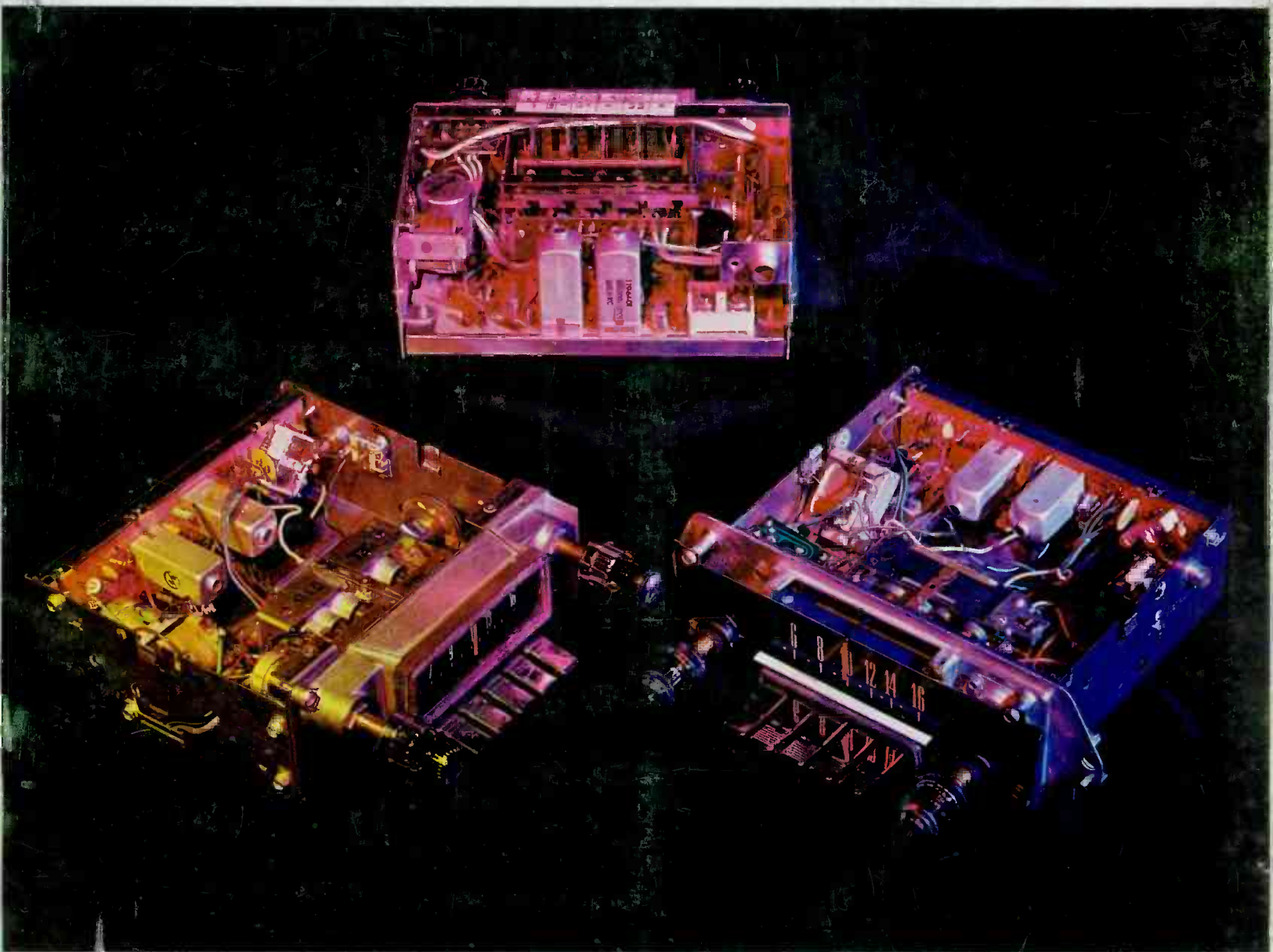


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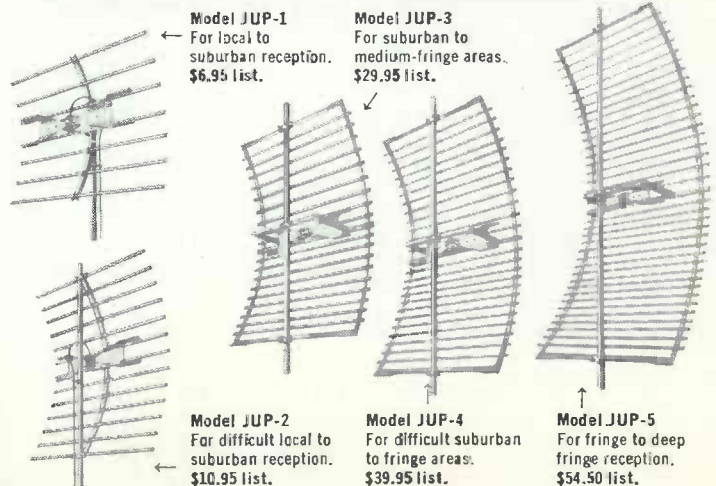
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Horizontal Troubleshooting from



by Thomas A. Lesh and Norman D. Tanner

The hard-driven components of the horizontal sweep system must work at peak efficiency to maintain satisfactory performance; thus, it's understandable that the horizontal section gives rise to more service problems than any other TV circuit. It also deserves its reputation of being tough to service, because its mode of operation is complex, and because testing procedures are hampered by the presence of extremely high voltages.

To help keep up with the continual demand for more service information about horizontal sweep, this article is aimed at up-dating and consolidating the reader's knowledge in this important area of servicing. It will furnish an increased overall understanding of how the horizontal circuit works, and will call attention to some specific problems that cause particular difficulty.

Two Main Divisions

In this study, just as in actual troubleshooting, we will find it convenient to split the horizontal system into two parts—taking the grid of the horizontal output tube as a dividing point. Most troubles are relatively easy to isolate either to the section ahead of this point (the oscillator-AFC circuit) or to the following section (the output and high-voltage system).

In many cases, analysis of visible symptoms will give clues that point toward one section or the other; for instance, most frequency-stability problems originate in the oscillator or AFC, and a large proportion of width problems develop somewhere in the flyback circuit. However, initial inspection of the symptoms may give misleading information, as in the many cases where so-called "flyback trouble" actually turns out to be the result of a weak oscillator.

Thus, it is often helpful to check the drive to the output tube quite early in the process of servicing—say, immediately after all pertinent tubes have been checked and the accessible sweep components inspected for obvious faults.

Even a rough check for the presence of the drive voltage, using an AC VTVM or a portable scope, can be useful on home calls as an aid in estimating the extent of trouble. Routine use of such a test is becoming more and more practical, since many newer-model sets are constructed so the grid of the horizontal output tube is accessible without removing the chassis from the cabinet.

In the more difficult cases of poor horizontal-sweep operation, the question is not merely whether the drive waveform exists, but whether it measures up to specifications. This question can be rapidly answered by inspecting the drive amplitude and waveshape with a calibrated scope, or by injecting a substitute signal from a flyback-circuit test instrument to see if the output section can regain normal functioning if properly driven.

Next comes the much more burdensome job of pinpointing the exact defect within one of the two major areas. We will begin tackling this problem by analyzing the output section, which causes service technicians the most grief.

Flyback and Yoke Circuit

The basic configuration of the horizontal sweep output circuitry has been fairly well standardized throughout the past ten years; nearly all models of receivers have included an autotransformer-type circuit generally similar to that shown in Fig. 1. This layout is notably simpler than those used in many sets

of the early 1950's; simplicity has been achieved, in the face of increasing power requirements, by making the individual components more rugged and by tightening up on their specifications. The great electrical stress applied to each component means that deterioration of any one part, or unwise choice of a replacement, can easily degrade the performance of the flyback-yoke circuit enough to result in a loss of raster. Even the most minor faults may show up as weak high voltage, a width problem (either too little or too much), or nonlinearity of sweep. By and large, modern circuits—unlike their predecessors—allow for only a minimum of finicky adjustments to width, drive, and linearity. These characteristics stay reasonably normal as long as the sweep circuits are in good condition; discrepancies great enough to annoy the viewer usually indicate a need for repairs, not adjustment.

It is very difficult to relate specific troubles to specific components in the horizontal flyback circuit, because of the extensive interaction among components. Before any attempt is made to discuss cures for particular problems, it would be well to review the operating cycle of the flyback system, and see how each component fits into the total picture.

This description will start at the beginning of horizontal scan—assuming the CRT electron beam has just retraced to the left side of the screen. At this time, the flyback transformer possesses stored energy, in the form of a collapsing magnetic field.

Scanning left half of screen: The damper tube conducts, dissipating the energy stored in the flyback. Its conduction causes the boost capacitor (C3 in Fig. 1) to be charged so that the plate connected to the fly-

back transformer becomes more positive than B+. The current path from the boost capacitor to the damper is via the portion of the flyback between terminals 1 and 4, partially shunted by the horizontal windings of the yoke. Current flows from the boost side to the "hot" side of the yoke (terminal 7 to 2). The amount of current decreases linearly as damper conduction tapers off; this reduces the strength of the deflection field developed by the yoke, and allows the electron beam to move from the left edge to the center of the screen. During this portion of the sweep scan, the horizontal output tube is held in cutoff by the negative-going swing of the drive signal at its grid.

Scanning right half of screen: The grid voltage of the horizontal output tube rises above cutoff as the damper current approaches zero. Using the charged boost capacitor as a plate-voltage source, the output tube conducts more and more as the grid voltage continues to rise. The plate-current path is downward from flyback terminal 5 to 1. In parallel with the portion between terminals 3 and 1 are the horizontal yoke windings; thus, current now passes from yoke terminal 2 to 7 (note the reversal from the preceding half cycle). As the current rises, it induces an increasingly strong deflection field that forces the electron beam toward the right edge of the screen.

Retrace: At the end of each scan, the horizontal output tube is sud-

denly driven into cutoff by a sharp drop in grid voltage. This interruption in current induces a pulse of high voltage in the flyback transformer, and stores energy in the transformer as mentioned at the beginning of this discussion. Yoke current rapidly reverses, and the electron beam is swept quickly back to the left edge of the CRT. The flyback pulse, stepped up in amplitude by a high-voltage winding on the autotransformer, is rectified to obtain a CRT anode voltage that exceeds 20 kv in many recent models.

The flyback system comprises a high-Q circuit that tends to oscillate when pulsed; it is tuned so that a half-cycle at the resonant frequency will correspond to the desired length of time for retrace. Only this one half-cycle of oscillation is permitted to occur at full strength; thereafter, the damper diode is driven into conduction on alternate half cycles, thus loading the flyback and reducing the oscillations to an insignificant level.

When you can visualize the horizontal flyback system as a functional unit, the mystery disappears from many servicing problems that have been costing servicemen an unnecessarily great amount of time and money.

"No Raster" Problems

A long list of possible defects can account for a blank CRT screen with high voltage weak or absent. It is convenient to divide these into four major categories:

1. Simple failure of a tube; or an easily located fault in a capacitor or some other component that is characteristically a weak link in the horizontal circuit.
2. Loss of adequate drive to the output tube.
3. Loss of efficiency in flyback-circuit operation, as a result of defective or incorrect parts.
4. Overloading of the flyback system, with or without component damage.

Category 1 presents no extraordinary service problems. Most of the troubles in category 2, which will be discussed in further detail in the second half of this article, are also relatively easy to handle. It is in dealing with the remaining two categories that the serviceman often finds himself in deep water.

In category 3, "loss of efficiency" implies that the flyback circuit is operating, but is unable to generate sufficient high voltage to produce a visible raster. Many of these conditions are "cool-running" troubles in which the horizontal-output tube and damper currents are below normal. Here are some of the more prevalent troubles:

- (a) A defect in the high-voltage circuit itself—for example, insufficient filament voltage on the HV rectifier tube, or a faulty high-voltage winding on the flyback transformer. In such cases, voltages and currents in the horizontal output and boost circuitry are normal.
- (b) B+ supply voltage below

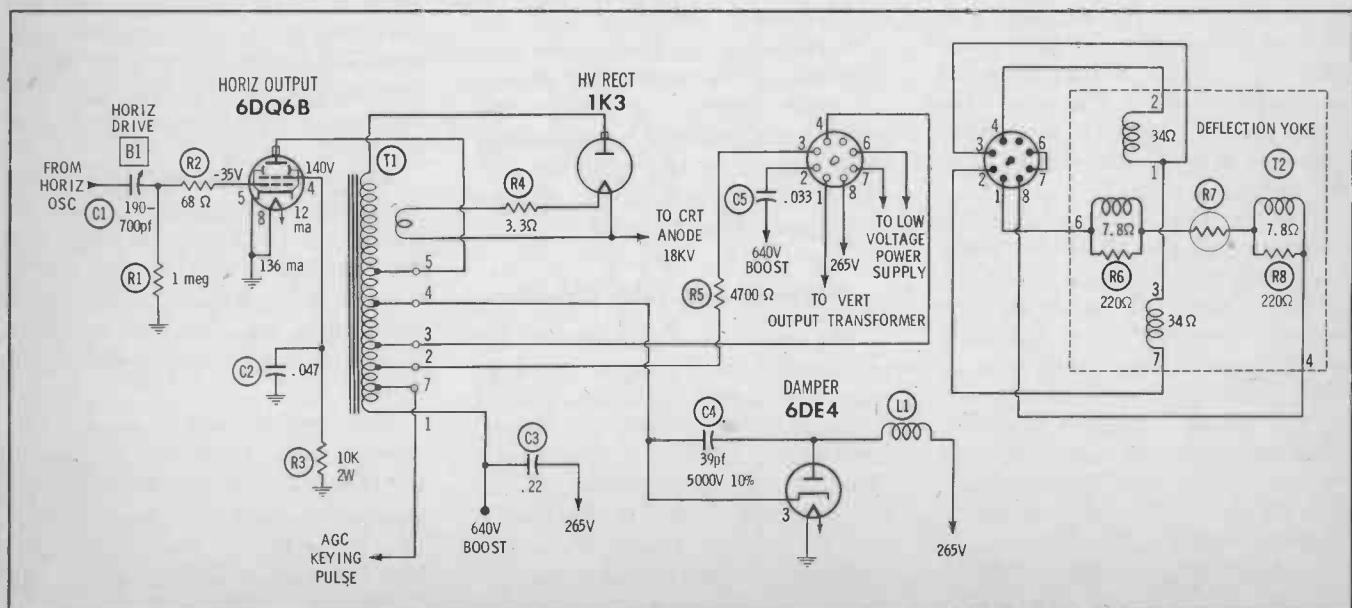


Fig. 1. Typical horizontal output circuit—from grid of output tube to anode of picture tube.

normal, due to a defect in the B+ circuit or an overload on some B+ line outside the horizontal section. In such cases, the loss of raster and reduction in high voltage may be the primary symptom.

- (c) Low plate current in the horizontal output stage, even though the tube is good and the drive signal is normal. An increase in value of a screen dropping resistor can produce this effect by decreasing both the screen voltage and the screen current. (Note that a screen-voltage measurement alone is not sufficient to identify this trouble; either the screen current or the resistance must also be checked.) A leaky screen-bypass capacitor (C2 in Fig. 1) can produce similar symptoms, but in this case the current through the screen dropping resistor (R3 in Fig. 1) will be greater than the current actually passing through the tube. (Moral: check the bypass capacitor before attempting to measure current.) If the output stage includes a cathode resistor, a loss of raster might be traced to this component being burned open or greatly increased in value.
- (d) A defect in the boost capacitor (C3 in Fig. 1) which prevents the boost voltage from rising very far above the B+ level. This fault could be either leakage, an open connection, or a significant decrease in capacitance.
- (e) Shorted turns in the flyback or yoke. Even a single shorted turn can lower the Q of the flyback circuit enough to drop the high voltage to a submarginal level. An ordinary ohmmeter check may fail to find the short for one of two reasons: The change in resistance from the normal value is insignificant, or the short appears only when high-voltage pulses are applied. It is sometimes feasible to check a yoke for this

type of internal short by disconnecting it and noting whether the remainder of the flyback circuit is then able to develop normal high voltage. However, operation of the circuit without the yoke does not give results that are consistent in receivers. It is preferable to make a substitute test with a similar component (if one is available) or with a flyback-circuit tester. Along a different line, an interesting and useful method of testing yokes and flybacks is the "ringing check," fully described in "Ringing Checks for Sweep Coils" PF REPORTER, March 1963.

- (f) Incorrect type flyback or yoke. A close match to the inductance of the original unit is necessary to preserve the proper Q and resonant frequency of the whole circuit.

Category 4 includes the most frustrating troubles of all — those which blow the sweep fuse, or cause the flyback transformer to overheat. These components seldom fail of their own accord; some other defect in the circuit is usually responsible for the excessive current. Such a defect can take a long time to find, if set operation must be restricted to short periods in order to protect it from further damage due to current overload. Some of the more common output-circuit defects that can cause these "hot-running" trouble areas follow:

- (a) Flyback or yoke winding shorted to core or ground; or short between horizontal and vertical windings of yoke. These faults sometimes give themselves away by arcing; in certain cases, they can be detected by disconnecting the suspected winding and checking with an ohmmeter.
- (b) Abnormally high current drain on boost line, as a result of a short in some load circuit. Boost filter capacitors, especially electrolytics, are likely offenders. Loads can readily be disconnected from the boost source to see if the burden on the flyback system is relieved.

- (c) Excessive power drawn by screen circuit of output tube, with resulting increase in power that must be dissipated by the plate. Note that screen-voltage readings may not reveal any abnormality; if value of screen dropping resistor has become too low, voltage will check "normal" even though screen current is excessive. (If you doubt this, try using Ohm's law to check it.)
- (d) Loss of cathode bias on output tube, in circuits where cathode is above ground potential. A shorted cathode-bypass capacitor is the probable culprit.
- (e) Failure of accessory components such as those in the damping network of the yoke. (To find all of these components, be sure to check inside the yoke cover, as well as in the HV cage.) This type of fault often causes a drastic increase in local RF currents within the yoke circuit — enough to burn out a resistor such as R5 in Fig. 1 — although no significant increase may be noted in the output-tube or damper current.
- (f) The fact bears repeating that loss of grid drive to the output tube can cause severe overheating of this tube and of the flyback transformer.

Minor Aches and Pains

When a sweep-circuit defect is not severe enough to destroy the raster completely, the screen presentation may contain definite clues to the location of the fault. This is fortunate indeed, since the malfunction might be small enough to escape notice if the whole sweep section had to be examined.

Width problems may indicate nothing more than an incorrect setting of the width control. (This is one service adjustment that has been retained in a fair proportion of recent-model sets.) If the control is set to the limit of its range, or if no control is provided, here are a few factors that may be involved in width defects:

- (a) Overall output of sweep circuit. Note the function of width coils is to *reduce* the power delivered to the yoke;

that is, they absorb power from the flyback transformer. Certain troubles in the output circuit have a similar effect, causing an unwanted shrinkage of the raster horizontally. A weak output stage or poorly functioning flyback are among the major suspects. Some receivers use a width sleeve to increase or decrease the width on the screen. The sleeve does not reduce power delivered to the yoke, but rather shields—and thereby decreases—the effects of the deflection-yoke currents on the CRT beam. Maximum width is attained when the sleeve is completely removed from the yoke. Inserting the sleeve into the yoke reduces the effect of the magnetic field and thus decreases width.

- (b) **High voltage.** If a defect that reduces sweep power also reduces CRT anode voltage, this tends to compensate for the loss of width, since the beam becomes easier to deflect; poor focus sometimes becomes the most noticeable symptom in these cases. On the other hand, if a malfunction lowers yoke drive without much effect on high voltage, a narrow picture is one of the first symptoms

noted. A likely cause is a mismatch between yoke and flyback transformer.

- (c) **Screen circuit of horizontal output stage.** Note that some sets use a pot in this circuit as a width control. The screen resistance must be set up to provide optimum screen power—enough that the output tube will adequately drive the flyback circuit, but not enough to exceed the screen and plate wattage-dissipation ratings of the tube. Screen current and voltage are both given in service data, as a means of gauging screen power.

Linearity faults can be divided into three categories, according to the portion of the screen most severely affected.

- (a) If only the right side of the raster is compressed, this means yoke current is reaching maximum before the scanning cycle is completed. The usual cause is that the horizontal output tube is being driven prematurely to saturation—either because the drive signal is poor or because of a defect in the output circuit itself. Look for troubles that decrease the bias on this tube.
- (b) If the left side is compressed or has a rippled appearance, the most probable site of

trouble is the damper circuit or the damping (anti-ringing) networks associated with the yoke.

- (c) A wrinkle, fold, stretch, or compression running vertically down the middle of the screen is related to the “drive line” that was a familiar sight in early TV models. This symptom merely indicates a lack of smooth transition between damper conduction and output-tube conduction in mid-cycle; the ordinary remedy is to correct a biasing error that has developed in the output stage (by adjusting a drive control, if provided; otherwise, by troubleshooting).

The “drive line” should not be confused with a filmy or milky trace that sometimes appears in a similar position when the CRT becomes unblanked during a portion of the horizontal retrace interval. Remedies for that condition (often called “phasing ghost”) include: AFC phase adjustment; installing horizontal retrace blanking; or correcting an excessively long horizontal retrace time due to incorrect component values in the flyback circuit.

A small percentage of sets include a horizontal linearity coil in the plate circuit of the damper. To promote long life of the sweep system, this coil should be set for a *dip* (minimum) in horizontal-output cathode current or sweep-fuse current (just as in color sets). This setting should coincide with acceptable linearity; if not, repairs are advisable. Note that the coil and its associated capacitors may not be at fault in such cases; the trouble could be in various other areas of the horizontal section, as indicated above.

A *dim raster* may be a clue to horizontal sweep trouble, although the possibilities of a weak CRT or a defective video circuit also need to be considered. This symptom is rather vague, and is of only limited help in troubleshooting. It generally means that the high voltage is below normal; however, this condition may be due to improper horizontal drive, inefficient operation of the output stage, or overloading of the flyback system, as well as to HV rectifier troubles.

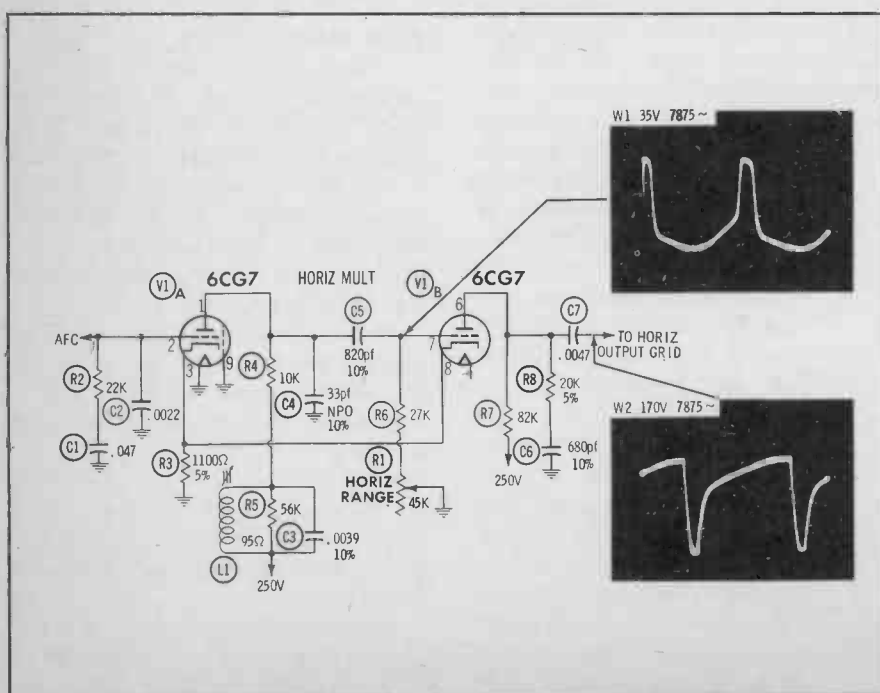


Fig. 2. Multivibrator has ringing coil in plate circuit of first section.

Oscillator-AFC

At this point, let's return to the question of why the horizontal drive waveform might fail to have the proper amplitude, shape, or frequency. Several distinct types of horizontal oscillator - AFC circuits are in common use; we will now have a look at each major type, tracing its normal operation and keeping our eyes open for possible trouble spots. In discussing frequency errors, we'll assume that a normal sync signal is supplied.

Cathode-Coupled Multivibrator

This popular circuit uses both sections of a dual triode, with the second section (V1B in Fig. 2) operated as a switching device. V1B conducts only long enough on each cycle to trigger horizontal retrace. When it is nonconducting, C6 changes from B+ through R7 and R8, and the gradually rising voltage across R8-C6 forms the linear slope of the drive waveform (W2 in Fig. 2). The next pulse of conduction in V1B discharges C6, and the cycle starts again.

Most troubles that affect the amplitude or shape of the drive waveform are located in this immediate area. For example, weak drive can be leakage or low value of C6, increased value of R7, or insufficient DC voltage available at the B+ end of R7. Incorrect drive wave-shape as well as incorrect amplitude can result from wrong values of these and associated components. One common type of distortion in drive waveforms — an excessively flattened positive peak—is related to insufficient grid bias on the output stage. Compression at the right edge of the raster is a common visual symptom of this condition. A small flat spot in the drive signal is normal (as shown in Fig. 3A), since the output-tube grid is driven to saturation at the end of each scan cycle; however, an exaggerated flat spot (as shown in Fig. 3B) should be cause for suspicion if the sweep circuit is turning in poor performance.

The remainder of the multivibrator circuit is concerned mostly with sustaining oscillation at the correct frequency of 15,750 cps. When the second section of the multivibrator (V1B) conducts, its cathode current rises, thus increasing the voltage drop across the common

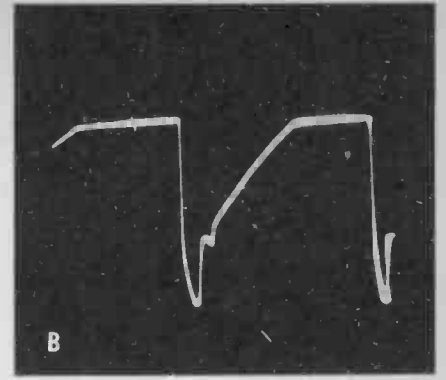
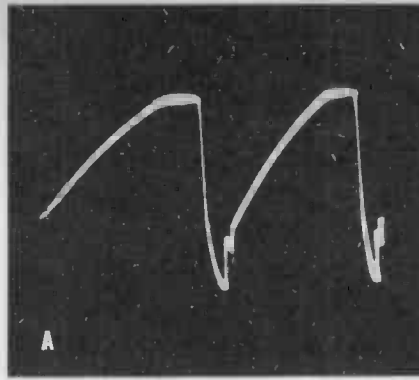


Fig. 3. Duration of flat top is important in horiz output grid waveform.

cathode resistor R3. As a result of the rise in cathode voltage, the first section of the tube is forced into cutoff. When V1A is driven into cutoff, the plate voltage (pin 1) rises toward the applied B+ voltage. This change in plate voltage (a positive-going signal) is coupled through C5 and tends to drive the grid of V1B positive, increasing its conduction. As the second section reaches saturation, the increasing voltage drop across cathode resistor R3 ceases; thus, the plate voltage of V1A is no longer changing. The grid of the second stage begins to draw current which charges C5 (grid side negative) and cuts off the second section of the tube. With V1B in cutoff, a lesser voltage drop is developed across R3 allowing V1A to begin conduction. (This first section is normally designed so that it comes out of cutoff as soon as conduction stops in the second section.) As the first section begins to conduct, the plate voltage at pin 1 goes in a negative direction (less positive). This negative swing in plate voltage appears at the grid of V1B as a negative signal, further assuring cutoff of this section.

The first section (V1A) soon reaches a steady state of conduction, and the second section (V1B) cannot conduct again until the charge on C5 leaks off through R1 and R6. Notice in Fig. 2 the RC discharge time is adjustable by the horizontal range control (R1) — thus it controls the length of the cycle. This control acts as a coarse adjustment of the horizontal hold, with finer adjustment being accomplished by ringing coil L1. Some receivers may omit the range control and use only the ringing coil as a means of adjusting oscillator frequency.

This ringing coil is comparable to the waveform coil found in a

blocking - oscillator circuit. Multivibrator operation shock-excites the ringing-coil into sine wave oscillations, which are superimposed on the grid waveform of the second section of the multivibrator. With the ringing coil adjusted properly, the sine wave increases the slope of the waveform during the period when the second half of the tube is just about ready to come out of cutoff. This means that slight fluctuations in cutoff-voltage have little effect on the timing from cycle to cycle. Misadjustment of the ringing coil has just the opposite effect. In other words, it slightly changes the starting time of conduction in the second half of the tube.

Oscillator troubles generally fall into one of two major categories:

- (a) Amplitude or distortion faults in the drive waveform applied to the grid of the horizontal output tube. Almost always, this is caused by a fault in C6, C7, R7, or R8.
- (b) Frequency faults in the multivibrator section. These faults may be due to a number of things: a value change in C5, a leaky C4, or trouble in the ringing circuit itself. The wide range of adjustment in the ringing coil may cover up many troubles in the multivibrator or AFC section unless they are intermittent. A good way to determine definitely if the multivibrator section is operating at the wrong frequency is to connect the scope to a known source of 15,750 cps (another receiver for instance); set the scope operating controls for two horizontal pulses. Move the scope to the suspected horizontal output grid, and

check to see if there is exactly the same number of pulses at this point. If the frequency is different, trouble exists in either the horizontal AFC or oscillator stage.

Common-Cathode AFC

The horizontal multivibrator section shown in Fig. 2 is usually controlled by an AFC circuit like that in Fig. 4. The purpose of the AFC circuit is to supply the necessary DC voltage to the grid of the first half of the multivibrator so it will cut off and resume conduction at just the right instant to maintain correct timing of each cycle.

A "too-fast" error in frequency will advance the phase of the feedback sawtooth waveform (W1 at the anode of M2) and result in a less-negative output from the AFC network. At the grid of the first multivibrator section, this less-negative voltage will make this section harder to cut off at the beginning of retrace, and will tend to slow up the start of the next cycle.

When the oscillator is running too slow, just the opposite effect is accomplished in the AFC diodes. A more negative DC voltage is developed and the grid of the multivibrator is easier to cut off; thus the frequency of the oscillator is increased.

When the oscillator is operating at the correct frequency (15,750 cps) the output of the AFC circuit may not be an exact zero reading. The correct DC voltage reference is the important factor; any voltage change above or below this reference will shift the operating frequency of the oscillator in the appropriate direction. Also, conduction of the two AFC diodes may not be exactly equal; however, as long as the relative conduction of the two remain constant, trouble will not be encountered.

Troubleshooting the common-cathode AFC circuit isn't really difficult, once the trouble has been determined to exist in this network. Isolating the trouble can normally be accomplished by grounding the grid of the first section of the multivibrator and adjusting the ringing coil until the picture is in sync or tends to drift slowly back and forth across the screen. If this condition can be reached, the trouble is in the AFC section; if it can't, the multivibrator section is probably at fault.

AFC faults can be placed into two main categories:

(a) *No raster*: This can be

caused by an AFC defect only if the grid voltage on the first half of the multivibrator stage changes enough that the tube can no longer conduct or that the tube is never cut off. This could be caused by an open AFC diode or open C4, or possibly a very leaky or shorted C2.

