Fig. 4 shows one such waveform, the waveform developed at the grid of one section of a balanced multivibrator. That is, it is one in which the conduction and nonconduction periods of the sections are equal. At time A, the tube section is cut off by a comparatively large negative bias on its grid. Between times A and B, the RC networks affecting the section gradually lose their negative charge; and the grid bias rises in a positive direction until it reaches the cutoff value at B where the tube section suddenly changes to a conductive state and remains so until time C. At time C, we have shown how a synchronization signal introduced at the grid will affect the conduction point on the next cycle. Synchronization is therefore obtained in a manner somewhat similar to that in the example of the thyratron sweep generator.

Oversynchronization

Both types of sweep generators are subject to oversynchronization if too much sync signal is applied, and the effects on the resulting waveforms are similar. In Figs. 5A and B are shown actual waveforms photographed at points in a multivibrator sweep circuit of an oscilloscope. Fig. 5A is the signal obtained at the plate of the first section, and Fig. 5B is the signal at the output of the discharge section. Fig. 5C is the waveform actually displayed on the screen of

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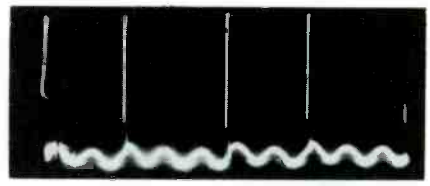
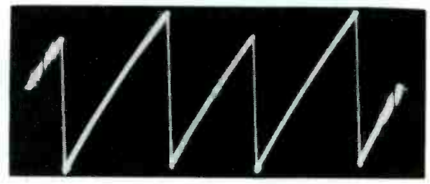
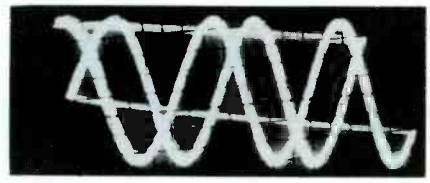


(A) Signal at the Plate of First Section.



(B) Sawtooth Signal Developed at Second Section.



(C) Waveform Seen on Oscilloscope Screen.

Fig. 5. Oversynchronization of a Multivibrator Sweep Circuit.

the oscilloscope. Fig. 5A shows that one cycle of sweep contains parts of three cycles of sine-wave signal and that the other cycle of sweep contains parts of two cycles of signal. Fig. 5B shows that the sweeps travel at a constant rate but that alternate cycles are of different length. Each cycle of sweep and retrace can be seen to correspond to certain portions of the waveform of Fig. 5C.

If oversynchronization is carried to extremes, the sawtooth waveform of Fig. 5B may even degenerate into one large cycle followed by two or three very small ones. In such a case, the waveform on the screen would also be greatly distorted. Some manufacturers have designed circuits to lessen or eliminate the possibility of oversynchronization. One method is to use a limiter stage ahead of the point of injection of the synchronization signal. An oscilloscope which uses this method is the Precision Model ES 550.

For simplicity, the synchronization signals shown in the preceding examples have been sine-wave signals. In cases in which the synchronization signal is taken as a part of the signal in the vertical amplifiers of the oscilloscope, it can take on any form, depending upon the waveform being viewed. Generally, stable synchronization will be more easily attained with signals of a peaked or sharply pulsed nature rather than with those of more even nature. Sometimes a signal may have more peaks at its negative extreme than at its positive extreme, or vice versa. A sync polarity-reversal switch on the oscilloscope may help the operator to obtain stable synchronization in such cases. If such a switch is not included, the same effect can sometimes be obtained if the signal to be observed is taken from a point that has a signal 180 degrees out of phase with respect to the signal at the first point. The signals between two successive stages in an amplifier usually have this phase reversal.

Hints for Synchronization

Synchronization is an important step in the operation of an oscilloscope and is one of the steps that is likely to give the technician some trouble. Let us summarize some of the points brought up in the preceding paragraphs by offering the following hints for synchronization:

1. Set the sync amplitude control to zero or nearly zero.
2. Adjust the sweep frequency controls so that the free-running frequency of the sweep is a little lower than the frequency of the incoming signal or a little lower than some submultiple of this frequency, if more than one cycle is to be viewed.
3. Advance the sync amplitude control until the waveform is steady on the screen. Do not use more sync signal than is necessary.
4. Use the correct sync polarity. If stable synchronization is still difficult to obtain, the following step may help.
5. Use the external sync feature of the oscilloscope, and apply a sync signal taken from a point in the circuit where a stronger signal can be found. This method works especially well when weak horizontal sweep signals are being viewed in a TV receiver. A lead placed close to the horizontal section of the deflection yoke will pick up enough sync signal for good synchronization.

PAUL C. SMITH

Notes On Test Equipment

(Continued from page 13)

calibrated to the third harmonic of the sixth range. A scale is provided for each range, and a linear scale calibrated from 0 to 100 is also provided.

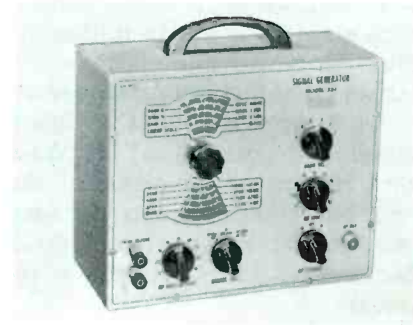


Fig. 2. EICO Model 324 Signal Generator.

The tuning mechanism is of the vernier type. Accuracy of calibration of the tuning dial is stated at ±1.5 per cent.

The scales are visible through two windows with four scales to each window. An illuminated hairline on each window serves as an index mark for tuning purposes.

Coarse and fine attenuator controls are provided so that the level of the RF signal at the RF output jack can be adjusted.

The RF signal may be either unmodulated, modulated internally with a 400-cps sine-wave signal, or modulated from an external signal source. The percentage of either external or internal modulation is adjusted by a control on the front panel. The same jacks used to apply the external modulating signal may also be used as output jacks for the 400-cps internal modulating signal. The 400-cps output signal is adjustable from 0 to 10 volts across a 100K-ohm load, or from 0 to 5 volts across a 10K-ohm load.

The percentage of modulation by the internal 400-cps signal can be adjusted from 0 to 50 per cent. When an external modulation signal is used, 30-per-cent modulation will be obtained from a signal of approximately 3 volts. These figures are for a modulation signal of 1000 cycles with the generator set at 1 megacycle. The external modulation signal may range in frequency from 20 to 1500 cycles.

The Model 324 employs a Colpitts type of RF oscillator and a Colpitts type of audio oscillator. Other construction features are: turret-mounted, slug-tuned coils; copper-plated chassis; line filters; a shielded ouput cable; and AUDIO IN/OUT jacks which will accept either banana plugs or spade lugs.

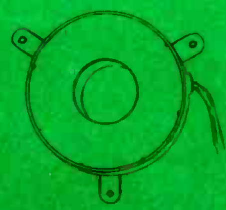
The size of the instrument case is 8 by 10 by 4¾ inches.

JACKSON MODEL 49 TUBE TESTER

The Jackson Electrical Instrument Co., manufacturers of the Jackson Model 49 tube tester, have included a number of new and interesting features in this tube tester. The Forty-Niner, as it is referred to by the manufacturer, is designed as a tube tester complete in itself; but in addition, a number of plug-in accessories have been designed to extend the range of testing operations that may be performed with the tester. As a result, the service technician may start with the Model 49 tester and purchase extra accessories for other functions.

Accessories available for the Model 49 tube tester are the Model 49N tester for high-resistance shorts, the Model 49C tester for filament current, the Model 49R tester for selenium rectifiers, and the Model 49S auxiliary tube-socket unit. All these accessories are shown together with the Model 49 tester itself in Fig. 3. The accessory units use the power supply and 4½-inch meter of the tube tester as a basis for their operation. Regardless of which unit is plugged in, the tube-test function is not disturbed in any manner.

The tube tester uses lever switches to set up the various tube elements for testing. The meter scale is divided into red and green sectors to indicate bad or good tubes and is also calibrated from 0 to 130 per cent to give a relative comparison with normal tubes. A smaller red-green sector is provided for the diode test. Additional scales are included on the meter for use with the accessory units. The filament current of a tube can be measured on either a 0 to 0.5-ampere scale or a 0 to 1-ampere scale. Bad, good, and peak



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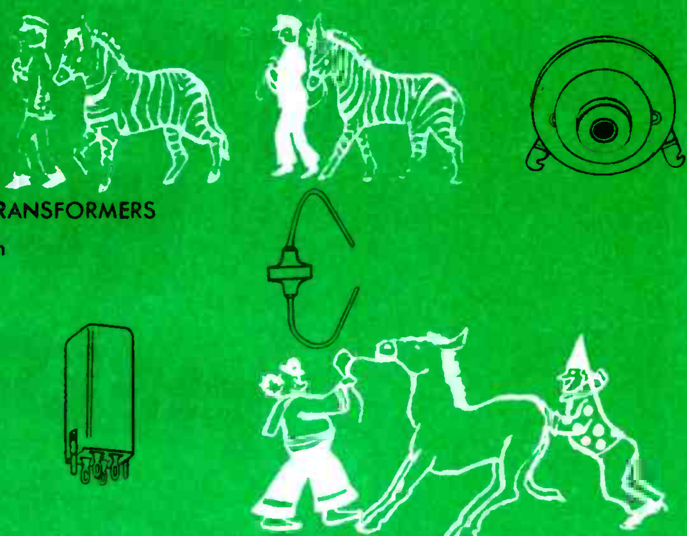

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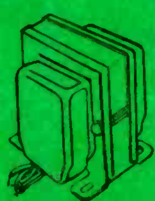

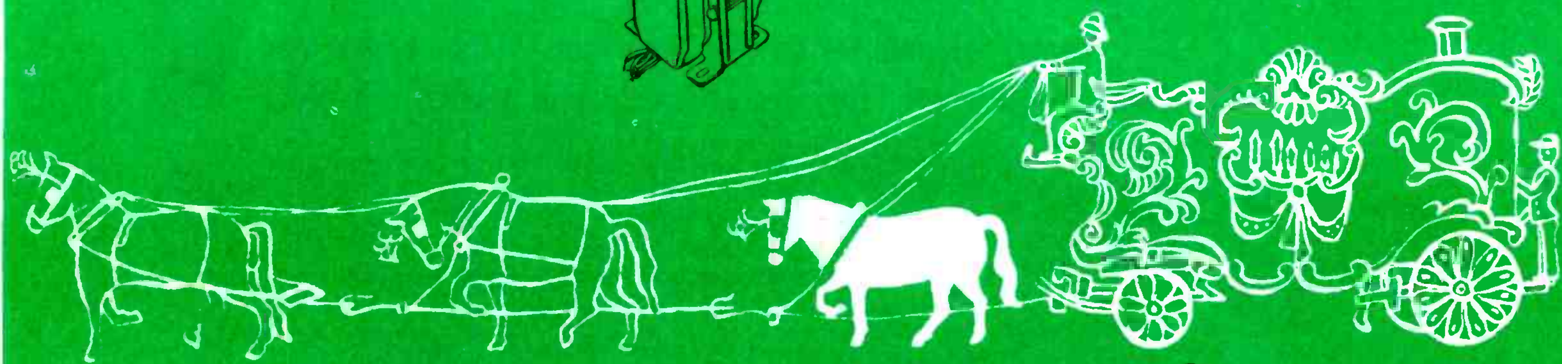

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LIGHTING · RADIO · ELECTRONICS · TELEVISION · ATOMIC ENERGY sectors are provided for use in testing selenium rectifiers. A neon lamp indicator shows when a tube element is shorted.

The LINE CONTROL switch is calibrated so that it will indicate whether the line voltage is higher or lower than normal when it is properly adjusted to center the meter needle.

The roll chart listing the tube types and setup data is designed for quick location of the desired information. The upper section of the chart lists tubes which can be considered primarily as televison types, and the lower section lists tubes which can be considered primarily as radio types. The tubes in each section are listed in numerical and alphabetical order, as is common practice; but the order of the first column reads downward, the second column reads upward, and the third reads downward again. When coming to the end of the first column, it is therefore not necessary to return to the top of the chart again in order to find the next tube listed. It will be found at the bottom of the second column instead, and the chart can be rolled back as you read up that column.

In order that the 49N, 49C, and 49R accessory plug-in units may be used, the Model 49 tube tester must be converted with plug-in adapters. The Model P49B plug-in unit converts the tester for use with these accessory units. This conversion has already been made in the tester shown in Fig. 4. This figure shows how an accessory unit may be plugged in and then mounted in the hole to the left of the meter. The accessory is held in place by one airplane type of fastener.

Fig. 5 shows the tube tester with the Model 49R tester for selenium rectifiers in place. When the accessories are not in use, one can either be left in place in the tube tester or it can be removed and the original cover plate can be replaced. In the latter case, a shorting plug is substituted for the accessory which is removed in order that the tube-test functions can be performed in a normal manner.

The tube-socket panel that is supplied with the instrument can also be removed and together with the tester can be converted for plug-in operation. The Model 49 tube tester comes equipped with octal, loctal, 7-pin miniature, and 9-pin miniature sockets, plus one blank which presumably can be removed and replaced by a tube socket of the owner's choice. These sockets provide for testing of the majority of TV and receiving tubes which the technician is likely to encounter. The tube sockets provided in the Model 49S accessory unit are those which are not used as often as those in the Model 49 tube tester. The instruction booklet which accompanies the Model 49S supplies information for testing many types of tubes which require these sockets which are seldom encountered.

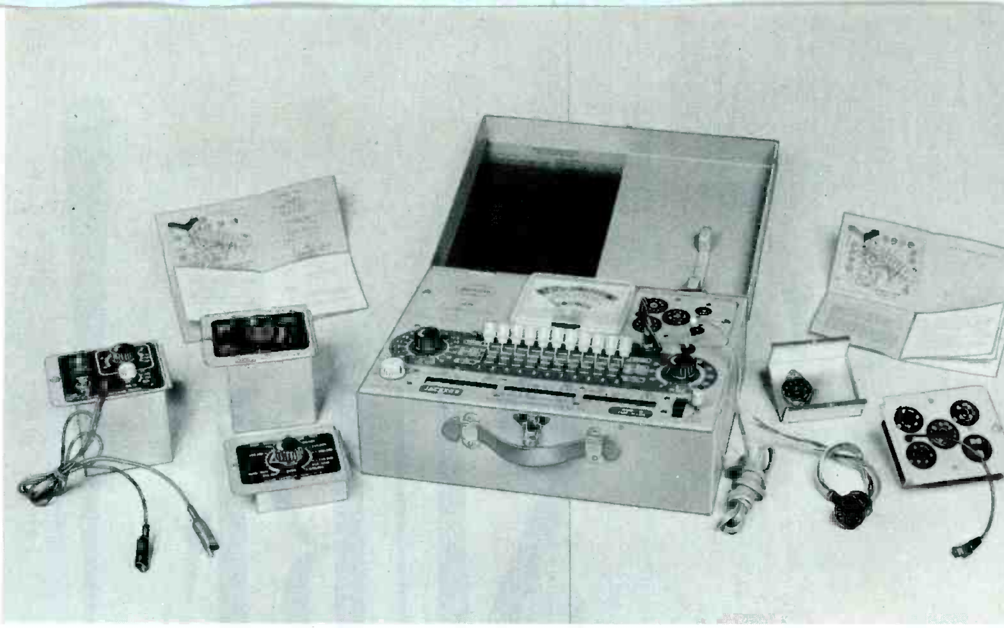


Fig. 3. Jackson Model 49 Tube Tester and Plug-in Accessories.

Fig. 4. Jackson Model 49 Tube Tester Showing Plug-in Adapter.

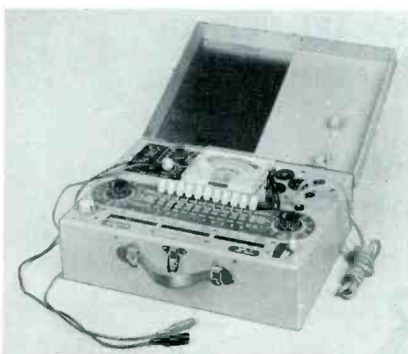


Fig. 5. Jackson Model 49 Tube Tester With Model 49R Tester for Selenium Rectifiers in Place.

The P49B and the 49S accessory units are accompanied by complete step-by-step instructions for installation, which is not difficult and can be completed in a few minutes.

Other plug-in accessories are under development and will be announced by the manufacturer as they become available.

The Model 49 tube tester is housed in a steel carrying case with a scratch-resistant finish. Size of the case is 14¼ by 10¾ by 5⅜ inches.