(b) *Loss of horizontal sync*: It is impossible to tie down any one or two components and say they are the usual cause when sync is lost. Questions that also have to be considered are: how great is the frequency error, can the picture be made to sync at any setting of the ringing coil, and is the loss intermittent or is it more noticeable on strong or weak stations? Normally the trouble can be pinpointed to one or two components by carefully analyzing the waveforms obtained at the same points as those shown in Fig. 4. For example, a shorted C3 or open R4 or R5 would result in no signal at the anode of M2. A leaky C2 or C4 would greatly change the

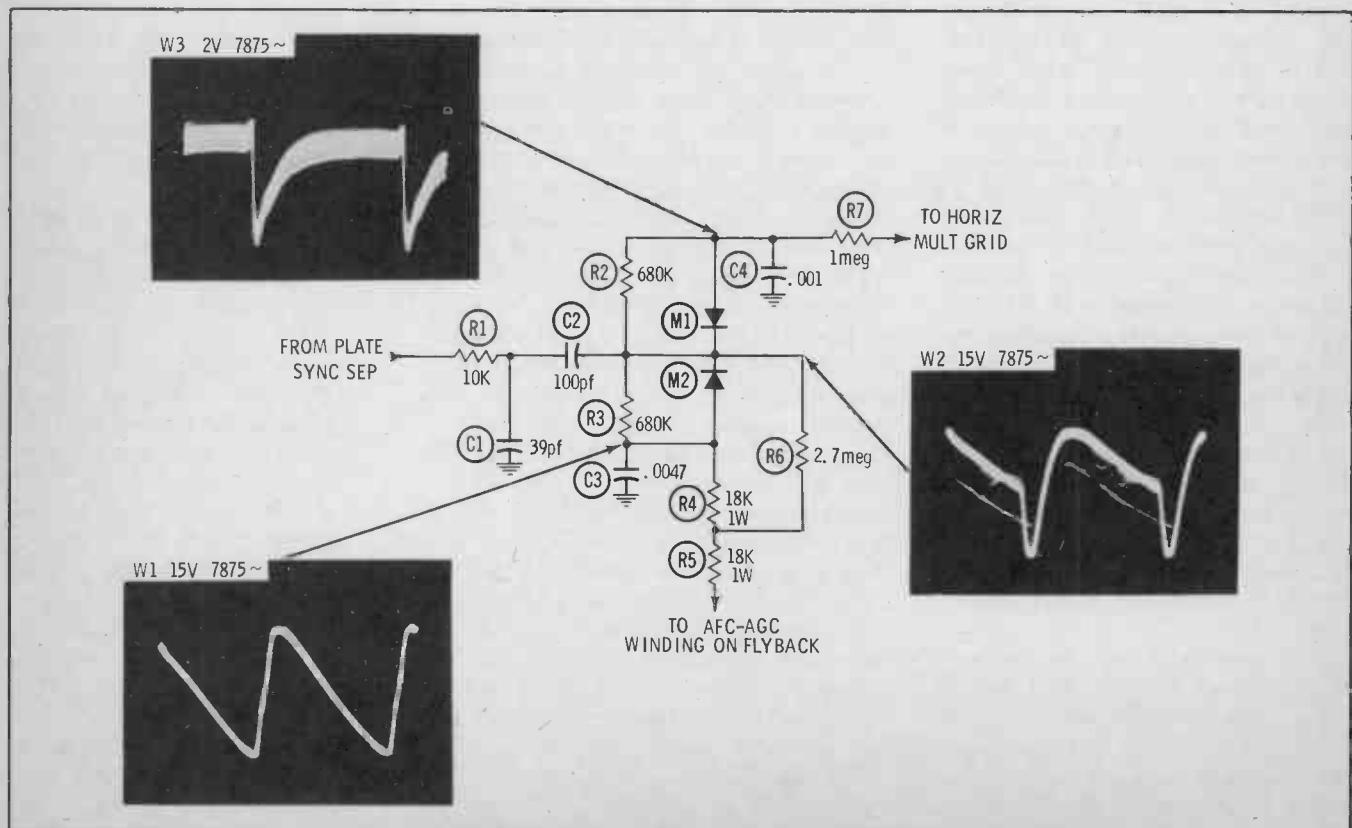


Fig. 4. Common-cathode AFC establishes bias on first half of multivibrator.

DC output voltage of the AFC network, thus causing the multivibrator section to operate at an incorrect frequency. In this case, W1 would change shape considerably and shift frequency somewhat from the normal 15,750 cps.

Synchroguide

The *Synchroguide* oscillator and triode AFC circuits, depicted in Fig. 5, have been used in television receivers for several years. This type of AFC-oscillator circuit has proven to be rather stable. However, component defects can certainly cause the oscillator to operate at the wrong frequency, resulting in symptoms ranging from horizontal bars in the picture to a very narrow raster or no raster at all. Understanding the basic operation of this circuit can lead to great savings in troubleshoot-

ing time.

The oscillator is held in cutoff during most of each cycle by the charge on C7. As this capacitor discharges through R4 and R5 the negative voltage on the oscillator grid is lowered to the point where the tube is allowed to conduct. When the oscillator tube conducts, a large negative pulse develops at the plate; the suddenly increased plate current discharges C9 and forms the flyback or fast portion of the drive sawtooth. When the oscillator goes into cutoff (immediately after the brief retrace or flyback pulse), C9 charges again through R10 and forms the scan portion of the drive sawtooth waveform, which is then coupled to the horizontal output grid.

The waveform coil (L2) "rings" and modifies the normal sawtooth shape of the oscillator plate waveform, adding a sine shape to it.

This altered waveform causes a more rapid voltage rise near the point where the oscillator tube begins conducting. The oscillator frequency is controlled mainly by the grid voltage on the tube, the bias causing the tube to go into or come out of cutoff more quickly or more slowly. An increase in negative grid voltage lowers frequency; a less-negative bias results in the oscillator operating at a higher frequency.

When the AFC tube conducts, increased cathode current flows up through R4 and lowers grid voltage on the oscillator—thus speeding up the cycle. Remember: The AFC tube conducts harder when the sync pulse tip is positioned higher on the feedback waveform (a modified sawtooth), this condition occurs when the oscillator is operating too slow. When the oscillator frequency is higher than normal, the top then rides lower on the waveform, thus

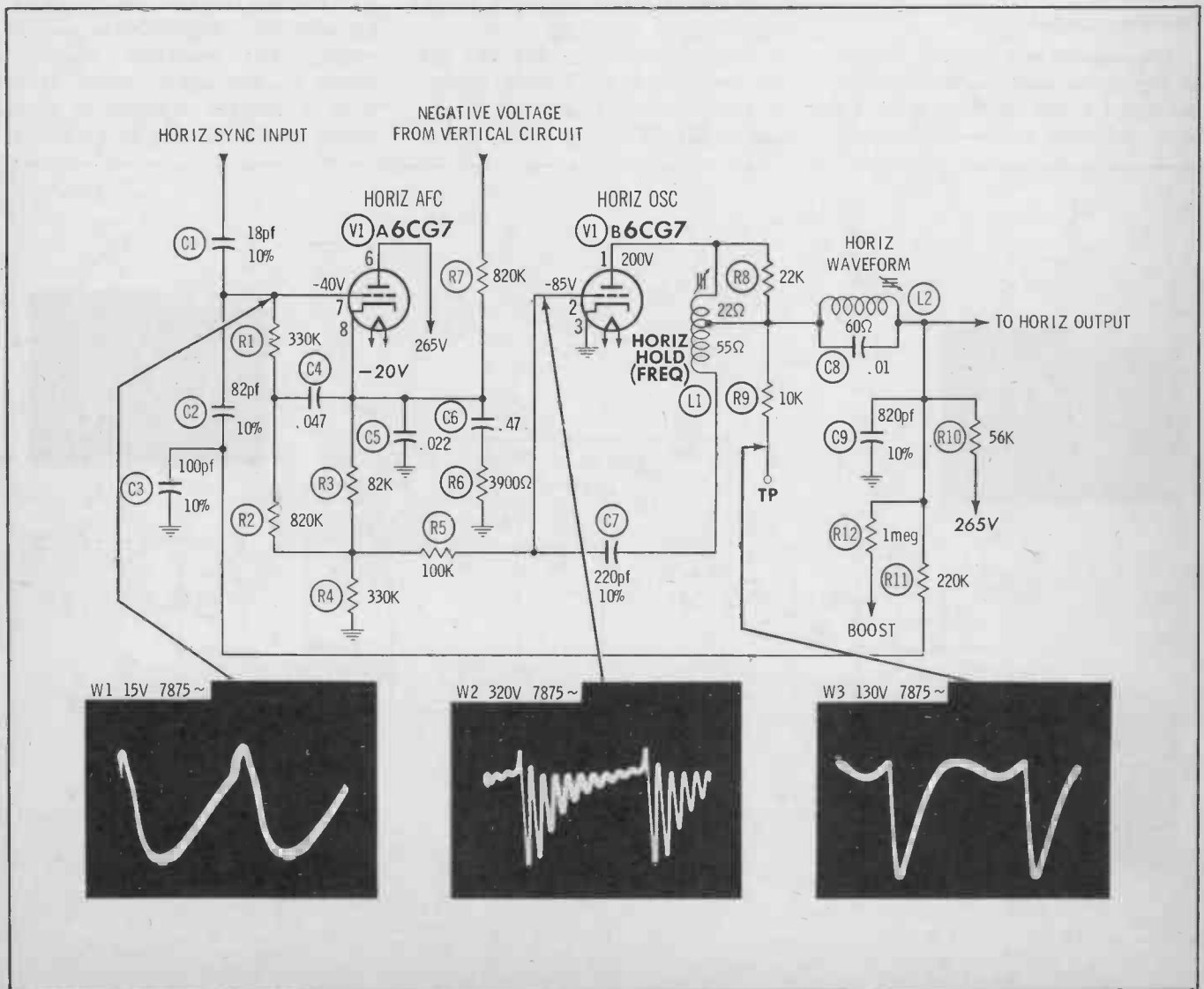


Fig. 5. Horizontal frequency coil is used as hold control in synchroguide circuit.

decreasing AFC tube conduction and increasing oscillator grid bias; the result is a slowdown in operating frequency of the oscillator.

DC voltages on the AFC stage may vary widely from one circuit to another. The service data for the particular receiver should be referred to for normal voltage reading. Also, slight changes in component values in either the AFC or oscillator section may be compensated for by a wide latitude of adjustment in the horizontal frequency and waveform coils.

Remember, though, even slight leakage in the sync coupling capacitor (C1) or AFC feedback capacitor (C2) can greatly upset the AFC operating voltages and pull the oscillator far from normal frequency. Leakage in the oscillator feedback capacitor (C7) will change the oscillator grid voltage, and may also shift the frequency considerably.

Sine-Wave Oscillator

The sine-wave oscillator (shown in Fig. 6) is aptly named because the signal at the oscillator grid is a nice, clean sine wave—the result of

“flywheel effect” in a tuned tank circuit. Oscillation is sustained by feedback from cathode to grid; the feedback network includes a grid-leak bias network (R6-C7), which sets up class-C operation (this oscillator tube conducts during only about 1/3 of the positive-going waveform cycle).

This mode of operation produces a characteristic wide negative pulse as drive capacitor C11 is discharged. The great width of the drive pulse doesn't affect horizontal retrace time, because the leading edge of the pulse triggers the retrace and the beam is well on its way before the trailing edge of the pulse occurs. Besides, the output tube remains in cutoff during the first half of the drive waveform, and so the pulse width has no adverse effect on operation of that stage, either.

The horizontal AFC tube (sometimes called reactance tube) keeps the oscillator operating at the correct frequency. Diodes M1 and M2 are connected in the familiar phase-detector arrangement, and change bias on the AFC stage as and if fre-

quency errors occur.

AFC grid voltage, and consequently plate current and oscillator grid voltage, vary with conduction of diodes M1 and M2. A voltage divider network, consisting of R10 and R11, feeds a small portion of the oscillator grid voltage to the AFC grid. The high resistance of R10 minimizes any loading effect on the oscillator and reduces the voltage to a correct proportion. Because this voltage divider network is used to derive bias for the AFC stage, an AFC-tube cathode resistor is not required.

Conclusion

An understanding of the operation of AFC, oscillator, and output circuits, along with a knowledge of the waveforms that should appear at various points throughout these circuits, can lead to valuable time saved when repairs are required. Concentrating scope checks and/or voltage and resistance measurements on the section which is at fault is the real solution to horizontal troubleshooting problems. ▲

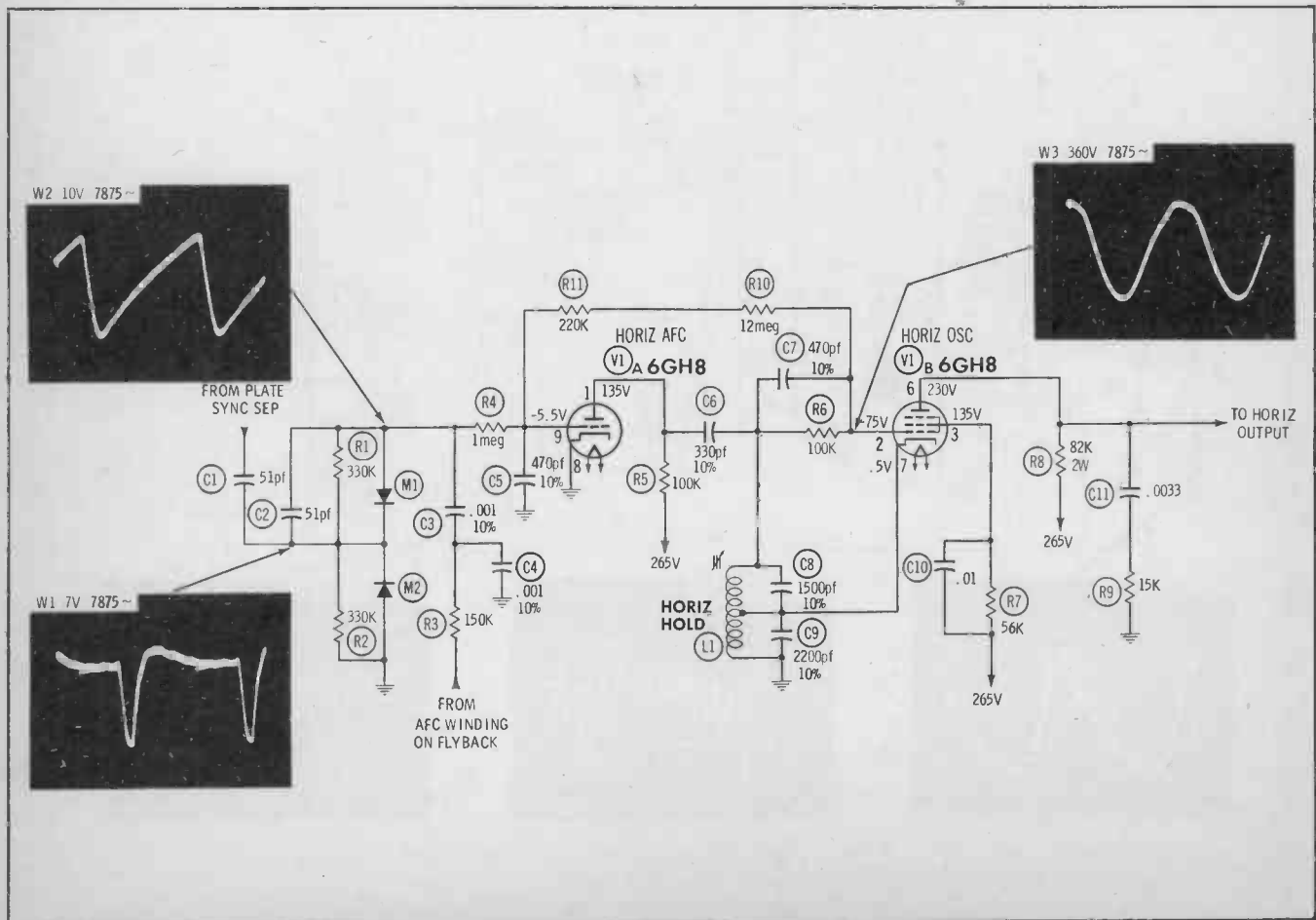


Fig. 6. Sine-wave oscillator is controlled by triode AFC and diode phase detector.

TUNER REPAIRS



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ALL labor on ALL makes**

**24-HOUR SERVICE with
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SARKES TARZIAN, INC.

TUNER SERVICE DIVISION

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Bloomington, Indiana
Tel: 332-6055

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North Hollywood, Calif.
Tel: 769-2720

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Circle 2 on literature card

January, 1965/PF REPORTER 9

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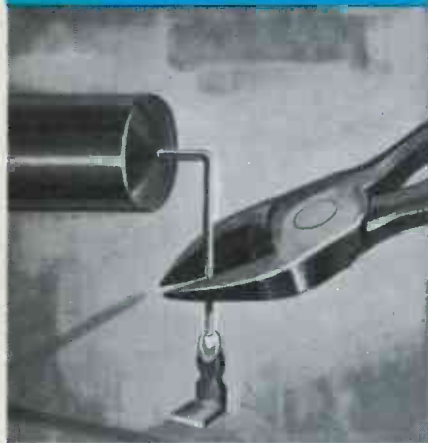
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PF Reporter™

PHOTOFACT

the magazine of electronic servicing

VOLUME 15, No. 1

JANUARY, 1965

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Subscription Prices: 1 year—\$5.00, 2 years—\$8.00, 3 years—\$10.00, in the U. S. A., its possessions and Canada.
All other foreign countries: 1 year—\$6.00, 2 years—\$10.00, 3 years—\$13.00. Single copy 50¢; back copies 65¢.

Indexed in Lectorindex.
Printed by the Waldemar Press Div.
of Howard W. Sams & Co., Inc.

ABOUT THE COVER

It is being said that radio programs are more colorful than ever. We think the color most satisfying to an auto-radio service technician is green—in the cash register. Many millions of auto radios offer a broad source of income for the service industry, so be sure of your share through speedy and efficient repair techniques like those starting on page 58.



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Letters to the Editor

Dear Editor:

Many thanks for the item "Futile Filtering" in your August 1964 issue. I just happened to have two sets in the shop with exactly that trouble, causing intermittent loss of horizontal drive. Your reference to the "May Troubleshooter" had me puzzled for awhile, but after careful searching, I tried the May 1963 edition and what do you suppose I found? I'll bet you can guess my suggestion, too: Indicate the year when you make reference to previous issues.

ROBERT C. PARKER

Seaside, Calif.

Thanks, a lot and congratulations, Bob, on your imaginative solution. From now on, you'll see the year appended to past-article references. As for these, here are the correct references: Peter Gernat's question (and the answer) appeared in the January 1963 issue on page 69. The reference to page 87 of the April 1963 issue is correct; it tells of trouble caused by inadequate horizontal shielding. As Bob points out, the "Off Again,—On Again, item appeared in the May 1963 issue, on page 79.—Ed.

Dear Editor:

I enjoy reading PF REPORTER very much and notice that you help readers from time to time with information we don't get elsewhere. I wonder if you can help me with the following problem: Several of my friends own radios made in Germany. Recently, two FM stations went on the air here, at frequencies above 100 mc. We find, however, that our receivers tune only to 100 mc. What would be the simplest approach to this problem?

J. ULLMAN

Sault Ste. Marie, Canada

First of all, I'm surprised that a modern set imported from Germany would tune only from 88 to 100 mc. Are you sure the receivers in question are actually built for FM? It is possible they are AM receivers for VHF bands. Secondly, assuming they are actually FM sets that tune only to 100 mc, I would suggest that you can raise the frequency of each tank coil in the RF, mixer, and oscillator stages by spreading the turns farther apart. At 100 mc, chances are these coils are made of heavy, stiff wire. You can raise the tank-circuit resonant frequency further by reducing the shunt capacitance—trimmer or fixed. You may find a bit of tracking error when you do this. Thirdly, keep in mind that when you raise the upper frequency limit, you also raise the lower limit. Thus, the lower end will no longer reach 88 mc (in case you have stations in that end of the FM band).—Ed.



Be a wise owl!

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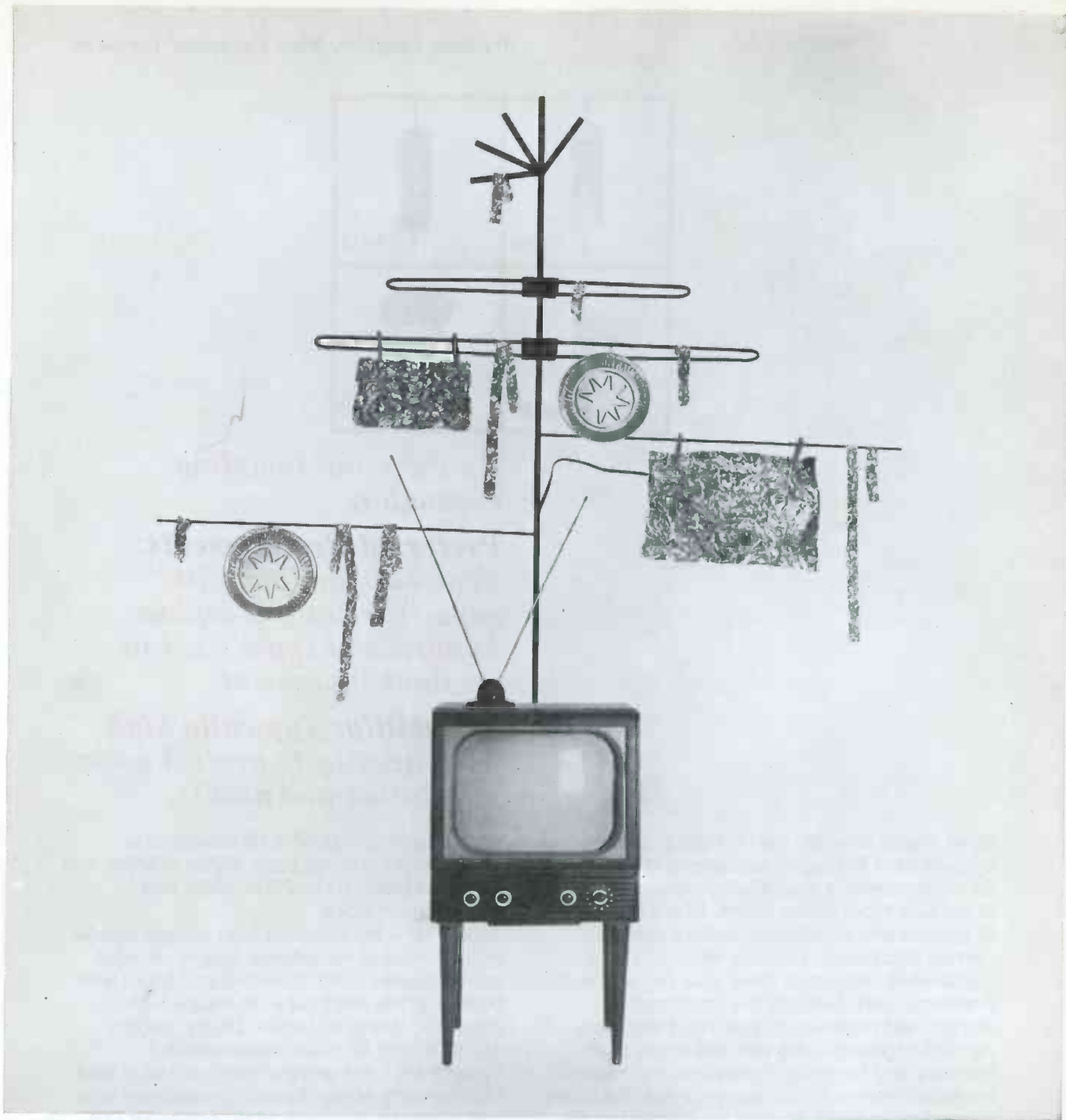
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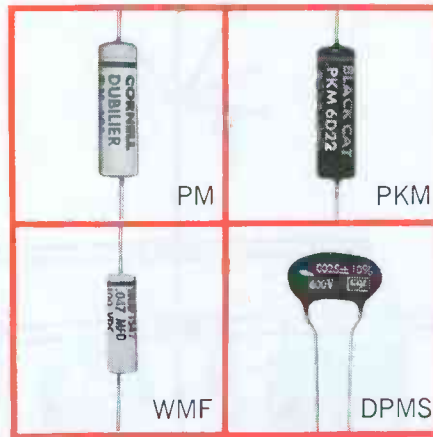
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Type PM—the general purpose axial lead tubular replacement that offers the advantages of the most expensive materials without added cost. The molded housing and ALL-MYLAR* dielectric are impervious to moisture. 200v, 400v and 600v units in stock.

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a requirement. ALL-MYLAR dielectric is protected by a tough outer Mylar wrapper and solid end seals. 100v, 200v, 400v, and 600v units in stock.

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*DuPont T.M.

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cover all replacement needs.*

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Type NLW—for transistorized and portable equipment, or other miniaturized applications. Ultra-miniature axial lead electrolytics,

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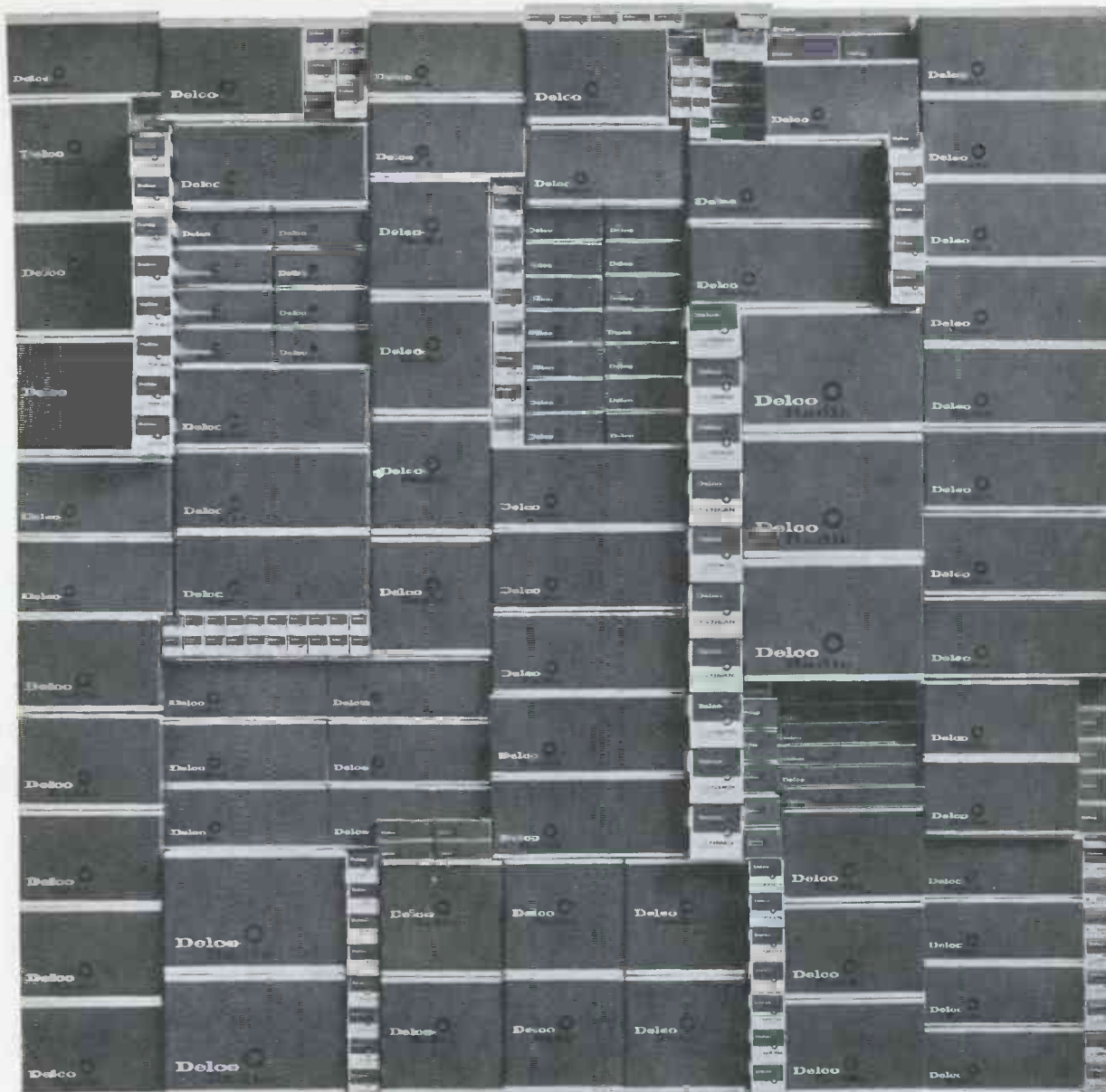
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Circle 8 on literature card



The Electronic Scanner

news of the servicing industry

Name Change

In an \$800,000 expansion and reorganization program, **Hy-Gain Antenna Products**, Lincoln, Nebr. has adopted the new name of **Hy-Gain Electronics Corp.** The plant facilities are being enlarged to almost twice original size, providing more than 70,000 square feet of office, manufacturing, and engineering space. Equipped with the latest production machinery, the new building will provide additional space for laboratories and test sites. According to the company, the expanded engineering facilities will permit additional research and development projects in design, development, and testing. Products to be included are: commercial, industrial, and military antennas; antenna systems and related components; antenna systems for business/industrial, Citizens Radio, and Amateur Radio services.

On-Job Education

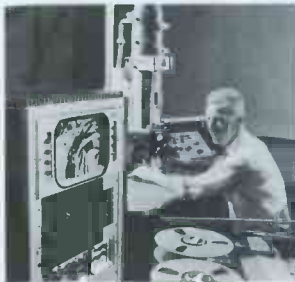


An Office of Job Training has been opened in Washington, D.C. by **NATESA**. Mr. Vincent Lutz, past president of **NATESA**, is in charge. His services will be available without charge to any electronic service group wishing to develop an on-the-job training program under provision of the Manpower Development and Training Act of 1962.

New Name

All **Eastman Kodak Co.** magnetic sound tapes marketed through electronic supply houses, audio departments, and similar outlets will hereafter be sold under the name **Kodak Sound Recording Tape**. The tapes will be identical to those previously sold under the Eastman brand name, except for new type designations and increased information printed on the back of the tape.

More Magnification



A system to apply television techniques to the electron microscope can boost the instrument's visible magnification power ten-fold to 2,000,000 times. C. H. Colledge, vice president and general manager of the Broadcast and Communications Products Div., **RCA**, described the system as "the most important single advance in microscope design since the perfection of the microscope itself." Images heretofore have been too dim to observe at high magnifications, or the specimens themselves were destroyed or altered when exposed to the microscope's strong electron beam. The TV system intensifies the images formed when specimens are examined in the microscope and displays them on standard TV monitors. The conventional electron microscope is capable of direct magnification of 200,000 times, enabling scientists to observe objects 1,000,000 times thinner than the human hair. The addition of television increases the instrument's direct magnifying potential ten-fold, so much that the average 1" paper clip would appear 32 miles long and a man's foot some 400 miles long. However, most observations in electron microscopy are made at magnifications well below these theoretical limits.

COMPLETE TUNER OVERHAUL

ALL MAKES — ONE PRICE



995

ALL LABOR AND PARTS
(EXCEPT TUBES & TRANSISTORS)*



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GUARANTEED COLOR ALIGNMENT — NO ADDITIONAL CHARGE

Simply send us the defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. Your tuner will be expertly overhauled and returned promptly, performance restored, aligned to original standards and warranted for 90 days.

UV combination tuner must be single chassis type; dismantle tandem UHF and VHF tuners and send in the defective unit only.

Exact Replacements are available for tuners unfit for overhaul. As low as \$12.95 exchange. (Replacements are new or rebuilt.)

And remember—for over a decade Castle has been the leader in this specialized field... your assurance of the best in TV tuner overhauling.