PAUL C. SMITH

Troubles In Sync Circuits

(Continued from page 19)

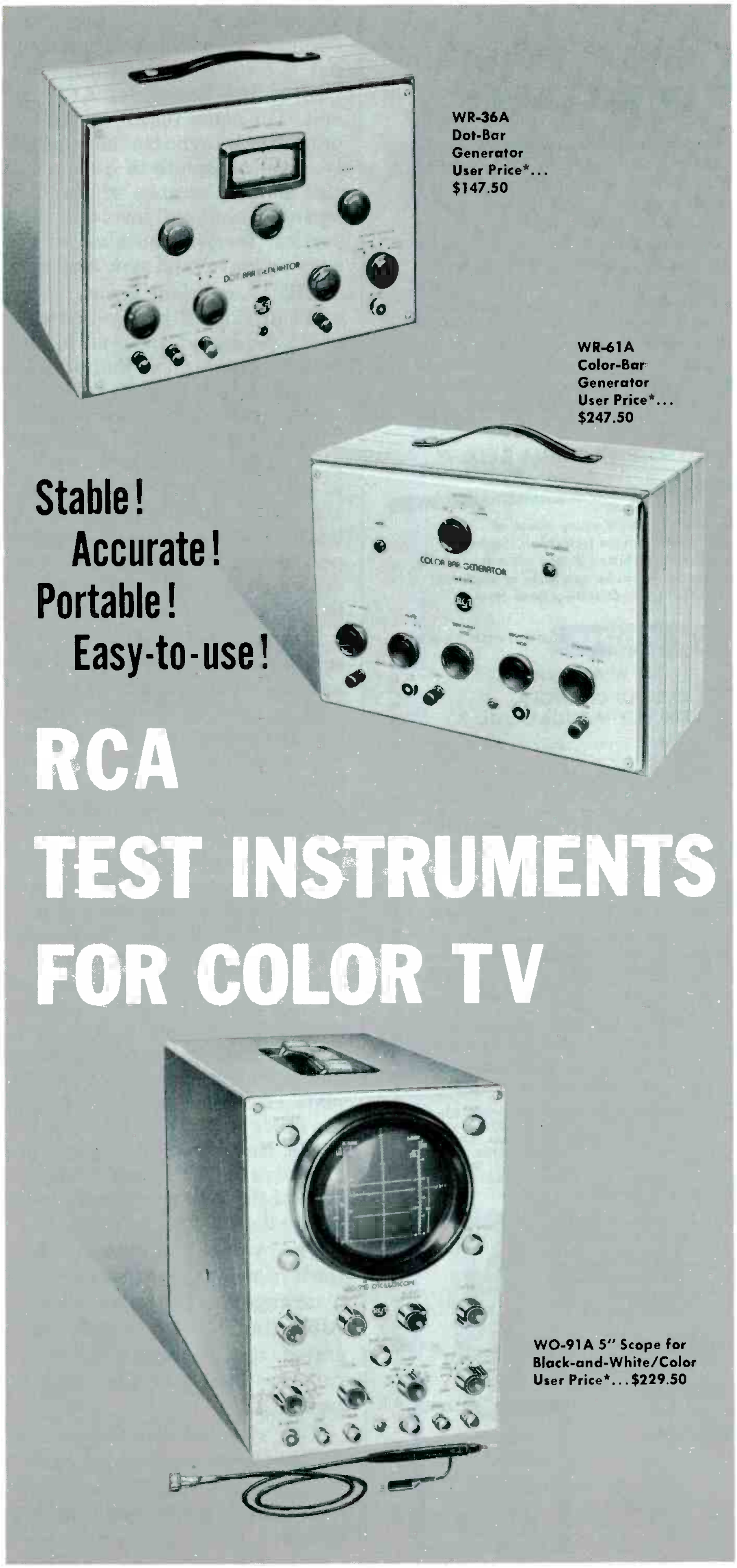
ing to the difference in the pulse frequencies. They also modify the pulse waveforms so that proper control of the respective oscillators may be achieved.

The high-pass filter network located at the input to the horizontal AFC stage has a short time constant and thus responds readily to the horizontal sync pulses and to the serrations in each vertical sync pulse. The long vertical pulses have no effect on this type of filter because the capacitors involved must charge and discharge at a higher repetition rate than that of the vertical pulses.

The filter or integration network found in the vertical sync circuit has a much longer time constant than that of the horizontal circuit. When a horizontal sync pulse is applied to this network, the capacitors involved start to charge slowly; but before they can become completely charged, the trailing edge of the pulse appears and the capacitors discharge to their original potential. This action produces only small fluctuations of voltage at the output of the integrator, and the vertical oscillator is biased so that it will not be triggered by these small variations. It can be seen from these two different filtering actions how the horizontal and vertical sync pulses, which are of the same relative amplitude, can be separated to synchronize their respective sweep oscillators.

The schematic diagram shown in Fig. 2 represents only one of the many sync circuits used. This circuit is divided into two major sections, one for the horizontal sync signal and one for the vertical sync signal. The sync take-off point is located in the plate circuit of the video output stage, and from this point the signal is applied to the two separators.

In the horizontal section, the video component is first removed by a sync separator utilizing one half of a 6SN7GT tube. The signal is then applied to one triode section of another 6SN7GT tube where it is amplified and inverted in polarity. The final horizontal



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sync stage consists of a cathode follower. From this stage, the signal is coupled through capacitor C98 to the horizontal AFC circuit. The cause for either vertical or horizontal sync trouble is usually easier to isolate in a circuit of this nature because of the two separate sections involved. The vertical section contains only a sync separator and sync amplifier.

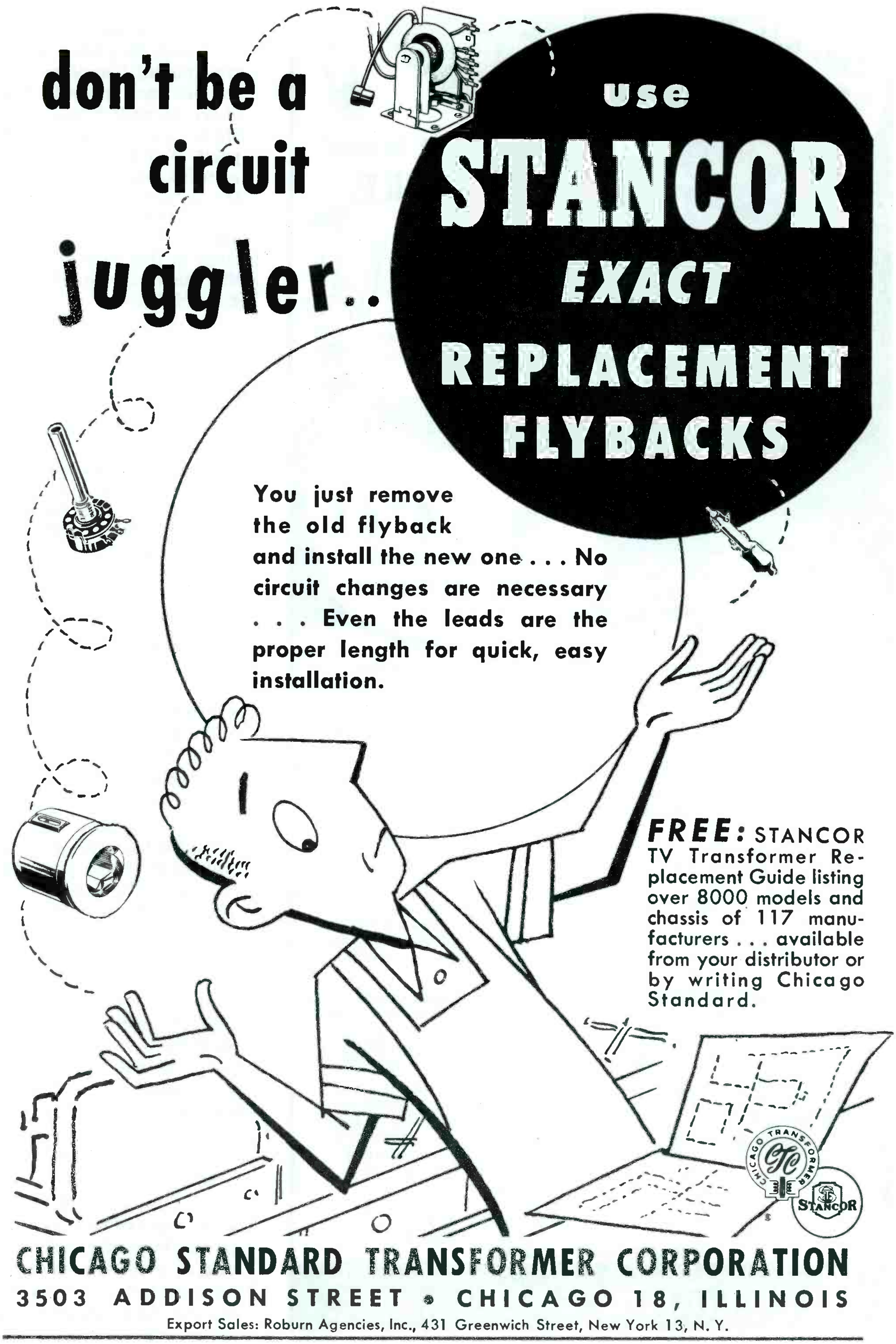
The sync circuit shown in the schematic of Fig. 3 employs a 6CS6 pentagrid tube as a sync separator and noise limiter. This stage is driven by a 30-volt peak-to-peak signal of positive polarity. This signal is derived from the plate of the video output tube and is coupled to the separator grid, pin No. 7. In addition, a 2-volt peak-to-peak signal of negative polarity is obtained at the video detector load and applied to the limiter grid, pin No. 1.

The noise-gate control R8 is set so that noise pulses of sufficient amplitude appearing at the limiter grid will cut off the tube; therefore, the noise pulses do not appear in the output. This variable bias together with the low plate voltage insures a sync output of constant amplitude.

The second sync stage in the schematic diagram of Fig. 3 functions as a phase inverter and utilizes one half of a 6SN7GT tube. Control of the horizontal oscillator in this receiver requires that two signals of opposite polarities should be applied to the AFC stage. This is accomplished when one signal is obtained from the plate circuit of the inverter and the other is obtained from the cathode. Resistors R75 and R77 are critical in value because the amplitude of the two sync signals must be equal.

The vertical integrator network receives the signal from the plate circuit of the phase inverter. After the signal has been integrated, it is coupled through capacitor C65 to the vertical oscillator.

The sync section represented in the schematic diagram of Fig. 4 is a conventional two-stage circuit. This circuit employs one 6SN7GT tube which serves as a sync separator, clipper, and phase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inverter. The input signal is supplied from the plate circuit of the video output. The plate voltage on the first sync stage is 155 volts above ground; however, the cathode is returned to a 135-volt point. With this arrangement, the plate is actually only 20 volts positive with respect to the cathode. This is satisfactory for the required clipping action. The final stage in this circuit is similar to that shown in the schematic diagram of Fig. 3.

The sync circuit shown in Fig. 5 is of a somewhat different design. A 12AU7 tube functions as a cathode follower and noise inverter, and the triode section of a 6AX8 serves as a sync separator. The cathode follower isolates the sync and AGC sections from the video amplifier and prevents loading of the plate circuit of the amplifier. From the cathode of this first triode stage, the signal is divided into three paths. The composite video signal is fed to the AGC keying tube through resistor R57 and to the sync separator through resistor R82. The signal is also applied directly to the grid of the noise inverter.

The noise inverter is normally biased beyond cutoff and has a plate voltage which is low with respect to the cathode. Noise pulses of sufficient amplitude appearing in the signal will drive the grid positive, overcome the bias, and cause the tube to conduct. The noise pulses will appear on the plate but in opposite polarity to those in the original signal which is coupled to the same point. In this manner, the noise pulses will cancel themselves and will not reach the sync separator. The output of the sync separator is fed to the integrator circuit and to the horizontal AFC circuit.

Slight variations of these typical sync circuits will be found in a large number of other television receivers in the field today. The waveforms and voltages appearing on the four schematic diagrams used as examples may prove helpful to the technician as a comparison when he is servicing somewhat similar sync circuits.

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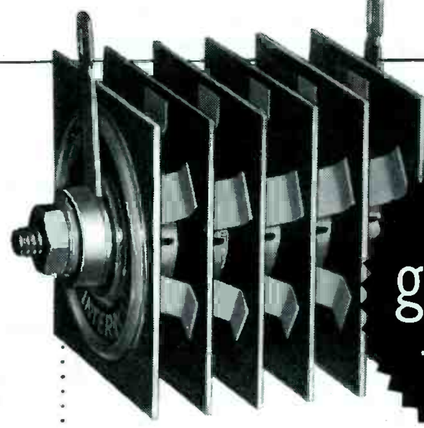

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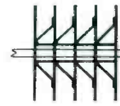

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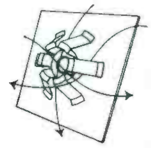

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It is somewhat impractical and virtually impossible to formulate a standard trouble-shooting procedure that will cover all the difficulties encountered in television sync circuits. Not only is this task difficult, but the technician should understand that defective components in certain other sections of the receiver are equally capable of affecting the operation of the sync section. There are a number of preliminary steps which should be taken to isolate the trouble while the receiver is still in the owner's home. A suggested procedure for localizing sync trouble is given in a logical order in the following:

1. Observe the trouble symptom.
2. Check reception on all operating channels.
3. Adjust the vertical and horizontal frequency controls.
4. Observe the effect of other pertinent controls.
5. Examine the vertical sync pulse on the picture tube screen.
6. Make direct substitution of all tubes which could produce the trouble symptom or symptoms.

Before the service technician assumes that there is only one obvious trouble symptom, he should consider the possibilities of other important symptoms that could lead him to the faulty section. Other symptoms that might appear with poor synchronization are brightness modulation, distorted sound, or poor focus. In some instances, loss of synchronization may be accompanied by a negative picture. This will usually indicate trouble in some stage prior to the sync take-off point rather than in the sync section.

A check should always be made to determine whether or not the trouble exists on all operating channels. The trouble may be due to station difficulties, local interference, or a defective antenna sytem. Possible AGC troubles that result in poor synchronization can often be detected in this manner. The receiver may operate properly on signals from distant stations but not on the strong local signals. This condition will warrant further checking of the AGC system.

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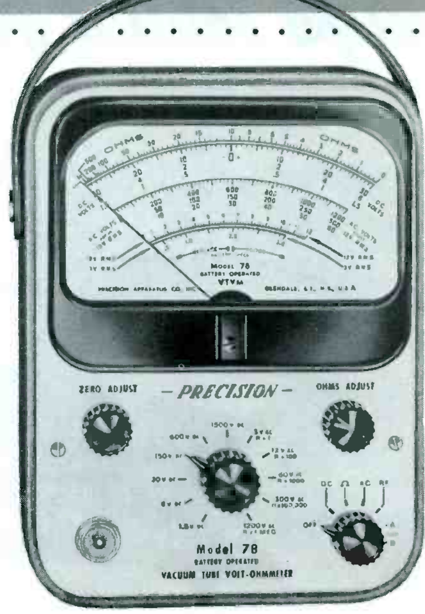

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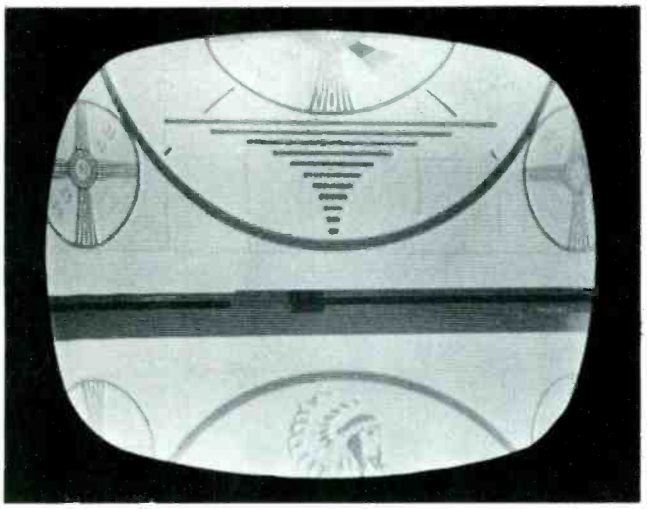

Fig. 6. Normal Vertical-Blanking Bar As It Appears on the Picture Tube Screen.

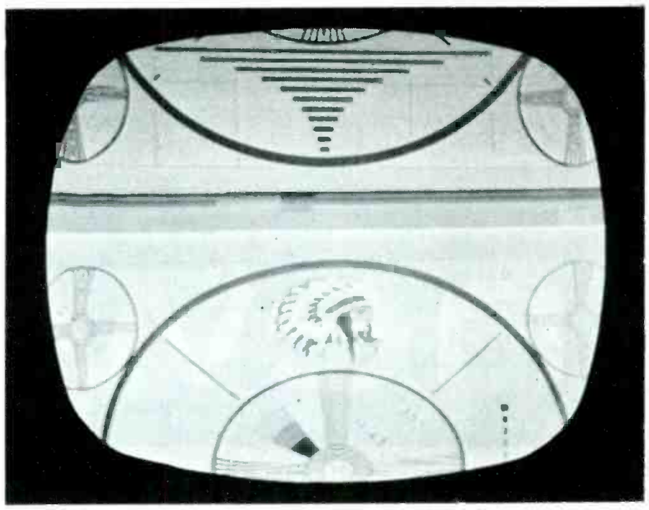

Fig. 7. Abnormal Vertical-Blanking Bar Resulting From Poor Low-Frequency Response in the Video Amplifier Stage.

If a component in the horizontal AFC or oscillator circuits should change slightly in value, it is often possible to compensate for the change by varying the horizontal hold or frequency adjustments. When the trouble symptom indicates poor vertical synchronization, the vertical hold control should be varied to determine if the range of the control is sufficient to cause the picture to lock in. If the control will not cause the picture to lock in but will hold several small pictures stationary in the vertical direction, this usually indicates that at least a portion of the sync signal is reaching the vertical section. From this, the technician might assume that the fault lies in the oscillator stage.

The modern TV receiver may contain one or more of a number of switches and other controls which will definitely affect the operation of the sync section. AGC, local distant, fringe lock, noise gate, and sensitivity are typical names for the controls which may be incorporated in many commercial receivers. The proper settings of these controls and switches can eliminate many of the symptoms of poor synchronization encountered in the field. These adjustments should never be overlooked when servicing the receiver in the home.

The functioning of the contrast control can be of value in isolating a sync trouble. If the trouble becomes more apparent as the contrast control is advanced, this usually indicates that the defect lies somewhere prior to the sync take-off point. On the other hand, if the trouble lessens when the control is advanced, it may then be assumed that the trouble is originating after the sync take-off point. The indications derived from this procedure are not always foolproof but may prove helpful in many cases.

In attempting to isolate the cause of poor synchronization to one section of the receiver, the picture tube can also serve as a halfway check point. With the proper control adjustments, the relative amplitude of the vertical sync pulses can be observed on the picture tube screen. This check may be made by turning up the brightness control and adjusting the vertical hold control until the vertical blanking signal appears like that shown in Fig. 6. In order to see the sync pulse, it may be necessary to reduce picture contrast. If the picture is completely out of syncronization, adjust the hold controls to produce as stationary a picture as possible. It may be impossible to make this test if the vertical or horizontal frequencies are too far out of range; however, it should require only a quick glance to determine whether the sync amplitude is normal or not.

The vertical sync pulse should appear darker than the darkest picture elements. The presence of a normal sync pulse at the picture tube will indicate that the trouble is in the sync circuit or in the individual oscillator circuits. If an abnormal pulse is present, as in Fig. 7, it can then be assumed that the trouble is originating in the RF, IF, or video circuits. Correct interpretation of this test procedure will aid in localizing sync troubles. The technician should perform this test on various makes of properly operating receivers in order to recognize and become acquainted with normal variations in the appearance of the blanking and sync pulses when they are presented on the screen.

After preliminary steps have been taken and the trouble has been localized, the tubes in the suspected section should be checked by substitution because changes in the characteristics of a tube will not always show up on a tube checker.

If a trouble symptom persists after all the tubes which could cause the difficulty have been temporarily replaced, the technician must remove the chassis and make further tests with shop equipment. If the trouble or defective stage has been isolated to the sync section, a voltmeter may be used to check the different circuits. The bias applied to each stage should be checked and compared with the manufacturer's information or other reliable service data. Any appreciable deviation will call for a more careful check of individual components in the circuit. Improper bias on a sync separator usually causes an inadequate clipping action which will permit a portion of the video signal to pass through the stage and

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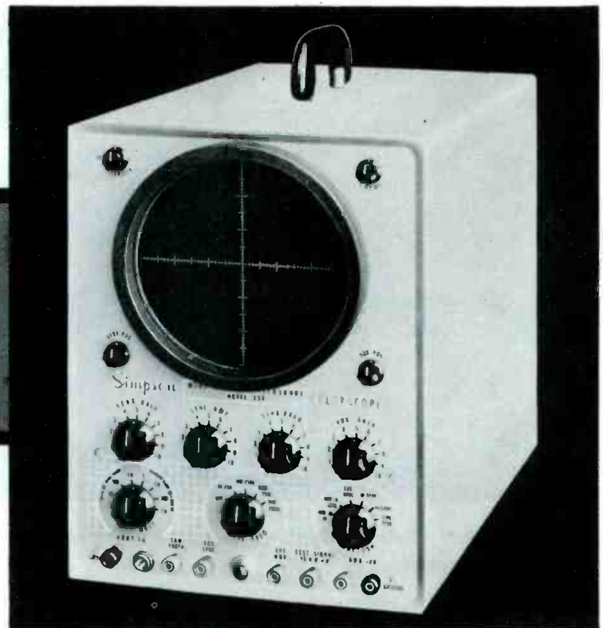

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- Vernier vertical attenuator for *continuous control* of the signal voltage.
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VERTICAL AMPLIFIER FREQUENCY RESPONSE—Wide band position: *Flat* within ± 1 db from 20 c/sec to 4.5 mc/sec; *flat* within ± 2 db from 10 c/sec to 5.0 mc/sec.

Narrow band position: *Flat* within ± 1 db from 20 c/sec to 200 kc/sec; *flat* within ± 2 db from 10 c/sec to 300 kc/sec.

RISE TIME—Less than 0.05 microsecond (wide band position).

VERTICAL DEFLECTION SENSITIVITY—Wide band: 40 mv R.M.S./inch minimum. Narrow band: 15 mv R.M.S./inch minimum.

HORIZONTAL AMPLIFIER FREQUENCY RESPONSE—*Flat* within ± 1 db from 20 cycles/sec to 200 kc/sec.

HORIZONTAL DEFLECTION SENSITIVITY—Horizontal input "Hi", 115 millivolts R.M.S./inch minimum. Horizontal input "Low", 1.4 volts R.M.S./inch minimum.

VERTICAL INPUT IMPEDANCE—3.3 Megohms shunted by 20 mmf.

HORIZONTAL INPUT IMPEDANCE 1.1 Meg.

LINEAR SWEEP OSCILLATOR—Saw tooth wave from 14 cycles/sec to 250 kc/sec. Sixty-cycle sine wave also provided.

INPUT CALIBRATION—18 Volt P-P test voltage available on panel.

INTENSITY MODULATION—Provision for internal, external and 60 cycles.

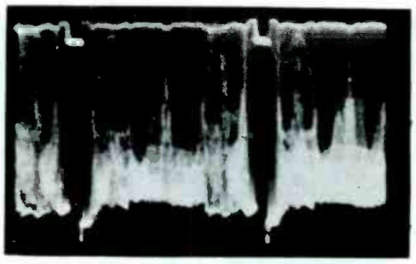


Fig. 8. Composite Video Signal Present at the Input to the Sync Section. (Oscilloscope Frequency Was 30CPS.)

affect the stability of the oscillators.

When synchronization is completely lost, one of the first checks should be that of all the coupling capacitors in the sync section. One of the most frequent offenders causing a symptom of this nature is a leaky coupling capacitor between the sync take-off point and the first sync stage.

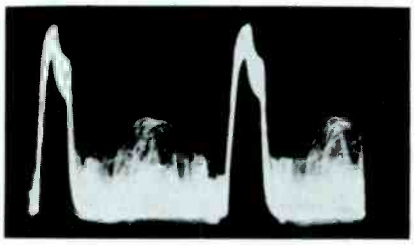


Fig. 9. Input Signal to Sync Section. (Oscilloscope Frequency Was 7,875 CPS.)

The oscilloscope is another very useful piece of test equipment when trouble shooting the sync circuits. A visual observation of the input and output signals at the different stages will indicate to the technician what each stage is accomplishing. With the sweep frequency of the oscilloscope set at 30 cycles, a waveform resembling that of Fig. 8 should be obtained at the input to the sync section. This waveform illustrates the composite video signal at one half the vertical sweep rate. With the oscilloscope set at this frequency, two vertical sync pulses become visible.

Fig. 10. Signal Appearing at the Separator Output. (Oscilloscope Frequency Was 30 CPS.)

The waveform shown in Fig. 9 represents the same input signal at one half the horizontal sweep rate. The oscilloscope frequency has been increased to 7,875 cycles, thus revealing two individual horizontal sync pulses. In both waveforms, the signal has a positive polarity because of the positive signal at the sync take-off point in the particular receiver used for illustration. The video portion of the signal appears as a blurred and somewhat hazy mass at the lower part of the pattern.

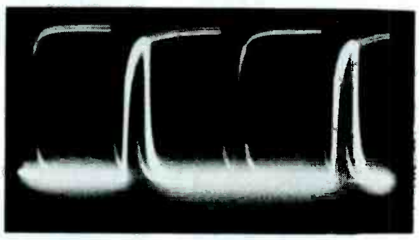


Fig. 11. Signal at the Separator Output. (Oscilloscope Frequency Was 7,875 CPS.)

The output signal from a typical sync separator is shown in the waveforms of Figs. 10 and 11. At this point, the video portion of the signal has been removed. The light haze appearing between the two vertical pulses in Fig. 10 represents the horizontal sync pulses. The clipping action of a sync separator can be checked if the input probe of the oscilloscope is placed at the output of this circuit. The video signal should not be present at this point, but a relatively clean trace like that in Figs. 10 and 11 should be observed. Another advantage in using an oscilloscope when signals in sync circuits are being traced is the quick and easy determination of the absence or presence of the signal.

Common Symptoms

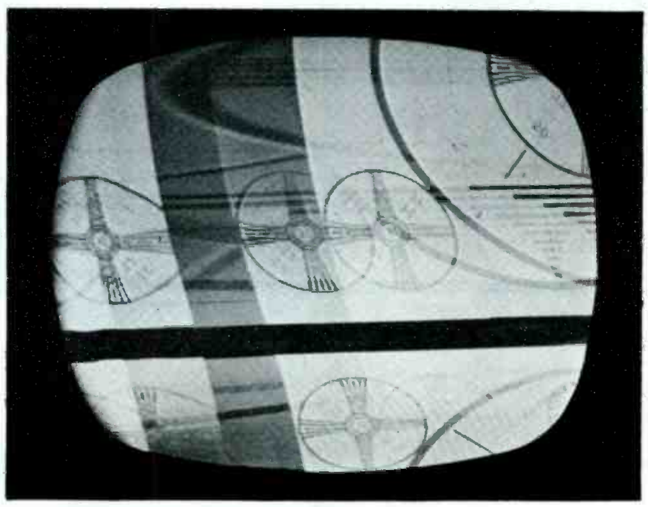
1. Loss of vertical and horizontal synchronization.

The complete loss of both vertical and horizontal synchronization, illustrated by the photograph in Fig. 12, is very often a result of a defective component located in the sync section. This symptom may be accompanied by other trouble symptoms that might give a clue as to what section of the receiver is at fault. A check of the tubes, coupling capacitors, and B+ voltages should be among the first trouble-shooting procedures for this symptom.

Possible causes for loss of vertical and horizontal synchronization are:

a. Defective tube in sync or noise-limiter stages.
b. Video-coupling capacitor shorted, leaky, or open. (See C60 in Fig. 3, C51 in Fig. 4, or C90 in Fig. 5.)
c. Plate or screen resistors open or too high in value. (See R70, R72, R76, R77, R78 in Fig. 3; R45, R48, R49 in Fig. 4; or R85, R89 in Fig. 5.)
d. Shorted or leaky coupling capacitor. (See C63 in Fig. 3; C53, C54 in Fig. 4; or C89 in Fig. 5.)
e. Shorted screen-bypass capacitor. (See C62 in Fig. 3.)
f. Sync-isolation resistor open or too high in value. (See R58 in Fig. 2, R67 in Fig. 3, R33 in Fig. 4, or R82 in Fig. 5.)

Fig. 12. Picture Showing Loss of Vertical and Horizontal Synchronization.



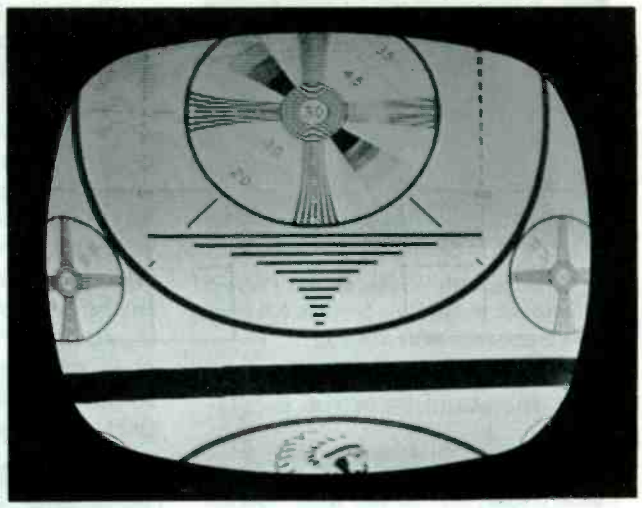


Fig. 13. Picture Showing Loss of Vertical Synchronization.

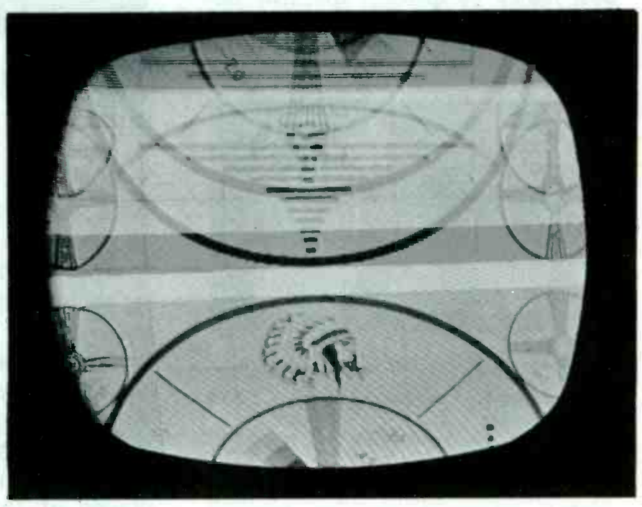


Fig. 14. Picture Taken During Sudden or Periodic Vertical Flopover.

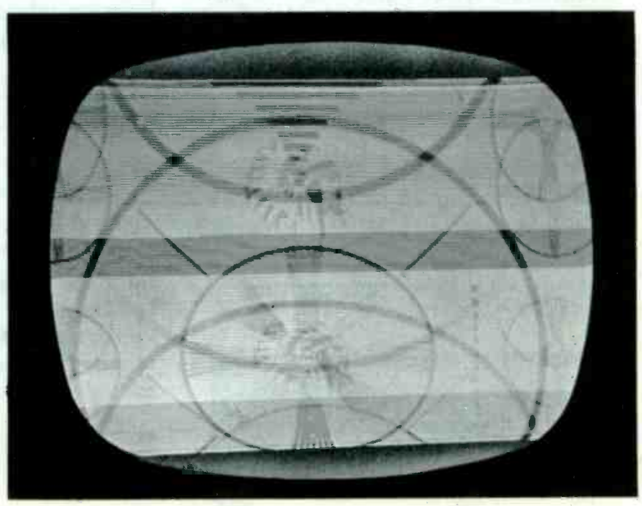


Fig. 15. Picture Showing Loss of Vertical Synchronization Accompanied by Height Reduction.

g. Resistance of voltage divider changed in value. (See R71 in Fig. 3, R46 in Fig. 4, or R86 in Fig. 5.)
h. Improper cathode bias. (See R68, R90, R95 in Fig. 3; R75 in Fig. 3; R47 in Fig. 4; or R57, R81, R83, R84 in Fig. 5.)
i. Open decoupling or B+ filter capacitor. (See C5 in Fig. 3.)
j. Improperly adjusted grid-bias control (See R8 in Fig. 3.)

It is possible for a negative picture or an overloaded condition to result from an inoperative sync circuit especially when the AGC network obtains its bias from this section. The loss of synchronization, a distorted picture, and buzz in the sound may indicate a shorted or leaky capacitor between the AGC and sync circuits. In many receivers, these two circuits have interlocking actions and can produce similar trouble symptoms. The service technician should never underestimate the influence of the noise-eliminator stage. A defective component or an inoperative tube in this circuit can seriously affect sync stability.

A leaky coupling capacitor in the grid circuit of a typical sync separator will not retain a large enough charge to develop the proper grid-leak bias. This trouble may be detected by an abnormal voltage reading on the grid of the tube.

2. Loss of Vertical Synchronization.

The photograph of Fig. 13 represents a trouble symptom in which the picture moves either up or down at a rapid rate and thus produces an appearance of multiple images. In many such cases, the range of the vertical hold control will not be sufficient to lock in only one picture.

The symptom shown in Fig. 14 illustrates another degree of poor vertical synchronization. In this instance, the picture may either tend to move slowly downward or to have an occasional flopover. These conditions can result from an inadequate or distorted sync pulse reaching the vertical oscillator circuit.

Possible causes of loss of vertical synchronization are:

a. Defective tube in the sync or noise-limiter stages.
b. Defective integrator component, (See R100, R101, R102, C84, C85 in Fig. 2; R79A, R79B, R79C, C64A, C64B, C64C in Fig. 3; R51, R52, C55, C56 in Fig. 4; or R92, R93, C94, C95 in Fig. 5.)
c. A 60-cycle hum present in sync signal.
d. Leaky, shorted, or open coupling capacitor to vertical oscillator. (See C79, C80, C83, C86 in Fig. 2; C65 in Fig. 3; C54 in Fig. 4; or C93 in Fig. 5.)
e. Open cathode-bypass capacitor. (See C78 in Fig. 2.)
f. Voltage divider changed in value. (See R92 in Fig. 2; or R90, R91 in Fig. 5.)
g. Plate-load resistor decreased in value. (See R76 in Fig. 3, R48 in Fig. 4, or R89 in Fig. 5.)

Another severe case of vertical sync trouble which is accompanied by a reduction in the height of the raster is pictured in Fig. 15. One of the most common causes for a condition of this nature is a shorted, open, or leaky coupling capacitor located between the sync and vertical oscillator circuits.

If a plate-load or voltage-divider resistor overheats and changes value for no apparent reason, the replacement should always have a higher wattage rating than that of the original. This is a good practice to follow when any section of the receiver is being serviced.

In some of the older TV receivers, the sync take-off point is located at the DC restorer diode and any sudden change in over-all picture brightness may result in a corresponding shift in the level of the sync signal. This condition often causes the vertical oscillator to skip and produce a momentary vertical roll.