Pioneers of TV

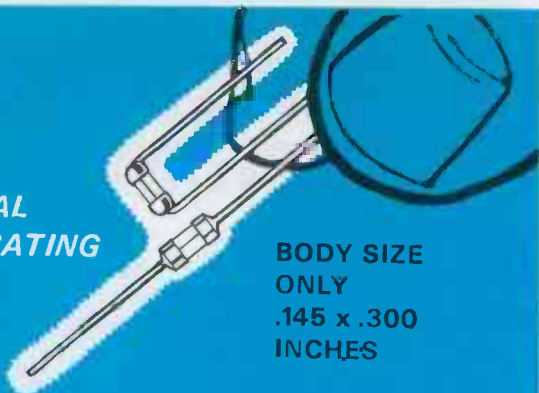


Tuner Overhauling

CASTLE TV TUNER SERVICE, INC.

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EAST: 41-90 Vernon Blvd., Long Island City 1, N.Y.
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For use on miniaturized devices,— or on gigantic multi-circuit electronic devices.

Glass tube construction permits visual inspection of element.

Smallest fuses available with wide ampere range. Twenty-three ampere sizes from 1/100 thru 15 amps.

Hermetically sealed for potting without danger of sealing material affecting operation. Extreme high resistance to shock or vibration. Operate without exterior venting.

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BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis, Mo. 63107

VHF television tuners employing 600 workers. At present, Oak Electro/netics Corp. (Hong Kong) Ltd., has a 5000-square-foot plant and employs about 80 in subassembly operations. The company has leased an additional 42,000 square feet in a new plant where tuners will be assembled from parts fabricated in the United States. Initial shipments are scheduled to begin in the last quarter of 1964 and full production by mid-1965.

UL Listing Program



The UL listing program, started in April 1964 to cover all of **Matsushita Electric's** 30 factories, divisions, and departments with specialized "UL listing" lines of communication, is now in full operation. This comprehensive program, named "Operation UL," has the basic objective of securing UL listing for every Matsushita electronic and home-appliance product. All products now coming off production lines have been or

will be submitted to one of the UL Testing Laboratories in Santa Barbara (Calif.), Northbrook (Illinois), New York or Chicago. Among the already approved products now being marketed in the United States is the Panasonic Model 763 (the first imported FM-AM line-connected, tube-chassis radio to be so listed.)

Color-TV Advertising

Is it possible to sell the "beauty and advantages" of color television via radio? **Packard Bell** thinks so! The company has been running an extensive radio advertising campaign via 60 stations in 25 major Western markets. The results are well worth watching. Radio has been used to sell color television

BUSS: 1914-1964, Fifty years of Pioneering....

New Plant



Construction of a complete new **Antennacraft** manufacturing plant was started in November. Located on their four-acre site just west of Burlington, Iowa, the new installation will enclose com-

plete office facilities, with machines and equipment for plastics molding, aluminum-tube rolling and one additional production line. Operation in the new structure is expected to begin on or about January 1, 1965.

Year's Service Free

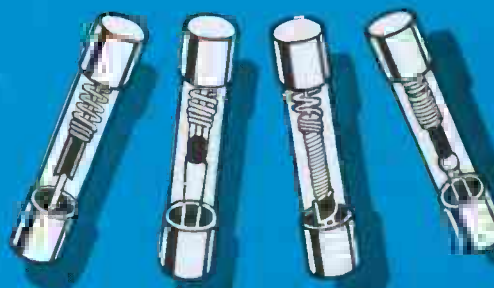
Effective immediately, all 1965 **Admiral** color television receivers sold in the Chicago area will carry a one-year parts and labor warranty at no additional cost. Victor Croft, general manager, announced that each sale includes setup and delivery in the customer's home, hookup to an existing antenna, and complete service for 12 months—including replacement or repair of defective parts and tubes. The unconditional *service* and *parts* guarantee is believed to be the only one of its kind in the industry.

License Law Pending

In their September convention at Roswell, N.M., **Television Electronic Service Assn. of New Mexico** elected new officers and discussed problems of the TV industry. They decided, among other things, that in January of 1965 they would try to get a television technician license law passed. The annual convention for 1965 was set to be held in Albuquerque next June.

Tuner Expansion

A major expansion program of **Oak Electro/netics Corp.** will convert their Hong Kong subsidiary to a manufacturer of



FUSETRON dual-element Fuses

time-delay type

"Slow blowing" fuses that prevent needless outages by not opening on motor starting currents or other harmless overloads—yet provide safe, protection against short-circuits or dangerous overloads.

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GMW FUSE
and HWA
FUSEHOLDER



FUSE SIZE
ONLY .270 x .250
INCHES

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Sub-Miniature FUSE-HOLDER COMBINATION

For space-tight applications. Fuse has window for inspection of element. Fuse may be used with or without holder.

Fuse held tight in holder by beryllium copper contacts assuring low resistance.

Holder can be used with or without knob. Knob makes holder water-proof from front of panel.

Military type fuse FM01 meets all requirements of MIL-F-23419. Military type holder FHN42W meets all military requirements of MIL-F-19207A.

BUSS

Write for BUSS
Bulletin SFB

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis, Mo. 63107

switch adding broadband radio reception to the existing two-way, shortwave system in the two mile-long tunnels. "So far as we know, there is not another tunnel anywhere with AM radio reception," Morris said. The 17.5-mile long bridge-tunnel, longest in the world, opened for traffic last April. It spans the mouth of Chesapeake Bay between Virginia Beach and Virginia's Eastern Shore. Its two tunnels dip as much as 90' under the bay surface beneath channels used by ships plying the ports of Hampton Roads and Baltimore. The technique that makes the system possible, developed by **General Electric**, is referred to as "Guided Radiation." The system consists of AM antennas mounted at each end of the tunnels and connected to amplifiers. The amplifiers boost the signals received by the antennas and feed them to antenna cables running the length of the tunnel ceilings. The cables were built into the tunnels originally to provide two-way short-wave communication for the bridge-tunnel's patrol cars, maintenance, and emergency vehicles. Only the outside antennas and amplifiers had to be added to make the system serve car radios.

Export Possibilities



Harold Harris, vice president in charge of sales and engineering of **Channel Master Corp.**, is in Yugoslavia as a member of a special U.S. trade mission to Yugoslavia. The trade mission, sent by the Department of Commerce, left October 2 on a one-month trip, to explore the Yugoslav market for American goods. The seven-man team took with them more than 360 specific proposals from U.S. firms interested in doing business in Yugoslavia, to discuss them with foreign trade representatives in the five major Yugoslav cities. ▲

....New Developments in Electrical Protection

before on a limited scale by individual dealers, but this marks the first time it has been used across the board by a major manufacturer. Their success could stimulate a new approach to television-set advertising.

Communications Seminar



The Newark-Herrlinger Corporation of Cincinnati, in cooperation with **Texas Instruments**, was recently host to more than 125 engineers and engineering buyers from the Cincinnati-Dayton area at a seminar on communications. A series of technical papers on semi-conductor applications for communication equipment in the megacycle and gigacycle range was offered at the meeting, with a question-and-answer period following the presentation of

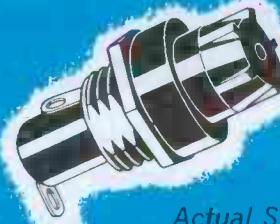
each paper.

The program is part of the service given to industrial customers by the Newark Corp., one of the larger radio parts distributors specializing in industrial sales.

Shown examining one of the portfolios of papers presented to each engineer attending the seminar are (L to R) Chuck Poncher, manager of Newark-Herrlinger; Harry Cooke, TI research engineer; Bob Spoeneman, TI local sales representative; Clancy Cordes, N-H industrial salesman; and Grady Giles, TI research engineer.

Underground Reception

In November, the Chesapeake Bay Bridge-Tunnel became the first travel facility in the world where motorists can listen to their car radios while driving through a tunnel. J. Clyde Morris, Executive Director of the Bridge-Tunnel, flipped a



Actual Size
Only 1-5/8 inches long...
Extends just 29/32 inch
behind front of panel

BUSS Space Saver Panel Mounted Fuseholder

- Fuseholder takes 1/4 x 1 1/4 inch fuses. Converts to 3/32 x 1 1/4 inch fuses simply by changing screw type knob. Holder is rated at 30 ampere for any voltage up to 250.

- Also available in military type which meets all requirements of MIL-F-19207A.

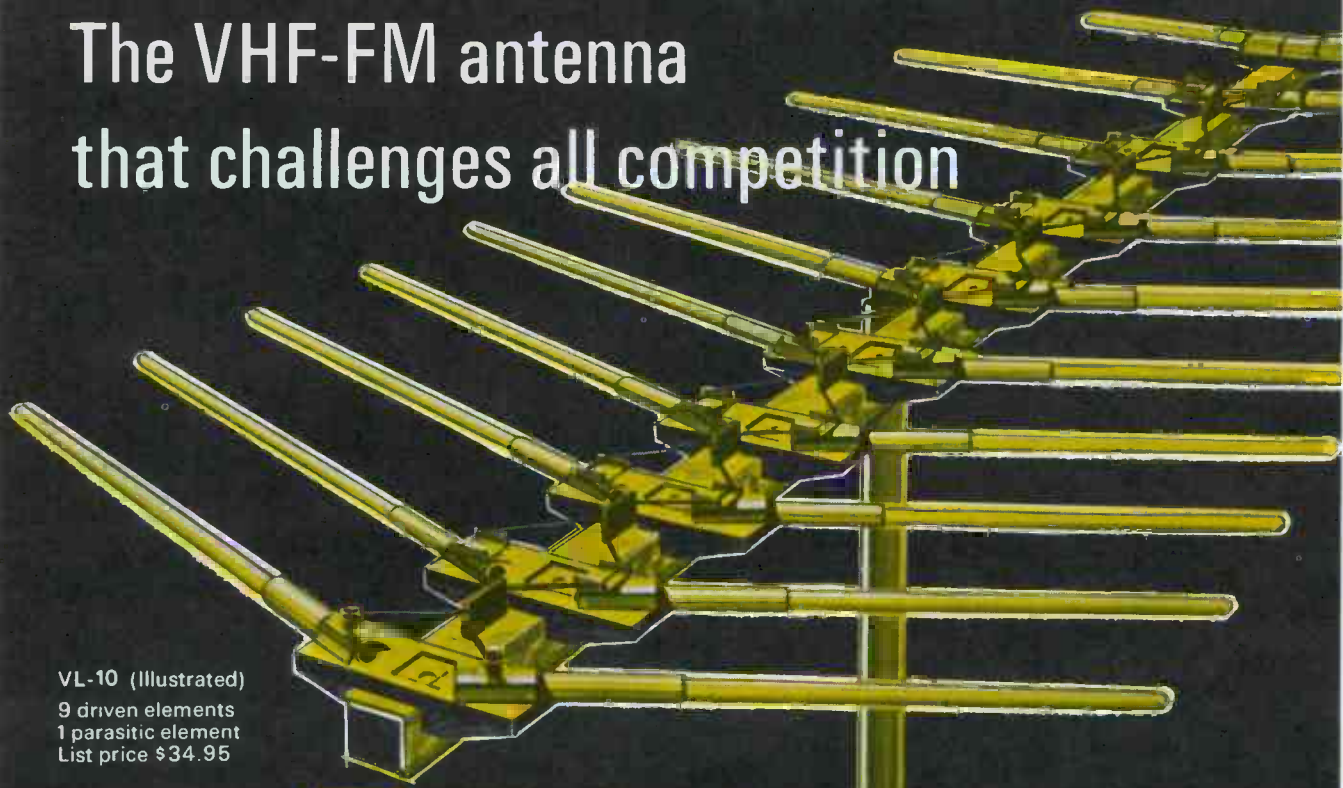
BUSS

Write for BUSS
Bulletin SFH-10

BUSSMANN MFG. DIV., McGraw-Edison Co., ST. LOUIS, MO. 63107

Circle 10 on literature card
January, 1965/PF REPORTER 19

The VHF-FM antenna that challenges all competition

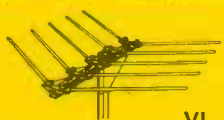


VL-10 (Illustrated)
9 driven elements
1 parasitic element
List price \$34.95

NEW **FINCO**® *Swept Element* "COLOR-VE-LOG" VHF-FM ANTENNA

Finco's Color Ve-Log challenges all competition on color or black and white reception and stands behind this challenge with a "Guarantee of Supremacy". The swept element design assures the finest in brilliant color and sharply defined black and white television reception – as well as superb FM monaural and stereo quality. FINCO precision-engineered features make these advanced-design antennas indispensable to good home sight-and-sound systems. And, of course, they carry the famous unconditional guarantee from the leading manufacturer in the field – FINCO. Promote the Color Ve-Log Antennas with pride, sell them with confidence, and profit handsomely.

Featuring Finco's Exclusive Gold Corodizing



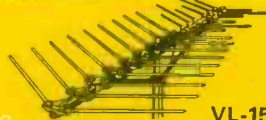
VL-5

5 element VHF-FM
5 driven elements
List price \$16.95



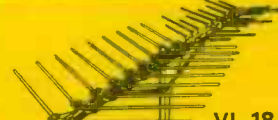
VL-7

7 element VHF-FM
7 driven elements
List price \$23.95



VL-15

15 element VHF-FM
9 driven elements
6 parasitic elements
List price \$46.95



VL-18

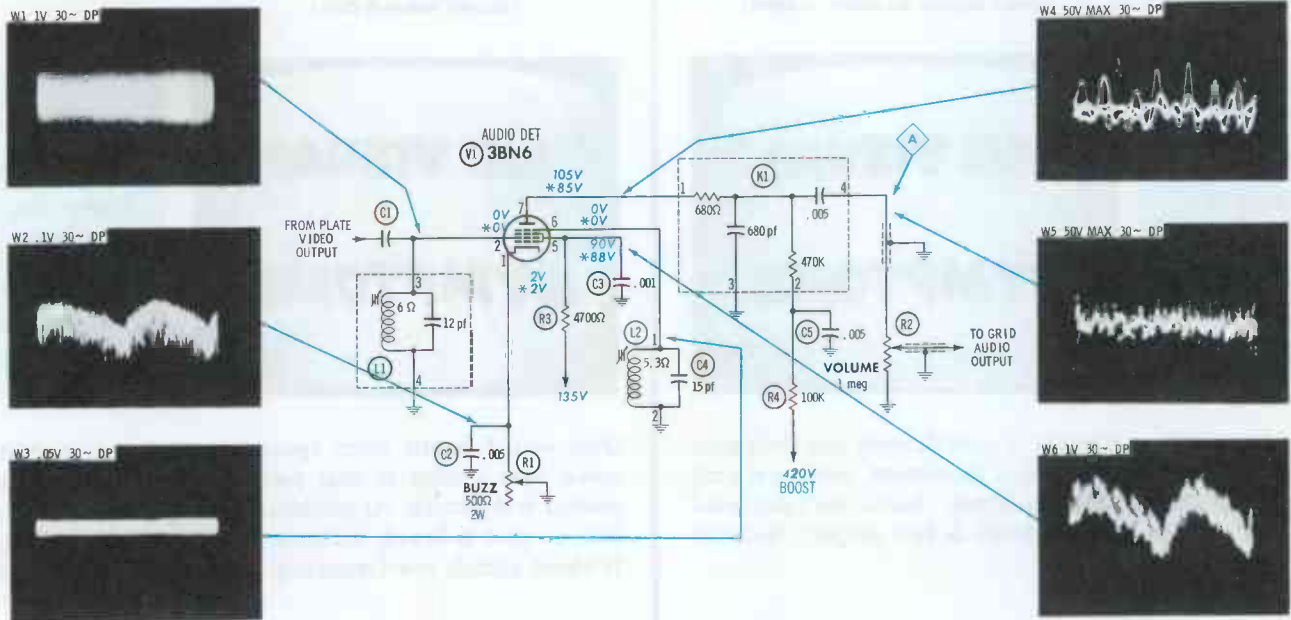
18 element VHF-FM
9 driven elements
9 parasitic elements
List price \$54.50

The FINNEY Company • 34 W. Interstate Street • Bedford, Ohio

Write for color brochure #20-307, Dept. 310



Boost-Fed Plate



DC VOLTAGES taken with VTVM, on inactive channel; antenna terminals shorted. *Indicates voltages taken with signal present—see "Operating Variations."

WAVEFORMS taken with wideband scope; TV controls set to produce normal picture and sound. Direct probe (DP) usable at all points throughout the circuit.

Normal Operation

Gated-beam FM detector circuit depicted above, uses 3BN6 (specially constructed tube) as audio detector and limiter. Sound IF stage isn't needed with this circuit; signal from plate of video output tube is applied directly to C1. Sound takeoff coil L1 is tuned to pass frequencies 25 kc above or below 4.5 mc, thus allowing only frequency-modulated 4.5-mc signal to appear at first control grid (second grid—pin 2) of tube. Resonant tank circuit—L2 and C4—develops and sustains oscillation when signal is present at pin 2. Signal at pin 6 (second control grid) is also 4.5 mc, but is 90° out of phase (in quadrature) with signal at pin 2. Tube conducts only when signal excursions on both control grids are positive, therefore frequency modulation of carrier (signal shifting above or below 4.5 mc) causes plate current to vary at audio rate—larger shift gives greater plate-current change, and louder audio. Sync pulses and other noise will not be heard unless amplitude of incoming sound signal becomes so low that tube is not driven into saturation on each positive peak. Buzz control (R1) adjusts gain of V1 and eliminates amplification of low-level sync pulses which may not have been filtered by input-grid network. Alignment of L1, L2, and R1 can be accomplished by reducing signal strength at antenna terminals until hiss is heard and adjusting for maximum undistorted sound, with minimum buzz. In this set, plate voltage is supplied from boost; defects lowering boost voltage will also reduce sound output. Volume control (R2) may be adjusted to tap off any desired signal level.

Operating Variations

- PIN 1** Cathode voltage varies from 0 to 4.5 volts, with or without signal, depending on setting of buzz control. Normal is 2 volts.
- PIN 2, 6** No valid information can be gained by measuring voltage on either of these control grids. With or without signal, VTVM loads circuits and results in zero reading.
- PIN 5** With or without signal, only slight variation is noted. Buzz control changes voltage only slightly—about 5-volt swing between minimum and maximum setting of control.
- PIN 7** Without signal, plate voltage ranges from 55 to 410 volts, depending on setting of buzz control. With signal, plate voltage swings from low of 55 volts to high of 220 volts with rotation of buzz control. Normal is 85 volts.
- WAVEFORMS** Grid signal (W1) shows frequency-modulated 4.5-mc signal; amplitude varies with rotation of fine tuning. Scope loads circuit at pin 6 (W3) but presence of 4.5-mc signal can be determined. W4 and W5 both display audio signals which vary in amplitude as audio of station signal fluctuates. Maximum amplitude is 50 volts p-p; decreases to near zero during pauses in transmitted audio signal. W6 contains slight audio signal and normal B+ ripple.

Sound Weak

No Buzz or Hum Present

SYMPTOM 1

R4 Increased in Value

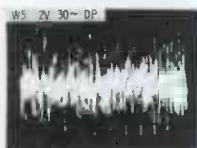
(Plate Supply Resistor — 100K)

Symptom Analysis



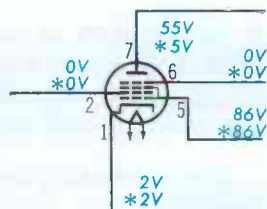
Sound heard from speaker is considerably less than adequate. With volume control at maximum, volume is only normal or slightly above normal. Audio isn't distorted by buzz or hum—output stage is first suspect, detector stage second.

Waveform Analysis



Scope troubleshooting in output stage with station audio is difficult—frequency and amplitude of signal constantly changing. However, input to volume control is only 2 volts p-p on *strongest* signal; proves defect is in preceding stage. Input (W1) to grid of V1 is normal — isolates trouble to defective detector stage. Small, undistorted 2-volt plate signal (W4) isn't conclusive in pinpointing component, but gives hint to trouble in plate circuit.

Voltage and Component Analysis



Best lead to trouble is gained from radical plate-voltage change—55 volts without signal, decreases to mere 5 volts with signal present. Tube isn't overconducting as readings are normal on pin 1 and 5. Boost voltage is normal, therefore trouble must be in plate supply path; cause may be increased value of R4 or 470K resistor located in printed couplate K1. Amount of resistance increase in supply resistor determines exact symptom; slight increase may be barely noticeable, greater increase results in severe loss of volume.

Best Bet: Scope to isolate, then VTVM.

No Audio

Loud Noise Present

SYMPTOM 2

L1 Open, Terminal 3

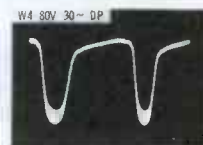
(Sound Takeoff Coil)

Symptom Analysis



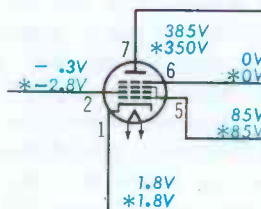
Only sound heard from speaker is roar or rumbling noise, very similar to that present when B+ filter capacitor is defective. At minimum setting of volume control, no roar is heard; defect in B+ filtering is unlikely. Without signal, low-frequency roar is less pronounced.

Waveform Analysis



Signal at detector plate (W4) doesn't resemble audio signal; however, this waveform does explain why low-frequency rumbling is present — unexplained pulse is approximately 60 cps in frequency. Pin 2, W1 (compare to normal W1) gives conclusive evidence of trouble in grid circuit—composite video signal is seen here. Defective L1 is likely culprit; this coil should pass only frequency-modulated 4.5 mc signal—not video—to grid of V1.

Voltage and Component Analysis



Pins 1 and 5 have near-normal readings—pretty well rules out defective components associated with these elements of tube. With or without signal, plate and first control-grid voltages are far from normal. Voltage on pin 7 has increased to near boost-supply. Pin 2 has negative voltage—should read zero. Plate voltage has risen because of negative grid voltage and increased bias on stage. Open L1 is quickly pinpointed by measuring resistance from pin 2 to ground; meter shows no continuity—normal indication is 6 ohms.

Best Bet: Scope or VTVM will locate this trouble.

Sound Missing

Sound Weak

SYMPTOM 3

Buzz in Speaker

Buzz present

SYMPTOM 4

R1 Open

R3 Increased in Value

(Buzz Control)

(Screen Supply Resistor — 4700 ohms)

Symptom Analysis



Symptom Analysis



With or without signal, only noise heard from speaker is annoying buzz. Volume control operates normally, changing level of noise in speaker output as it should, but maximum setting doesn't provide even slightest audio—just buzz. Buzz control has no effect.

Slight amount of audio can be heard from speaker but is almost over-ridden by annoying buzz. Volume control varies amount of sound heard from speaker; however, even at maximum setting of control, volume is weak. Buzz control has only very slight effect on buzz.

Waveform Analysis

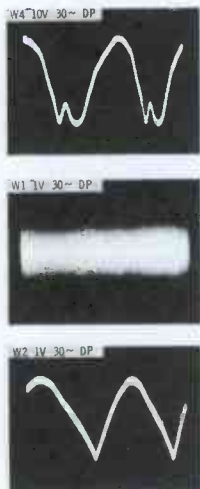


Plate signal (W4) is reduced in amplitude and isn't audio signal; it resembles 60-cps sine wave. Waveform changes shape as tone of buzz varies. Absence of audio signal at plate suggests trouble is probably before plate circuit. Normal signal at pin 2 (W1) further isolates trouble—control grid circuit components are probably okay. Loss of audio signal at cathode (W2) suggests trouble in cathode circuit is likely; signal here is B+ ripple.

Voltage and Component Analysis

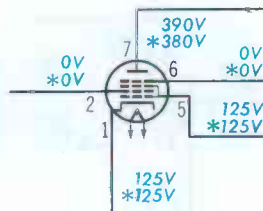
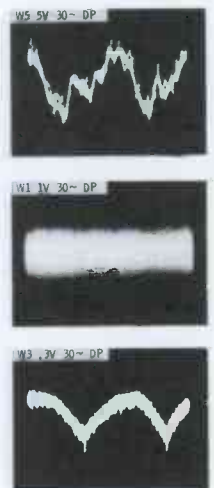


Plate voltage of 380 volts suggests tube is drawing only slight plate current. 125 volts at pin 5 confirms reduced conduction—normal reading is 90 volts. Most significant clue is 125-volt reading on pin 1. With cathode floating (ungrounded), voltage on pin 5 is also present on cathode. Break in printed-circuit board would give same symptom; in either case, resistance measurement from cathode (pin 1) of V1 to ground will reveal open circuit. Shorted tube could damage buzz control. B+ resistors should also be checked.

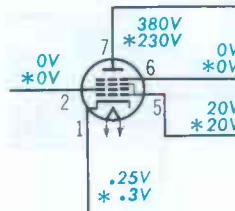
Best Bet: Scope finds stage, VTVM locates component.

Waveform Analysis



Only slight amount of audio signal (5 volts p-p) is present in W5; also, during pauses, considerable B+ ripple can be seen. W1 is normal—indicates trouble somewhere between grid circuit of V1 and input to volume control. Signal at pin 6 (W3) is predominantly 60-cps ripple; only slight amount of 4.5-mc signal is present. Scope is useful in isolating trouble to sound detector stage, but will not pinpoint defective component.

Voltage and Component Analysis



Tube conduction and plate current of V1 are greatly reduced, proven by decreased voltage on cathode and increased voltage on plate. Screen grid (pin 5) measures only 20 volts (normal is 90), therefore trouble in screen supply path is likely; reduced tube conduction would otherwise cause screen voltage to increase, not decrease. Weak volume is explained by lower amplification of tube—usual with screen-voltage reduction. Decreased cathode voltage changes bias on stage, thus allowing passage of 60-cps signal—reason for buzz.

Best Bet: VTVM will do entire job.

Buzz In Sound

Volume Greatly Reduced

SYMPTOM 5

L2 Open, Terminal 1

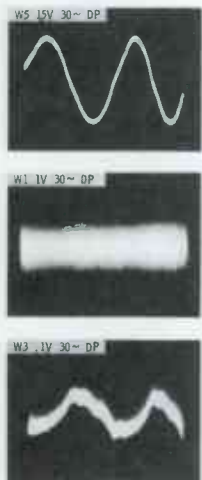
(Quadrature Coil)

Symptom Analysis



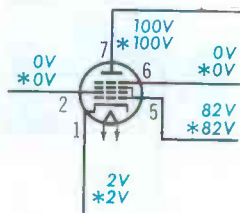
Only very slight amount of audio can be heard, even at maximum setting of volume control. Hum or buzz is quite pronounced. Volume control operates normally—will change output level, and nothing is heard at minimum setting. R1 varies volume but buzz is still present.

Waveform Analysis



Input to volume control (W5) proves trouble is in preceding stage. Slight amount of audio is present, but majority of signal is 60-cps sine wave; explains why hum is being heard. W1 shows incoming sound signal to be normal; trouble must be in detector stage. W3, on second control grid, gives most conclusive evidence to trouble; 4.5-mc signal isn't present here. Content instead is rather minute audio signal dominated by 60-cps hum.

Voltage and Component Analysis



Practically no helpful information can be gained from voltage measurements. All tube elements show normal or near-normal readings, with or without signal. Variations are so slight that no conclusive evidence is gained as to defective component. Ohmmeter is most useful in isolating open quadrature coil when resistance measurements are made from pin 6 to ground—shows no continuity; normal reading is 5.3 ohms. Open quadrature coil has little effect on bias of stage; therefore DC voltages remain almost normal.

Best Bet: Scope and ohmmeter checks.

No Audio

Only Faint Hum

SYMPTOM 6

C1 Open

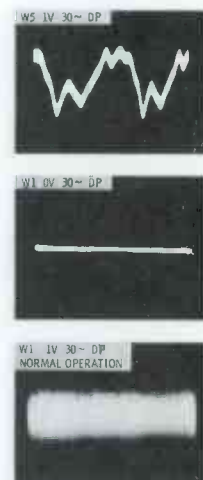
(Grid Coupling Capacitor — 3.3 pf)

Symptom Analysis



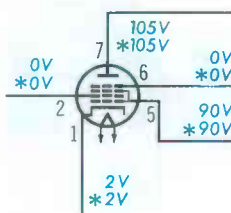
Absolutely no audio can be heard from speaker, even with volume control at maximum; only sound heard is faint hum. Defect could be in either detector or output stage. Buzz control is operative, as it increases or decreases hum level, but still no audio is present.

Waveform Analysis



Output of detector stage (W5) shows complete loss of audio signal—only 60-cps ripple is present. W1, taken at pin 2, shows absolutely no 4.5-mc information at detector input; normal signal at this point is 1 volt p-p (see accompanying normal W1). Picture is normal, therefore video output stage is probably okay. Open C1, or break in printed-circuit board, is probable suspect when picture is normal and signal is missing at control grid.

Voltage and Component Analysis



Without signal, voltage measurements on V1 aren't helpful; all readings are normal. With signal, readings remain same; plate and screen voltage should decrease. Symptoms hint that loss of signal at control grid (pin 2) is responsible for trouble. With troubles like this, scope is more helpful in determining defect than is VTVM. In fact, VTVM will seldom pinpoint fault in signal-handling component such as capacitor. With scope and tests outlined in Waveform Analysis, defective stage and/or components aren't difficult to locate.

Best Bet: Scope is almost necessary.

A fifth wheel? Who needs it?



Does a manual rotator require a fifth wire?

Sure. Like your car needs a fifth wheel. Who needs it!

Somebody else maybe. Not us, thank you. Channel Master Tenn-a-Liner rotators are designed to give you more torque on four wires than another rotator does on five.

The other guy may need that fifth wire to try to bring his turning power up to ours. (Due to an inherent weakness in his potentiometer circuit). But it may also do more harm than good. Because you're asking for a lot of unnecessary trouble with that fifth wire. And expense.

Like extra callbacks due to a 25% increased chance of connection failure. Not to mention the added cost of the wire itself. At least 25%. Do you need it?

Not when Channel Master Tenn-A-Liners (automatic *and* manual) can turn even the heaviest antenna arrays—under the toughest weather conditions. A 300 lb. ice-loaded installation won't faze a Tenn-a-Liner. Nor will a 70-mile an hour gale. (Tenn-a-Liner "guts" are made of hard steel only—never soft zinc or aluminum. And their thrust bearing, unlike the other guy's, is built-in). What's more, no manual rotator is more accurate. *And none costs less.*

A fifth wire? Like we said: who needs it? You?



Compass, Model 9520



Automatic, Model 9524. The only rotator that can aim an antenna within 1 degree of transmitter location. Only 3 wires. Foolproof Control console. No irritating gear click.

CHANNEL MASTER rotators

ELLENVILLE, NEW YORK

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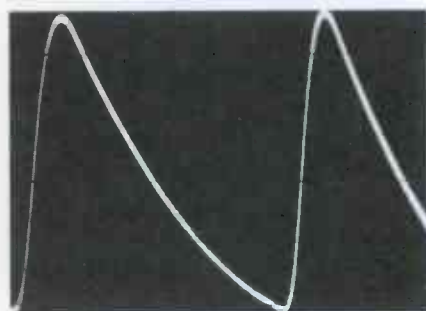


CURING BUZZ... HUM and other Irritating Noises

Reproduction of sound is an integral function of most entertainment equipment service technicians are called upon to repair, and a good portion of servicing time is spent in correcting troubles in various sound circuits. In addition to restoring volume to normal levels,



(A) Full-wave ripple



(B) Half-wave ripple



(C) Noise in FM



(D) Buzz in TV



(E) D at 5000 cps

Fig. 1. Ripple and noise waveforms found at plate of audio output tube.

overcoming distortion, and regaining fidelity, sound servicing often involves reducing to an acceptable minimum any buzz, hum, or other unwanted noise that may develop. One of our punning customers described these noises as being "EAR-irritating."

The varying degree of annoyance of the noises to different listeners adds a sensitive human factor to servicing these troubles. While many TV customers often accept without complaint noises of rather high levels, hi-fi listeners are critical of buzz or hum of even the slightest magnitude.

The fact that audibility of the noise depends on speaker conditions also must be considered. Larger, better speakers make noises of any type more audible and therefore more noticeable and annoying. Likewise, mounted speakers present greater audibility (including noise) than do unmounted ones. The small 5" or 6" speaker sometimes used for bench servicing does not indicate reliably how acceptable the sound will be when heard through the larger speaker mounted in the equipment. The waveshape, frequency content, or substance of the noise signals can also affect the degree of irritability produced, and certain types of small-amplitude noises can be more annoying than other types that are of much greater amplitude.

Since most troubles that involve noise require bench servicing, and since speakers employed during bench servicing don't always develop these noises at their irritating worst, a noise measurement of some sort is necessary to determine how clean (or unclean) the sound will actually be when played through its proper speaker. One effective technique involves scoping the signal at the plate of the audio output tube.

These traces contain information that can be extremely useful in servicing complaints of unwanted noise.

Fig. 1 shows several of these containing noise components. Let's examine them and note a few facts about the various kinds of unwanted noise represented. Fig. 1A shows nominal ripple found in the power supply of small radios using full-wave B+; this signal is not aurally irritating even when its peak-to-peak amplitude rises to more than 8 volts. Fig. 1B is a photo of the more-than-10-volt ripple typical of AC-DC radios using a filter circuit consisting of two high-value electrolytics and a resistor; this is a common circuit which we will cover more fully later. These saw-tooth ripple signals, while not often ob-

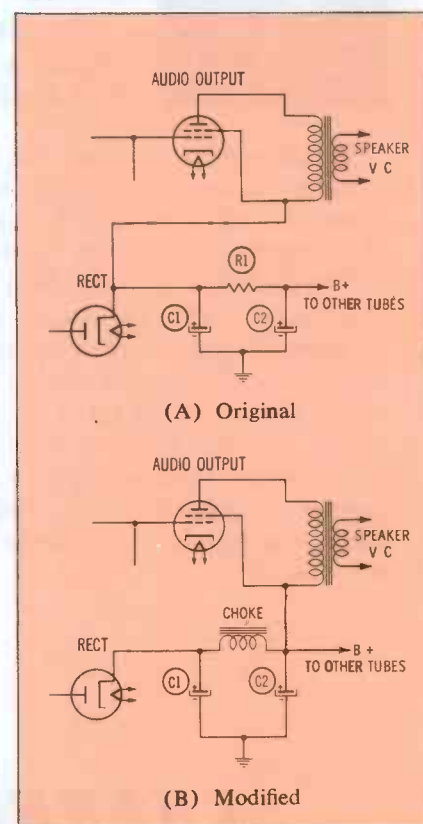


Fig. 2. Supply circuit can be modified to reduce hum level in receiver.

jectionable when applied to the usual small speaker found in these sets or to a small service-bench speaker, can be quite unsatisfactory if fed to larger speakers. In Fig. 1C, the background noise found in a small FM receiver, and in Fig. 1D, the buzz in TV sound, were both objectionable to hear — even on small, unmounted speakers — although their amplitudes were less than one half that of the Fig. 1A and 1B signals. The noise in Fig. 1C was caused by a ratio-detector filter in an FM receiver.

Comparing traces 1A and 1B with 1C and 1D reveals that the actual content or shape of the noise signals is more significant than the amplitude in determining whether the noise will be annoying. Further analysis of irritating signals can be developed by scoping at sweep settings that will present two or three individual cycles of the irritating signals. For example, the signal in Fig. 1D, when viewed at an approximate 5000-cps scope sweep, produced the trace of Fig. 1E. The three sharp pulses in 1E suggest the probability of poor filtering in circuits associated with horizontal deflection, and were eliminated by replacing an electrolytic in that section. The 15,750-cps signal of Fig. 1E, being beyond the response of most TV audio amplifiers, would not ordinarily be expected to produce much audible sound; in this case, the pointed shape of the signal apparently caused intermodulation and created the objectionable buzz that could be heard in the sound, with the horizontal-frequency signal acting as a “carrier.”

The conditions of taking the waveforms may offer important clues, too. For instance, the normal audio-output plate signals of Figs. 1A and 1B were obtained with the volume control at minimum—excessive hum or noise would be a certain indication of either power-supply or output-stage trouble. Fig. 1C was noted during a lull in the sound from an FM station. Figs. 1D and 1E were taken with the final sound-IF tube removed from the TV set. When normal sound was being fed through to the speaker, these various background noise signals could not be identified, nor scoped, with any accuracy. (At normal listening levels, sound peaks at the audio plate measure around 50

volts.) This will depend somewhat on the output transformer used.

In Radios and Record Players

The B+ filter circuit used in small AC-DC radios and record players is shown in Fig. 2A. Because plate voltage for the audio output tube is generally taken directly from the rectifier cathode, amplitude of the ripple will be relative to the capacitance of the first filter (C1). In sets using 3" or 4" speakers, C1 might be as low as 30 mfd; for larger speakers, C1 will usually be more than 50 mfd. In some early sets, C1 is 30 mfd, R1 is 1000 ohms, and C2 is 50 mfd; by merely transposing C1 and C2, ripple and audible hum can sometimes be materially reduced. Increasing C1 to a larger capacitance would be necessary when a customer wants to use a larger 8" or 12" speaker with the equipment; and in some cases the dual filter capacitor should be replaced so that C1 could then be at least 60 mfd. When C1 has a high capacitance, a resistance should be inserted between the rectifier and C1 to prevent rectifier damage during the initial charging surge. To bring about even lower hum levels, R1 could be replaced with a small iron-core choke, and the output plate voltage taken off at the top of C2, as shown in Fig. 2B.

Because a great many complaints of hum result from capacitance loss in filters, servicemen develop the habit of testing the capacitors by shunting them with new units. Actually, a scope trace taken at the audio output plate will be more conclusive, indicating more definitely where trouble really lies.

For example: A set with a C1 of 30 mfd evokes a complaint of too much hum. The serviceman shunts C1 with another 30-mfd unit and the hum does decrease slightly, so a new dual filter is wired into the set, using an exact replacement. Result—very little improvement. Why? The original C1 was not really bad and scoping would have revealed a ripple like that in Fig. 1B, with an amplitude of about 12 volts. Shunting C1 with another 30 mfd would decrease the ripple to about 9 volts, but this is due only to the *added* capacitance; when a new 30-mfd unit is installed, ripple again is 12 volts. If, instead

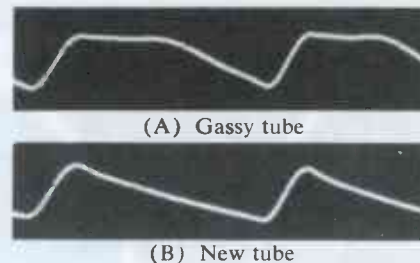


Fig. 3. Waveforms scoped at output.

of using the shunting test, a scope trace had been taken for analysis, the 12-volt level would have been evidence enough that C1 was not defective, because a 12-volt ripple is not abnormal for 30 mfd. The result might have suggested transposing filter sections (if the original had been a 30-50 unit) or replacing C1 with a unit of more than 50 mfd. If loss of capacitance had been causing the hum, the ripple would have climbed to more than 12 volts. Thus, if a serviceman is aware that a 30-mfd C1 begets a 12-volt ripple (or thereabouts), and 60 mfd a 9-volt ripple, etc., he can quickly decide whether a new filter with characteristics identical to the original will be enough.

Analysis of the ripple shape can be even more helpful, especially in

• Please turn to page 44

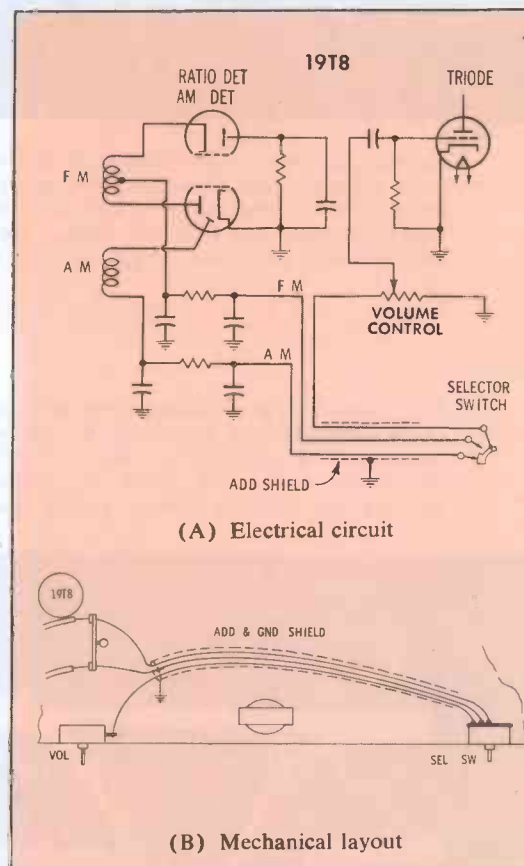
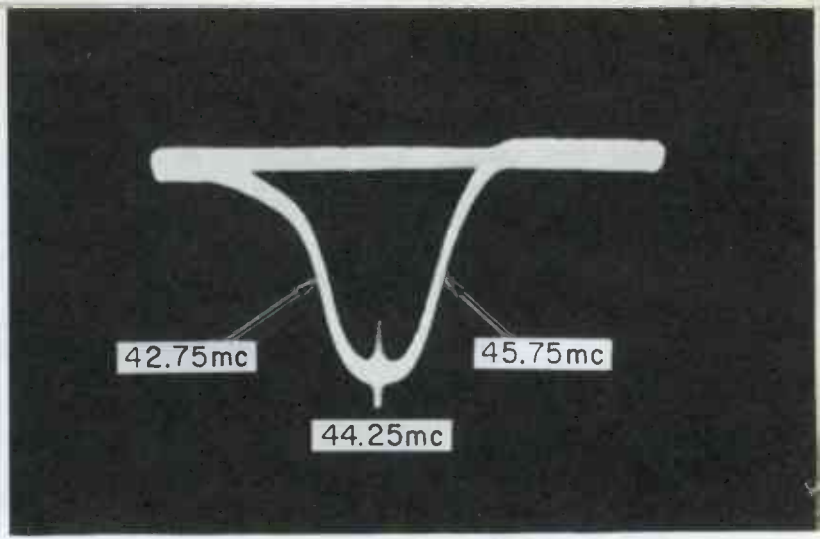
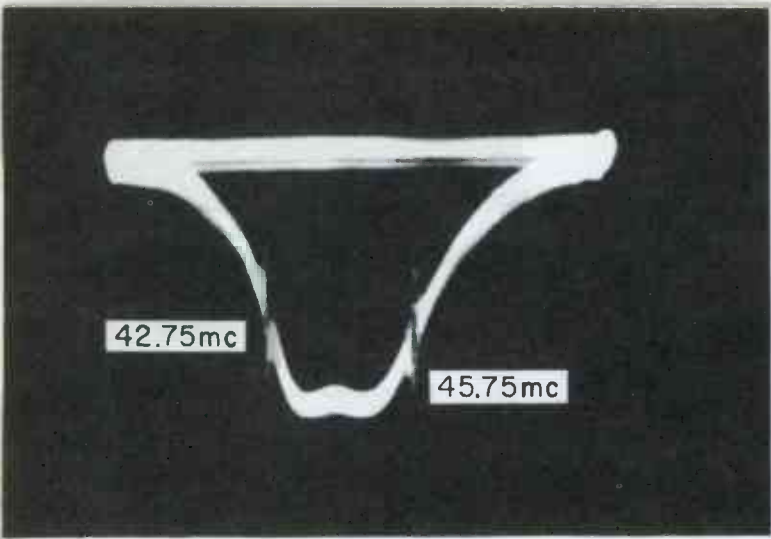
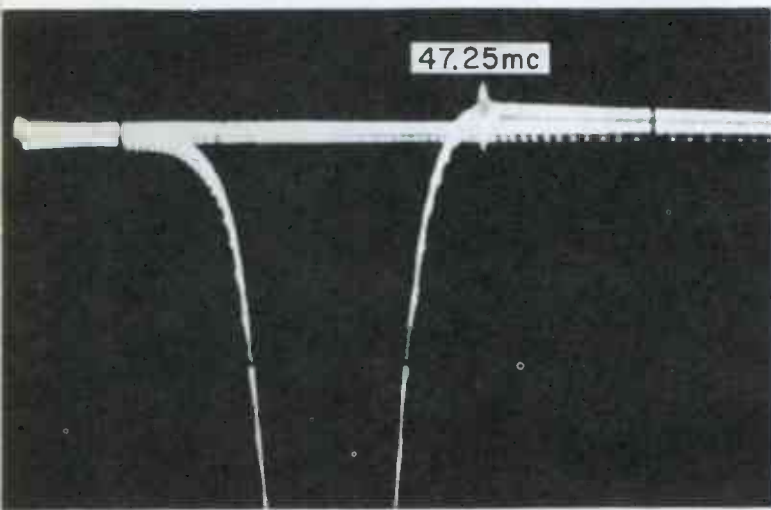


Fig. 4. Zenith Model 8C02 had odd-sounding buzz emitting from speaker.



Most receivers use an overcoupled (double-tuned) transformer preceding the video detector. Preset this coil by connecting the generator to the grid of the final IF stage and adjusting both slugs to position the 42.75-mc and 45.75-mc markers at or near the top of the response curve.

A properly aligned receiver displays an overall response similar to the one above. The picture carrier (45.75 mc) should be positioned near the midway point on the slope—50%. The 50% marker on the opposite side of the curve should be at least 3 mc lower in frequency (42.75 mc).



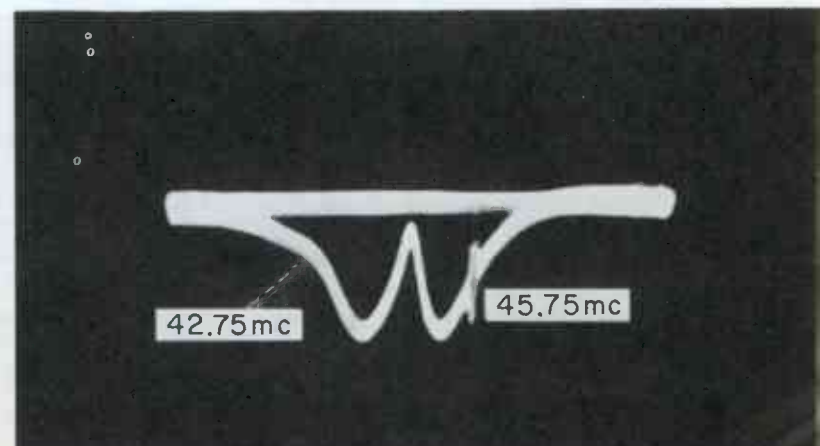
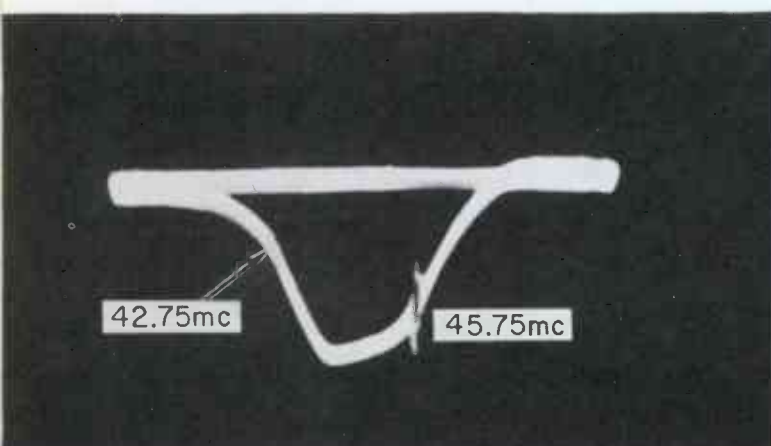
WAVEFORMS

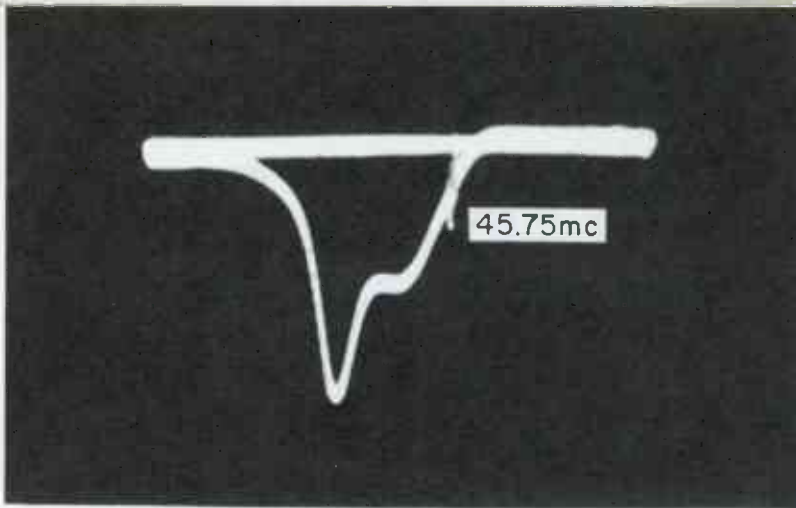
for Sweep Alignment

Correct alignment of the trap (or traps) can be determined most accurately by increasing the scope vertical gain (as here) until the trap notch is visible; check to see that the marker (in this case 47.25 mc) falls in the trap notch. Some receivers also incorporate traps at 39.75 and/or 41.25 mc.

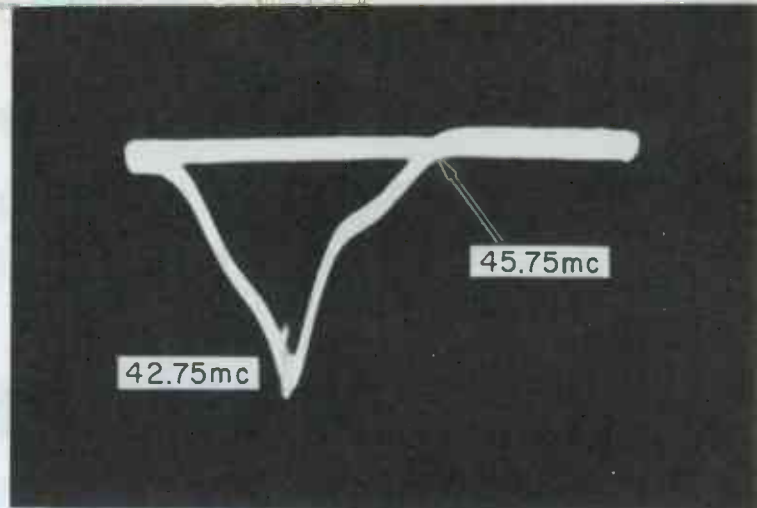
This response curve was obtained with the mixer plate coil misadjusted. Overall amplitude is reduced; also, the 45.75-mc marker is too high on the curve. The picture carrier should be at the 50% point, or slightly above. However, be sure the 42.75-mc marker is also 50%—it isn't here.

The excessive dip in this response was caused by improper setting of the 42.75-mc trap. The trap is now 44 mc, as indicated by the notch. Notice that the 45.75-mc and 42.75-mc markers are still at 50%. A misadjusted trap alters the shape of the response but does not change the bandwidth.





Misalignment of the first-IF grid coil causes the 45.75-mc marker to appear near the base line. This coil has greater effect on the picture carrier side of the curve, shifting the picture-carrier downward; under these conditions, the entire response curve will be far too narrow in the upper portion.

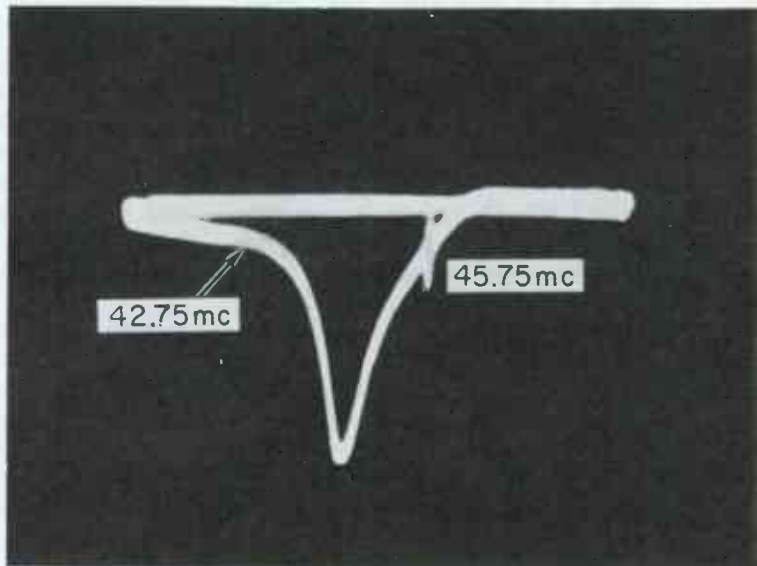


A detuned second-IF coil (in the grid circuit of the second stage) affects both sides of the response curve. It shifts the entire curve, causing the 42.75-mc marker to appear near the top of the curve and the 45.75-mc marker to fall on the base line—bandwidth is reduced at the 50% point.

The picture quality of a television receiver is many times deteriorated because the coils in the video IF strip aren't aligned properly. This need not be the case with any TV set leaving your shop, if you will only familiarize yourself with the correct response curve and the effect that misaligned stages have on this curve. The group of sweep waveform photos shown here displays both the normal (photos 1 through 3) and abnormal (4 through 10) response curves.

All abnormal photos were taken with the individual coils misadjusted to show their effect on the response curve. More or less detuning of any stage will cause a somewhat different response, but the same section of the curve will be affected.

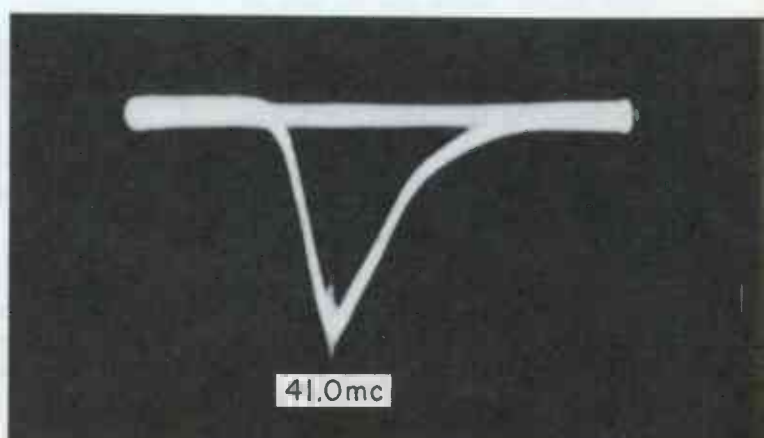
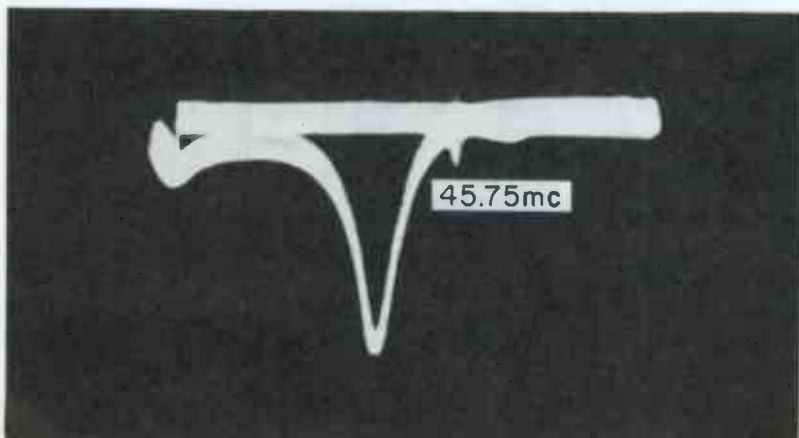
All waveforms (except 1 and 9) were taken with the sweep and marker generators connected to the mixer-grid test point. The scope was connected to the output of the video detector in all instances. A negative bias was applied to the grid circuit of the RF amplifier to prevent overloading of the receiver. Generator output was kept at a minimum. Arrows indicate the relative position of other frequencies on the response curve.



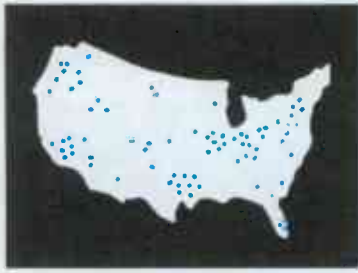
A sharp response (as in this photo) can be caused by misalignment of the overcoupled transformer. Here, the 45.75-mc marker appears near the base line. The 42.75-mc marker is also near the base line, but on the opposite side of the curve. Bandpass of overcoupled transformer is reduced.

With the generator connected to the grid of the final IF tube, misalignment of the overcoupled transformer causes an effect like the one above. The 45.75-mc marker is on the base line—the curve is sharply peaked. A small second peak can be seen at the left edge of the photo below.

A completely misaligned receiver may present any one of various response curves. An example is the one above, in which the center of the curve is at 41 mc. The response curve is quite sharp, and greatly reduced in amplitude. Scope vertical gain was increased for taking this photo.



REPORT ON



UHF STATION ACTIVITY



Up-to-date story of TV's "orphan".—by George F. Corne, Jr.

The so-called "all-channel law," which went into effect last April, ushered in what many observers hope and predict will be a continuing period of expansion in UHF television broadcasting. This growth is important to you as a dealer or service technician because the coming of UHF TV to your area means new income from the sale of UHF antennas, converters, all-channel tuners, UHF strips in VHF-only sets, and signal boosters. By keeping informed of station and application activity you can be prepared for new developments when they happen.

Station Status

An idea of the current expansion of UHF broadcasting can be obtained by comparing the number of UHF stations operating at the end of 1963 with the number in operation at the beginning of November, 1964.

The total number of UHF stations authorized in '63—including those granted construction permits (CP's)—was 211. Some of these were in the process of construction; others had operated at one time but were temporarily shut down for some reason (often due to lack of audience and advertising). The total number of UHF stations actually in operation—transmitting programs—in December, 1963, was 120. Of these, 88 stations were providing commercial service, 32 noncommercial. Of the noncommercial outlets, 29 were providing educa-

tional services (ETV); the remaining three noncommercial stations included WNYC-TV (channel 31) New York City; WUTV (channel 36) Charlotte, N. C.; and WYAH (channel 27) Portsmouth, Virginia.

As of November, '64, 127 stations were operating, 88 commercial and 39 ETV. This cumulative number makes allowance for stations coming on the air for the first time, those restarting, and those whose authorizations were cancelled. From January to November of this year, then, the number of UHF stations on the air increased by seven—a gain of almost 6%.

The FCC has announced its intention to consider cancellation of some "long-time" construction permits in an effort to speed UHF growth. Some of the stations authorized by these permits were never built; the others have not been in operation for a considerable length of time—years in some cases. The Commission hopes to reactivate these channels or make them available to other applicants.

Application Activity

In 1963, the applications filed with the FCC for UHF stations numbered 74. Of these, 52 were for commercial operation and 22 for noncommercial. In the first 10 months of 1964, 70 applications were filed—59 commercial, 11 ETV. In some cases, more than one applicant is seeking the same channel in the same location (for example, channel 55 in Rochester, Minnesota). Naturally, the FCC can grant only one of the applications in such cases (unless a time-sharing agreement is approved), so the 70 new applications represent

only 59 potential new stations.

Status By States

Below, you'll find the UHF station status presented on a state-by-state basis. Given are stations that were transmitting or were holders of CP's as of December, 1963, and stations that began transmitting, were granted CP's, or were applied for during 1964 (up to November). The up-to-date map accompanying this information will give you an overall look at UHF station status for the same time periods. The symbols in black and white indicate commercial and ETV stations at the end of 1963; those in color illustrate the UHF picture since January, 1964. Correlating the listings with the map will help you visualize developments in your particular area.

ALABAMA

Stations Transmitting

Decatur	WMSL-TV	23	
Florence	WOWL-TV	15	
Huntsville	WHNT-TV	19	
Huntsville	WAFG-TV	31	
Montgomery	WCOV-TV	20	
Montgomery	WAIQ	26	ETV
Montgomery	WCCB-TV	32	

Authorized, Not Transmitting

Birmingham	WBMG	42	
Birmingham	.....	48	
Huntsville	WAAY-TV	25	
Mobile	WEIQ	42	ETV
Tuscumbia	WVNA-TV	47	

Began Transmitting During '64

Montgomery	WKAB	32	Mar
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Applications Filed During '64

Anniston	70	Mar
Anniston	70	Apr
Gadsden	37	Mar
Homewood	.....	54	Jan
Huntsville	.....	25	May
Tuscaloosa	.....	51	Mar

ARKANSAS

Authorized, Not Transmitting

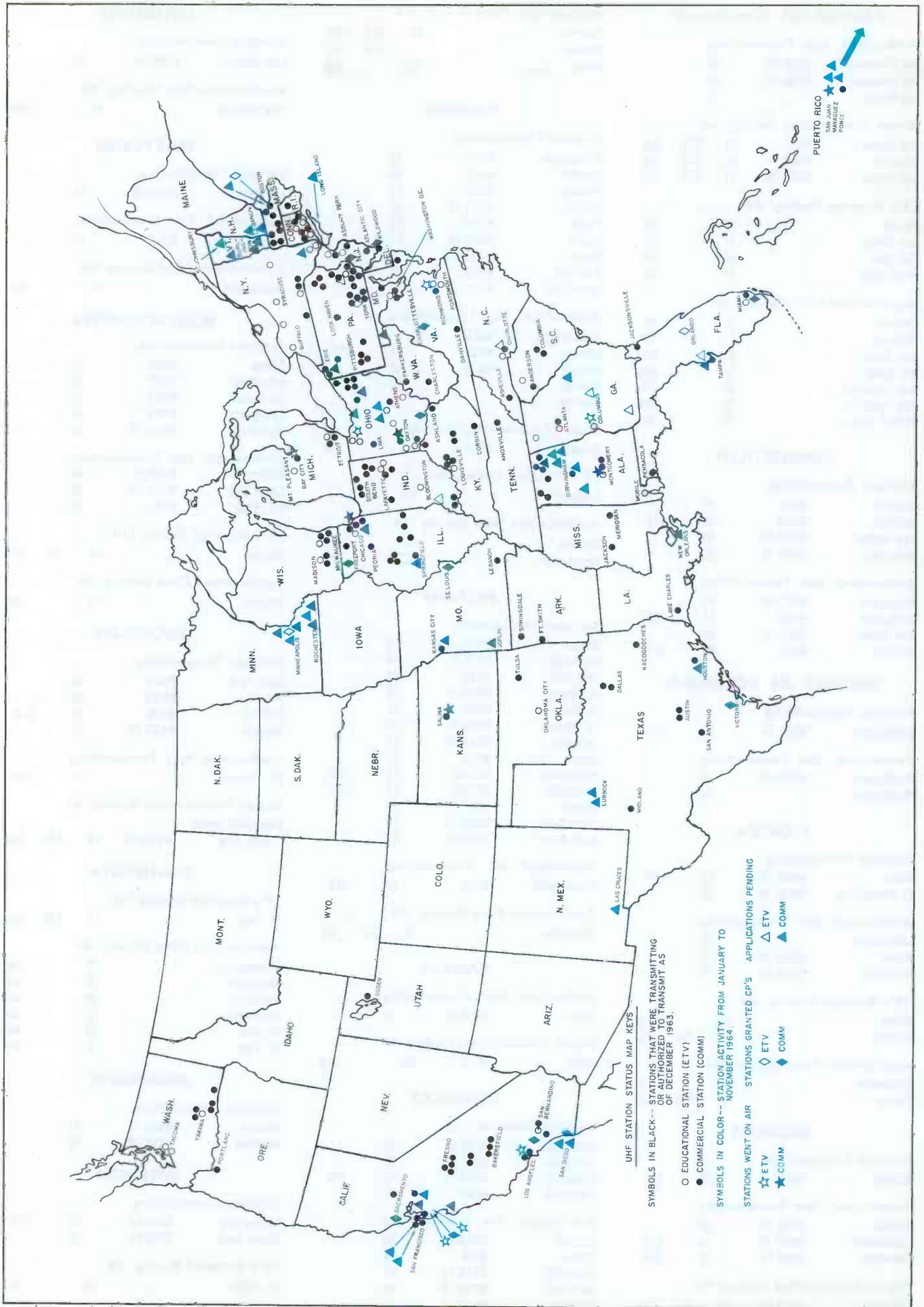
Ft. Smith	KEFS-TV	22	
Springdale	.....	35	

CALIFORNIA

Authorized, Not Transmitting

Bakersfield	KERO-TV	23	
Bakersfield	KLYD-TV	17	
Bakersfield	KBAK-TV	29	
Fresno	KMJ-TV	24	
Fresno	KFRE-TV	30	
Fresno	KJEO	47	
Fresno	KAIL	53	
Hanford	KDAS	21	
Los Angeles	KMEX-TV	34	
San Bernardino	KCHU	18	
San Bernardino	KVCR-TV	24	ETV
Stockton	KOVR	13	
Visalia	KICU-TV	43	
Corona	KICB-TV	52	
Los Angeles	KIIX-TV	22	
Sacramento	KVUE-TV	40	
San Francisco	KBAY-TV	20	

Note: Material for a portion of this article was adapted from the Howard W. Sams book "North American Radio-TV Station Guide" by Vane A. Jones.