3. Loss of Horizontal Synchronization.

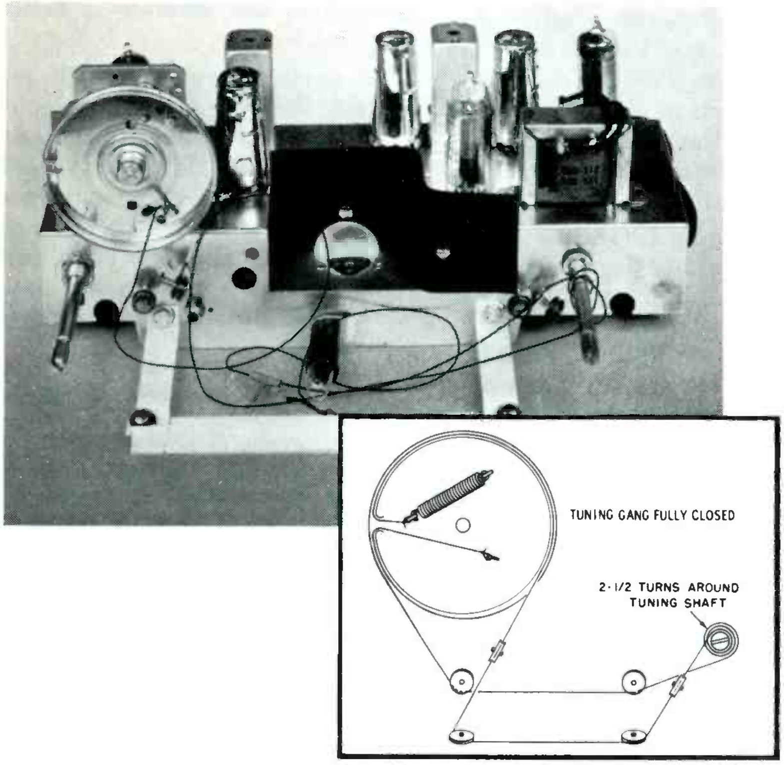
Loss of horizontal synchronization, as illustrated by the photograph in Fig. 16, is usually a direct result of a failure in the horizontal AFC or oscillator circuits. In many cases, however, this symptom can develop from a defective tube or component in the sync section. Trouble originating in the horizontal oscillator circuit usually produces a number of dark diagonal or horizontal bars on the screen. When the trouble is affecting the sync pulses fed to the oscillator, the picture often tends to drift back and forth. In this case, the hold control may be capable of stopping the picture; but the synchronization will still be very erratic.

In some instances, the trouble symptom will not appear until the receiver has been on for a certain period of time. This difficulty usually indicates that the heat generated in the receiver is affecting some component and is causing the oscillator frequency to drift out of range. A common offender causing a trouble of this kind is one or both of the mica or ceramic capacitors coupling the sync signal to the horizontal AFC circuit.

Possible causes of loss of horizontal synchronization are:

a. Defective tube in sync or noise-limiter stages.
b. Open grid-leak resistor. (See R87 in Fig. 5.)
c. Open or leaky coupling capacitor to horizontal AFC. (See C96, C97, C98 in Fig. 2; C69, C70 in Fig. 3; C61, C62 in Fig. 4; or C104 in Fig. 5.)

how long would it take you to solve this service problem?



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

TUBE PLACEMENT CHARTS

7. Top and bottom views are shown. Top view is positioned as seen from back of cabinet. Blank pin or locating key on each tube is shown. Charts include fuse location for quick service reference.

TUBE FAILURE CHECK CHARTS

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

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9. Detailed parts list is given for each model. Proper replacement parts are listed (with installation notes where required). All parts are keyed to chassis photos and schematics for quick reference.

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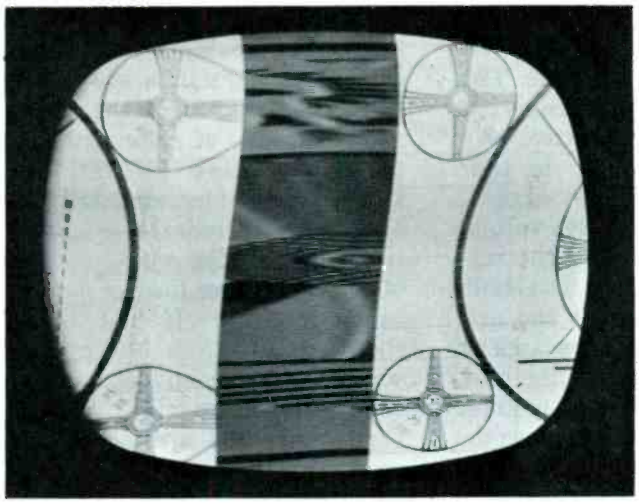

Fig. 16. Loss of Horizontal Synchronization.

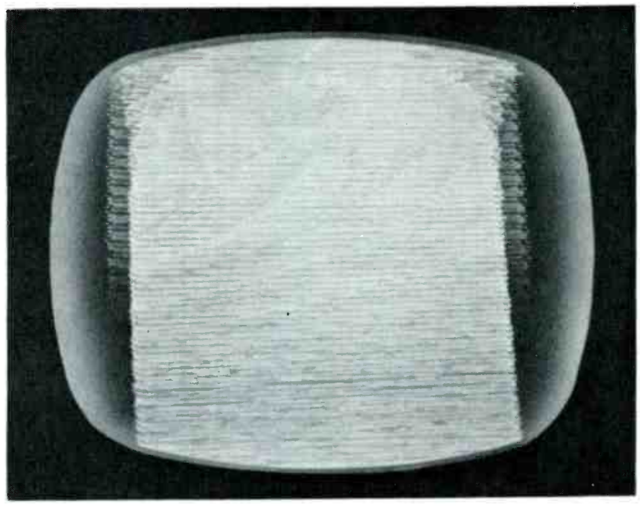

Fig. 17. Christmas-Tree Effect Resulting From Erratic Operation of the Horizontal Oscillator.

d. Plate resistor open or too high in value. (See R91, R117 in Fig. 2.)
e. Open or leaky cathode bypass capacitor. (See C95, C99 in Fig. 2.)
f. Open signal path in horizontal sync circuit. (Check tube sockets for corrosion or broken connections.)
g. Improper grid bias or horizontal sync tubes. (See R116, R118, R119 in Fig. 2.)

An open resistor in the grid-leak network of a sync separator will sometimes result in the development of a train of oscillations when the contrast control is advanced. In a few other cases, it has been noticed that a Christmas-tree effect can result when the contrast is reduced. This trouble symptom is shown in the photograph of Fig. 17. An open filter capacitor located in the B+ circuit of the sync section is capable of producing this effect. The open capacitor will permit hum or vertical sync pulses to reach the AFC stage and thus cause erratic triggering of the oscillator.

4. Horizontal Pulling in the Picture.

The trouble symptoms shown in Figs. 18 and 19 represent different degrees of horizontal pulling or bending. This trouble is encountered when the horizontal oscillator is trying to lose synchronization momentarily. Troubles of this nature are usually caused if some sort of sync-pulse distortion or some hum modulation reaches the oscillator stage. One of the more common causes of picture pulling is insufficient filtering in the sync or AGC sections.

Possible causes of horizontal pulling in the picture are:

a. Defective tube in the sync or noise-limiter stages.
b. Incorrect time constant in grid-leak network. (See C91, R87 in Fig. 5.)
c. Defective component in horizontal sync take-off network. (See R75, R77, C69, C70 in Fig. 3; R47, R49, C61, C62 in Fig. 4; or R89, C104 in Fig. 5.)
d. Improper value of plate-load resistor. (See R91, R117 in Fig. 2.)
e. Improper filtering of bias supply. (Check all filter capacitors.)
f. Open screen-bypass capacitor. (See C62 in Fig. 3.)
g. Leaky coupling capacitor in horizontal sync circuit. (See C96, C97 in Fig. 2.)

If the time constant is too long in the grid-leak network of the sync separator, the horizontal

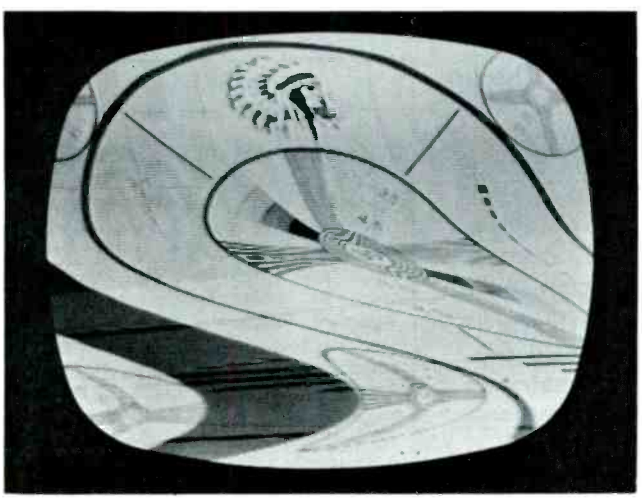

Fig. 18. Extreme Horizontal Pulling of the Picture.

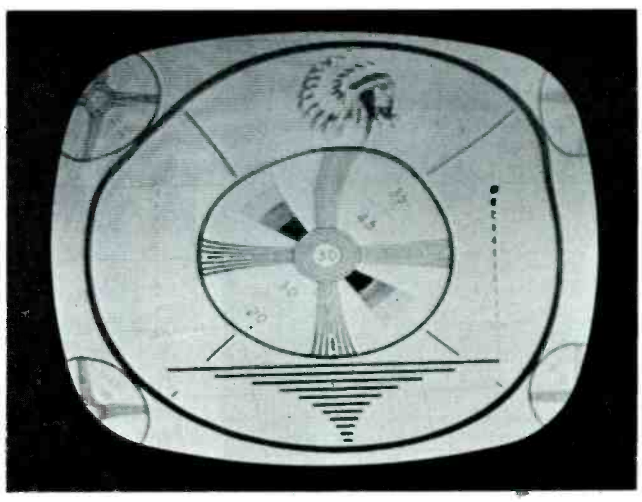

Fig. 19. Horizontal Bending at the Top of the Picture.

sync pulses immediately following the vertical sync pulse will be reduced slightly in amplitude. This is because the grid capacitor charges to a higher negative voltage during the vertical pulse than it does during the horizontal pulses. A greater negative voltage will then be present on the separator grid when the first horizontal pulses appear at the grid than when the last ones appear. During this first instant, the horizontal pulses will be of a lower amplitude and will often cause the picture to bend at the top. The top of the picture is rather sensitive to variations in the amplitude of the horizontal sync pulses especially when the control of the oscillator changes from the equalizing pulses back to the horizontal sync pulses.

5. Vertical Jitter.

The nature of vertical jitter will not permit a pictorial illustration, but undoubtedly the service technician has encountered this condition sometime in the past. The vertical oscillator acts as if it were about to lose synchronization. Instead of rolling, the picture tends to have a vetrical jitter or bounce. With some troubles of vertical jitter, poor interlacing may also appear.

Possible causes for vertical jitter are:

a. Defective tube in the sync or noise-limiter stages.
b. Defective component in the vertical-integrator network. (See R100, R101, R102, C84, C85 in Fig. 2; R79A, R79B, R79C, C64A, C64B, C64C in Fig. 3; R51, R52, C55, C56 in Fig. 4; or R92, R93, C94, C95 in Fig. 5.)
c. Improper lead dress. (Check yoke and other leads near sync or oscillator stages.)
d. Open plate or screen-bypass capacitor. (See C82 in Fig. 2, C62 in Fig. 3, or C92 in Fig. 5.)

Horizontal pulses or portions of the video signal reaching the vertical oscillator stage will also produce this symptom. Remember to check for improper lead dress and for poor shielding.

Many sync troubles which have an intermittent characteristic can develop in a receiver. This type of trouble is usually difficult to isolate, and probably a great deal of the technician's time will be consumed in doing so. In these cases, the possibility of an intermittent tube should never be overlooked. Other causes of intermittent operation may include loose connections, cold solder joints, or drops of solder or other foreign particles causing shorts. If the trouble should result from one of these sources, the technician may be able to detect the fault by tapping the components in the suspected area. A visual inspection of the foil pattern employed in the newer printed-wiring boards will usually reveal any broken signal path or possible short circuit.

An intermittent trouble may also occur only after a receiver warms up. This usually indicates that heat is affecting one or more of the components. A soldering iron or heat lamp may prove very helpful when trouble occurs from increased temperatures in a certain section. The lamp or iron should be placed close to the components in question, and a voltage or resistance measurement should be taken. Exercise care if heat is being applied to a printed-wiring board. Excessive heat may cause the printed wiring to pull away from the board. In order to save time when an intermittent trouble is encountered, many technicians prefer to change a number of capacitors and resistors in the defective section at one time. The receiver can be left on while the technician attends to other work, after which the check can be made.

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Dollar and Sense Servicing

GIGACYCLE. If you come across a "gigacycle" one of these days in a technical article, have your laugh and then translate it as kilomegacycle. Some engineers, particularly in Europe, are favoring this new term to mean 1,000 megacycles. American engineers generally favor the kilomegacycle, abbreviated kmc, for this purpose. Actually, we could just as easily say 1 billion cycles.

Traveling-wave tubes for microwave relays operate in this range; a 4-gigacycle tube with a 50-db gain is described in a recent issue of *Electrical Communication.*

Dollars and Sense

(Continued from page 37)

ROBOTESTER. After sweating for hours on a tough TV trouble-shooting job, have you ever yearned for a tester that could be plugged into a set for automatically checking circuits one after another—a tester that would stop when it came to a bad circuit and light up lamps to tell exactly where the trouble was? Well, it's here, even though it is not yet ready for such trouble shooting. Lavoie Labs of Morganville, N. J., demonstrated their Robotester at a press show held in the wine cellar of Leone's restaurant in New York City.

This robot works from an endless loop of punched tape. At present, to test a TV set, you have to yank all the tubes and push tester plugs in their places. The tape is punched beforehand to tell the machine to connect one particular socket and pin number to another socket and pin number and then to tell what resistance and tolerance that circuit should have.

Tests are made at the rate of 120 per minute. Up to 90 per cent of circuit defects, excluding tubes, can be found. Cost of the tester is around $3,000, which is one drawback for servicing. Another drawback is the need to pull all tubes.

If TV set manufacturers provided one or two special test sockets at the rear of each TV chassis for the purpose and included the appropriate endless punched tape in a little metal can attached to the chassis, it is quite conceivable that we could have here a new service instrument someday.

BACKWARD. Now comes an 8DP4 put out by RCA in sample quantities for manufacturers to "feel out" the market for 8-inch TV sets. Success of GE's 14-inch portable at around $100 has raised hopes that the public may be ready for truly portable sets for practically every room in the house, including bathrooms. These will be line operated because battery operation is not as yet practical for TV.

Those who remember the early days of TV will say, "This is where I came in!" But such is not so. Back in 1948, *Television Digest* announced the Pilot 3-incher as the "Tiny TV That's Read, Not Viewed." The set started off at $100, but within a year it was being dumped at half price or less. Today, these sets are largely gathering dust except for an occasional showing at a charity bazaar where they can be billed as "The Tiniest TV Receiving Set in the World" for a dime a look.

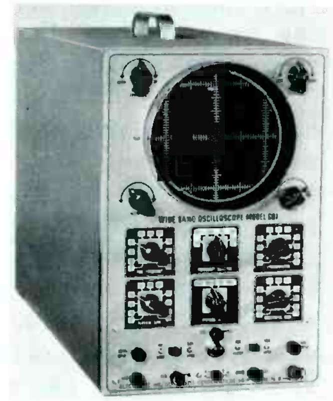
It's a good idea to hang onto one of these old TV sets and keep it in repair. It makes a good show-window display once or twice a year and makes a business-getting exhibit at various events around town.

• *Please turn to page 95*

Product Report

Editor's Note:
The material appearing in this column has been taken from literature supplied by the manufacturers of the various products. The *PF REPORTER* cannot assume responsibility for claims of originality or application.

OSCILLOSCOPE

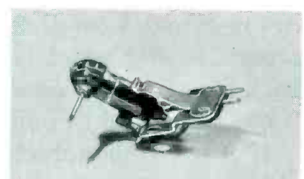


A new oscilloscope announced by the Electronic Measurements Corporation, 280 Lafayette Street, New York, has many features that make it suitable for use in color TV servicing.

The vertical amplifier has a sensitivity of 20 millivolts per inch and a bandwidth of 5 megacycles. A blanking amplifier eliminates retrace lines and gives clearer pictures. An astigmatism control is provided for better foscusing action.

The price for this oscilloscope is $117.90 when it is factory assembled or $70.90 for the kit.

CERAMIC CARTRIDGE



A new high quality ceramic cartridge has been announced by the American Microphone Company, Pasadena, California, the electronics division of the Elgin National Watch Company.

The new turnaround cartridge features an osmium stylus for microgroove recordings and a sapphire stylus for standard recordings. The styli are mounted as a single unit and can be replaced without the use of tools.

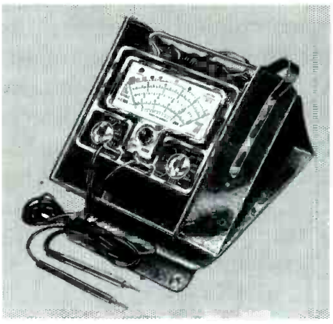
NEW SERVICING TOOL

A new tool developed by the Walsco Electronics Corporation speeds the servicing of color television receivers by enabling technicians to make repairs and measurements when the back cover of the receiver is removed.

This new tool, the Color TV Interlock Cheater, protects the high-voltage supply by eliminating the grounding action of the high-voltage interlock. In addition, the socket on the rear of the tool accepts a high-voltage probe and enables a direct measurement of the high voltage to be made.

The dealers' net price for the tool is 59¢.

VOM



The Phaostron Instrument and Electronic Company announces the Model 666 VOM. The meter is fused, the meter movement has protection against overloading, and a signal light warns the operator when an overload or a voltage of incorrect polarity is being applied to the meter.

The Model 666 has only 2 jacks through which all measurements are made, has separate range and function switches, and has forty-three unduplicated ranges. One unusual feature of the Model 666 is the provision for measurements of alternating currents up to 15 amperes.

The Model 66 has a nonmagnetic steel case and a leather carrying case, and it sells for $59.50.

FLYBACK TRANSFORMERS

The Triad Transformer Corporation, Venice, California, announces that fourteen new flyback transformers have been added to their line of correct-replacement units.