CALIFORNIA (Continued)

Authorized, Not Transmitting

San Francisco	KSAN-TV	32
San Francisco	KFOG-TV	44
San Mateo		14

Began Transmitting During '64

Los Angeles	KCET	28	ETV	Sep
San Jose	KTEH	54	ETV	Sep
San Mateo	KCSM-TV	14	ETV	Sep

CP's Granted During '64

Guasti		46	Jul
San Diego		39	Jul
San Jose		48	Oct
Santa Rosa		50	Jul

Applications Filed During '64

Carmel		35	Jul
Modesto		17	Mar
San Diego		51	May
San Diego		51	Aug
San Francisco		26	Feb
San Francisco		26	Sep
Walnut Creek		26	Jan

CONNECTICUT

Stations Transmitting

Hartford	WHCT	18	
Hartford	WEDH	24	ETV
New Britain	WHNB-TV	30	
Waterbury	WATR-TV	20	

Authorized, Not Transmitting

Bridgeport	WICC-TV	43	
Bridgeport	WCTB	71	ETV
New Haven	WELI-TV	59	
Norwich	WCTN	63	ETV

DISTRICT OF COLUMBIA

Stations Transmitting

Washington	WETA-TV	26	ETV
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Authorized, Not Transmitting

Washington	WOOK-TV	14
Washington		20

FLORIDA

Stations Transmitting

Miami	WSEC-TV	17	ETV
St. Petersburg	WSUN-TV	38	

Authorized, Not Transmitting

Jacksonville		36
Miami	WGBS-TV	23
Pensacola	WPEA-TV	15

CP's Granted During '64

Miami		33	Sep
Orlando		24	ETV Mar

Applications Filed During '64

Clearwater		32	Feb
Tampa		16	ETV Aug

GEORGIA

Stations Transmitting

Atlanta	WETV	30	ETV
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Authorized, Not Transmitting

Atlanta	WATL-TV	36	
Chatsworth	WCLP-TV	18	ETV
Columbus	WJSP-TV	28	ETV

Began Transmitting During '64

Columbus	WJSP-TV	28	ETV Jul
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Applications Filed During '64

Cochran	50	ETV	Sep
Pelham	14	ETV	Sep
Wrens	20		Aug

ILLINOIS

Stations Transmitting

Champaign	WCHU	33
Danville	WICD	24
Decatur	WTVP	17
LaSalle	WEEQ-TV	35
Peoria	WTVH	19
Peoria	WEEK-TV	25
Peoria	WMBD-TV	31
Rockford	WTVO	39
Springfield	WICS	20

Authorized, Not Transmitting

Bloomington	WBLN	15	
Chicago	WXXV	20	ETV
Chicago	WCIU	26	
Chicago		32	
Chicago		44	

Began Transmitting During '64

Chicago	WCIU	26	Feb
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CP's Granted During '64

Freeport		23
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Applications Filed During '64

Chicago		38	Oct
Springfield		36	Jul

INDIANA

Stations Transmitting

Ekhart	WSJV	28	
Evansville	WFIE-TV	14	
Evansville	WEHT	50	
Ft. Wayne	WANE-TV	15	
Ft. Wayne	WPTA	21	
Ft. Wayne	WKIG-TV	33	
Lafayette	WFAM-TV	18	
Marion	WTAF	31	
Montpelier	KS2ZGA	72	ETV
Montpelier	KS2ZGD	76	ETV
Muncie	WLBC-TV	49	
South Bend	WNDU-TV	16	
South Bend	WSBT-TV	22	

Authorized, Not Transmitting

Bloomington	WTIU	30	ETV
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Applications Filed During '64

Vincennes		52	ETV Jan
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KANSAS

Authorized, Not Transmitting

Salina	KSLN-TV	34
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Began Transmitting During '64

Salina	KSLN-TV	34	Aug
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KENTUCKY

Stations Transmitting

Lexington	WLEX-TV	18	
Lexington	WKYT-TV	27	
Louisville	WFPK-TV	15	ETV
Louisville	WLKY	32	

Authorized, Not Transmitting

Ashland	WALN-TV	59
Corbin	WJSK	16
Louisville	WFPK-TV	21
Louisville	WTAM-TV	41
Newport	WNOP-TV	74

LOUISIANA

Stations Transmitting

Lake Charles	KTAG-TV	25
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Applications Filed During '64

New Orleans		26	Mar
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MARYLAND

Stations Transmitting

Salisbury	WBOC-TV	16
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Authorized, Not Transmitting

Baltimore	WTLF	24
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Applications Filed During '64

Cumberland		17	Jul
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MASSACHUSETTS

Stations Transmitting

Adams	WCDC	18
Greenfield	WRLP	32
Springfield	WWLP	22
Springfield	WHYN-TV	40
Worcester	WWOR-TV	14

Authorized, Not Transmitting

Boston	WIHS-TV	38
Cambridge	WTAO-TV	56
Pittsfield	WPFL	64

CP's Granted During '64

Boston		44	ETV Oct
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Applications Filed During '64

Boston		25	Sep
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MICHIGAN

Stations Transmitting

Allen Park	WJMY	20	
Detroit	WKBD	50	
Detroit	WTVS	56	ETV
Saginaw	WKNX-TV	57	

Authorized, Not Transmitting

Mt. Pleasant		14	ETV
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Began Transmitting During '64

University Center (Bay City)	WUCM-TV	19	ETV Oct
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MINNESOTA

CP's Granted During '64

St. Paul		17	ETV Aug
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Applications Filed During '64

Minneapolis		23	Apr
Rochester		55	Feb
Rochester		55	May
Rochester		55	Jun
St. Paul		23	May
St. Paul		23	Sep

MISSISSIPPI

Stations Transmitting

Jackson	WJAQ-TV	25
Meridian	WCOC-TV	30

MISSOURI

Stations Transmitting

Kansas City	KCSD-TV	19	ETV
Poplar Bluff	KPOB-TV	15	

CP's Granted During '64

St. Louis		30	Oct
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• Please turn to page 38

'63

'64

TV Tube Usage Guide

The past two years have seen the introduction of many new tube types. The following chart gives a complete list of the tubes used in '63 and '64 television receivers, and the manufacturer or brand name using each specific type. The average use per model, along with total usage, is also given. This list will inform you how better to stock your tube caddy, or your shelves, with the tubes needed to service late-model receivers.

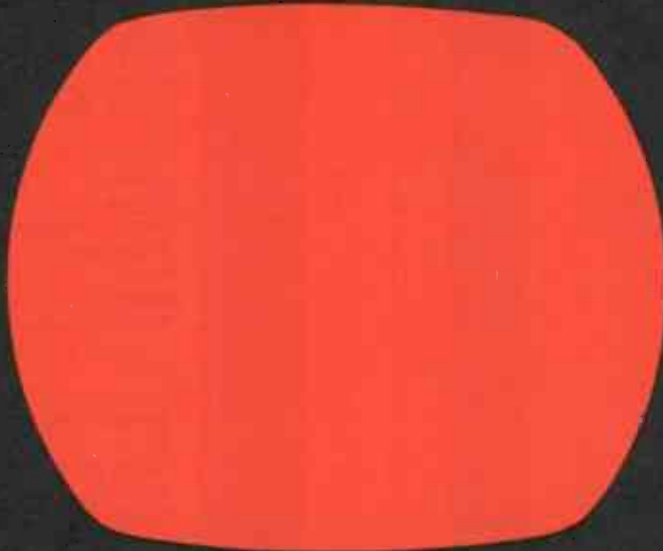
Tube Type	Manufacturer or Brand Name	Average Use Per Model	Total Usage	Tube Type	Manufacturer or Brand Name	Average Use Per Model	Total Usage
1AD2	General Electric	1	20	3DG4	Dumont, Sylvania, Zenith	1	62
1B3	Airline, Andrea, Bradford, Coronado, Sonora	1	16	3DK6	Bradford, Channel Master, Coronado, Magnavox, Penncrest, Truetone	2	51
1G3	Admiral, Airline, Coronado, Curtis Mathes, Firestone, Olympic, Packard-Bell, Philco, RCA, Sylvania, Truetone	1	479	3DT6	Airline, Coronado, Firestone, Olympic, Motorola	1	59
1J3	Sylvania	1	16	3DZ4	Philco, Silvertone, Sylvania, Truetone	1	96
1K3	Airline, AMC, Bradford, Catalina, Coronado, Dumont, Emerson, Magnavox, Penncrest, Penney, J. C., Philco, Silvertone, Truetone, Westinghouse, Zenith	1	111	3EH7	Admiral, Coronado	1	32
1V2	Admiral, Packard-Bell, Zenith	1	150	3EJ7	Admiral, Coronado, Olympic	1	50
1X2B	Admiral, Arvin, Channel Master, General Electric, Magnavox, Penncrest	1	43	3GK5	General Electric, Philco, RCA, Sylvania, Truetone, Westinghouse, Zenith	1	103
2AF4A	Airline, AMC, Bradford, Coronado, Motorola, Olympic, Penncrest, Penney, J. C., Truetone	1	82	3HA5	Admiral, Silvertone	1	53
2AS2	Zenith	1	86	3HG8	Sylvania	1	2
2CY5	Bradford	1	6	3HM6	Westinghouse	1	4
2DZ4	Admiral, Airline, Firestone, Motorola	1	92	3HT6	Westinghouse	1	4
2FS5	Penney, J. C.	2	2	4BL8	Admiral, Coronado, Motorola	2	80
2GK5	Admiral, Airline, AMC, Arvin, Bradford, Coronado, Firestone, Magnavox, Motorola, Olympic, Penncrest, Truetone	1	137	4BZ6	Admiral, Silvertone	2	59
3A3	Admiral, Airline, Dumont, Motorola, Packard-Bell, Philco, RCA, Sylvania, Westinghouse	1	263	4CB6	Silvertone	1	16
3AF4	RCA, Westinghouse	1	14	4DK6	Admiral, Philco, Sylvania	1	76
3AT2	Zenith	1	47	4DT6	Silvertone, Sylvania, Truetone, Westinghouse	1	48
3AU6	Arvin	1	1	4EH7	Philco, Truetone, Sylvania	1	62
3AV6	Airline, Firestone	1	26	4EJ7	Philco, Sylvania, Truetone	1	62
3AW3	Motorola	1	35	4GK5	Motorola	1	21
3BN6	Airline, AMC, Bradford, Coronado, Penncrest, Penney, J. C., Truetone	1	53	4HA5	Motorola	1	21
3BZ6	Airline, AMC, Bradford, Coronado, Firestone, Magnavox, Olympic, Penncrest, Penney, J. C., Truetone	2	150	4HS8	Silvertone	1	22
3CB6	Airline, AMC, Arvin, Bradford, Channel Master, Coronado, Penncrest, Truetone	2	32	4JC6	RCA	1	10
				4JD6	RCA	1	10
				4KN8	Penncrest	1	1
				5AQ5	Airline, AMC, Coronado, Magnavox, Olympic, Penncrest, Truetone	1	44
				5BC3	Sylvania	1	70
				5CG8	Admiral, Airline, AMC, Arvin, Bradford, Coronado, Firestone, Magnavox, Olympic, Penncrest, Truetone	1	205
				5DJ4	Motorola	1	35
				5EA8	Magnavox, Penncrest	2	7
				5EW6	Silvertone	1	22
				5FG7	Penney, J. C.	1	2
				5HG8	Philco, Sylvania	1	59
				5JV8	Silvertone	1	22
				5KD8	Sylvania	1	5
				5KE8	RCA	1	10

Tube Type	Manufacturer or Brand Name	Average Use Per Model	Total Usage	Tube Type	Manufacturer or Brand Name	Average Use Per Model	Total Usage
5U4GB	Dumont, Emerson, Packard-Bell, Sonora	1	69	6EM5	Andrea, Dumont, Emerson	1	64
5U8	Channel Master	1	1	6EM7	Curtis Mathes, Dumont, Packard-Bell, Sylvania	1	24
6AQ5	Airline, Catalina, Olympic, Packard-Bell, Philco, RCA, Silvertone, Sylvania, Truetone, Westinghouse, Zenith	1	333	6EW6	Admiral, Airline, Curtis Mathes, Philco, RCA, Sylvania, Westinghouse, Zenith	2	486
6AF4A	Catalina, Dumont, General Electric, Magnavox, Philco, Zenith	1	220	6EW7	Admiral, Packard-Bell	1	222
6AF11	General Electric	1	20	6FD7	Philco, Sylvania	1	81
6AH5	Admiral, Curtis Mathes, General Electric, Zenith	1	135	6FG7	Admiral, Sonora	1	71
6AL3	Motorola	1	35	6FM7	Zenith	1	86
6AL5	Dumont, Sylvania	1	20	6FQ7	Admiral, Airline, Andrea, Coronado, Firestone, Magnavox, Olympic, Packard-Bell, Penncrest, Philco, RCA, Sylvania, Westinghouse, Zenith	2	798
6AL11	Admiral, General Electric	1	149				
6AR11	General Electric	1	70	6FS5	Sonora	1	1
6AS5	Sonora	1	1	6FV8	Admiral	1	31
6AS8	Andrea, Dumont, Emerson	1	64	6FY7	General Electric	1	20
6AU4	Packard-Bell, Sonora	1	4	6GB5	Magnavox	1	9
6AU6	Andrea, Dumont, General Electric, Packard-Bell	1	43	6GC5	Magnavox	1	9
6AW8A	Airline, Andrea, Arvin, Dumont, Emerson, Packard-Bell, Philco, RCA, Sylvania, Westinghouse	1	225	6GE5	Admiral, General Electric	1	152
6AX3	Admiral, General Electric	1	231	6GF7	Admiral, Airline, Philco, RCA, Sylvania, Westinghouse	1	211
6AX4	Olympic	1	18	6GH8	Admiral, Airline, Curtis Mathes, Dumont, Emerson, Magnavox, Packard-Bell, Philco, RCA, Sylvania, Silvertone, Westinghouse, Zenith	2	742
6AY3	Airline, Catalina, Magnavox, Packard-Bell, Sylvania, Zenith	1	228				
6B10	General Electric	1	20	6GJ5	Sylvania	1	86
6BA11	Zenith	1	77	6GJ7	Sylvania, Zenith	1	100
6BE3	Philco	1	10	6GK5	Dumont, Emerson, Magnavox, Olympic, Packard-Bell, Philco, Sylvania, Zenith	1	284
6BJ8	Magnavox	1	9	6GK6	Motorola, Zenith	2	135
6BK4	Admiral, Airline, Packard-Bell, Philco, RCA, Sylvania, Westinghouse, Zenith	1	261	6GM6	Admiral, Airline, Dumont, Emerson, Packard-Bell, Philco, RCA, Sylvania, Westinghouse	1	439
6BL8	Motorola, Truetone	2	106	6GN8	Curtis Mathes, Magnavox, Olympic, Zenith	1	58
6BN6	Airline, Catalina, Curtis Mathes, Packard-Bell, Zenith	1	187	6GT5	Airline, Catalina	1	6
6BQ5	Admiral, Airline, Andrea, Catalina	1	306	6GU7	Admiral, Airline, Philco, RCA, Sylvania, Westinghouse	2	422
6CX8	Andrea, Sonora	1	8	6GV5	Zenith	1	74
6DE4	Andrea, Emerson, Philco	1	89	6GW8	Dumont	1	4
6DE7	Airline, Catalina, Olympic	1	24	6GX6	Admiral	1	79
6DK6	Admiral	1	79	6GY5	Philco	1	10
6DQ5	Admiral, Packard-Bell	1	73	6GY6	Admiral, Airline, Philco, RCA, Sylvania, Westinghouse	2	422
6DQ6B	Admiral, Andrea, Curtis Mathes, Dumont, Emerson, Motorola, Olympic, Packard-Bell, Philco, Sonora	1	234	6GZ5	Admiral	1	79
6DR7	Philco	1	42	6HA5	Admiral, Motorola, Philco, Zenith	1	212
6DS4	Admiral, Airline, Andrea, Catalina, RCA, Sylvania, Westinghouse	1	196	6HB6	Admiral	1	70
6DT5	Sonora	1	1	6HE5	Zenith	1	47
6DT6	Andrea, Dumont, Emerson, Magnavox, Motorola, Olympic, Sonora, Sylvania	1	180	6HF5	Zenith	1	47
6DV4	RCA, Sylvania, Westinghouse, Zenith	1	147	6HG8	Philco	1	80
6DW4	Admiral, Airline, Philco, RCA, Sylvania, Westinghouse, Zenith	1	207	6HJ8	Philco	1	42
6DZ4	Admiral, Airline, Emerson, Magnavox, Motorola, Packard-Bell, Sylvania	1	543	6HL8	Zenith	1	47
6EA8	Airline, General Electric, Packard-Bell, RCA, Sylvania, Westinghouse, Zenith	1	252	6HS8	Curtis Mathes, Motorola, Zenith	1	122
6EH7	Admiral, Dumont, Motorola, Philco, Sylvania, Zenith	2	593	6HZ6	Admiral, Airline, Philco, RCA, Sylvania, Westinghouse	1	221
6EJ7	Admiral, Airline, Dumont, Motorola, Olympic, Packard-Bell, Philco, RCA, Sylvania, Westinghouse, Zenith	1	494	6JB6	Zenith	1	42
				6JC6	Admiral	2	140
				6JE6	Airline, Philco, RCA, Sylvania, Westinghouse	1	141
				6JE8	Philco	1	53
				6JH6	Airline, Philco, RCA, Sylvania, Westinghouse	1	141
				6JH8	Zenith	2	94
				6JT8	Zenith	1	86
				6JU8	Admiral, Airline, Philco, RCA, Sylvania, Zenith	1	238

you get **PRODUCT PLUS** *from your Sylvania Distributor*

suddenly

**COLOR TV
HAS A NEW
RED STANDARD**



Sylvania's new EUROPIUM RED.

New COLOR BRIGHT 85 picture tube brings more natural color to television and increases monochrome brightness 43%.*

The startling news in the television industry is Sylvania's new picture tube, and its new, truer red phosphor.

EUROPIUM RED, developed at GT&E Laboratories, is the brightest red known to the industry. And, to match it, now the full brightness of blue and green is used. The result is a color picture tube that gives the entire television industry a boost.

Because the COLOR BRIGHT 85 tube is *really* bright, dealers can demonstrate color TV effectively in normally lighted showrooms. As the set's brightness is adjusted, the colors remain true—not shifting to unnatural tones in the highlights of the picture.

Another thing, black and white performance is far better than you've ever seen before in a color tube. Be-

sides the increased brightness, there's improved contrast in a sharp, vivid picture.

The new, exciting COLOR BRIGHT 85 picture tube is a product plus from Sylvania for the entire color television industry, and particularly for dealers. In color, as in black and white, you know it's good business to handle the Sylvania line.

SYLVANIA
SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS **GT&E**


NEW CAPABILITIES IN: ELECTRONIC TUBES • SEMICONDUCTORS • MICROWAVE DEVICES • SPECIAL COMPONENTS • DISPLAY DEVICES

*Tests show the COLOR BRIGHT 85 tube is 43% brighter, on the average, than standard color picture tubes.


Tube Type	Manufacturer or Brand Name	Average Use Per Model	Total Usage	Tube Type	Manufacturer or Brand Name	Average Use Per Model	Total Usage
6JV8	Admiral	1	211	13GB5	Penncrest	1	4
6JZ8	Philco	2	20	13GF7	RCA, Silvertone	1	9
6KA8	Airline, Philco, RCA, Sylvania, Westinghouse	1	141	15BD11	General Electric	1	23
6KD8	Sylvania, Zenith	1	202	15CW5	Motorola	2	66
6KT8	Zenith	2	94	15DQ8	Motorola	2	24
6KU8	Sylvania	1	86	15HB6	Motorola	1	12
6KZ8	General Electric	1	16	15KY8	Silvertone	1	16
6BL8	Philco	1	10	15LE8	Motorola	1	12
6RK19	Curtis Mathes	1	1	16A8	Motorola	1	12
7GV7	Motorola	1	12	16AQ3	Motorola	1	33
8B8	Arvin	1	1	16AUP4	Arvin	1	1
8B10	General Electric	1	23	16AYP4	RCA	1	10
8BE8	Airline	1	2	16BNP4	Airline	1	3
8BQ5	Airline, AMC, Bradford, Coronado, Firestone, Penncrest, Penney, J. C., Truetone	1	91	16BSP4	Truetone	1	1
8CG7	Motorola	1	21	16GK6	Motorola	1	33
8CW5	Airline, Bradford, Penncrest, Truetone	1	17	17AY3	RCA, Sylvania	1	15
8CW8	Coronado	1	4	17BE3	Philco, Truetone	1	53
8EB8	Olympic	1	2	17BF11	General Electric	1	23
8EM5	Airline, Bradford, Coronado	1	5	17BS3	Silvertone	1	1
8FQ7	Admiral, Philco, RCA, Silvertone, Sylvania, Truetone, Westinghouse	1	130	17C5	Silvertone	1	16
8GJ7	Motorola	1	12	17CFP4	Penney, J. C.	1	2
8JV8	Admiral, Silvertone	1	31	17D4	Philco	1	4
9A8	Motorola	3	99	17DE4	Airline, Coronado, Firestone	1	27
9GV8	Admiral	1	31	17DMA4	Westinghouse	1	4
10AL11	Admiral	1	31	17DQ6B	Philco, Silvertone	1	26
10CW5	Truetone	1	1	17GJ5	Sylvania	1	5
10DE7	Airline, AMC, Arvin, Bradford, Coronado, Magnavox, Olympic, Penncrest, Truetone	1	51	17JB6	RCA	1	10
10GK6	Truetone	1	1	17J28	Admiral, General Electric, Philco, Westinghouse	1	94
10JA8	Westinghouse	1	4	19ABP4	Philco	1	4
10JY8	Philco	2	104	19AFP4A	Andrea	1	7
10KU8	Sylvania	1	5	19AU4	Motorola	2	24
11AP4	General Electric	1	23	19AUP4	Magnavox	1	2
11AR11	General Electric	1	23	19AVP4	Dumont, Emerson	1	28
11CP4	Admiral	1	15	19AXP4	Silvertone	1	16
11JE8	Philco	2	8	19BLP4	Philco	1	11
11KV8	RCA	1	10	19CHP4	Admiral, Coronado, Penncrest	1	36
12AF3	Arvin, Magnavox, Penncrest	1	4	19CMP4	Westinghouse	1	4
12AL11	Admiral	1	15	19CVP4	Sylvania	1	5
12AX4GTA	Airline, Bradford, Olympic, Penney, J. C.	1	28	19CXP4	Zenith	1	30
12AX7A	Airline	1	12	19DAP4	Silvertone	1	22
12AY3	Airline, AMC, Bradford, Coronado, Penncrest, Truetone	1	62	19DEP4	General Electric	1	20
12AZ7A	Dumont, Emerson, Packard-Bell	1	60	19DFP4	Philco	1	10
12BE3	Admiral	1	31	19DHP4	Curtis Mathes	1	1
12BH7A	Arvin, Channel Master	2	3	19XP4	Bradford, Coronado, Olympic	1	39
12BY7A	Airline, Channel Master, Dumont, Magnavox, Packard-Bell, Penncrest, Philco, RCA, Sylvania, Westinghouse	1	142	21FBP22	Zenith	1	47
12C5	Airline, Firestone	1	11	21FJP22	Admiral, Airline, Motorola, Packard-Bell, RCA, Westinghouse	1	192
12CA5	Bradford, Coronado, Penncrest, Penney, J. C., Truetone	1	19	21FKP22	Philco, Sylvania	1	44
12CU5	Airline, Coronado	1	6	21GY5	Philco, Truetone, Westinghouse	1	57
12DQ6B	Airline, Arvin, Bradford, Magnavox, Olympic, Penncrest, Penney, J. C.	1	32	21HJ5	Admiral, Airline, Coronado	1	38
12FX5	RCA, Westinghouse	1	14	22BH3	Silvertone	1	22
12GC6	Motorola	2	24	22JG6	Silvertone	1	16
12GN7	Coronado, Penncrest, Truetone	1	39	23AFP4	Dumont, Zenith	1	8
12GT5	Airline, AMC, Bradford, Zenith	1	47	23AHP4	Airline, AMC, Bradford, Catalina, Coronado, Firestone, Penncrest, Truetone	1	58
12GW6	Airline, Firestone	1	23	23ARP4	Motorola	1	35
12W6GT	Airline, Firestone, Penney, J. C.	1	25	23AWP4	Bradford, Coronado, Penncrest	1	13
13FD7	Philco, Sylvania	1	9	23BGP4	Truetone	1	86
				23BTP4	Sylvania	1	49
				23BVP4	Packard-Bell, Zenith	1	42
				23CP4A	Philco	1	161
				23DAP4	Admiral, Emerson	1	33
				23DSP4	Motorola	1	52
				23EDP4	Philco	1	44
				23MP4	Zenith	1	10
				27ZP4	Magnavox, Sonora	1	2
				33GT7	Airline	1	23
				33GY7	General Electric	1	15
				50C5	Admiral	1	12
				400CB4	Airline	1	2
					Channel Master, Penncrest	1	2

Note: Material in this guide adapted from the Howard W. Sams book "TV Receiver Tube Usage Guide."

MORE EXCITEMENT FROM QUAM!



you can easily handle
any auto radio
speaker replacement



New Quam Multi-Tap Speakers in 5"x7", 6"x9", and 4"x10" sizes. Taps for 10, 20, and 40 ohm impedances.

with Quam speakers and rear seat kits —
multi-taps and exact replacements —

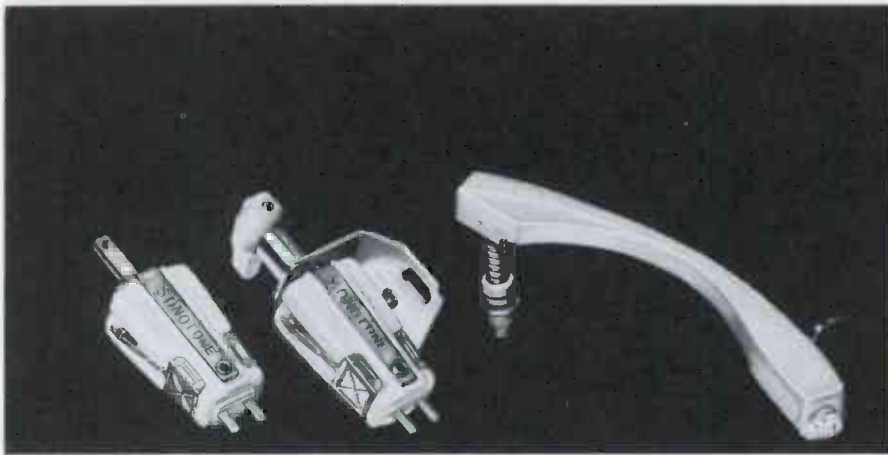
Eight speaker *sizes* handle virtually any auto radio replacement—but size alone is not enough. You need the right voice-coil impedance—and QUAM has it! Choose multi-tapped models for stocking convenience; or, for specific applications, one of the 25 Quam *exact* replacements. (In addition, any Quam speaker may be special-ordered with any voice-coil impedance for an extra \$1.00 list. This service is a QUAM exclusive.)

Write for your free copy of the Quam Auto Radio Speaker Replacement Guide, which gives you complete replacement information on front and rear seat speakers for auto radio models from 1955 to 1963.

QUAM-NICHOLS COMPANY, 234 EAST MARQUETTE ROAD, CHICAGO, ILLINOIS 60637

Circle 14 on literature card

QUAM



How to turn crystal



into gold

You can strike it rich with the new Sonotone line of crystal cartridges. It offers direct replacements for "Ronette," "Vaco" and "BSR" models with typical Sonotone quality.

Here are the extras you get—New improved crystal elements for longer pickup life. Mono ("14T") and stereo ("20T") models. High output voltage. Modern turnover type for LP, 45 and 78 rpm records. Available with or without mounting brackets or turnover knobs to fit most arms.

Oh yes, they come in a slim, lightweight plastic tonearm, too. You have a choice of the mono ("14T") or stereo ("20T") cartridge. It's easy to install because it's prewired. It has a shielded cable, spring mounting post and a plated finger lift. It's complete with arm rest and all necessary hardware. Get details today. Write:

SONOTONE
audio products

Sonotone Corp., Electronic Applications Div., Elmsford, New York
Cartridges • Speakers • Microphones • Headphones • Hearing Aids • Batteries

Circle 15 on literature card

UHF Station Activity

(Continued from page 32)

Applications Filed During '64

Joplin	.....	30	Oct
Kansas City	.....	25	Aug

NEW HAMPSHIRE

Applications Filed During '64

Lebanon	.....	49	Sep
West Lebanon	.....	49	Jul

NEW JERSEY

Authorized, Not Transmitting

Asbury Park	WRTV	58	
Atlantic City	WHTO-TV	46	
Glen Ridge	WNJE-TV	77	ETV
Linden	WNJU-TV	47	
New Brunswick	WTLV	19	ETV
Wildwood	.....	40	

CP's Granted During '64

Burlington	.....	41	Jul
Wildwood	40	Mar

NEW MEXICO

Applications Filed During '64

Las Cruces	22	Oct
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NEW YORK

Stations Transmitting

Binghamton	WBJA-TV	34	
Binghamton	WINR-TV	40	
Buffalo	WNEO-TV	17	ETV
Elmira	WSYE-TV	18	
New York	WNYC-TV	31	ETV
Schenectady	WMHT	17	ETV

Authorized, Not Transmitting

Binghamton	WQTV	46	ETV
New York	WREG	25	ETV
Rochester	WROH	21	ETV
Syracuse	WHTV	43	ETV

Applications Filed During '64

Newburgh	.....	21	Jul
Patchogue	75	Aug

NORTH CAROLINA

Stations Transmitting

Asheville	WISE-TV	62	
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Authorized, Not Transmitting

Charlotte	WUTV	36	
Charlotte	WTVI	42	ETV

Applications Filed During '64

Concord	59	ETV	Oct
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OHIO

Stations Transmitting

Akron	WAKR-TV	49	
Athens	WOUB-TV	20	ETV
Cincinnati	WKRC-TV	12	
Cincinnati	WCET	48	ETV
Columbus	WOSU-TV	34	ETV
Lima	WIMA-TV	35	
Newark	WGSF	28	ETV
Oxford	WMUB-TV	14	ETV
Toledo	WGTE-TV	30	ETV
Youngstown	WFMJ-TV	21	
Youngstown	WKBN-TV	27	
Youngstown	WKST-TV	33	
Zanesville	WHIZ-TV	18	

GOOF-
PROOF

VOM



Here's the most foolproof volt-ohm-milliammeter ever made. Protection approaches 100%. It's the VOM you will want to have on hand where inexperienced people are running tests . . . or will reach for yourself on those days when you're all thumbs. The 260-5P will save you all kinds of headaches from burned out meters and resistors, bent pointers, damaged pivots, cracked jewels, and inaccuracies caused by overheating.

Combined Protection You Won't Find In Any Other VOM

1. Reset button pops out to indicate overload.
2. You cannot reset circuits while overload is present.
3. Protective circuit does *not* require massive overloads which can cause hidden damage to the instrument.
4. All ranges are protected except those not feasible in a portable instrument—1000 and 5000 volts DC and AC; 10 amp DC.

SIMPSON
260-5P

ONLY \$78.95

Write for Bulletin 2066

Ranges—The 260-5P has the same ranges and takes the same accessories as Simpson's famous 260-4 volt-ohm-milliammeter.

Simpson
INSTRUMENTS THAT STAY ACCURATE

Representatives in Principal Cities
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SIMPSON ELECTRIC COMPANY

5209 W. Kinzie Street, Chicago, Ill. 60644 • Phone: (312) EStbrook 9-1121
Export Dept.: 400 W. Madison Street, Chicago, Ill. 60606 Cable, Amergaco
California: Simpson Instruments, Inc., P.O. Box 488, 1130 Simpson Way, Escondido, Calif. • Phone: (714) SH 5-8202
In Canada: Bach-Simpson Ltd., London, Ontario
In India: Ruttonsha-Simpson Private Ltd., International House, Bombay-Agra Road, Vikbrali, Bombay

WORLD'S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT

Circle 16 on literature card

January, 1965/PF REPORTER '39

Authorized, Not Transmitting			
Ashtabula	WICA-TV	15	
Bowling Green	WBGU-TV	70	ETV
Dayton	WOME-TV	22	
Youngstown	WXTV	45	

Began Transmitting During '64			
Bowling Green	WBGU	70	ETV Feb
Dayton	WKEF	22	Sep

CP's Granted During '64			
Portsmouth		30	Aug

Applications Filed During '64			
Canton		29	Aug
Columbus		40	Apr
Columbus		40	May
Lorain		31	Jun

OKLAHOMA

Stations Transmitting			
Oklahoma City	KOKH-TV	25	ETV

Authorized, Not Transmitting			
Tulsa	KCEB	23	

OREGON

Authorized, Not Transmitting			
Portland	KHTV	27	

PENNSYLVANIA

Stations Transmitting			
Erie	WSEE	35	
Erie	WEPA-TV	66	
Harrisburg	WHP-TV	21	
Harrisburg	WTPA	27	
Johnstown	WARD-TV	19	

Lebanon	WLYH-TV	15	
Philadelphia	WPCA-TV	17	
Pittsburgh	WQEX	16	
Scranton	WNEP-TV	16	
Scranton	WDAU-TV	22	
Wilkes-Barre	WBRE-TV	28	
York	WSBA-TV	43	

Authorized, Not Transmitting			
Allentown	WFMZ-TV	67	
Bethlehem	WLEV-TV	51	
Harrisburg	WDTV	33	
Lock Haven	WBPZ-TV	32	
Oil City	WSEI	64	
Philadelphia	WGTI	23	
Philadelphia	WIBF-TV	29	
Philadelphia	WUHY-TV	35	ETV
Pittsburgh	WENS	22	
Pittsburgh	WAND-TV	53	
Reading	WHUM-TV	61	
York	WNOV-TV	49	

CP's Granted During '64			
Hershey		65	ETV Jul

Applications Filed During '64			
Allentown		39	ETV Jun
Erie		24	May

PUERTO RICO

Stations Transmitting			
San Juan		18	

Began Transmitting During '64			
San Juan	WTSJ	18	Aug

Applications Filed During '64			
Mayaguez		22	May

Ponce		20	May
San Juan		30	May

RHODE ISLAND

Authorized, Not Transmitting			
Providence	WNET	16	

SOUTH CAROLINA

Stations Transmitting			
Anderson	WAIM-TV	40	
Columbia	WNOK-TV	19	
Columbia	WCCA-TV	25	

Authorized, Not Transmitting			
Greenville	WNTV	29	ETV

TENNESSEE

Stations Transmitting			
Knoxville	WTVK	26	

TEXAS

Stations Transmitting			
Richardson	KRET-TV	23	
San Antonio	KWEX-TV	41	

Authorized, Not Transmitting			
Austin	KVET-TV	24	
Austin	KTXN	67	
Dallas	KAEI	29	
Houston	KNUZ-TV	39	
Midland	KOCD-TV	18	
Nacogdoches	KTES	19	

CP's Granted During '64			
Victoria		19	Aug

MONEY-MAKING OPPORTUNITY WITH A NEW TYPE OF BUSINESS

NOW . . . NuTone, America's largest manufacturer of Built-In Music Systems . . . offers you a fine opportunity to own and operate a profitable business in your locality.

You can start in full or spare time without previous experience. You need not worry about large inventory stocks . . . because NuTone's network of wholesalers can furnish everything you need at extra special discounts available to you.

The modernization market is booming . . . and Built-In Music Systems are in big demand. Thousands of new homes have NuTone Built-

In Home Entertainment Systems . . . you can supply an even larger market through the existing homes in your area.

Home owners are surprised at the moderate cost . . . and are pleased to learn that they can have a complete music and intercom system installed in the homes they now own.

You can start this business at a minimum investment . . . and expand it to a large staff of sales and installation specialists. We offer you complete details . . . just mail coupon to . . .

Mr. Dickinson, Product Manager, Electronics Division, NuTone, Inc., Cincinnati 27, Ohio.

BUILT-IN MUSIC and INTERCOM INSIDE and OUTSIDE the HOME!



FREE FACTS COUPON INTERCOM-RADIO BUSINESS

NAME _____
 ADDRESS _____
 CITY _____ STATE _____

PF-1

YOU CAN BE FIRST TO START THIS BUSINESS IN YOUR COMMUNITY

Get The GENERATOR That Has EVERYTHING!

3. EXCLUSIVE 5:4 CROSSHATCH

Faster convergence, easier linearity checks

4. SINGLE COLOR BAR

3.58MC color reference signal, gives *positive*, simple color performance check

5.

500-DOT PATTERN

0.1 μ sec dot—smallest anywhere! Complete screen coverage, more accurate convergence

2. GUN KILLERS

Check all three color guns, speed purity checks

1. READY FOR THE FUTURE

Broad-Coverage signal for VHF and UHF. Interchangeable CRT assemblies handle *all* color tubes

6. SEPARATE HORIZONTAL & VERTICAL BARS

Spot vertical and horizontal misconvergence faster, speeds over-all job

HICKOK

Model 662
\$159.⁹⁵

- 1. Ready For The Future**—Untuned, broad-coverage RF signal injects signal directly into antenna terminals, covers both VHF and UHF. Interchangeable CRT assemblies assure coverage of all present and anticipated color tubes, including new 25" tubes.
- 2. Gun Killers**—Individual pots and switches control each of the CRT guns separately. You can check the picture for emission, gas, shorts, in addition to individually checking the R-Y, B-Y and G-Y signals.
- 3. 5:4 Crosshatch**—Means more vertical lines, more horizontal lines and complete screen coverage including hard-to-converge areas at the edges.

- 4. Single Color Bar**—Simplified color reference bar at 3.58MC color burst frequency for definite color performance checks, impossible with gated rainbow generators.
- 5. 500-Dot Pattern**—Superior to 150-dot system because dot size is smaller (actual size, 1 line or 0.1 μ sec) for accurate convergence and complete screen coverage—no blank spots.
- 6. Separate Horizontal and Vertical Bars**—Quickly determines major areas of misconvergence, saves time by showing you where to start first.

HICKOK

THE HICKOK ELECTRICAL INSTRUMENT CO.

10566 Dupont Avenue • Cleveland, Ohio 44108
Represented in Canada by Stark Electronics, Ajax, Ontario
Internationally by Hughes International, Culver City, Cal.

Circle 18 on literature card

January, 1965/PF REPORTER 41



SO SMALL you can hold it like a pencil, guide it just as easily.

SO LIGHT IN WEIGHT you can use it for hours without tiring.

SO EFFICIENT it does the work of irons having much higher wattage.

SO COOL AROUND THE HANDLE it will never overheat your hand.

SO RUGGED it's unbeatable for long life and dependable performance.

SO LOW IN COST you can't afford to be without it.

Weller[®]

"Pencil" Soldering Iron

A 25-watt, 115-volt iron that's ideal for miniature-type soldering.

Complete with tip and cord set. Screwdriver-shaped tips available in three sizes. Model W-PS. **\$5.20** list.

Buy Weller "Pencil" Soldering Irons at your Electronic Parts Distributor.

WELLER ELECTRIC CORP., 601 Stone's Crossing Rd., Easton, Pa.

Circle 19 on literature card

Applications Filed During '64

Houston	.....	29	Feb
Lubbock	.....	20	Aug
Lubbock	.....	20	Sep

VERMONT

Applications Filed During '64

Burlington	.....	22	Aug
Rutland	.....	49	Aug
Saint Johnsbury	30	Aug
Windsor	26	Aug

UTAH

Stations Transmitting

Ogden	KWCS-TV	18
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VIRGINIA

Stations Transmitting

Hampton	WHRO-TV	15	ETV
Portsmouth	WYAH-TV	27	ETV

Authorized, Not Transmitting

Danville	WBTM-TV	24
Newport News	WACH-TV	33

Began Transmitting During '64

Richmond	WCVE-TV	23	ETV	Sep
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CP's Granted During '64

Charlottesville	64	Jun
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WASHINGTON

Stations Transmitting

Pasco	KEPR-TV	19	
Richland	KNDU	25	
Tacoma	KPEC-TV	56	ETV
Tacoma	KTPS	62	ETV
Walla Walla	KNBS	22	
Yakima	KNDU	25	
Yakima	KIMA-TV	29	
Yakima	KYVE	47	ETV

WEST VIRGINIA

Stations Transmitting

Parkersburg	WTAP-TV	15
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Authorized, Not Transmitting

Charleston	WKNA-TV	49
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WISCONSIN

Stations Transmitting

Madison	WMTV	15	
Madison	WHA-TV	21	ETV
Madison	WKOW-TV	27	
Milwaukee	WISN-TV	12	
Milwaukee	WUHF	18	
Milwaukee	WMVT	36	ETV

Authorized, Not Transmitting

Milwaukee	WCAN-TV	24
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Conclusion

We have presented this summary of UHF station activity to give you an indication of local developments in your own area and an idea of the general trends. Nationally, the full growth of UHF will take place gradually over a period of several years. But when one of these new stations does arrive in your town, you'll find yourself in a UHF area seemingly overnight. UHF is coming; be ready for it. ▲

Hickok GIVES YOU

Speed, Accuracy and Profit, Plus Obsolescence Protection IN AN ALL NEW, NO-COMPROMISE MULTI-SOCKET TUBE TESTER!

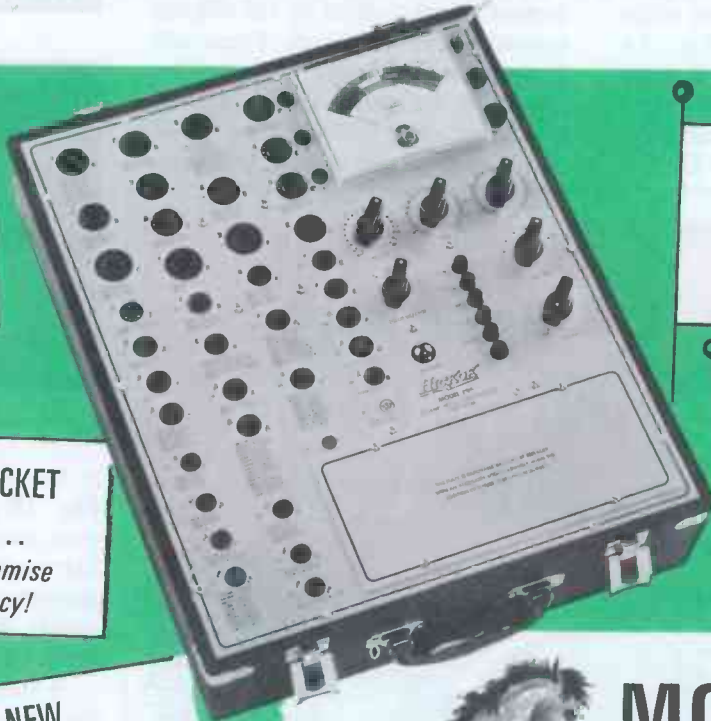
100% G_m TESTS ...
*No Emission Tests,
No Compromise!*

MULTI-SOCKET
SPEED ...
*No Compromise
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NEW
HIGH-SENSITIVITY
LEAKAGE AND
GAS TESTS!

OBsolescence
PROTECTION
*Realistic, Practical
No Compromise!*

MORE PROFIT
*Because You'll Sell
More Tubes ...
Sell Them
Honestly!*



MODEL 799

Mustang

\$199⁹⁵

From the laboratories of the world's leading tube tester manufacturer comes the model 799 "Mustang"—a completely new tube tester. Built to put profit in your pocket, the "Mustang" checks *more* tubes, checks them *faster* and checks them *honestly*.

Multi-socket tube testers used to have two serious drawbacks: circuit limitations made them obsolete overnight and, at best, no more than 10% of their tests were actually mutual conductance. But the Hickok "Mustang" doesn't compromise; it delivers *honest* mutual conductance tests. And a unique circuit approach, together with an

easily replaceable accessory socket panel, makes it "circuit ready" for any possible new tube types.

A solid state power supply gives increased accuracy and dependability. An all-transistorized gas and leakage test circuit sets a new standard of reliability for spotting "tricky" tube defects that can "chew up" your profit.

We call it the "Mustang" because it uses fresh, new engineering ideas and because it gives you a real opportunity to break into new profits.

See it at your Hickok distributor or write for circular TT799.

Hickok

THE HICKOK ELECTRICAL INSTRUMENT CO.

10566 Dupont Avenue, Cleveland, Ohio 44108

Represented in Canada by Stark Electronics, Ajax, Ontario

Internationally by Hughes International, Culver City, California

Circle 20 on literature card

January, 1965/PF REPORTER 43

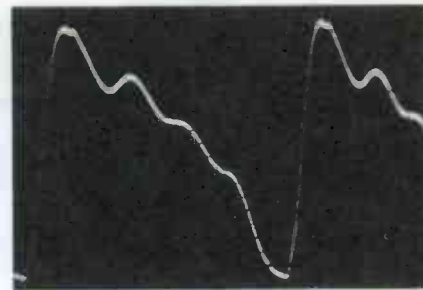
Checking Buzz, Hum

(Continued from page 27)

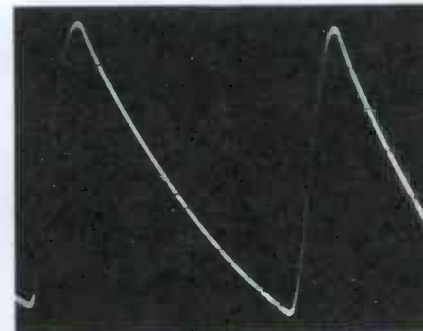
odd hum conditions. Gassy output tubes distort the ripple in a manner that is usually easily identifiable. The hum or buzz resulting from this fault frequently does not become objectionable until the equipment has run for awhile, but the ripple distortion can be seen on the scope before it can be heard. Fig. 3A shows ripple in a set with a gassy 50C5. Fig. 3B portrays the same ripple with a new 50C5 installed. (Fig. 3B is identical to Fig. 1B, but

scoped at a different scope-gain setting.)

Why can 3A cause such an objectionable buzz while the normal ripple is generally accepted? The answer involves an analysis of the two signals. The waveform of Fig. 3A contains the 60-cps fundamental frequency plus high-level odd harmonics, characterized by the clipped appearance of the signal. These odd harmonics, generated by rectifier action in the gassy (thus partially over-conducting) 50C5, are additive in nature and transfer efficient-



(A) Before



(B) After

Fig. 5. Waveforms in Zenith receiver

ly through the output transformer. Fig. 3B consists of both odd and even harmonics; but the high-order harmonics *subtract*, leaving the smooth sawtooth that is handled poorly by both the output transformer and the speaker.

A similar type of radio or record-player buzz that is commonly slow in developing is caused by an entirely different condition. In AC-DC sets using 35C5 or 50C5 tubes, the filament voltage is usually about 60 AC volts above ground and is applied between pins 3 and 4. Since pins 2 and 5 connect to the control grid, the tiniest leakage between pins 2 and 3, or between 4 and 5, couples enough raw AC to the grid to create very noticeable hum in the speaker. The condition can be due to leakage in wafer-type tube sockets, suggesting replacement with a molded socket; but more often the cure lies in replacing the tube. Tubes of the 35B5 and 50B5 group are not nearly so susceptible to this weakness. This trouble is easily identified by scoping; the trouble shows up as a sine wave on the *grid*, rather than only at the plate as in the case of other types of distortion.

A most strange case of excessive hum was found in one Zenith 8C02 AM-FM radio, which has the circuit shown in Fig. 4. A scope trace (Fig. 5A) was taken at the output-tube plate, with the volume control turned to minimum. The ringing ef-

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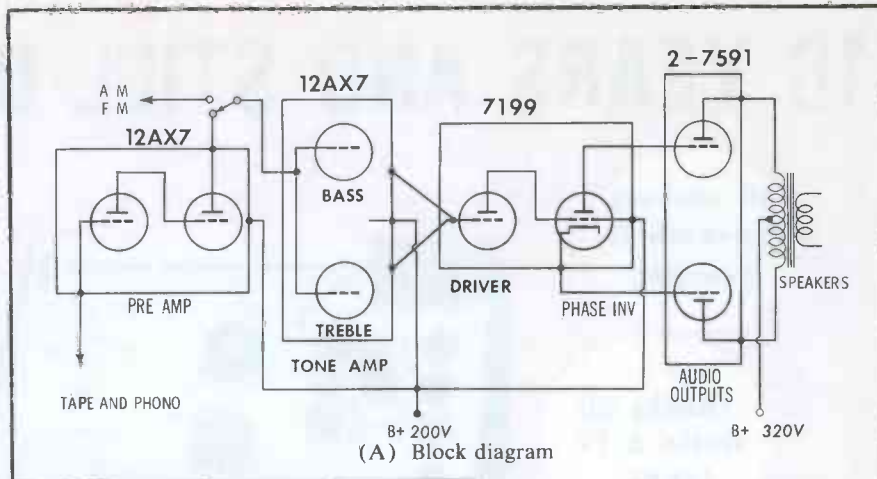
Circle 22 on literature card

January, 1965/PF REPORTER 45

fect on the trace in 5A could be diminished somewhat by moving the leads connecting the selector switch with the volume control and the AM and FM detectors. A cure was effected by encasing these leads in shielding, after which the normal plate ripple looked as in Fig. 5B. Obviously, the leads were radiating furiously without a shield.

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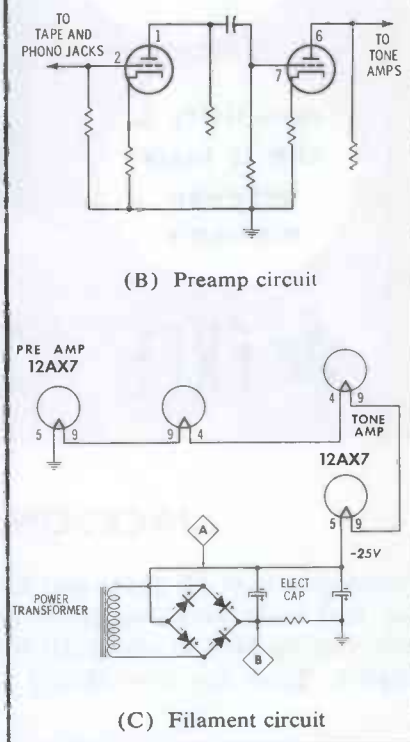


Fig. 6. Hum was from channel B.

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tolerated by owners of hi-fi amplifiers. Hi-fi addicts are most critical of, and little likely to accept, unwanted noises of any type. In addition to the critical standards of "Golden-ear" listeners, the natural characteristic of a good audio amplifier can transform the most minimal hum or buzz into irritating sound at objectionable levels. This is due, usually, to the high efficiency of output transformers and speakers used with such equipment. The high gain can also exaggerate any noise that develops in early stages. For example, the hum levels in Fig. 1A or 1B, although acceptable in small radios, could never be accepted in a sensitive audio amplifier.

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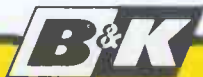
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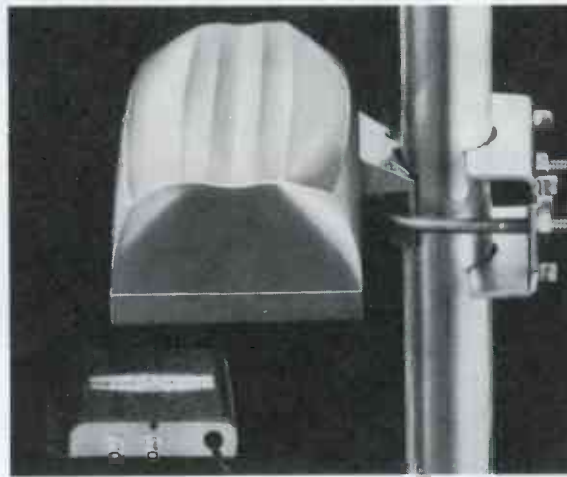
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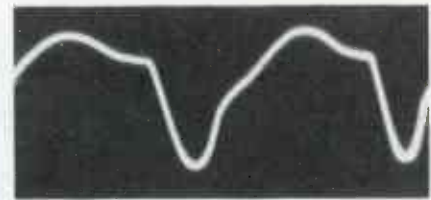
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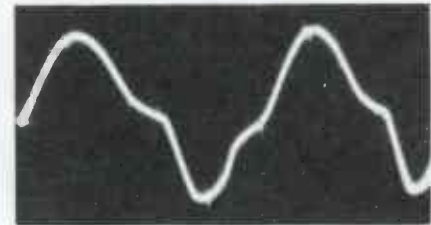
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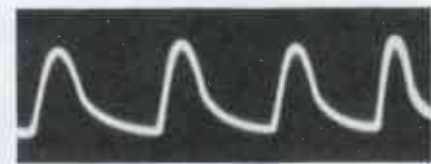
(A) Point A—before



(B) Point B—before



(C) Point A—after



(D) Point B—after

Fig. 7. Signals in filament supply.

amplifiers often involves some tedious troubleshooting, one case of bad hum was cured without any testing at all. This 20-watt amplifier had hum that sounded similar to that caused by an open grid circuit or by an unshielded input cable. It was noted that merely touching the chassis caused the hum to disappear—a clue that led to a cure. Adding a .02-mfd, 600-volt capacitor at the power transformer from the chassis to one leg of the AC power line cured the hum entirely.

The speed and ease of curing this case was more than offset by the trouble created by a hum complaint in a Fisher Model 800. This unit contains a multiplex FM tuner, driver, phase inverter, and push-pull, high-power output amplifier for each channel, plus preamplifiers for tape and phono inputs.

The customer who brought in the unit was less specific in his complaint than are most hi-fi owners; his statement that the unit had too much hum led to assumption on my part that the complaint was present for all types of programing, but this proved not to be the case.

In preliminary troubleshooting of stereo equipment, I usually connect a speaker to one channel and a



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dummy load (a 10-watt, 4-ohm resistor) to the other. After apparent trouble has been corrected, speakers are connected to both channels for final tests. With this method there is considerably less cluttering up of the bench. (*Editor's Note:* A transformer similar to the one shown on page 69 of our April 1964 issue will permit checking both channels simultaneously, but with only one speaker.)

With the speaker connected to the output of channel A, and the dummy load to channel B, no hum was heard, regardless of where the

selector switch was positioned—for AM, FM, Tape, or Phono. Transposing the speaker and dummy loads resulted in hum with the selector switch in the Tape or Phono positions. Since both channels receive B+ from the same source (see Fig. 6A), the probability of a power supply defect was ruled unlikely. Since hum was present only when the tape or phono preamp was switched in, troubleshooting was directed to that particular stage in channel B.

The signal circuit of the preamp is shown in Fig. 6B. The old trick

of shunting the signal to ground through a large capacitor led us to the defect. With the capacitor shunting pins 6, 7, or 1 to ground, hum was virtually nullified; but, when we shunted pin 2, the hum increased. With pin 2 shunted to ground, the input tube in effect became a grounded-grid amplifier, and the hum thus indicated that AC voltage was being picked up by the cathode. This led logically to an examination of the filament circuit.

The heaters for the preamp stages are in series with filaments of the tone-control amplifier, and operate from DC voltage developed by a bridge rectifier, as shown in Fig. 6C. A faulty bridge rectifier or a defective filter could cause the trouble, and the scope is capable of indicating which. At point A, the trace in Fig. 7A was obtained; at point B, that in Fig. 7B. Since these traces indicate a 60-cps ripple, and the normal bridge rectifier output develops only 120-cps ripple, the fault was indicated to be a defective bridge rectifier. After replacing the defective rectifier, the trace at point A appeared as in Fig. 7C and point B viewed as in 7D. The ripple frequency was correct and much lower in value; more important, the amplifier output was entirely free of hum.

Conclusion

Some servicemen might consider scoping hum or buzz in small radios or in amplifiers as rather exotic, but the ability to identify the cause of hum or buzz from the scope trace can't help but save time. A trial of the technique will make believers out of most doubting Thomases. ▲



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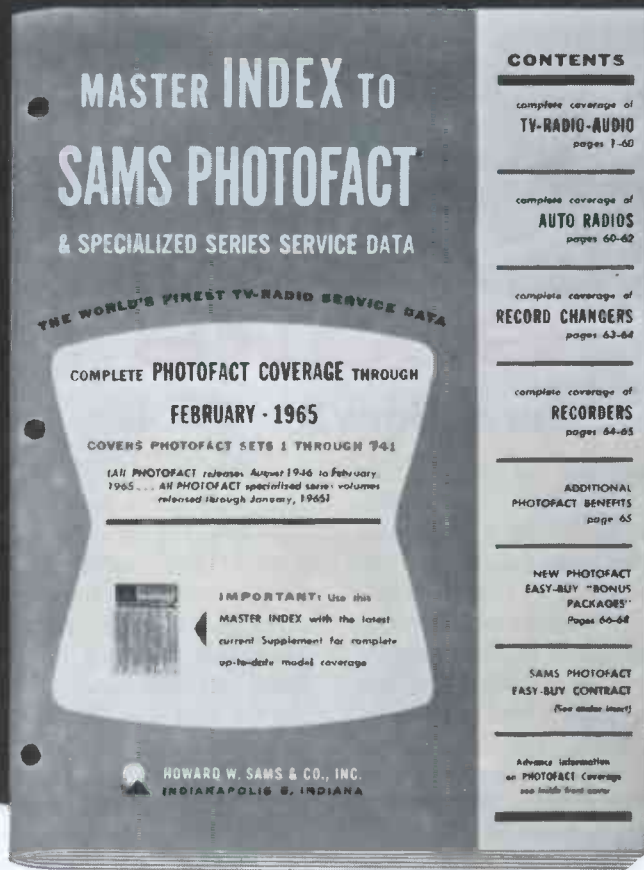
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New electronic entertainment devices and new versions of existing devices offer a constant challenge to the service technician. Competition demands that he keep abreast of all the latest developments and be prepared to provide proper service to his customers. Technical books are an ideal source of information for the technician who faces this problem.

Technical publishing is growing rapidly and has become one of the largest and most promising facets of the publishing industry. This is not because someone has a good sales pitch. The publishers are hiring men from the field to write and edit the various books, making the texts present a true and useful picture of the servicing business and the problems that daily face the technician. For two or three dollars, a technician can now purchase a book that, in the long run, may earn him one-third more gross income with-

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Primers and Basics Books

People who want to get started in a career in electronics can now find scores of basic books which present all the fundamentals of electricity and electronics. These basic books are generally fully illustrated and frequently include projects for the reader to perform so that he can enhance his learning by actual experience with the circuits and equipment being discussed. Many technicians use primer books as re-

freshers for different phases of electronics.

Case Histories

The case-history book is familiar to most technicians. The author generally reports on his actual servicing experiences. He describes the trouble and tells what he did to improve it, often mentioning his mistakes so that the reader can more readily understand the writer's thought process and therefore understand why a certain solution was chosen.

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References and Guidebooks

The term "reference book" suggests a heavy volume that belongs on a shelf in some musty-smelling library, not in a service shop. This simply is not true of many technical references being published today. Technicians can now obtain general reference books that give substitutions for all types of tubes, transistors, printed-circuit components, etc. These don't belong in a library; they belong on your service bench at fingertip distance, or they belong in your tube caddy—some belong in both locations.

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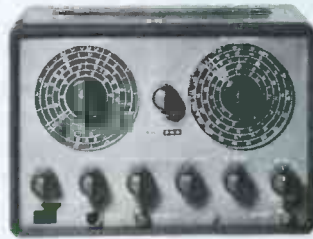
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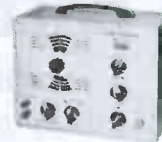


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only reference available—there are also comprehensive collections of schematics and diagrams for a general class of equipment (commercial equipment, for example). Mathematic references kept close at hand aid in working on certain equipment where logarithms or advanced algebra might be required. Manuals for different types of radio stations and broadcasting equipment in general are valuable assets, since they give needed information about the equipment and information about laws and rules governing the use, maintenance, and repair of the equipment. There are several excellent reference handbooks of tables and formulas for solving many problems in electronics.

How-to-do Books

Not all how-to-do books are do-it-yourself books, and anyone who thinks so should examine a recent catalog from one of the larger technical publishing houses. Subject matter ranges from how to use your test equipment to how to program for larger computer projects. The simple, down-to-earth, and straightforward approach is used throughout most of the books. Generally, the author is not a theoretician, but rather a working, practical-thinking individual who knows what reader wants to know.

Maybe you say you know how to use your test equipment, or you wouldn't have it around. This is generally true, but there are often other beneficial ways that you could be using your equipment to speed up your servicing and improve your technique and income. Once again the term "benefitting from the experience of others" applies.