These new transformers are designed for use in Admiral, Emerson, General Electric, Motorola, Philco, Sentinel, Wells-Gardner, and Westinghouse television receivers; and they are electrically and mechanically interchangeable with the manufacturers' original equipment.

LEAKAGE CHECKER

The Service Instruments Company (Senco) has announced a new instrument designed to check for grid-to-cathode and cathode - to - heater leakage in vacuum tubes and for leakage in all types of capacitors. The instrument, the Model LC2, will detect grid emission and gas in 70 popular tubes used in radio and television receivers.

The Model LC2 is available in kit form at $19.95 net price or in assembled form at $24.95 net price.

POWER-LINE CHECKER

The Triplett Electrical Instrument Co., Bluffton, Ohio, is producing a new instrument.

The Model 3000 Line Chek is an aid when the effect of an additional load on a power line is in doubt. It enables the technician to connect to the line an electrical load approximately equal to that of the appliance to be installed before the installation is made. The dealers' net price of the Model 3000 is $34.50.

Examining Design Features

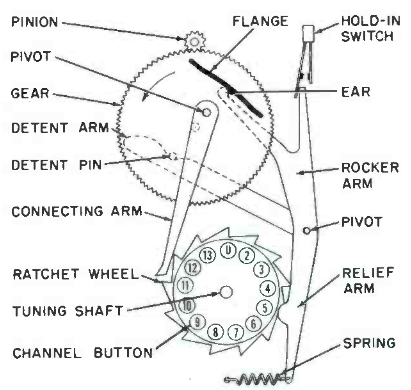
(Continued from page 25)

left corner of the newer chassis, and this location is very easily reached for servicing.

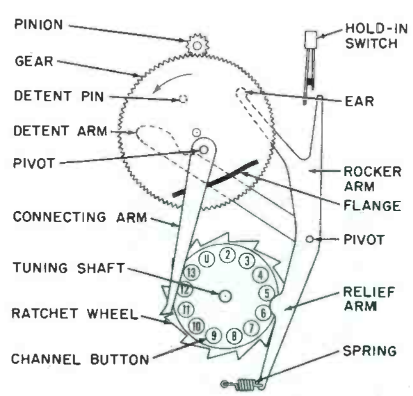
The following relationships exist between the major parts, which are labeled in Fig. 1. The tuning motor drives the pinion which in turn rotates the large gear. The connecting arm translates the rotary motion of the gear into a downward thrust which is applied to one tooth of the ratchet wheel. The hub of this wheel is fastened to the shaft of the tuner. Since there are 13 teeth on the ratchet wheel, a 360-degree rotation of the tuner shaft is accomplished in 13 steps. Each step corresponds to one of the channel positions of the selector.

The stepper unit includes a spring-loaded detent arm. A pin that projects from the gear becomes seated in the notch in the detent arm each time a tuning cycle is completed. This feature keeps the stepper unit from coasting past the on-channel position. The starting torque of the motor is sufficient to bring the pin out of the detent when the next cycle begins. The detent spring can be seen in the photograph, but the detent arm and pin are out of sight behind the gear.

When the tuning button is pressed, the motor field is supplied with 12.6 volts AC from a winding on the power transformer. The armature is thrust forward by the magnetic field and is connected to the pinion through a clutch. This clutch must disengage immediately when power is removed from the motor at the end of the tuning cycle; otherwise, the mechanism will not stop precisely in the on-channel position. A spring is used for the purpose of pushing the armature rearward and out of engagement with the pinion.



(A) When the Unit Is Resting in a Channel Position.



(B) After the Ratchet Wheel Has Been Turned.

Fig. 2. Relationships Between Parts in the Stepper Unit.

The simplified line drawings in Fig. 2 should aid the reader in visualizing the movements which are made by the main parts of the stepper unit. The mechanism is shown in its resting or on-channel position. The detent pin on the gear is resting in the notch on the detent arm. The connecting arm and the relief arm of the stepper unit are positioned so that they do not touch the ratchet wheel. This wheel can therefore be turned freely without becoming fouled in the stepper mechanism, and the channel selector can be operated manually from the front panel of the receiver.

A flanged track is positioned on one side of the gear. This flange serves as a cam and guides the rocker arm which controls the operation of the hold-in switch. The upper end of the rocker arm has a projecting ear. When the stepper unit approaches its resting position at the end of a cycle, this ear is brought into contact with the flange. The contour of the flange is such that the rocker arm is pulled to the left. The short finger of the rocker arm then spreads the contacts of the hold-in switch, and the motor circuit is broken. When the stepper unit begins to move through its next cycle, the rocker arm is released from the flange and the contacts of the hold-in switch close.

Fig. 2B shows the stepper unit as it appears after completion of approximately two thirds of the tuning cycle. The gear has been turned approximately 240 degrees from its original position. Since the pivot point of the connecting arm is not at the center of the gear, the counterclockwise rotation of the gear has imparted a cranking motion to the arm. This motion has pushed the arm downward against one tooth of the ratchet wheel, and the wheel has been turned to a new position. In this figure, the connecting arm has just passed through the lowest point of its travel. Additional rotation of the gear will cause the connecting arm to be lifted away from the ratchet wheel.

The relief arm has an important function during the latter part of the tuning cycle. Although this arm is not actually an integral part of the rocker arm, it is shown in the drawing as though it were. This was done because the two pieces are linked together and operate as one.

The relief arm is a part of an ingenious arrangement which enables the automatic tuning system to provide "express service" on the VHF band. In other words, it does not stop at unused channels. The relief arm operates in conjunction with the ring of small plastic buttons on the surface of the ratchet wheel. Each of these buttons is labeled with a channel number. If no station can be received on a certain channel, the button that corresponds to that channel may be removed. Since they are merely pressed into holes in the wheel, these buttons can easily be taken out with long-nosed pliers. The manufacturer recommends that the U button should be left in place.

Notice the curved projection on the inner side of the relief arm.

Whenever the ear on the rocker arm is not in contact with the flange, a spring pulls the relief arm to the left and the projection presses against one of the buttons. See Fig. 2B. When the relief arm is in this position, the ear on the rocker arm will be in a position at which the ear will hit the leading edge of the flange as the latter comes around. The rocker arm will then be pulled inward, and the tuning mechanism will come to a stop in the manner that has been described.

In Fig. 2B, the Channel-6 button is shown next to the projection on the relief arm. If this button were missing, the relief arm would be allowed to move to the left of its normal position. The ear of the rocker arm would then be pulled to the right and out of reach of the flange, and the hold-in switch would not be opened. The next tuning cycle would begin automatically, and the mechanism would not pause on Channel 6.

Maintenance and Repair

Two potential trouble spots within the automatic tuning system are the clutch spring and the contact points of the hold-in switch. If the spring becomes weak or if the points stick together, the tuning system either will operate continuously or will not stop precisely in the desired channel position. Poor contact surfaces on the switch may be suspected as a cause of trouble if the mechanism stops between channel positions.

If the owner complains that the mechanism will stop on certain desired channel positions but not on others, the technician should check the ratchet wheel in order to see whether some of the buttons are missing. Buttons removed by the technician during the setup procedure should be given to the owner because he might need these in case he moves to a different locality.

The manufacturer recommends motor-cup grease as a lubricant for the flange and also for the teeth of the pinion and ratchet wheel. A thin film of SAE 20 oil should be maintained on most other bearing surfaces.

Front-Panel Controls Used With Vertical Chassis

A design problem is faced by any manufacturer who wishes to place operating controls on the front panel of a television receiver that has a vertical chassis. The control knobs have to be located at a considerable distance from the chassis, and some means of spanning this distance must be devised. Several different manufacturers have come up with various solutions to this problem. Their designs are of interest to the technician mainly from the standpoint of the disassembling procedure. The procedure for removing a vertical chassis from a receiver will probably be somewhat unusual if the receiver has front-panel controls, and the technician should have some advance knowledge of what he may expect to find when he removes the chassis.

Subchassis on Side Rails

The Raytheon chassis that is shown in Fig. 3 has a number of controls mounted on two small subchassis. When the receiver is assembled, the subchassis are located so that the control shafts project from the left and right upper corners of the front panel. Long side rails connect the subchassis to the main chassis. The side rails are screwed directly to the main chassis and in many cases are connected to one side of the AC line; therefore, they may present a shock hazard. On the other hand, the small subchassis are electrically "cold" because they are insulated from the rails.

Each subchassis is secured to the front of the cabinet by means of two small screws. These screws and the control knobs must be removed before the receiver can be disassembled. The rest of the disassembling procedure is unusual in that it should be carried out while the receiver is in a face-down position. The main chassis is bolted to two upright braces which are fastened to the sides of the cabinet. If the receiver is placed face down, the chassis will lie on top of these braces and will not fall out of position after the mounting bolts have been removed. Once freed, the entire chassis assembly can be lifted out of the cabinet as a unit.

Shafts Mounted in Cabinet

Look inside the cabinet before you attempt to pull any control knobs off the front panel of a new Sylvania receiver. If the chassis is mounted vertically, the knobs may be permanently attached to long connecting shafts which are not removable from the cabinet. These shafts are shown in Fig. 4. Plastic sockets containing splined holes are on the tips of the connecting shafts. These holes receive the short shafts of a row of potentiometers which are mounted along the bottom edge of the chassis. The only long shaft which is attached to the chassis is that of the tuner. The channel-selector and fine-tuning knobs are the only ones which have to be removed if the receiver is being disassembled. When the chassis is being put back into the cabinet, some care is required in order that the potentiometer shafts will be correct-

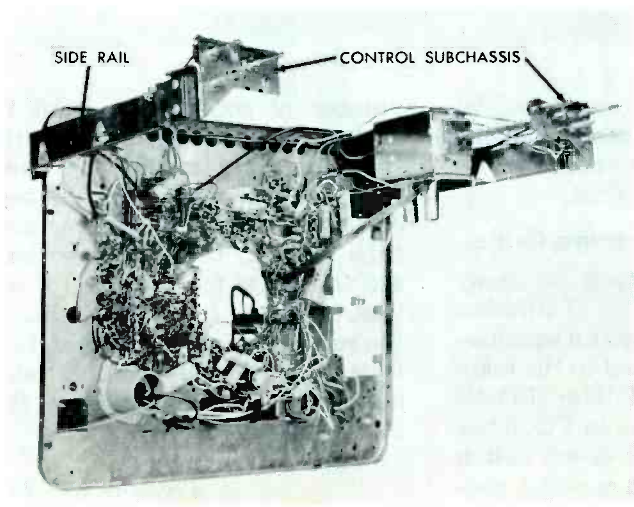


Fig. 3. Control Subchassis Mounted on a Vertical Chassis by Means of Side Rails.

ly aligned with the holes in the sockets; but reassembling the receiver is not difficult.

Certain Admiral receivers utilize long connecting shafts which are somewhat similar to those in

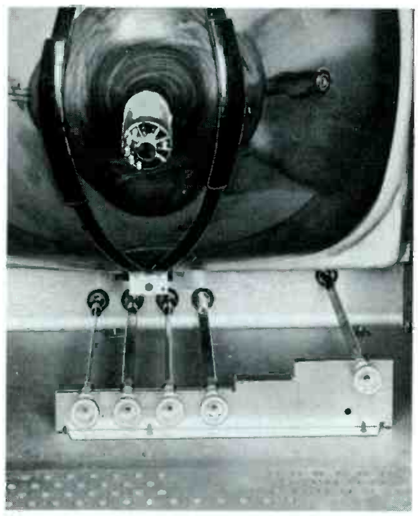


Fig. 4. Interior View of the Receiver Cabinet Showing Permanently Mounted Control Shafts.

trols are mounted on one of these, and the local-distant switch and the vertical-hold and brightness controls are mounted on the other. The first subchassis is equipped with spring clips, and it simply snaps into place in a mounting hole in one corner of the front panel. The second subchassis is fastened to the cabinet with two screws. The location of this second set of controls is not the same in all models of receivers. The controls may be placed on the bottom edge of the front panel or else on the front edge of the side of the cabinet. The connecting cables are plugged into two receptacles on the main chassis.

Printed wiring is used extensively in these receivers, and the components are arranged so that a large percentage of all trouble shooting and alignment can be done while the chassis is in the cabinet. In case the chassis does have to be removed for repairs, a

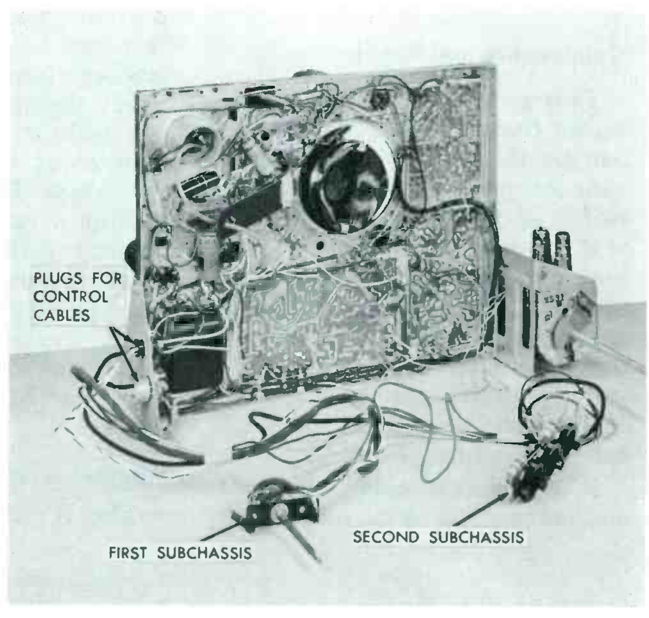


Fig. 5. A Control Subchassis Connected to a Vertical Chassis by Means of Cables.

Fig. 4, but these receivers are designed so that the shafts and the control knobs may both be removed from the cabinet.

Subchassis and Connecting Cables

Front-panel controls on many of the current models of Admiral receivers are mounted on subchassis that are connected to the main chassis by cables. The 18Y4B chassis that is shown in Fig. 5 has two subchassis. The on-off switch and the volume and contrast controls are mounted on one of these, ...

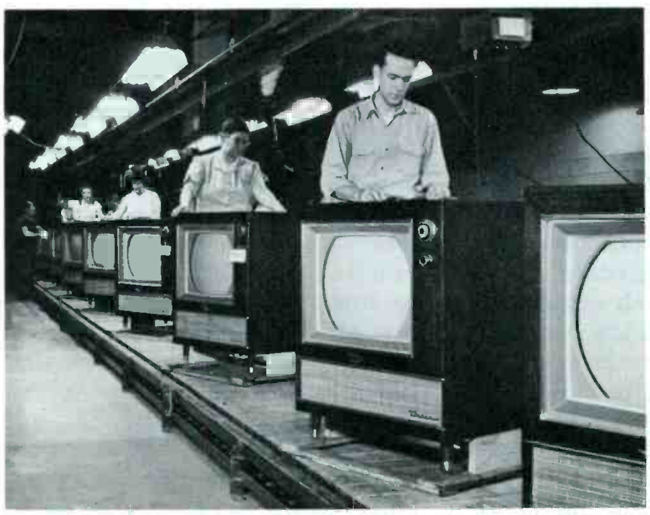
number of connections must be broken. The ones associated with the separately mounted picture tube are the yoke plug, the second-anode lead, and the picture-tube socket. Other connections are the plugs for the control cables, speaker, and pilot light. If the receiver is of the combination type, a radio-phono plug also must be disconnected from the television chassis.

THOMAS A. LESH

Are You Prepared to Service One of These Color TV Receivers?

The RCA Victor plant at Bloomington, Indiana, has color TV sets in mass production at the rate of *one per minute per assembly line*. To newsmen inspecting the facilities, Robert A. Seidel, Executive Vice-President of RCA Consumer Products said, "The era of color television has arrived." He went on to say that proof of this can be seen in the fact that we are now able to produce color picture tubes and color sets in mass quantities and in the fact that color programs are now being scheduled frequently on the air and are becoming more frequent daily. He continued, "During 1956, RCA alone expects to manufacture and to sell more than 200,000 color television receivers."

Color TV Chassis Undergo Tests Before Being Installed in Cabinets



Completed Color Receivers Near the End of an Assembly Line

Base Mounts for Antenna Masts

(Continued from page 29)

cases, some other form of antenna mounting system should be used.

Chimney Mounts

Small, lightweight antennas can be quickly and efficiently installed with one of the various chimney mountings which are available. An arrangement similar to the one shown in Fig. 2 is the general method of mounting an antenna to a chimney. Many forms of the support bracket are available with either one or two steel bands which strap the support brackets of the mast to the corner of the chimney.

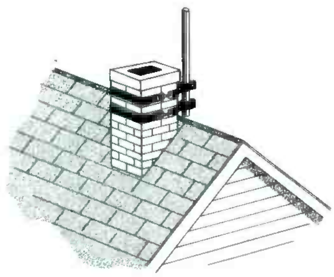


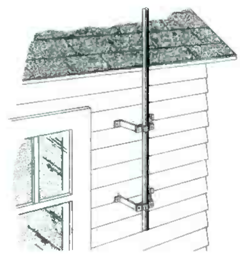
Fig. 2. Chimney Mount.

The stresses produced by the wind and by the weight of the antenna are transmitted directly to the chimney structure. Large or heavy antennas should not be installed upon a chimney unless the chimney has been thoroughly checked for cracks, breaks, or other structural weaknesses. It is important to make sure that the chimney will safely support any installation that is placed upon it.