Conclusion

Technical books can effectively serve the technician in both daily routine and in special cases where he wants to advance his theoretical knowledge or tackle a problem that is new or difficult. Books, in essence, become tools for the reader, giving him new skills and confidence that he might not have had before he started reading them. In a world of rapid change and stupendous technical growth, the technician is obligated to keep abreast of what is happening, and books are one of the best sources of up-to-date information. ▲

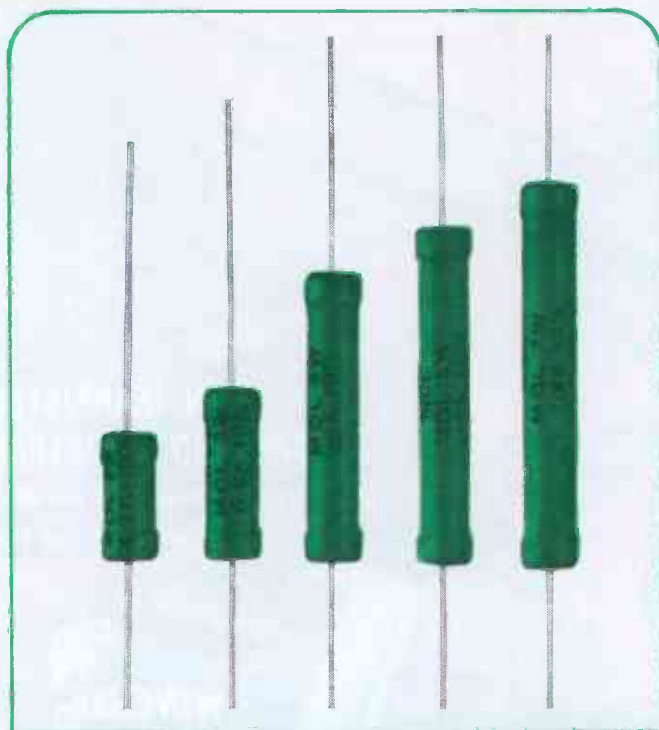


MALLORY

Tips for Technicians

Mallory Distributor Products Company
P.O. Box 1558, Indianapolis, Ind. 46206
a division of P. R. Mallory & Co. Inc.

What you should know about film resistors



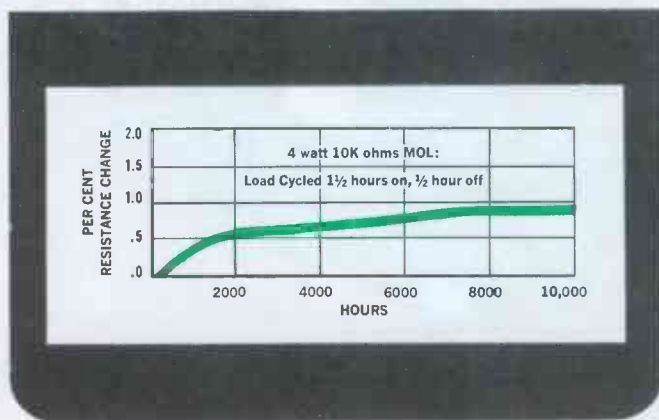
If you've been looking inside some of the recent model television sets, chances are that you've noticed some unusual-looking resistors. Especially in the sizes readily identifiable as under 10 watts. You'll probably find them in spots where you're used to seeing small wirewounds.

There's a good reason. These are metal oxide film resistors. And the reason they're making such a hit is that they have as good stability and life as wirewounds—but they cost only about half as much in most values.

What's different about them?

First, they're made differently. A thin layer of tin oxide is evaporated onto a high quality ceramic rod, at high temperatures. A spiral groove is then cut, by a highly precise automatic machine, to produce a resistance path with the desired ohmic value. Then the end connections are applied and the whole works gets a coating of silicone finish. You can get a lot higher resistance values, size for size, than with wirewounds, because you're not limited by the problems of winding hair-thin wires. Top resistance for the 4, 5 and 7 watt sizes is 120,000 ohms; for 2 and 3 watts, 56,000 ohms. Standard tolerance is 10%.

Second, they behave differently. Their stability is really terrific. We've run them with on-off load cycling for 10,000 hours and measured changes of less than 1%. They'll take heavy brief overloads without damage, aren't bothered by humidity or vibration. And they're noninductive up to 250 mc. The name to ask your Mallory Distributor for is the MOL film resistor. He has them in 2, 3, 4, 5, and 7 watt ratings, in popular resistance values. And when you need a higher wattage (up to 200 watts) ask him for Mallory vitreous enamel resistors—you can't beat them for cool operation and stable life.



Typical stability test data: 10,000-hour load cycling test. Average resistance change is less than 1%!

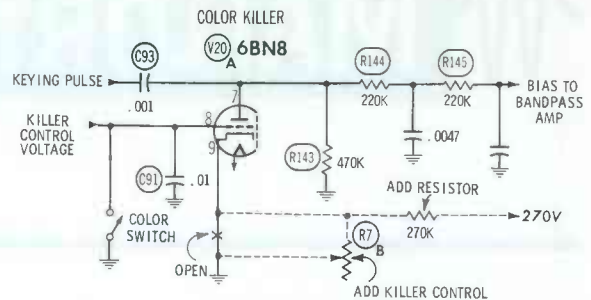
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: Zenith 29JC20 (early run). Covered in PHOTO-FACT Folder 599-2.

Symptoms: Difficulty in receiving weak color signals in fringe areas. Color may come and go, and fine tuning is critical.

Tip: The following change will provide better color reception in fringe areas by improving the operation of the killer stage when a weak burst signal is received. Replace the contrast control (Zenith part number 63-4846) with a dual contrast/color killer control (part number 63-4981), and rewire the circuits according to the information here. We've shown both the physical and electrical changes necessary to complete the job. Front section: R7A contrast control. Look at the con-



rol from the rear, with the terminal lugs up. Ground the left lug, connect the green-white wire to the center lug, and the blue-white wire to the right lug. Wire C29 (330 pf) from the right lug to the tap lug. (This portion of the dual control is wired exactly as the original contrast unit.)

TWIN TRANSISTOR SUPER COLORTRON

Not 10 DB, not 15 DB but a whopping
33 DB gain on the low band and FM—
33 DB gain on the high band actually
amplifies the signals 45 times



TWIN TRANSISTOR STANDARD COLORTRON

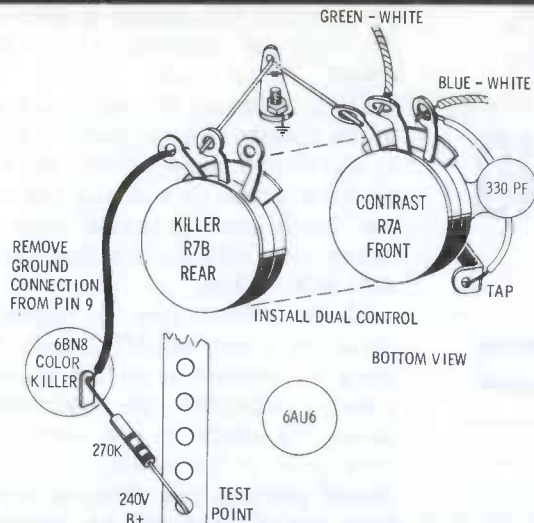
18 DB gain on the low band and FM—
18 DB gain on the high band



NEVER BEFORE —33 DB gain!

NEVER BEFORE —Same gain on every channel 2—13 plus FM!

NEVER BEFORE—3.5 DB noise figure or less on all channels!



Rear section: Ground the center lug of the killer control. Remove the ground connection from pin 9 of the 6BN8 color killer (V20A); connect a wire from the left lug to pin 9 (don't solder). Connect a 270K, 1/2-watt resistor from pin 9 to the 240-volt B+ (available at the test terminal shown), and solder both this joint and the pin 9 connections.

Testing Procedures: Remove the contrast knob and set the killer control full counterclockwise, using a 1/8" flat screwdriver. Tune in a station telecasting color. If color can't be tuned in, adjust the killer control *clockwise* until normal color appears on the screen. Set the channel selector to a black-and-white program, and check for presence of colored noise (snow). If colored noise appears in the picture, adjust the killer control slightly *counterclockwise*, until the noise is removed. The color killer control is properly set when color programs are produced in color and black-and-white programs are free of colored noise. In the majority of instances, this will occur with the control set at (or close to) its fully counterclockwise position.

POTENT NEW PRE-AMPS

from Winegard with Super High Gain

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- Will Take Highest Signal Input of Any Twin Transistor Antenna Amplifiers Made.
- Have Lowest Noise Figure Ever Obtained on TV Antenna Pre-amps.
- Can Be Used on Any TV Antenna for Black and White, Color or FM.

Up to now there have been two serious drawbacks to *all* antenna pre-amps (including our own)—

First—there have never been antenna pre-amps that had enough gain for *every* application. Second—all antenna pre-amps have had from 4 to 6DB gain less on the high band. This is unfortunate because the high band channels normally need pre-amplification more than the low band due to greater reception losses at the higher frequencies.

NOW Winegard has created two big solutions to this problem—the Super Colortron with a flat 33 DB measured gain on all channels 2—13 and the Standard Colortron with a flat 18 DB gain on all channels 2—13. For example, the Super Colortron will blow up a 50 microvolt signal to 2250 microvolts even on 13, the highest channel. Compare this with the best twin transistor pre-amps previously available where a 50 microvolt

signal would be amplified only to 175 microvolts—a tremendous difference in signal power. This increase in amplification will cover *all* applications—particularly for *fringe* area color. (See comparison charts to the right).

Of equal importance to gain is the noise figure of a pre-amp. Winegard engineers have lowered the noise figure on these new pre-amps as much as 2 DB over any other TV pre-amp available. They will bring perfect color even to deep fringe areas.

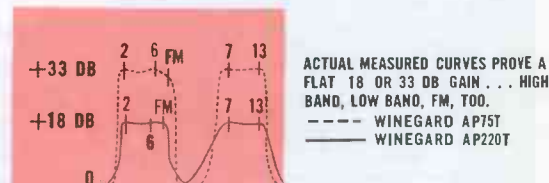
Compare these new Winegard antenna pre-amps with any others on the market today. Compare construction—totally weather-proofed polystyrene case, even the terminals are protected . . . convenient, rugged mounting bracket that snaps on boom. Compare performance—highest gain . . . lightning protected circuit . . . lowest noise! Then try a new Twin Transistor Colortron and see it in action!

The Super Colortron (AP75T) uses a 75 ohm system with RG59U Coaxial cable. Has three RG59U Connectors. For runs of over 70 ft., RG11U is recommended. The AP75T supercedes the AP215N. Model AP75T lists for only \$79.95.

SPECIFICATIONS: GAIN: +33 DB per band. BAND PASS: 54MC-108MC, 174MC-216 MC. RESPONSE = 1/4 DB per 6 MC channel. VSWR: Input 1.5:1. Output: 1.75:1. MAX. SIGNAL INPUT: 55,000 MV. MAX. SIGNAL OUTPUT: 2,000,000 MV. INPUT IMPEDANCE: 300 ohm. DOWNLEAD IMPEDANCE: 75 ohm. OUTPUT IMPEDANCE 75 or 300 ohm. 117V 60 CPS 1.8 watts.

The Twin Transistor Colortron Antenna Amplifier (AP220T, 300 ohm) lists for only \$44.95. The AP275T (75 ohm) amplifier lists for \$49.95.

SPECIFICATIONS: GAIN +18 DB per band. BANDPASS: 54 MC-108 MC, 174 MC-216 MC. RESPONSE = 1/4 DB per 6 MC channel. VSWR: Input 1.5:1. Output: 1.75:1. MAX. SIGNAL INPUT: 80,000 MAX. SIGNAL OUTPUT: 660,000 MV. INPUT IMPEDANCE: 300 ohm. OUTPUT IMPEDANCE: AP-220T -300 ohm, AP275T-75 ohm. 117V, 60 CPS. 1.8 Watts.



<p>COLORTRON TWIN NUVISTOR (AP220N). 300 ohm. Input: 400,000 microvolts . . . highest of any amplifier, tube or transistor. List \$39.95. AP275T (75 ohm) List \$44.95.</p>	<p>TWIN NUVISTOR FM AMPLIFIER ONLY. (AP320), 18 DB gain. 180,000 Microvolts Input. List \$39.95. AP375—same, but coax. List \$44.95.</p>	<p>REDHEAD SINGLE TRANSISTOR ANTENNA AMPLIFIER (RD300) Most reliable, highest gain single transistor model available. Input: 20,000 microvolts. 300 ohm input and output. List \$29.95.</p>	<p>LHF 212—Twin Transistor UHF antenna amplifier has 12 DB gain on all UHF channels M-83. Noise figure 8 DB at 900 MC. List \$44.95.</p>	<p>UHF 110X Single transistor UHF antenna amplifier has +8 DB gain on channels 14-72. List \$34.95. UHF 110T (translator model) —same, but has 12 DB gain on channels 72-83. List \$34.95.</p>
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 ANTENNA SYSTEMS
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In 1964, automobile sales were excellent, and projected sales figures for 1965 indicate another good year. Since nearly all cars are now delivered with radios, this continued growth should prove beneficial to shops specializing in auto radio repair. To realize maximum profit however, repairing each radio in a minimum amount of time is essential. AGC (automatic gain control) circuits are often the stumbling blocks that produce a non-profit repair.

Two basic AGC systems are in common use since the move to all-transistor automobile radios: The *half-wave system*, using one AGC diode to control the gain of the RF and IF stages—a few sets employing this system supply AGC voltages to the RF stage only; and the *full-wave-doubler system*, with two AGC diodes to control the RF and IF stages. The theory of operation and troubleshooting techniques for each system will be discussed separately.

Half-Wave AGC System

Fig. 1 illustrates the basic DC circuit of a typical half-wave AGC system. The bleeder-current path provides a voltage (about 9.6 volts) across the 470K resistor, biasing the base element of X1 for normal gain during low-signal conditions. (The IF-stage bias divider—the 47K and 18K resistors in Fig. 2—provides similar bias conditions for X2.)

When a strong signal enters the radio, the collector of X2 will swing positive or negative with the incoming signal. During the instant that the collector is positive, additional electrons will flow from ground to

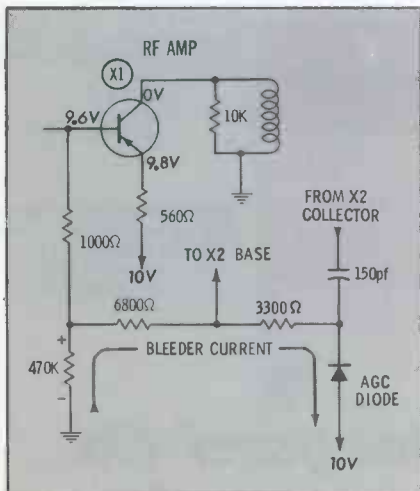


Fig. 1. Bleeder-current path for X1.

SERVICING AUTO RADIO AGC

Understanding and troubleshooting the solid-state circuits . . .

by Philip R. Powell

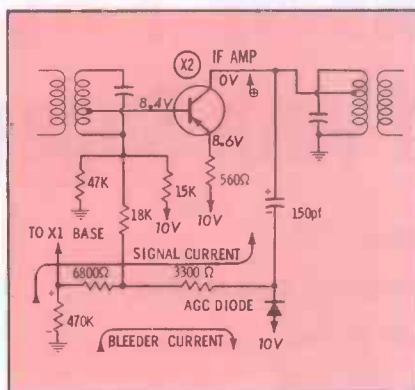


Fig. 2. Signal-current path for AGC.

the bottom plate of the 150-pf capacitor; this current adds to the bleeder current and increases the voltage across the 470K resistor. The net effect is a small increase in the bias voltage, at the base of X1, which reduces the gain of the stage. When the incoming signal swings negative, the 150-pf capacitor discharges through the diode to the 10-volt source. This "pump" action—drawing current through one circuit and discharging it through another—is necessary for proper AGC-system operation.

Troubleshooting

The usual AGC complaint is of distortion on strong stations. Back in the vacuum-tube days, we checked for AGC action by measuring the grid voltage; in this case, however, the base voltage of 9.6 volts may change only .2 volt, a change that will be difficult to determine accurately on the 15-volt meter scale. The best point at which to measure AGC action (see Fig.

3) is across the emitter resistor of the stage in question. Using the lowest meter scale (VOM or VTVM), connect the negative lead to the emitter and the positive lead to the 10-volt supply. When the receiver is tuned to a strong station, the .2-volt reading should drop to nearly zero, which will indicate normal AGC action.

If the circuit fails to respond, check for a shorted AGC diode by using an ohmmeter on the Rx100 scale. Connecting the ohmmeter across the diode in one direction, then again in the reverse direction, should produce two different readings, one of which will be approximately ten times greater than the other. Failure to get a ten-to-one difference in the two readings indicates a defective diode. This test should be performed with the diode removed from the circuit.

A reading, two or three times higher than the normal .2 volts across the emitter resistor, can indicate the following troubles:

1. A leaky transistor—Read the emitter-to-base voltage by placing the negative lead of the meter on the base and the positive lead on the emitter. When no station is tuned in and the voltage drop across the emitter-resistor is two or three times normal, an emitter-to-base reading of .2 volt indicates a leaky transistor. If the emitter-to-base bias has changed for increased conduction, the transistor is probably okay.
2. Open in AGC bleeder-current path — A high emitter-resistor voltage reading, along with a high emitter-base bias reading,

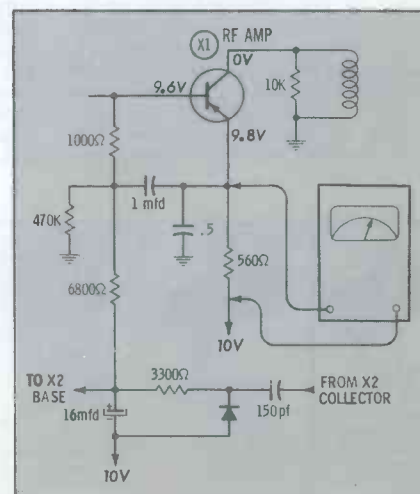
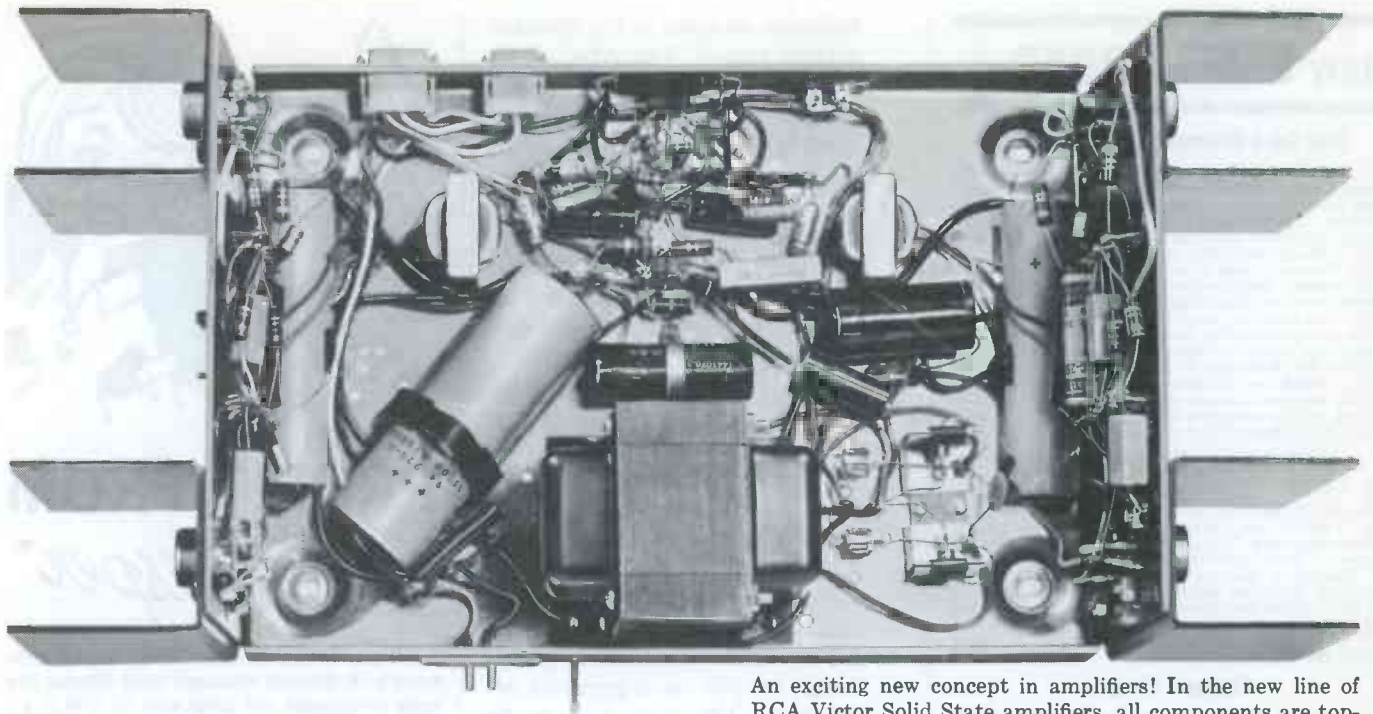


Fig. 3. Measure AGC voltage at emitter.



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indicates an open in the bleeder-current circuit. The AGC diode should be suspected first and checked with an ohmmeter. Forward and reverse readings across the diode should produce one reading under 1000 ohms and another that is approximately ten times greater. The ohmmeter can also be used to check continuity of the complete bleeder-current path.

One problem that occasionally pops up is a diode that is placed backwards in the circuit; the symptoms are the same as for the open circuit mentioned above. This wiring fault could happen in several ways: carelessness on the part of the manufacturer, error in the markings on the diode, or error in installation by you or a previous repairman. The only way to be 100% safe is to check the diode's polarity with an ohmmeter.

Trace the internal wiring in your ohmmeter to determine which lead, red or black, goes to the negative post of the battery; the lead that does is the true negative lead. Place this lead on the cathode of the diode to be checked and the other lead on the anode (arrowhead). The low reading should be obtained with this connection, and reversing the probes should give the high reading. Defects like these, which throw the stage into heavy conduction, cause the radio to be weak; often, the AGC circuit is overlooked as a source of trouble.

3. Capacitor failures — Open capacitors result in oscillations and can be checked by parallel-

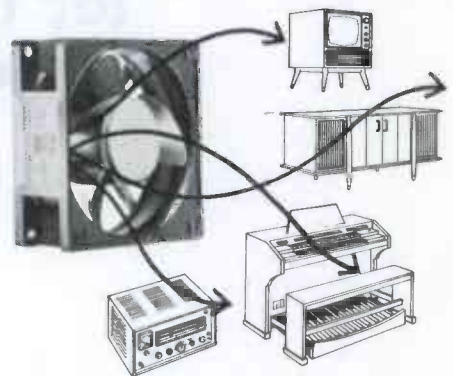


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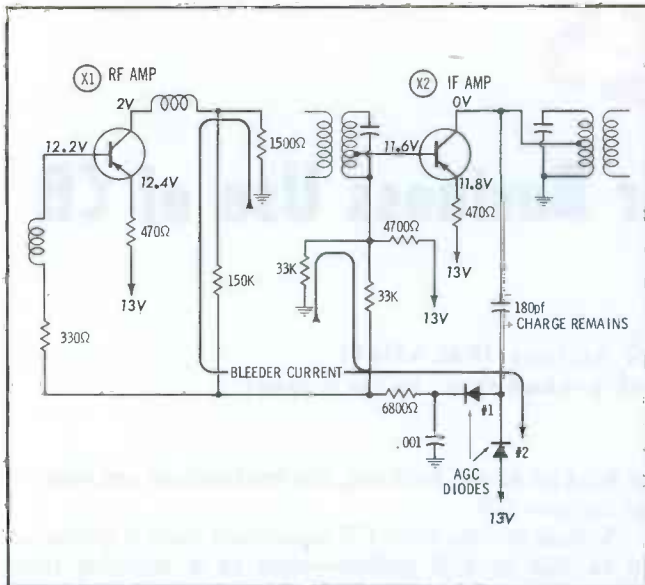


Fig. 4. Full-wave AGC system has two bleeder circuits.

ing a capacitor, which is known to be good, across the suspected one. Leaky or shorted capacitors can throw the RF and IF transistors into heavy conduction. A high emitter-resistor voltage, along with a high emitter-to-base voltage (see 1), indicates the transistor is not at fault; the transistor's emitter-resistor voltage should be observed with a meter while the suspected capacitor is disconnected from the circuit. If conduction returns to normal with a capacitor disconnected, the capacitor is defective.

Full-Wave AGC System

The full-wave system, similar in most sets to the half-wave system, has two bleeder circuits (see Fig. 4). One is composed of the 1500-ohm and 150K resistors in the collector circuit of X1, and the other consists of the two 33K resistors in the base circuit of X2. The two diodes conduct in the proper direction to allow bleeder current to flow.

The major difference in developing full-wave AGC is that following a positive-to-negative signal swing on the collector of X2, the 180-pf capacitor is left with the charge shown. As the next positive swing occurs on the collector, the signal's positive voltage is added to the capacitor's charge to produce a larger positive voltage at the junction of the two diodes. This, in turn, produces more AGC current as the strength of the incoming signal increases.

Troubleshooting

Troubleshooting techniques for the full-wave circuit are identical to those of the half-wave system; however, be particularly on the lookout for either or both of the diodes being defective. As outlined previously, ohmmeter checks will point out defective or improperly installed diodes.

The inherent simplicity of AGC circuits in transistorized auto radios, coupled with an understanding of time-saving checks, will speed your repair of AGC problems. Keep up-to-date on these new semiconductor applications, and you'll keep your cash register ringing. ▲

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Circle 35 on literature card

January, 1965/PF REPORTER 61



NEW RULES

Spur Business Use of CB

Latest FCC actions that affect operational procedures... by Leo G. Sands

The roof is about to fall in on the Citizens Radio business, unless manufacturers and dealers alike turn to other than the hobbyist market. Revised CB rules have been announced that, even though temporarily postponed, are slated to become effective eventually. Several companies have already petitioned the FCC to hold public hearings, hoping something can be done to stay the adoption of these new rules which specifically prohibit the use of CB radio where the equipment "is operated as a hobby, in and of itself, or for the exchange of aimless small talk." The FCC's announcement of the new rules, however, was followed quickly by a letter to manufacturers from the Federal Trade Commission requesting them to include in their advertisements a statement that the equipment is not for hobby use. So, in spite of the efforts of some companies

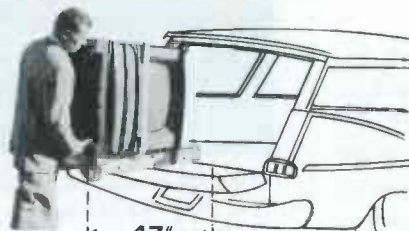
to hold on to the hobbyist, the implications are clear—go business CB.

Annual income from CB equipment sales is estimated to be \$25 to \$50 million—most of it resulting from sales to hobbyists; manufacturers and large distributors naturally don't want this market to disappear. While some manufacturers, as noted above, are fighting the rule changes with the hope that hobby-type operation will be allowed to continue—although it never has been lawful—most are planning to put more effort into building up the CB business market.

CB Brighter for Business

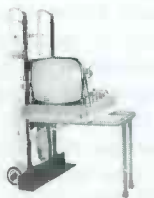
The CB business market has suffered from lack of attention and many potential users have been discouraged by the monopolization of channels by hobby-

SAVES
your back...
SAVES
your time...



YEATS SHORTY DOLLY for RADIO and TV

just 47 inches high for STATION WAGONS and PANEL PICK-UPS

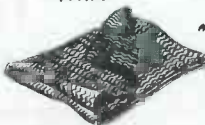


FOLDING PLATFORM
15 1/4" x 24 1/2" top.
Snaps on or off.
(Platform only)
\$11.95

Designed for TV, radio and appliance men who make deliveries by station wagon or panel truck... the short 47 inch length saves detaching the set for loading into the "wagon" or pick up. Tough, yet featherlight aluminum alloy frame has padded felt front, fast (30 second) web strap ratchet fastener and two endless rubber belt step glides. New folding platform attachment, at left, saves your back handling large TV chassis or table models. Call your YEATS dealer or write direct today!



YEATS Model No. 5
Height 47"
Weight 32 lbs.



FURNITURE PAD

"Everlast" COVER AND PADS

YEATS semi fitted covers are made of tough water repellent fabric with adjustable web straps and soft, scratchless white flannel liners. All shapes and sizes — Write



TV COVER



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CAR OWNERS SAY...

"Terrific," "Fabulous,"
"Improves radio 100%!"



VERBA-MATIX

America's Prestige

REVERBERATION

The only system with

- 4 Transistors • Heavy 7 oz. Ceramic-Magnet Speaker • Complete Control Panel (with Reverb % Control) • No Drilling, No Screws, for easy installation • Fits all Cars, Neg. or Pos. Ground (12 volt) • All Speakers 2 to 40 ohms • No Noise Driving Over Bumps.

Made in U.S.A.

For complete details see your Distributor or write PF-1



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Area Code 312 666-0066

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ists. But, under the new rules, only seven of the 23 channels in the 27-mc band will be available for use by stations not controlled by the same licensee. The other 16 channels will be reserved for communications between units (base and mobile or portable) covered by the same station license. Therefore, if the rules actually go into effect as proposed, business users will have 16 channels that should be free from interference by hobbyists.

Since the introduction of 23-channel sets about two years ago, full-channel coverage has become very popular. Most manufacturers now offer all-channel sets, and other multichannel units are almost ready for the market.

Informing the Businessman

Enterprising dealers and distributors are using local advertising to sell CB to businessmen. Many use direct-mail letters sent to all known businesses in their service area. Dealers using this approach report many telephone calls in response, requesting a demonstration. While some prospects will write letters containing specific questions, return-reply postcards included with the direct-mail pieces have not proved as effective for CB selling as they have in some other fields. Advertising in newspapers and on local radio stations is relatively inexpensive and highly productive. The most effective means of finding live prospects, however, remains the old canvass of every business that could benefit from the use of radio communication.

Manufacturers generally agree that their toughest job is finding "aggressive" dealers and motivating other dealers into action. Some prepare dealer sales-training manuals, direct-mail pieces, and nontechnical sales literature to sell the concept and benefits of CB radio. Manufacturers' advertisements can often be used locally for dealer tie-ins.

The CB dealer who sells to the business market runs head-on into competition from sellers of FM-mobile radio equipment. And, this competition will be intensified as some CB manufacturers expand into the FM-mobile field. CB equipment must be sold on the basis of *lower cost*, and the price gap between CB and FM-mobile radio is narrowing.

Manufacturers' Analysis

The problem facing manufacturers is to determine the kind of product they should offer the business market. The sales director of one large manufacturer has said he expects to sell 23-channel sets for use as

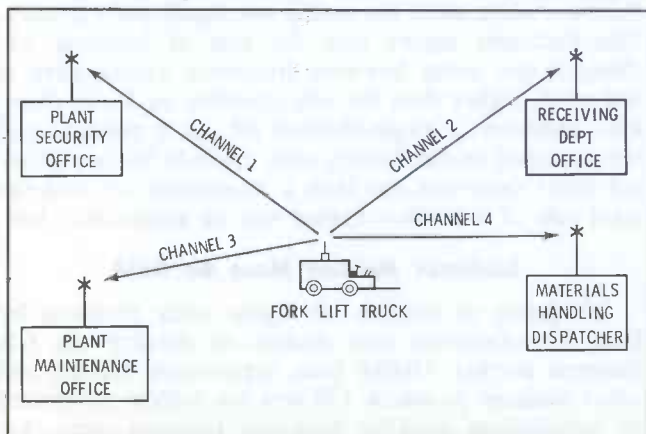


Fig. 1. Multichannel CB for warehouse use.

at last...
instant color patterns
at your finger tips...
zero warm-up time



THE ALL NEW SENCORE CG135 DELUXE TRANSISTORIZED COLOR GENERATOR

The big push is on in Color TV. Equip yourself now with the new, solid state Sencore CG135 and cash in on the zooming volume of new service business as Color-TV booms! Instant, service-ready RCA standard color bars, cross-hatch, white dots and individual vertical and horizontal bars enable you to set up or trouble-shoot more Color TV sets per day; earn top money in this fast growing service field. It's an analyzer too: Color gun interruptors, unmodulated video for chroma circuit trouble isolation and unmodulated sync pulses to keep Zenith receivers in sync for this test, make color trouble shooting a snap. Sturdy all-steel construction for rugged, heavy duty in the field or shop. Another Best Buy in profit-building service instruments **\$149⁹⁵** from Sencore at

COMPARE THESE FEATURES: SEE WHY THE CG135 IS IN A CLASS BY ITSELF

- Solid state construction employs high priced GE "Unijunctions" to develop six "jump out proof counters" that guarantee stable patterns at all times with no warm-up
- Standard RCA licensed patterns as shown on schematics throughout the industry
- Handy universal color gun interruptors on front panel
- Lead piercing clips insure non-obsolence
- CRT adaptors optional
- Crystal-Controlled 4.5mc Sound Carrier Analyzing Signal to insure correct setting of fine tuning control
- RF output on Channel 4 adjustable to Channel 3 or 5 from front of generator when Channel 4 is being used
- No batteries to run down; uses 115 V AC
- Less than one foot square, weighs only 8 lbs.

professional quality — that's the difference!