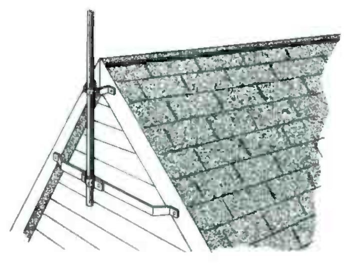
Wall or Eave Mounts

If the antenna is mounted on an outside wall or on the eaves, this will also permit the installer to make use of the building to gain antenna height when the roof is inaccessible. A wall mount is shown in Fig. 3A. It is composed of two metal brackets which extend the mast clamp beyond the overhang of the roof. The brackets should be bolted solidly to the side of the wall to prevent the weight of the antenna from pulling them loose and damaging the house siding. In cases in which the weight of the antenna assembly and mast may be excessive, additional wall brackets can be mounted.

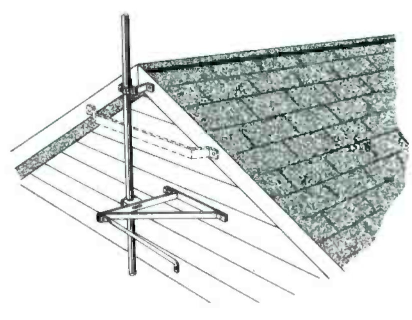
Two different types of brackets for mounting antennas on the eaves are shown in Figs. 3B and 3C. The lower bracket in Fig. 3B is designed to span the opening between the eaves of a house with a steep sloping roof. In Fig. 3C, the roof slope is much less and a wall bracket has been mounted below the peak to provide adequate support for the antenna mast. The lower bracket of Fig. 3B is drawn in dotted lines on Fig. 3C in order to show that the use of such a bracket on this type of roof will not provide as sturdy an installation.



(A) Wall Mount.



(B) Eave Mount.



(C) Wall and Eave Mounts Used When Conventional Eave Mount Is Impractical.

Fig. 3. Wall and Eave Mounts.

Ground Mounts

Antenna structures which are mounted on the ground must be provided with a solid supporting

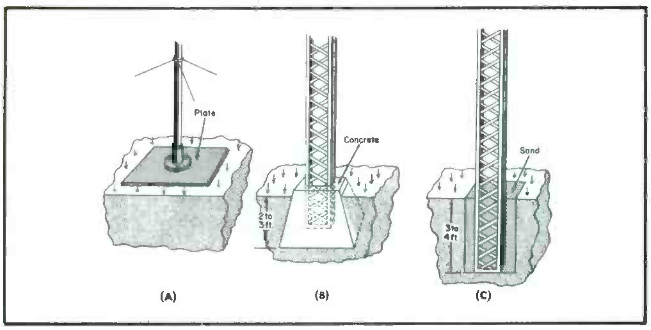


Fig. 4. Ground Mounts.

base which will not be easily deteriorated by the action of water and soil acids. The usual lightweight type of supporting bases which are used above ground are not suitable as a base for a ground-supported antenna. Material such as steel and concrete should be used as platforms for antenna structures on the ground.

Antenna masts or towers that are fastened to the side of a building or are supported by guy wires can be set upon a steel plate, as shown in Fig. 4A. The base should be large enough to support the weight of the antenna structure without sinking into the ground.

Self-supporting towers and masts require an earth-loaded footing to prevent the wind from overturning the structure. The term earth loading refers to the amount of earth that must be moved in order for the footing to be dislodged by tower stresses.

The footing shown in Fig. 4B is made of concrete poured around the base of the tower which had previously been placed in the hole. Concrete could be poured into the hole, bolts could be inserted into the wet cement, and the tower could be bolted to the top of this footing. The footing is shaped to make the bottom larger than the top. This shape produces a higher earth loading than will be obtained by straight sides or sides which slope inward toward the bottom.

A tower can be based if three to six feet of the tower is placed in a hole and if sand is poured around it, as shown in Fig. 4C. Clay and damp soil will not fill the hole unless they are tamped down. This type of base is less permanent than that shown in Fig. 4B. When sand or soil is placed around the tower, it is good practice to cover the buried section with a heavy coating of paint such as red lead; or if possible, the buried section should be covered with a heavy coating of tar.

The useful life of any base mount will be greatly extended by application of a coating of weatherproof paint. Wall brackets and roof mounts which are coated with a weatherproofing material will not cause rust streaks on the roof and walls of buildings. The bolts used in the installation should also be painted after the installation is completed.

George B. Mann

Maintenance of Tape Recorders

(Continued from page 33)

is in operation. The resulting large hum signals and heavy transients surging through the circuits do the harm.

The continuity of a head should not be checked with an ohmmeter because the direct current flowing through the head can magnetize it. Permanent magnets and magnetized tools such as a screwdriver must not be permitted to touch the heads, capstan, or other parts. Erase heads seldom become magnetized because they demagnetize themselves during normal operation.

Demagnetizing of Heads and Parts

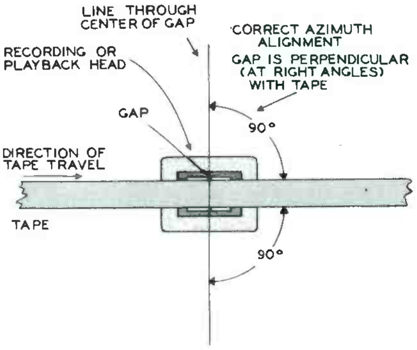
Several manufacturers supply head demagnetizers. These are specially constructed electromagnets for 117-volt AC operation. They are fitted with appropriate pole pieces that can reach mounted heads.

With the recorder turned off and the demagnetizer plugged into a 117-volt outlet and turned on, the pole pieces of the demagnetizer are held very close to (but not touching) the gap of the head to be demagnetized. The demagnetizer is moved slowly up and down several times parallel with the gap of the head and then is slowly moved away from the head before being turned off. The slow withdrawal of the demagnetizer with the power applied is important. This operation can be repeated several times if necessary. Capstans and guides can be demagnetized in a similar manner with the head demagnetizer.

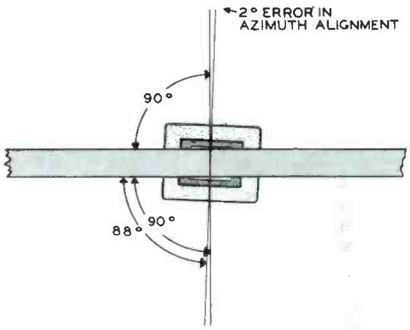
Azimuth

The incompatibility which is encountered when tape recorded on one recorder cannot be played back satisfactorily on another machine has been mentioned in previous columns. The differences in heads, equalization, and speed of different recorders account for much of the unsatisfactory reproduction. Another common although oftimes unsuspected cause of unsatisfactory reproduction is incorrect azimuth alignment of the record and playback heads.

If we review some of the basic principles of recording on magnetic tape, we find that the tape movement across the faces of the heads is perpendicular to the gaps in the heads, as shown in Fig. 1A.



(A) Head Correctly Aligned.



(B) Head Tilted.

Fig. 1. Sketch Showing Relationship Between the Head and the Tape.

The signal is recorded in a definite pattern on the tape as the tape moves across the gap in the record head during the recording mode. The gaps in both heads must be positioned the same way in relation to the tape if the signal is to be faithfully reproduced when the recorder is in the playback mode.

If a recording is made on a recorder which employs a combination record and playback head and is then played back on the same machine, the playback will sound all right even though the head may be tilted slightly (may have incorrect azimuth, as shown in Fig. 1B) because the same gap is used for recording and playback. The quality of the reproduction would suffer, however, if the tape were played back on another recorder with a playback head that is correctly aligned.

If separate record and playback heads are used, either one or both can be out of alignment and affect the reproduction. In any case, the incorrect azimuth affects the frequency response because the high frequencies are not recorded or reproduced. The reproduced signal can sound muffled and distorted if the azimuth is very far from correct.

Routine frequency checks and other tests that are made on professional recorders to detect and eliminate undesirable conditions, such as incorrect azimuth, are responsible for much of the consistent high quality achieved in commercial broadcasts and recordings. The amateur can take a tip from this practice and make sure that the heads on his recorder are correctly aligned.

Checking and Adjusting Azimuth

Record and playback heads are equipped with some type of arrangement to permit them to be tilted and aligned for correct azimuth. The head alignment screws can be seen in Fig. 2 which shows the head assembly of the DeJur Model TK820 tape recorder. Erase heads are not usually fitted with the same alignment screws or nuts because azimuth is not critical with an erase head even though the head has to be positioned carefully.

Several manufacturers supply test tapes that contain specific sections for use when heads are being aligned. Instructions are supplied with these tapes, and spoken announcements are recorded on the tape at appropriate spots. Details for correct alignment procedure are usually included in the instruction manual that accompanies the recorder; but in any case, the process is basically simple.

The cover over the heads must be removed to allow access to the adjustment screws or nuts. To adjust the azimuth of the playback head, the test tape is threaded on the recorder which is then operated in the playback mode. While the appropriate high-frequency signal (which is usually 5,000 to 15,000 cps, depending upon the test tape and the speed used) is being played back, the adjustment screw or nut on the playback head is turned until the highest signal output is obtained. The output can be measured with a VTVM connected to the output of the recorder or can be read on the VU meter, if one is provided on the recorder. The signal should be monitored so that the spoken signals on the tape can be heard. An oscilloscope can be very useful while tests or adjustments are being made. Besides being able to check signal amplitude on the screen, the operator can observe any unusual disturbances which might be present in the signal but which are not readily heard.

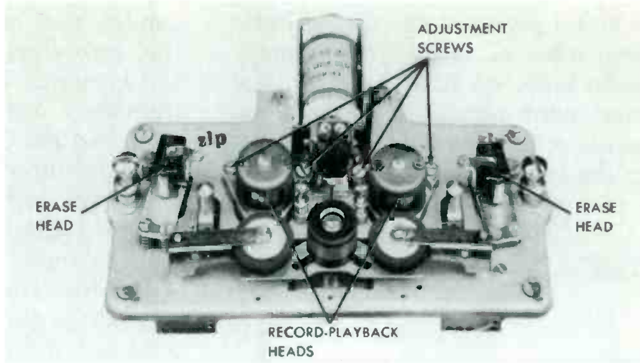


Fig. 2. Head Assembly of DeJur Model TK820 Tape Recorder Showing Screws for Azimuth Adjustment.

Next, the azimuth of the record head is adjusted. An unrecorded tape is threaded on the recorder, and the meter or meters for measuring output are connected as they were for adjustment of the playback head. A signal generator is connected to the input of the recorder, and a signal (which is 5,000 to 15,000 cps, depending on the recorder and speed used) is recorded on the tape. While the high-frequency signal is being recorded, the adjustment screw or nut on the record head is turned to the position that produces the maximum signal on the meter which is connected to the output of the recorder.

Azimuth adjustments are not difficult to make. Test tapes can be obtained from most supply houses, and very little test equipment is needed. Heads should be demagnetized before the adjustments are made; and as always, the instructions supplied by the manufacturer of the recorder should be followed.

Proper maintenance and adjustment of a tape recorder are important because the effects are reflected in the quality of the reproduction to be obtained with the recorder. Service men and operators should experience no difficulty in making most adjustments and in taking care of a recorder if they have some knowledge of the way a tape recorder operates.

There is always a possibility of unusual things happening to disrupt the normal operation of a mechanical and electrical piece of equipment. Usual causes of trouble are the simple things such as an interconnecting cable that sags out of place and interferes with some mechanical movement or a shock mount that is forced out of proper alignment and cannot dampen noise.

ROBERT B. DUNHAM

Votage Dividers In B+ Circuits

(Continued from page 32)

a triode or to the plate and screen grid of a pentode.

It is not always easy to draw a line of distinction between load circuits and integral parts of the B+ system in television receivers because the absence of a true bleeder resistor sometimes forces the load circuits to take over some of the functions of a bleeder.

Some of the circuits which are connected to the B+ system are true loads upon it because a flow of electrons is essential to their operation. A number of other circuits require only the establishment of a DC potential without the need for continuous electron flow. For example, a certain DC level may have to be maintained on the grid of a sync or AGC tube in order that the tube will be correctly biased; but a grid circuit of this type will not normally draw current.

Each of the B+ circuits in the diagrams includes a special voltage divider for almost every external circuit which requires an unusual value of DC voltage. This accounts for the fact that the B+ circuits of television receivers often contain many parallel chains of resistors.

In Figs. 2, 3, and 4, the wattage ratings of all resistors in the B+ system are given. This information furnishes a general indication of the amount of current which normally is expected to flow through each resistor. The resistors in many of the parallel branches are rated at only one-half watt because a small current is all that is required in those branches.

Discussion of Design Features

The following discussion will cover some of the distinguishing features of the individual circuits in Figs. 2, 3, and 4.

In theory, bleeder circuits are associated with large wire-wound resistors of high wattage and low resistance ratings. The circuit that is shown in Fig. 2 contains three resistors of this type—the 10-watt resistors R102 and R105 plus the

15-watt resistor R104. All these are wire-wound.

Fig. 2 shows a circuit in which B+ voltages of 235, 230, and 115 volts are derived from the rectifier output of 260 volts by voltage-divider action. The simplest portion of the B+ network is that which is associated with the 115-volt line. Resistors R104 and R105 form a bleeder circuit of low resistance and high current capacity, and the 115-volt B+ line is connected to the junction of these resistors. When the receiver is in operation, there are eight parallel current paths from the 115-volt line to ground. These paths exist through the bleeder resistor R105, the brightness control R2, and the circuits of six tubes. All the current for these eight branches must pass through R104, and this resistor therefore has a high wattage rating.

The resistor R102 is rated at 10 watts because it must carry all the current for the 235-volt and 230-volt branches of the B+ system. The voltage drop across R102 is 25 volts. The resistor R101 is rated at only 1 watt, even though it carries the heavy current of the 230-volt line, because the difference of potential across R101 is only 5 volts. Since $P = EI$, voltage drop is as important as current in the determination of wattage ratings.

The voltage on the 230-volt line is not developed across a single large bleeder resistor; instead, a parallel combination of four tube circuits and a resistive voltage divider is used to develop this voltage. Note the voltage divider that is connected from the 230-volt line to ground. In this branch of the circuit, a variable plate voltage is obtained for the horizontal AFC tube through the slider of the horizontal hold control R4.

The cascode RF stage is supplied with one special voltage from the junction of R17 and R18. Since the voltage requirements of cascode amplifiers are somewhat unusual, these requirements will be fully explained later in this article.

A second B+ system is shown in Fig. 3. This circuit uses no bleeder resistors of high wattage, but it contains numerous parallel voltage dividers composed of resistors of low wattage. The 235-volt output of the rectifier is connected directly to the circuits of seven tubes. In addition, two voltage dividers that are connected from the 235-volt line to ground furnish special operating voltages to the noise canceller which is a stage in the sync section of the receiver.

A second main branch of the B+ system is connected to the output terminal of the rectifier through R112. The potential at the least positive end of this resistor is 220 volts. Three tubes are supplied with B+ voltage directly from this point, and three other circuits receive portions of the voltage at this point through grounded voltage dividers. In addition, the 220-volt circuit has one branch that appears to have no DC connection to ground. This extra circuit is actually grounded through the circuits of three tubes when the receiver is in operation. The three tube circuits in parallel and the resistor R115 act as a voltage divider, and the potential at the junction is 170 volts.

Since the 1-watt resistor R112 carries all the current of the combined 220-volt and 170-volt lines, it would seem at first glance that R112 should have a higher wattage rating than R115 which carries only the current for the 170-volt line. The reason why R115 has a relatively high power rating of 5 watts is that the voltage drop across R115 is relatively large. The drop is 50 volts across R115 but only 15 volts across R112.

In a third major branch of the B+ system in Fig. 3, the output voltage of the rectifier is divided approximately in half in the circuit that is associated with the resistor R113. A low B+ voltage of 120 volts is developed across four tube circuits and two voltage dividers. The resistor R113 is rated at 5 watts because it must withstand moderately high current in combination with a voltage drop of 115 volts.

The circuit that is shown in Fig. 4 is a part of the 21-inch Crosley Super-V chassis. An important feature of this B+ circuit is that a connection between two major branches of the B+ system is made through the audio output tube and not through a bleeder resistor. If a bleeder resistor were used in place of the tube, some power would be consumed in heating the resistor. This power would not contribute directly to the operation of any circuit; therefore, it would be wasted. The circuit in Fig. 4 is very efficient in its distribution of current. All the current that passes through the 150-volt branch of the B+ line and its several connections to ground is used to satisfy the large current requirements of the audio output tube V9.

Since a discharge path to ground exists through voltage dividers, the B+ filter capacitors will hold a charge for only a short while after the receiver has been turned off. In some receivers which have a B+ circuit like that in Fig. 4 but which do not contain the resistor R51 (shown in broken lines), the discharge of some of the filter capacitors will be relatively slow because the only remaining discharge path from the 150-volt line to ground is the one through the very high resistance of the brightness control.

In each of the foregoing three figures, notice that the various branches of the B+ line have individual filter capacitors which are supplements to the output filter of the rectifier. Voltage variations might occur in the B+ system in response to fluctuations in signal voltage in the tube circuits if the extra capacitors were not included.

Certain circuits in television receivers characteristically contain special voltage dividers. The brightness control is usually connected between ground and the low B+ line in order that the DC potential on one element of the picture tube may be varied. Another control which is frequently connected as a voltage divider in in the B+ system is the horizontal hold. This control provides a means for altering the plate voltage of the AFC tube in the pulse-width type of AFC system.

Voltage dividers which provide fixed operating potentials for specific circuits are most frequently found in the various sync-separator stages and in the grid or cathode circuits of AGC keying tubes.

Cascode Amplifier

The grid of the second triode in most RF amplifiers of the cascode type is held at a DC potential of more than 100 volts by a special voltage divider in the B+ circuit. This feature is necessary in order that the second triode will be correctly biased. The voltage on the grid must be only slightly less positive than the voltage on the cathode, and the latter element has a normal operating voltage of more than 100 volts. Refer to the schematic diagram of the cascode RF stage in Fig. 5, and observe that the two triode sections of the RF amplifier are connected in series across a 240-volt B+ supply. The tubes themselves behave as a voltage divider, and the voltage at the plate of the first triode and the cathode of the second is approximately equal to half the plate voltage of the second triode. Both sections of the tube must conduct almost equally if the correct voltage is to be maintained at the plate of the first triode and at the cathode of the second triode.

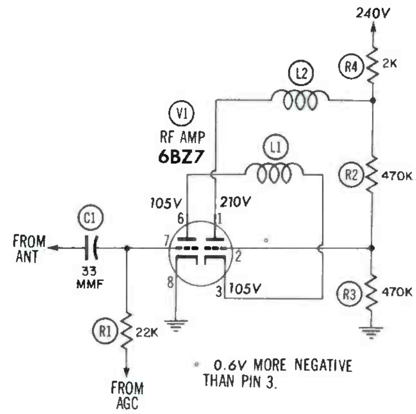


Fig. 5. Simplified Schematic Diagram of a Cascode RF Amplifier.

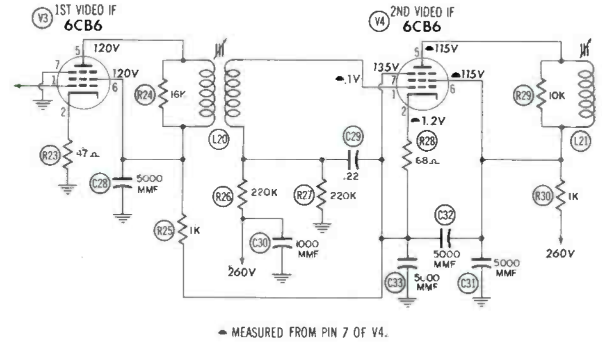
In some television chassis, two of the video IF tubes are connected in a series arrangement which resembles the layout of a cascode RF amplifier. An IF circuit of this type is shown schematically in Fig. 6. Trying to trace the DC plate circuit of the first IF amplifier would be very confusing to a technician who did not realize that the return to B+ is made through the second IF amplifier. Note in Fig. 6 that the grid voltage for the second IF amplifier is independently obtained from a voltage divider composed of R26 and R27.

Servicing B+ Circuits

Trouble probably lies within the rectifier or its filter if B+ voltage is low or absent in all parts of a television receiver. Insufficient output voltage from the rectifier could be caused by weak tubes, weak selenium rectifiers, leaky filter capacitors, a defective power transformer, or inadequate AC line voltage. One end of each filter capacitor should be disconnected from the circuit before the capacitor is checked. If the capacitor were left connected, it would be shunted by resistance and no valid test could be made.

Defects in the B+ distribution system are unlike rectifier troubles in that the former affect some portions of the B+ system much more seriously than they affect other portions. For instance, a leaky condition in capacitor C3D in Fig. 2 would lower the voltage on the 115-volt B+ line. The leak would also cause an increase in the current drawn through R104,

Fig. 6. Schematic Diagram of Series-Connected IF Amplifiers in Admiral Chassis 18SX4BZ.



and the voltage drop across R104 would become greater than normal. The loss of voltage between the 115-volt line and ground would be counteracted by the gain in voltage across R104, and the output voltage of the rectifier would not be greatly affected.

If R86 in Fig. 2 became open, the effect would be felt chiefly in the horizontal sync circuit. The voltage on the 230-volt line would be changed only slightly because the voltage divider that includes R86 normally draws little current.

Failure of a power amplifier tube such as a video output tube will cause a sharp increase of voltage on the particular B+ line that feeds the amplifier. In the usual servicing procedure, this bad tube will be discovered and replaced before the change in B+ voltage would be noticed.

In case an incorrect voltage is measured at several points in a B+ system but not at all points, it should be possible to trace the cause of the incorrect voltage to a single branch of the system. The technician should notice which one of the B+ lines seems to be affected most severely, and he should check the components in the branch that is associated with that line. If the voltage on one B+ line is very abnormal, special attention should be given to resistors that normally carry heavy current and to filter capacitors.

It might be helpful to draw a diagram of the affected part of the B+ system. The technician will waste less time in unsoldering components for testing purposes if he will stop and figure out which components he should test first.

THOMAS A. LESH

PLANNING TO MOVE

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Audio Facts

(Continued from page 27)

Fig. 2B) to bend, and the signal is thereby developed.

The ceramic element consists of two thin pieces of barium titanate attached together and polarized to produce a voltage when the element is bent. The terminal end of the element is mounted between two pads of elastomer. These pads, the damping pads at the center of the element, the coupler-lever assembly, the damping pad in the stylus assembly, and the lever portion of the stylus play significant parts in giving the ML44 its desirable characteristics of high compliance and smooth wide-range frequency response. The arrangement of levers serves as a means by which the relatively stiff ceramic element can be matched to the modulated record grooves.

Full instructions for the mounting and use of the ML44 are supplied with each cartridge. Mounting is not difficult because the ML44 is designed to fit standard arms, but it is interesting to see how the cartridge can be used with different inputs.

The input-adapter network is mounted in the arm with the cartridge when the ML44 is to be connected to a magnetic or constant-velocity input. The yellow and black network leads with terminal jacks are connected to the terminals on the cartridge, and the red and black leads with pin terminals are connected to the cable leading to the preamplifier. Shielded cables up to 6 feet in length can be used without disturbance to the response or output of the cartridge.

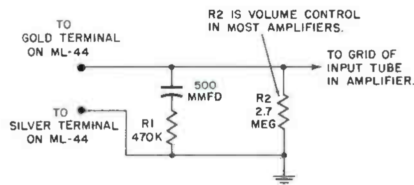


Fig. 3. Circuit Used in Connecting the ML44 Cartridge to a High-Impedance Input.

When the ML44 is used with a preamplifier having a constant-amplitude input, a 220K-ohm resistor is connected in series with the hot (gold) terminal on the cartridge and the network is not used. The resistor should be mounted in the arm and connected directly to the hot terminal of the cartridge.

The circuit shown in Fig. 3 can be used to obtain good frequency response when the ML44 is connected to a high-impedance input. The network adapter is not used.

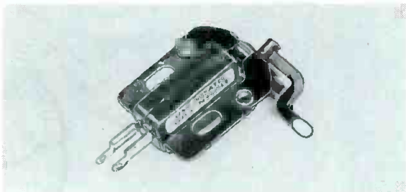
Astatic 55TJ Cartridge

The Astatic 55TJ shown in Fig. 4A is a high quality ceramic cartridge designed for use in standard arms of record changers and single players. It can be adapted to most types of inputs. It is fitted with a dual 1-mil and 3-mil replaceable stylus. The stylus can be seen in playing position in Fig. 4B. The stylus assembly, which can be lifted out with the fingers, has been removed from the cartridge in Fig. 4C.

Fig. 5A illustrates how the stylus is shifted from one side to the other by the turning of the lever. The arrangement of what we might call the working parts is shown in Fig. 5B and should require very little explanation because of the similarity in many respects to the cartridge described previously. The shaft of the stylus rests in the notch of the coupler lever attached to the end of the ceramic element. The element is made up of two thin pieces of ceramic attached together and polarized to produce a voltage when the element is bent. The output end of the element is held in an elastic mounting. Damping blocks are located at about the center of the element, as shown in the illustration.

Sonotone 3T Series Cartridge

The Sonotone 3T ceramic cartridge shown in the photographs of Fig. 6 has been specifically designed for high quality reproduction from modern records. The 3T is a turnover cartridge which will play all records because it is equipped with 1-mil and 3-mil styli, in common with the other cartridges discussed. Instructions are supplied with the 3T for mounting it in any standard arm and for matching it to magnetic, constant-amplitude, and high-impedance inputs. The stylus assembly, which is shown removed in


(A) Assembled Unit.


(B) The 3-Mil Stylus in Playing Position.

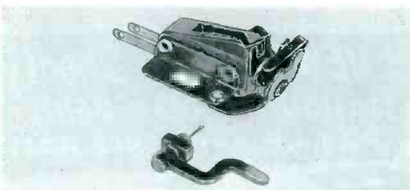
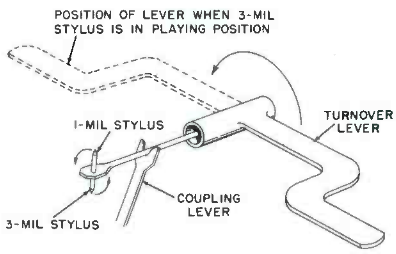
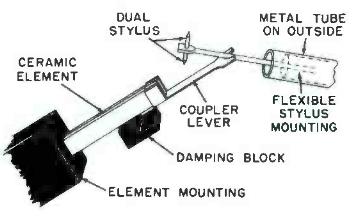

(C) With the Stylus Assembly Removed.

Fig. 4. Astatic 55TJ Ceramic Cartridge.



(A) Stylus Shifting Mechanism.

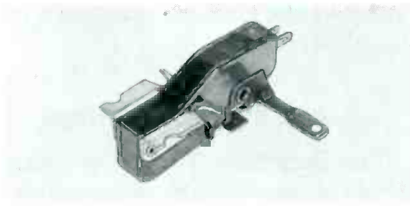


(B) Working Parts.

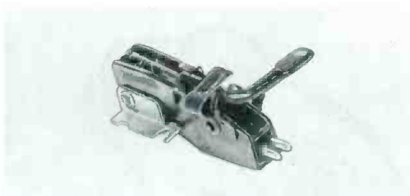
Fig. 5. Parts in the Astatic 55TJ Cartridge.

Fig. 6C, can be removed and replaced without the aid of tools.

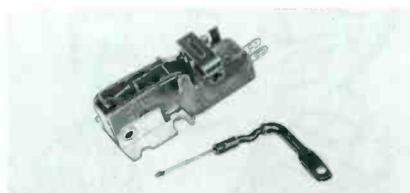
The turnover mechanism and the manner in which the lever operates to shift from one stylus to the other is shown in Fig. 7A. The



(A) Assembled Unit.

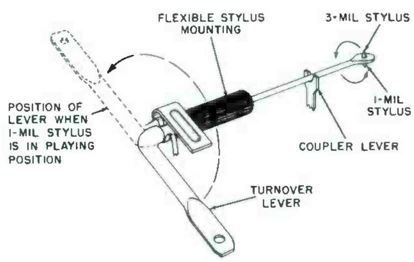


(B) The 3-Mil Stylus in Playing Position.

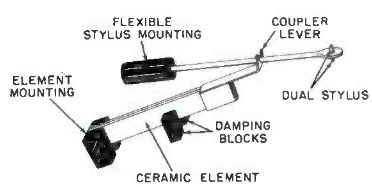


(C) With the Stylus Assembly Removed.

Fig. 6. Sonotone 3T Series Ceramic Cartridge.



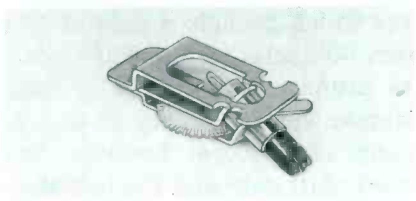
(A) Stylus Shifting Mechanism.



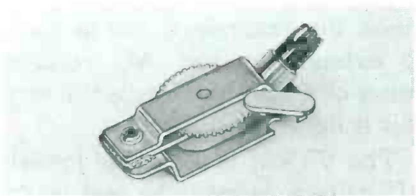
(B) Working Parts.

Fig. 7. Parts in the Sonotone 3T Series Cartridge.

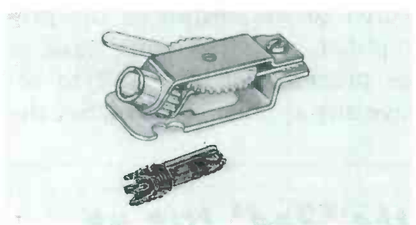
ceramic element and other working parts are shown in Fig. 7B. We can see that an arrangement of flexible mountings, damping blocks, and notched extension lever has been used in the 3T. In addition, the interior of the cartridge, which is completely enclosed, is filled with a damping compound to aid in producing a smooth response. This is typical of the refinements that are responsible for the quality of the cartridge as indicated in the following specifications supplied by the manufacturer.



(A) Assembled Unit.

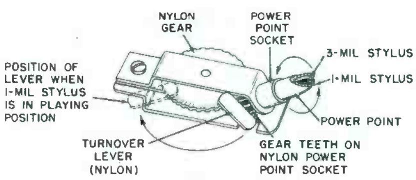


(B) The 3-Mil Stylus in Playing Position.

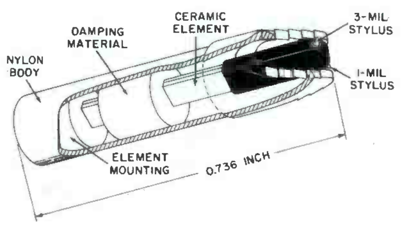


(C) With the Power Point Removed.

Fig. 8. Electro-Voice Power Point 56T.



(A) Stylus Shifting Mechanism.



(B) Working Parts.

Fig. 9. Parts in the Electro-Voice Power Point 56T.

Frequency Response—smooth from 20 to 20,000 cycles; flat within ±1.5 db to 12,000 cycles with a smooth roll-off up to 20,000 cycles.

Output Voltage—0.5 volt ±2 db at average microgroove recording level.

Impedance—equivalent to 490-mmfd capacitor.

Compliance—2 × 10^{-6} cm per dyne.

Stylus Mass—.006 gram.

Vertical Stylus Force—4 to 6 grams in professional tone arm; 6 to 8 grams in changer arm.

Weight—11.5 grams.

Electro-Voice Power Point 56T

In the literature about the Power Point 56T, Electro-Voice, Inc., says that this is not a cartridge nor a needle but a complete transducer. Anyone will have to admit that both the slip-in unit and the mounting mechanism of the Power Point 56T are unique.

This transducer can be supplied in any of three basic mounting mechanisms: the turnover, the fixed, or the type that turns under. The turnover type is shown in the photographs in Fig. 8. It can be mounted in standard arms and adapted for most applications.

Fig. 8C illustrates that the Electro-Voice unit can be removed from the tubular nylon socket. No tools are required. It can be slipped from the keyed socket and replaced with the fingers.

Moving the turnover lever causes the nylon gears that turn over the Power Point to revolve, as shown in Fig. 9A. Details of construction of the unit, which is less than ¼ inch in diameter and less than ¾ inch long, are shown in Fig. 9B. Its outside case is nylon. The sapphire stylus tips are mounted on the end of the ceramic element. The other or output end of the element is mounted in the end of the case. This is a simple and effective arrangement which results in reduced resonances and high lateral compliance.

The following are some of the specifications furnished by the manufacturer for the Power Point 56T.

Compliance—1 × 10^{-6} cm per dyne.

Capacitance—400 micromicrofarads.

Output—0.85 volt with 1-megohm load.

Response—Uniform from 20 cps to 10 kilocycles; usable at 15 kilocycles.

Tracking Force—5 to 8 grams.

Net Weight—300 milligrams.

by Robert B. Dunham

Shop Talk

(Continued from page 35)

Note that the application of 250 millivolts on all the direct-current ranges will cause the meter needle to deflect to full scale *provided that the voltage source is able to supply the current drawn by the meter.* On the 10-ampere range, the resistance of the meter shunt is only .025 ohm; and this will impose a considerable drain on the voltage source. Since this meter possesses a 100-microampere range, it is best to make low-voltage measurements on this range; and these measurements should not be made across circuits which have impedances in excess of 250 ohms. This is because the total resistance presented by the meter, even when it is set to the 100-microampere range, is only 2,500 ohms.

Oscilloscope Preamplifier Used With VTVM

Signal-tracing devices are extremely useful servicing aids, particularly in radio receivers. There are a number of such devices on the market; but if you do not already possess one, satisfactory results can be obtained by using an RF probe and the audio system of a television receiver, of a hi-fi system, or of a radio receiver. The output of the probe would be applied to the input of the audio system, and then the probe could be used to follow received signals through the RF and IF stages of a defective radio receiver.

Fig. 3. A Calibrated Oscilloscope Preamplifier. (Photograph Courtesy of Kirby Products Corporation.)

Along these same lines, a useful instrument around the service shop is a calibrated preamplifier for an oscilloscope. One such unit which is commercially available is shown in Fig. 3. Internally, it consists of several RC-coupled amplifiers which provide a gain of 100 from 60 cycles to 100,000 cycles. Its primary function is to help improve the sensitivity of an existing oscilloscope; however, because of its gain and the fact that its gain control is linear, it can be used for several additional purposes. For example, it can be used to extend the low AC voltage range of a VTVM. Here is the way this is done.

The VTVM is set at its lowest AC voltage range. The test leads of the instrument are then connected to the output of the preamplifier, and the input leads of the preamplifier are used to receive any applied voltages. Set the preamplifier gain control at 100. Check the voltage to be measured, and note the needle reading of the VTVM. Whatever value is indicated should be divided by 100. If the VTVM indicates 2 volts, the actual voltage value is 20 millivolts.

The reader will undoubtedly understand that to use the preamplifier as indicated, several very rigid requirements must be met. First, the over-all gain of the preamplifier must be as stated—100 in this case. Second, this gain should be independent of line-voltage fluctuations; and third, the markings on the gain control of the preamplifier should remain as established. In the unit illustrated in Fig. 3, voltage regulation and negative feedback help to attain the desired objectives.

The same preamplifier, through its calibrated gain control, can assist in testing voltage amplifiers. Connect a signal source which is set at a low level to the input of the amplifier under test. Connect an oscilloscope across the output of this amplifier. Adjust the oscilloscope for a presentation of reasonable size on the screen—say 20 spaces on the ruled grille. Without changing the settings on the signal source or the oscilloscope, connect the signal source to the input of the preamplifier and connect the output of the preamplifier to the vertical input of the oscilloscope. Adjust the gain control on the preamplifier until the presentation on the oscilloscope is equal in vertical size to that obtained with the amplifier under test. The gain of the amplifier can be read directly from the dial setting of the preamplifier.

If the amplifier gain should exceed 100, you can approach the problem by setting the vertical attenuation control of the oscilloscope to the X10 position when the first measurement is taken. Then when the preamplifier is substituted for the amplifier under test, the attenuation control is switched to the X1 position; thus, an additional gain of 10 is provided. This, in conjunction with the preamplifier gain of 100, will provide an over-all gain of 1,000.

Checking a VTVM With Its Own Meter

Probably the most popular instrument in use today for measuring voltage is the VTVM. Practically every service technician has a VTVM, and sometimes this instrument is the only voltmeter

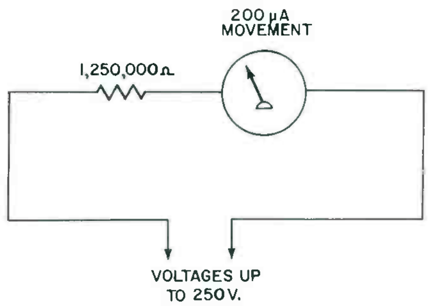
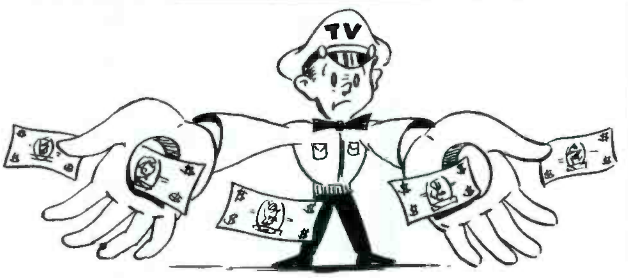


Fig. 4. Circuit for Voltage Measurements With a 200-Microampere Meter Movement.

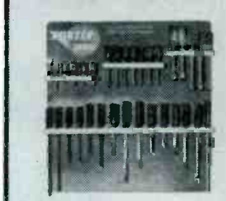
in the shop. If this is true of your setup, have you ever stopped to



Life. According to General Electric, the average life of picture tubes is about 4 years, which means that 50 per cent will have been replaced by the end of their 4th year of use. Continuing with averages—the second picture-tube replacement will be needed along about the 8th year. The average owner usually decides to scrap the set instead of giving it a second new tube because a tube replacement costs somewhere between a fourth and a third of the price of a new set.

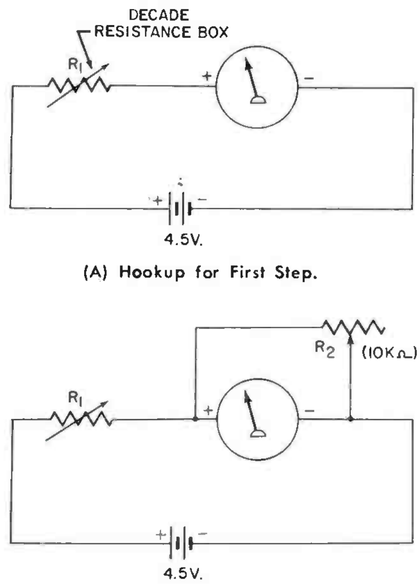
An estimated 4,250,000 picture tubes were replaced in 1955, and about a million of these were rebuilts. For 1956, the replacement prediction is around 6,000,000 at a consumer cost of close to $300,000,000. Practically all of the money in 1955 went through the hands of service technicians, though admittedly not as much stayed with them as should have. Many of them just haven't the heart to charge their full markup and labor rates on such a big job because they know how hard it is for the customer to pay—and yet the service technician is entitled to his full price just as much as is the auto repairman who charges $85 for a clutch job.

MARKUS . . *Dollar and Sense Servicing*



wonder what might happen if you were called upon to repair that VTVM? Suppose you are faced with an inoperative VTVM and you start off by checking its tubes. These are found to be all right, and the next step would be to check DC voltages. But how? The answer is not difficult, provided that the meter movement is not the cause of the trouble.

To use this meter to measure volts, first determine from the operating manual what its current rating is. Usually, it is approximately 200 microamperes. Let us assume that you wish to measure 250 volts. Then with this value of voltage, we would need a resistor



(A) Hookup for First Step.

(B) Hookup for Second Step.

Fig. 5. Steps in Determining Meter Resistance.

of 1,250,000 ohms (250 volts divided by .0002 ampere) in series with the meter movement. If we therefore remove all connections to the meter movement and connect a 1.25-megohm resistor in the manner shown in Fig. 4, we will be able to check voltages up to 250 volts. The exact amount of voltage can be determined from the position of the meter needle during the measurement. If it stops at mid-scale, the voltage value is 125 volts; if the needle is $6/10$ of the way up the scale, the voltage is $6/10$ of 250 volts, and so on. (We are disregarding the internal resistance of the meter movement in these measurements; but since this is only a few thousand ohms at the most, very little error is introduced. The internal meter resistance needs to be taken into account for voltage measurements only when it approaches a value which is roughly $1/10$ or more of that of the series resistor. A resistance equal to that of the meter movement should be inserted into the VTVM circuit in place of the movement.)

To determine the internal resistance of a meter movement, take a 4½-volt battery and a variable resistor of about 1 megohm; connect these two items and the meter movement in series, as shown in Fig. 5A. Always start with all of the resistance of R1 in the circuit to prevent meter burnout. Slowly rotate R1 until the meter reads full scale. Next, shunt a 10,000-ohm variable resistor across the meter movement in the manner shown in Fig. 5B; and adjust it until half scale is indicated on the meter. When this adjustment has been made, the resistance of R2 will be exactly equal to the meter resistance.

by MILTON S. KIVER

"Now the next time I come into your store perhaps you'll stock JENSEN NEEDLES, eh?"

Dollars and Sense

(Continued from page 69)

ACCESSIBILITY. With color TV sets getting too heavy for one man to remove the chassis without risking a disability compensation claim, you can expect to see soon a variety of cabinet and chassis design tricks that will eliminate chassis pulling entirely for repairs in the home.

On the RCA set, the top of the cabinet comes off to give access to the picture-tube adjustments, but this doesn't get you under the chassis. In Hoffman's color set, however, the chassis is mounted vertically and the side of the cabinet comes off to give access to the bottom of the chassis. The ultimate would be a frame with snap-in cabinet panels so that any side could be easily removed for repairs.

Another trend is toward making the chassis in two or more lighter-weight sections that can be taken out independently for servicing. This has both advantages and drawbacks. Three small units cost more to make and to hook together in the factory than one large chassis. For servicing, it likewise costs more in time and labor to disconnect and remove one or more sections for repair and to replace and hook them up again to see if the set works. Trouble shooting is more difficult with separate units, particularly for troubles like hum which is hard to isolate to a particular section sometimes.

We predict the answer will be a single chassis mounted in such a way that the service technician can easily get at both the top and bottom of it.

CASH. In 1941, ten-dollar bills accounted for the highest percentage (23.8 per cent) of the country's circulating cash. In 1955, however, the twenty-dollar bill led the money popularity parade by accounting for 31.9 per cent of the $30.2 billion in coin and paper passing through people's hands.

In 1941, it was enough to take along change for a ten on a service call, but today it should be change for a twenty--not only because there are more twenties out, but also because service charges have just about doubled on the average and now are more likely to fall into the $10-to-$20 range than anywhere else. Do these figures check with your own experiences?

by JOHN MARKUS

PF REPORTER

INDEX TO ADVERTISERS

May, 1956

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Write for receiving tube manual; speaker catalog sheets; FM and short wave antenna catalogs. *See advertisement page 94.*

2S. ARROW (Arrow Fastener Co., Inc.)

Catalog sheets and 6-page 2-color illustrated folder describing T-25 staple gun designed for use in installation of intercom systems. Price sheets also available. *See advertisement page 82.*

3S. B&K (B&K Manufacturing Co.)

Informative article titled: "Profitable TV Servicing in the Home," by Henry Gronski. General Manager of Central Television Service, Chicago. Also Bulletin No. 500 on newest B & K Dynamic Mutual Conductance Tube Tester, and Bulletin No. 104 on CRT Cathode Rejuvenator Tester. *See advertisement page 40.*

4S. BLONDER-TONGUE (Blonder-Tongue Labs., Inc.)

Free subscription to B-T Bulletin, containing new technical information on VHF and UHF. *See advertisement Insert.*

5S. BOGEN (David Bogen Co., Inc.)

Complete new Public Address System Catalog. *See advertisement page 46.*

6S. BUSSMANN (Bussmann Mfg. Co.)

Bulletin showing fuses and fuse-holders adapted to protection of TV and other electronic equipment (Form SFB). *See advertisement page 4.*

7S. CLAROSTAT (Clarostat Mfg. Co., Inc.)

56 Distributor's Catalog Form No. 754346010 Listing Controls and Resistors for Radio, Audio & TV. *See advertisement page 28.*

8S. CORNELL-DUBILIER (Cornell-Dubilier Electric Corp.)

200D2. Service replacement capacitors for electronic and other applications. *See advertisement page 79.*

9S. ELECTRIC SOLDERING IRON (Electric Soldering Iron Co., Inc.)

Catalog file of soldering irons of 21 different models, solder pot catalog of 9 models, solder gun tips. *See advertisement page 88.*

10S. ELECTRO-VOICE (Electro-Voice, Inc.)

Power Point Cartridge. Completely new way to change both cartridge and needle in seconds. Brings profit back to the Phono-Cartridge business. Write for Bulletin No. 223. *See advertisement page 36.*

11S. HUNTER (Hunter Tool Co.)

New Electronic Catalog of Hunter Tools. *See advertisement page 93.*

12S. ILLINOIS CONDENSER (Illinois Condenser Co.)

Spec. Sheet on the "Illini 300" Photo Flash Kit. *See advertisement page 92.*

13S. JACKSON (Jackson Electrical Instrument Co.)

Bulletin describing three Jackson Tube Testers. Full specifications given for Models 648P, 561 and 49. *See advertisement pages 65 & 86.*

14S. JENSEN (Jensen Industries, Inc.)

Wall Chart—NEW 1956, completely illustrated; contains all up-to-date replacement needle information, including point size, point material, cartridge numbers; list price. *See advertisement page 95.*

15S. MALLORY (P. R. Mallory & Co., Inc.)

New Components Catalog No. 556-A for 1956-57. Complete information. *See advertisement pages 10, 11.*

16S. MASTRA (Mastra Company)

Complete Catalog Folder on full line of Tote Boxes. Special Tote Box quotations on request. *See advertisement page 91.*

17S. MOSLEY (Mosley Electronics, Inc.)

New Brochure, Form F-3, describing new Flush Wall Plate Outlets for Master TV Antenna Distribution Systems. *See advertisement page 92.*

18S. PERMO (Permo, Inc.)

No. FP-556 Fidelitone Products Dealers Cartridge to Needle Catalog and Selector Guide. *See advertisement page 69.*

19S. RAM (Ram Electronics Sales Co.)

FREE 1956 Ram TV Field Service Manual PF-5 features "PIX-A-FAULTS," "TROUBLE-FACTS," Circuit Diagrams, plus COMPLETE cross-reference replacement listings for flybacks, yokes, vertical osc. and output xfmrs, linearity and width coils—all authentic recommendations from TV manufacturers' specifications. *See advertisement page 83.*

20S. SECO (Seco Mfg. Co.)

Seco GCT5—Tube Tester. Seco FB4—Flyback Checker. Seco-Monitron—SL10. *See advertisement page 56.*

21S. SHURE (Shure Bros., Inc.)

Cartridge Replacement Booklet—covering ceramic and crystal replacements. *See advertisement page 81.*

22S. SPRAGUE (Sprague Products Co.)

C-611 New Distributor Stock Catalog—completely revised, with over 1,000 new items. Available May 20th. *See advertisement page 2.*

23S. TARZIAN (Sarkes Tarzian, Inc.)

Silicon Rectifiers Brochure furnishing complete descriptions, illustrations, specifications, etc., of new line of Silicon Power Rectifiers. *See advertisement page 42.*

24S. TRIAD (Triad Transformer Corporation)

New General Catalog TR-56, listing complete line of Triad Transformers. New Correct Replacement TV Guide TV-56, listing recommended television replacements. *See advertisement page 84.*

25S. TRIPLETT (Triplett Electrical Instrument Co.)

631 Combination Volt-Ohm-Milliammeter and Vacuum Tube Voltmeter. *See advertisement page 30.*

26S. UNIVERSITY (University Loudspeakers, Inc.)

78A2 "Ultimate in Sound" Brochure; Form 78A32 "PSE" Brochure; 78A8 "KwiKit" Do-It-Yourself Brochure. *See advertisement page 73.*

27S. VACO (Vaco Products Co.)

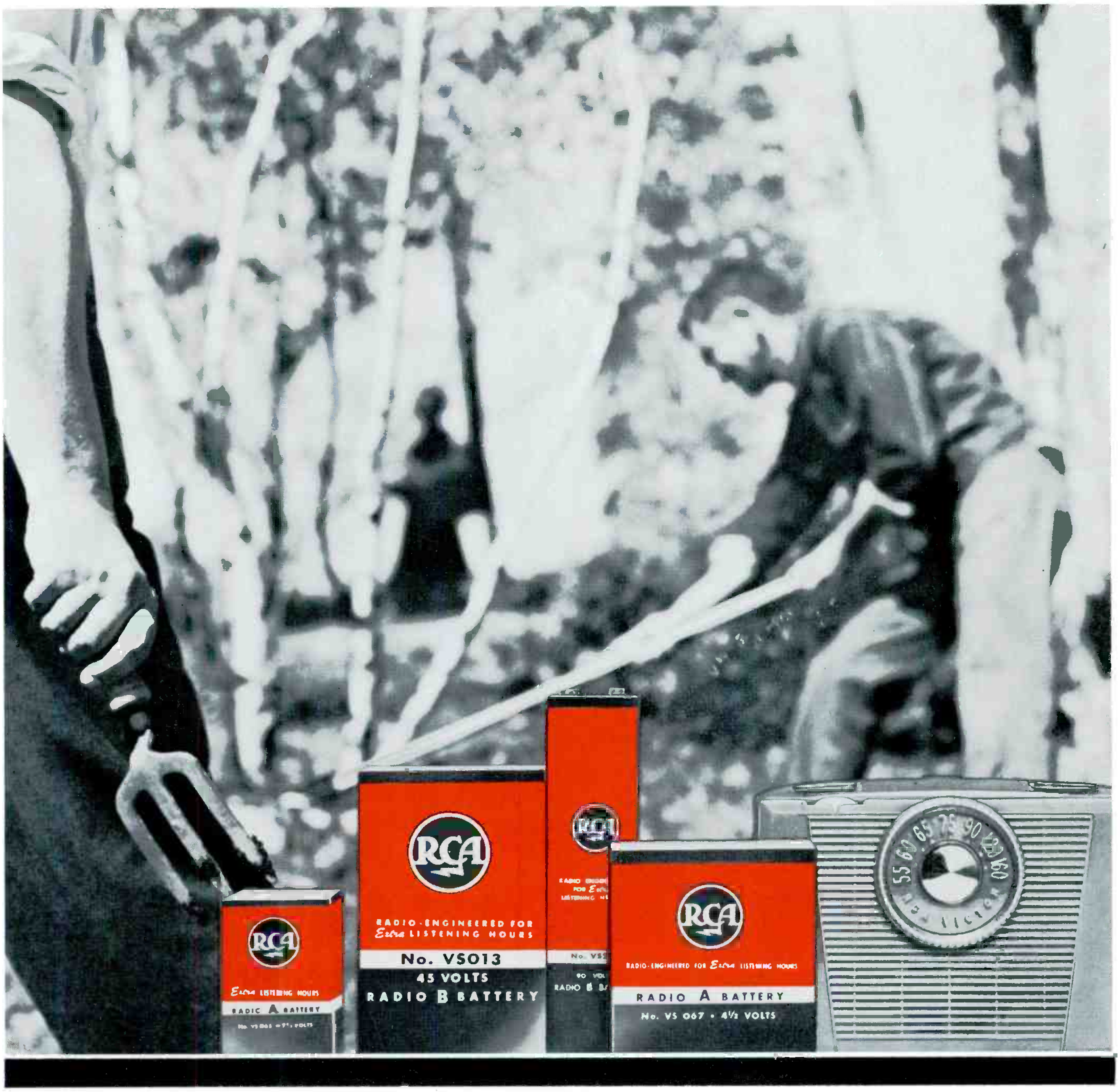
8-Page Catalog on Screwdrivers, Nutdrivers, Pliers, Specialty Tools. *See advertisement page 72.*

28S. WINSTON (Winston Electronics, Inc.)

Technical Bulletins on use of Color Test Equipment. Additional information on use of Sweep and Sync Circuit analyzer. *See advertisement page 48.*

29S. XCELITE (Xcelite, Inc.)

Catalog on complete Screwdriver, Nut Driver, Reamer line; literature on Electronic Pliers. *See advertisement page 8.*



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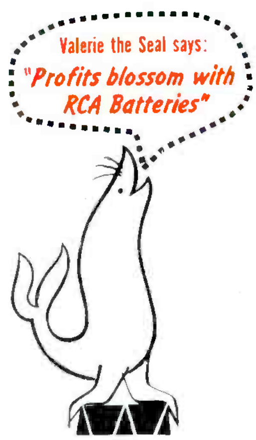

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Sentinel
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Westinghouse
DUMONT
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GE
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Magnavox
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