SENCORE

426 SOUTH WESTGATE DRIVE • ADDISON, ILLINOIS

Circle 38 on literature card

January, 1965/PF REPORTER 63

200,000 OHMS PER VOLT



TRIPLET

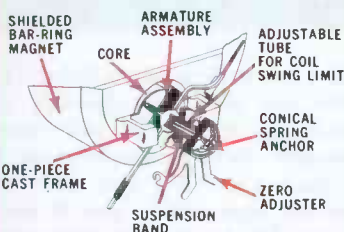
**Model 630-NS
VOLT-OHM-
MICROAM-
METER**

\$99.50

SUGGESTED
U.S.A. USER NET

NEW AND THE FIRST

TRIPLET SUSPENSION MOVEMENT
no pivots... no hair springs
no jewels... thus **NO FRICTION**



FACTS MAKE FEATURES:

- 1** 200,000 OHMS PER VOLT D.C. for greater accuracy on high resistance circuits. 20,000 OHMS PER VOLT A.C.
- 2** 5 μ a SUSPENSION METER MOVEMENT. No pivots, bearings, hair-springs, or rolling friction. Extremely RUGGED. Greater sensitivity and repeatability.
- 3** 62 Ranges, usable with frequencies through 100 Kc. Temperature compensated. 1 $\frac{1}{2}$ % D.C. ACCURACY, 3% A.C.

Low voltage ranges and high input impedance make the 630-NS especially useful in transistor circuit measurement and testing. Input impedance, at 55 volts D.C. and above, is higher than most vacuum tube voltmeters.

The unit is designed to withstand overloads and offers greater reading accuracy. Reads from 0.1 μ a on 5 μ a range. Special resistors are rigidly mounted and directly connected to the switch to form a simplified unit. Carrying cases with stands are priced from \$9.90.

TRIPLET ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO
Circle 39 on literature card

base stations and 8-channels sets for use as mobile units. Other sales directors believe there will be a big demand for 23-channel sets by business users; some indicate they believe single-channel sets will be the best sellers.

Business Applications

Let's look at a few typical requirements of business users. A small taxicab company, for example, could get by with a single-channel set, assuming use of a frequency that is not unduly congested. On the other hand, a multichannel set would enable the dispatcher or the driver to switch to an uncrowded channel when interference arose.

A larger cab company could make use of multi-channel sets by having each driver monitor a different channel as he moves from one zone to another. To call a cab in the northeast zone, for example, the dispatcher would transmit on one specific channel and on a different channel to contact a cab in another zone.

Radio and TV service technicians, as well as nearly all other kinds of service and delivery organizations, usually need only one channel. Those who venture out of base-station range could make use of a second channel, such as Channel 10, the new unofficial Travel-Aid Channel for summoning aid when on the road.

Only a single-channel set is required on fork-lift trucks operating within a plant area, since lift drivers normally communicate only with their supervisor. There might be several systems within a single plant area, each operating on a different channel. In sparsely populated areas where there is no channel congestion, single-channel sets should be satisfactory. Multi-channel sets, however, will add flexibility to intraplant systems, when there is a need for mobile units to communicate with various base stations for differing reasons (see Fig. 1).

It is apparent, therefore, that single-, multi-, and all-channel sets each will continue to find a market, which types will find the largest market will be determined only after more sales experience, user evaluation, and market analysis. The price differential between a 6-channel set and a 23-channel set has been narrowed considerably, and manufacturers seem to feel that business users will prefer to buy sets with all the major features, because they cost but little more than sets with fewer features. Even if only one or two of the 23 channels are actually required, consumer buying habits suggest that 23-channel sets will be bought by most business users, since the cost is not significantly greater. Manufacturers report that the cost of building 23-channel sets using low-cost frequency synthesizers is not much higher than for sets operable on fewer channels. However, a single-channel set (or a multichannel set equipped at the factory with crystals for one channel only) does cost less than a 23-channel set, and the total cost of a multiset system can be appreciably less.

Business Market Must Be Sold

It's going to require intelligent sales planning by both manufacturers and dealers to develop the CB business market. Unlike tires, typewriters, trucks, and other business products, CB sets are seldom advertised in publications read by potential business users. Instead, they are advertised in magazines read by hobby-

ists, CB dealers, and radio parts distributors. The ultimate user has not become CB brand-conscious, except through word-of-mouth boosts or knocks. Most prospective business CB users have not even heard of CB radio, except for hobby use.

The time is ripe for CB manufacturers to publicize CB use as an effective business tool, in publications read by prospective users. But, while some advertising in such publications would undoubtedly be very beneficial, the cost would be prohibitive unless supported by intensive consumer-market analysis. Most CB manufacturers will continue to concentrate their advertising dollars in publications read by prospective dealers, not consumers. Thus, the burden of advertising to the end-user rests upon the shoulders of the dealers.

Servicing Considerations

Under existing FCC rules, the user can adjust his own transmitter without having to possess a radiotelephone operator's license. The new rules stipulate that a licensed operator (first or second class) must check the operation of a CB set after it has been repaired. This requirement changes the complexion of the CB service business.

While a service shop has been able, in the past, to operate a CB service business without having licensed personnel, such operation soon will be impossible. The shopowner interested in two-way service should employ at least one licensed technician in order to participate legally in CB service. He will then also be able to service FM-mobile equipment. There are several FM-mobile equipment manufacturers who seek competent independent shops to service their equipment locally.

The new CB rules do not constitute a change in FCC policy; they are only a clearer definition of the Citizens Radio Service which was always intended to be a short-range communications service for "citizens" for business or personal use. It was never intended to be a means for engaging in ham-type operations by persons disinclined to learn code at five words per minute and to spend a few hours studying basic radio laws and elementary electronic fundamentals.

Education Leads to Sales

While it is unfortunate that the hobbyist took over CB en-masse, his activity gave the electronics business a new market, one which may be lost because of the redefined role of the citizens' band. The CB dealer and



**top money maker in
the service business**



NEW IMPROVED SENCORE CR133 CRT CHECKER & REJUVENATOR

The new, improved CR133 CRT Checker is designed to test all present picture tubes — and it's ready for future tubes too! Two plug-in replaceable cables contain all sockets required. The compact, 10 lb., CR133 checks CRT emission, inter-element shorts, control grid cut-off capabilities, gas and expected life. Checks all tubes: conventional B&W, new low drive B&W, round color tubes and new rectangular color picture tubes. Exclusive variable G2 Volts from 25 to 325 Volts insures non-obsolence when testing newly announced "semi-low" G2 CRT tubes. New Line Voltage Adjustment insures the most accurate tests possible. Uses well-filtered DC for all checks to avoid tube damage and reading errors. Color guns are individually tested as recommended by manufacturers. Exclusive automatically controlled rejuvenator applies rejuvenation (ACR) voltage as required by individual tube condition; precisely timed to prevent over-rejuvenation or tube damage. The ACR feature is most useful for color tube current equalization to insure proper tracking. Hand-wired and steel-encased for protection of meter and panel in truck or shop, the new improved CR133 is only **\$89⁹⁵**

The famous CR128 CRT Checker and Rejuvenator is similar to above, but with a three position G2 slide switch and without Line Voltage Adjustment at \$69.95

professional quality — that's the difference!

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January, 1965/PF REPORTER 65

*before you buy any
color generator...
get all the facts*

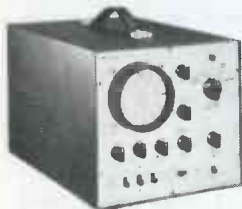


only one has all
these features and
it's only 99⁵⁰*

LECTROTECH V6

Any comparison will prove that the Lectrotech V6 truly stands alone. Provides all of the time-tested standard features plus many Lectrotech exclusives for the fastest, most reliable color installation and servicing. The V6 gives you: Crystal-controlled keyed rainbow color display • All cross hatch, dots, vertical lines only, horizontal lines only • Red-blue-green gun killer (usually extra or not available on other color bar generators) • Exclusive Dial-A-Line feature (Horizontal adjustable 1 to 4 lines wide) • Exclusive solid state reliability • Exclusive voltage-regulated transistor and timer circuits • Exclusive simplified rapid calibration • Off-On Standby Switch • Adjustable dot size • Color level control • Connects to antenna terminals (no connections needed inside of set) • Power transformer—line isolated, to prevent shock hazard • Lightweight and portable, only 4½" H. x 7⅝" W. x 10⅜" D. Weight, 7½ lbs.

*Except our own V7



V7 Sensational new Lectrotech V7 — the only complete Color TV Test Instrument.

Has all the features and performance of the V6 PLUS Lectrotech's exclusive built-in Color Vectorscope for simplified visual color servicing.

Complete.....only **189⁵⁰**



See your distributor or write for details
before you buy any color generator.

LECTROTECH, INC.
1737 Devon Avenue • Chicago, Illinois 60626

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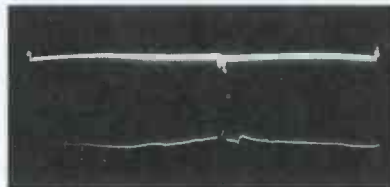
service shop technician must look to the business market and act quickly to stay in the CB business; and, manufacturers must lend support with sales training and sales aids. The hobbyist market need not completely disappear, however, if CB manufacturers make an all-out push to convert CB hobbyists into hams—most of whom are capable of learning enough code and theory to pass the novice ham license test—and come up with low-cost equipment for the ham bands in which novices are permitted to operate.

Conclusion

The market potential for business use of the citizens' band is tremendous. Every one of the nation's thousands of hotels and motels, and countless service stations, are prospects for CB communication with motorists on the Travel-Aid Channel 10. Of the nations 80,000,000 motor vehicles, of which some 12,000,000 are trucks, only about two million have been equipped with CB or FM-mobile radio. These items just scratch the surface. The market is there, but it must be sold. ▲

What's Wrong With This Waveform?

Clues: It was taken at the plate of the sync separator. The scope's horizontal sweep was expanded for a better look at the details of the waveform.



Ans. —This waveform—taken at 30 cps—should display both vertical and horizontal sync pulses of nearly equal height. Both should be of negative polarity. The horizontal pulses actually are present—their tips form the characteristic “fringe” along the bottom edge of the waveform — but something is wrong with the vertical pulse. It should make a bright spot at the bottom center of the waveform, representing a large, heavy negative pip. There is a spot, but it's almost level with the base line along the top of the waveform. This means only a weak vertical pulse is getting through the separator.

This fault would cause vertical rolling—at least intermittently—without affecting horizontal sync. It could be due to a weak sync separator tube, with enough cathode emission to supply the brief bursts of current for horizontal pulses, but not enough to conduct for the longer interval needed to produce a vertical pulse. If this isn't the trouble, no other faults in the sync separator seem likely, since the horizontal pulses are being cleanly separated from the video signal. Weak vertical pulses will probably be noted in the signal at the grid of the separator, as well as in the plate signal. The most likely culprit is poor low-frequency response in some circuit through which the TV station signal must pass before it reaches the sync separator. Defective coupling capacitors in the video or sync-input circuits are common faults; another possibility is misalignment of the RF or IF stages.



The Troubleshooter

answers your servicing problems

Volume Comes and Goes

I am having difficulty locating the trouble in a Zenith radio, Model L507 (covered in PHOTOFAC Folder 229-18). The receiver loses reception when tuned to stations near 600 kc. It will operate for a short time, then there seems to be an AGC defect that cuts out the reception. I have tried all tubes, also the oscillator coil and oscillator trimmer capacitor. When reception is lost there is no static, only a rapid fading out of the station signal. It would be unreasonable to assume a defective tuning capacitor for this reason, I believe. I would certainly appreciate any help you might offer in this matter.

EDWIN C. MYHRE

Carlton, Minn.

Since the symptoms you describe indicate that the trouble is dependent on the frequency to which the radio is tuned, the source is most likely in the RF or converter stages. If the 610-kc station is strong and then reception is lost entirely, chances are the trouble is in the oscillator. Since you have checked the tube, the fact that the defect is somewhat voltage dependent points first suspicion at a defective capacitor in the converter stage. The absence of static does seem to rule out the tuning capacitor (although strange things sometimes happen).

The best way to start, then, would be to check, by substitution, capacitors in the converter stage. Or you might try bridging them momentarily with good capacitors; this could cause the bad one to "snap back" and reveal itself.

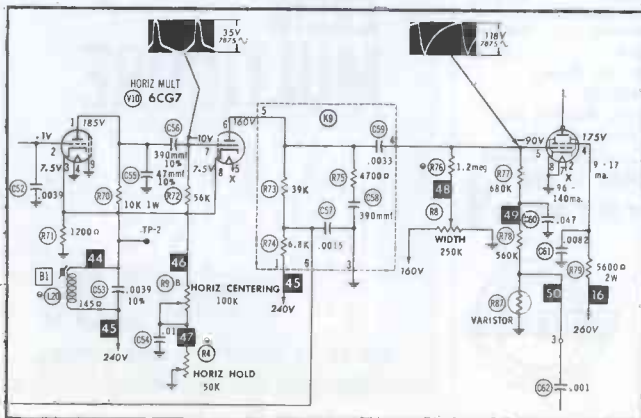
Narrow Picture

I am servicing a Philco TV Chassis 12N51A, covered in PHOTOFAC Folder 590-2. The trouble is insufficient width. All voltages in the horizontal oscillator section are normal; however, on the grid of the horizontal output tube (6DQ6) there is only -30 volts (schematic shows -90 volts). I checked the components in K9—all are within tolerance. Also, the resistors in the grid circuit of the output tube are okay. The only abnormality is the lowered reading on the output grid. Could you give me some hints as to what is causing the narrow picture?

TED POULEY

Monon, Ind.

Your description of the symptoms points to trouble in the horizontal-oscillator stage. You mentioned checking



just in time for the
fm and uhf boom!
an all transistorized
field strength meter.



THE ALL NEW SENCORE FS134 FIELD STRENGTH METER

Once again, you can turn to the roof tops for a fast dollar in antenna installations. But this time, you can do it the easy way. No more running up and down ladders, locating cumbersome AC extension cords, lugging heavy tube operated field strength meters on the roof, or worse yet, getting the shock of your life from the AC line as you hold onto a soil pipe. Here is a new portable field strength meter to fill your every need in VHF, UHF or FM antenna installations. Many customers want all antennas on one mast thus creating interaction. Here is where the FS134 goes to work. You can optimize antenna location and orientation in seconds. Just connect the antenna, tune in the station and adjust. Self-contained speaker blasts forth the sound from the TV or FM station to insure that you have the exact signal that you are looking for. The FS134 is so light weight (only 9 lbs.) that you can take it with you up the chimney if necessary. Get rid of the assistant at the other end of the transmission line and the needless "yelling" back and forth. Get the FS134 today . . .

\$199⁵⁰

only

COMPARE TO ANY OTHER FIELD STRENGTH METER
AT TWICE THE MONEY

- Sensitivity . . . 5 microvolts on VHF and FM, 15 microvolts on UHF
- Input impedance . . . 300 ohms or 75 ohms with plug-in transformer
- 500 KC band width
- Powered by easy to get "C" cells
- 4 inch meter with 2 percent accuracy calibrated in DB and microvolts.

professional quality — that's the difference!

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Circle 42 on literature card

January, 1965/PF REPORTER 67

the components in K9, but did you check C59 (which is a part of the component network) for leakage? I suggest you open the circuit at terminal No. 4 and connect a VTVM (set to read voltage) from this point to ground. Now, turn the receiver on and check for the presence of positive DC voltage on the meter; if DC voltage is present, C59 is leaky, and the component pack should be replaced.

With your oscilloscope, check to insure the proper drive waveform is being fed from the oscillator section to the output grid. An improper waveform could be causing the low bias.

Won't Be Still

I have a Philco Chassis 8L71 in my shop for repairs. The problem is the picture has vertical bounce or jitter. The bounce can be stopped temporarily by varying the height control, but at this setting the height of the picture is insufficient to fill the screen. I have changed the vertical output transformer, and tried a replacement yoke—both to no avail. Most of the capacitors in the vertical oscillator and output-circuits have also been substituted. The height and linearity controls have been replaced, too.

I fed a drive signal from my sweep analyser to the grid of the output stage, but the bounce was still present. All voltages are well within tolerance; however, the waveforms are distorted by the unstable picture, as the condition seems to be radiated back into the vertical input stage. Any suggestions will certainly be appreciated.

MOORE'S ELECTRONICS

Barbourville, Ky.

Philco Chassis 8L71 is covered in PHOTOFAC Folder 403-2. From the symptoms you describe and the troubleshooting procedures you have taken thus far, it looks as if you have pretty well isolated the trouble to the vertical output stage. My first impression is that you have improper

B+ filtering—either on the main B+ line or on the boost line. Be sure to scope the supply lines, looking for some odd pulse that may be interfering with the vertical circuit.

Another possibility is trouble in the printed circuit board; an intermittent open joint could be causing the trouble. It is also possible that you have a bad tube socket, especially in the vertical output stage. The output stage develops considerable heat, and the tube socket (mounted on the printed board) is prone to develop crystallization at the pin contacts on the upper side. I've had this trouble in several receivers of this vintage.

It is also possible that the trouble may be caused by stray coupling from another circuit; perhaps by a wire that is not dressed properly. Try moving some wires that are in close proximity to the vertical circuit to see if any change takes place on the screen. And don't fail to change that socket!

What's A Sure Cure

Lately I have been plagued with several AC-DC radios in which the volume intermittently "goes up and down." The tubes have checked okay, yet occasionally changing the 'BA6 corrects the condition. Other times, I have found an intermittent open or thermal capacitor to be the cause; in some cases, I have been unable to find a cure.

Some of my customers claim to correct the trouble by striking the set; however, I don't prefer this idea. Is there a sure cure for this type trouble? If not, would you please give me a reasonable procedure to follow?

GEORGE O. THOMPSON

Montreal, Quebec

Variations in volume such as you describe can be due to any number of causes. Frequently the defective component isn't revealed by routine voltage and resistance



TYPE IL . . . why use old fashioned wax end-filled cardboard capacitors in radio repairs? Avoid call-backs with Planet type IL dual section tubular electrolytics . . . hermetically sealed in aluminum tubes with wax impregnated insulating jacket. Planet IL's are also available in 450 volts for TV servicing. Ask for them by type number at your distributor.

PLANET SALES CORP.

225 Belleville Ave.
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send for New **FREE** CRYSTAL CATALOG . . . with New TRANSISTOR OSCILLATOR CIRCUITS

3 PLANTS TO SERVE YOU BETTER
HERMETICALLY SEALED
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NON-OVEN CRYSTALS

Gold or silver plated, spring mounted, vacuum sealed or inert gas, high freq. stability, 10 milliwatt max. current cap. Meet mil. specs.

Frequency Range	Price
1000KC to 1600KC (Fund. Freq.)	Prices on Request
1601KC to 2000KC (Fund. Freq.)	\$5.00 ea.
2001KC to 2500KC (Fund. Freq.)	4.00 ea.
2501KC to 5000KC (Fund. Freq.)	3.50 ea.
5001KC to 7000KC (Fund. Freq.)	3.90 ea.
7001KC to 10,000KC (Fund. Freq.)	3.25 ea.
10,001KC to 15,000KC (Fund. Freq.)	3.75 ea.
15MC to 20MC (Fund. Freq.)	5.00 ea.

OVERTONE CRYSTALS

15MC to 30MC Third Overtone	\$3.85 ea.
30MC to 40MC Third Overtone	4.10 ea.
40MC to 65MC Third or Fifth Overtone	4.50 ea.
65MC to 100MC Fifth Overtone	6.00 ea.
DRAKE 2-B Receiver Crystals	\$4.00

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For Motorola, GE, Gonset, Bendix, etc.

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ERSIN MULTICORE NEW EASY DISPENSER PAK ONLY 50¢

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checks. About the best thing you can do is to consider the exact nature of the symptom and try to deduce where the trouble should logically be (for example, a sudden drop in volume accompanied by "static" could indicate a loose or dirty volume control or bandswitch). The "sledgehammer" approach is to be avoided, but light tapping of a component (or working the shaft, if it has one) frequently localizes the trouble. If the difficulty appears to be associated with heat, the judicious application of heat, with a soldering iron or gun, can sometimes give a clue.

There is one other point to keep in mind with AC-DC radios. Most of these sets use a built-in loop antenna, and the ground return for the received RF signal is through the power wiring. The switching on and off of appliances in a building frequently changes the RF characteristics of this return path, and the volume of the set consequently rises and falls in an intermittent fashion. There isn't much that can be done about this when it occurs, but being aware of it could save time spent in futile troubleshooting attempts.

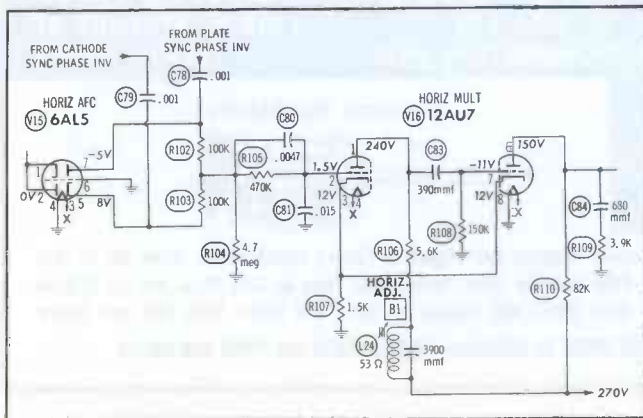
What Did I Miss?

I have an Admiral TV receiver, Model 20SY4LS (PHOTOFACT Folder 326-2), which has the following symptoms: low boost voltage (240 volts) and no bias on grid, above-normal screen voltage, and 240 volts on top cap of horizontal output tube. All voltages in the horizontal-oscillator section are normal. I have substituted all the filter capacitors, replaced the yoke and flyback transformer, and almost all the capacitors and resistors in the horizontal oscillator and output stage. However, the trouble is still present. I suspect that the trouble lies in a section of the receiver that I have overlooked, although I can't see what else could affect the boost voltage. Please advise me where to look for the trouble.

ARTHUR DiFRANCESCO

West Hartford, Conn.

According to your description of the symptoms, the trouble is most likely in the horizontal AFC section. An explanation for each symptom is: the boost voltage is low because the horizontal oscillator is not running. Absence of bias and increased screen voltage on the horizontal output tube are results of the same defect—the oscillator is dead. The flyback isn't open because you are measuring B+ voltage on the plate of the horizontal output tube; this is normal under the above conditions. You state the voltages in the horizontal oscillator section are normal. This clue brings us to the horizontal AFC section. You will probably find capacitors C78 and/or C79 to be leaky—placing a positive voltage on the horizontal AFC stage and shifting the horizontal oscillator so far off frequency that it becomes inoperative. This can be checked rather easily—simply ground pin 2 of V16 and see if high voltage returns. ▲



add an fm-stereo service center
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THE SENCORE MX129 FM STEREO MULTIPLEX GENERATOR & ANALYZER

FM-Stereo growth continues to mount and is fast becoming as big a field as Color TV. This means more FM-Stereo service business for you, now and in the future. Is your shop equipped? It can be—completely and economically—with the MX129, the FM-Stereo "Service Center in a Case." The instantly stable, 19-Transistor, crystal controlled MX129 is the most versatile, most portable (only 7½ pounds), most trouble free and efficient multiplex unit on the market—just like having your own FM-Stereo transmitter on your bench or in your truck. Powered by 115 volts AC, it produces all signals for trouble shooting and aligning the stereo section of the FM receiver . . . can be used to demonstrate stereo FM when no programs are being broadcast. Self-contained meter, calibrated in peak to peak volts and DB, is used to accurately set all MX129 controls and as an external meter to measure channel separator at the FM-Stereo speakers. NO OTHER EQUIPMENT IS REQUIRED. **\$169⁵⁰** only

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January, 1965/PF REPORTER 69

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Notes on Test Equipment

analysis of test instruments . . . operation . . . applications

by Allen B. Smith

Versatile 5" Lab Scope

The Heath Model IO-12 oscilloscope pictured in Fig. 1 has been available for over two years, and in that time has proved itself in many shops. The instrument has vertical bandpass sufficient for viewing chroma and color-burst signals in color TV sets and has several features to speed repair of black-and-white sets. The IO-12 is very similar in electrical design to the previous Model O-11, although the controls and panel have been changed to present a more attractive exterior. The horizontal- and vertical-amplifiers are essentially identical to those in the O-11, but the sync-sweep-and-blanking section has been altered to achieve greater stability and versatility.

Functions of the Model IO-12 are relatively straightforward as can be seen from the block diagram shown in Fig. 2. A signal applied to the vertical-input terminals is coupled through the frequency-compensated vertical-attenuator network to the input cathode follower, through the vertical gain control to the vertical amplifiers and the deflection amplifier. Of particular interest are the input attenuator network, which has no noticeable effect on waveform shape at any frequency or at any attenuator position, and the positive and negative synchronizing pulse, which are picked off the plate of the push-pull deflection amplifier for internal synchronization. The SYNC-SELECTOR



Fig. 1. 5-mc scope has front-panel adjustment for two preset sweep freqs.

switch chooses pulses for internal, external, or line synchronization, and applies the choice to the cathode of the first half of the sweep generator.

The nine-position HORIZONTAL FREQUENCY (sweep) SELECTOR switch adds frequency-determining capacitors of various values into the cathode circuit of the second half of the sweep multivibrator to determine coarse sweep frequencies, and a 7.5-megohm potentiometer provides fine adjustment (FREQ VERNIER) of the sweep frequency. In each preset sweep position, there is a separate 7.5-megohm control (PRESET ADJ) for fine adjust-

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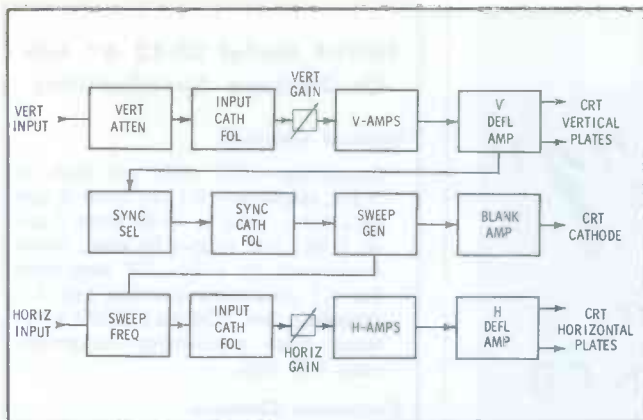


Fig. 2. Sync, sweep, and blanking circuits have been modified from previous 5" scope to provide greater utility.

ment. These preset positions enable the scope to be preset to two often-used frequencies—usually 30 cps and 7875 cps for TV servicing. The retrace-blanking pulse (applied during less than 30% of the sweep time) is fed to the CRT cathode through a blanking amplifier.

The output waveform from the sweep generator (or the external or line-sweep signal) is fed through a cathode follower to the horizontal amplifier, then to the push-pull deflection amplifier, and finally to the horizontal plates of the CRT.

Power for all critical circuits (sweep and deflection, primarily) are provided by a supply that features electronic regulation. The same supply provides all necessary calibration, sync, and sweep reference voltages—plus, with a separate rectifier, unregulated high voltage for the CRT.

The particular Model IO-12 evaluated in our lab was constructed from kit form in approximately ten hours. Assembly was accomplished with no problems, and the instructions and check-off system were easy to follow. The individual small components (resistors and capacitors, particularly) must be identified by color code or by marking, as they are not called out by part number on cards as in some kits. In all, however, the entire construction procedure through final evaluation and checkout went without a hitch.

As mentioned previously, the scope can be used with good results for tracing color waveforms in color sets. The waveform shown in Fig. 3 was taken from the 5U1 CRT with our lab camera to illustrate the output signal of a typical single-stage chroma bandpass amplifier. Stability and fidelity of the waveform are excellent, even making no allowances for the instrument's price.

In the field, our Model IO-12 was used to service several black-and-white home TV sets for sweep, video, and sync problems. Those using the scope reported nothing but

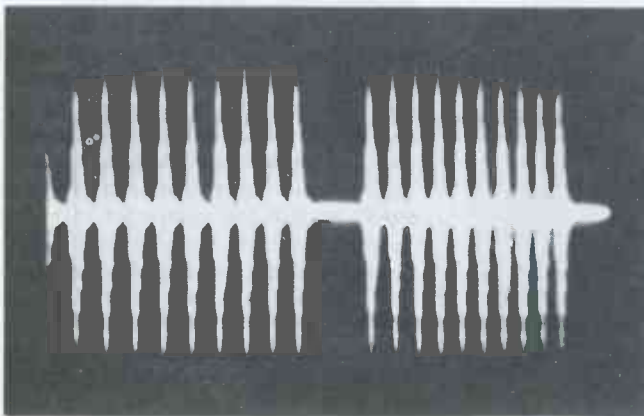


Fig. 3. High-frequency response of the output signal from chroma bandpass amplifier shows scope's service capability.

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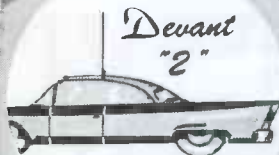
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HEATH Model IO-12 5" Lab Oscilloscope Specifications

Vertical Channel:

Sensitivity—.025 volts per inch @
1 kc; response—±1 db from 8 cps
to 2.5 mc, +1.5 to -5 db from 3 cps
to 5 mc; rise time—.08 usec; input
impedance @ 1 kc—2.7 megohms
for X1 attenuator position and 3.3
megohms for X10 and X100 posi-
tions; trace positioning—instan-
taneous DC type.

Horizontal Channel:

Sensitivity—.3 volts per inch @ 1
kc; response—±1 db from 1 cps
to 200 kc, ±3 db from 1 cps to
400 kc; input impedance @ 1 kc
—4.9 megohms; trace positioning
—as for vertical channel.

Sweep Generator:

Range—10 cps to 500 kc in 5 steps;
preset ranges—#1, 10 cps to 100
cps, and #2, 1000 cps to 10,000
cps, the two being changeable to
any two frequencies between 10
cps and 500 kc; sync—automatic,
using self-limiting cathode follow-
er, for synchronizing on positive
or negative internal, external, or
line sources.

Features:

Retrace-blanking amplifier; phase-
shift control for line-synchronized
waveforms; built-in voltage calibra-
tor; provision for Z-axis modula-
tion; low-voltage supply fully regu-
lated.

Size (HWD):

14 1/8" x 8 5/8" x 16"

Weight:

20 1/2 lb.

Power Source:

105-125 volts, 50-60 cps AC, 80
watts.

Price:

\$76.95 kit.

favorable comment for its sensitivity,
stability, and ease of operation. The
scope has also been used to service a
closed-circuit color-TV system with
perfectly acceptable performance.

The assembly-instruction manual ac-
companying the kit devotes several
pages to general scope-operating tech-
niques and waveform analysis and
shows several test setups for servicing
various items of equipment. The ac-
cessory use of demodulator and low-
cap probes is also touched upon
briefly.

We have used both this scope and
its direct ancestor the O-11 in the
preparation of many articles for PF
REPORTER and in securing the normal
and abnormal waveforms for illustra-

tions for *Symfact* and other features. Correct use of the instrument and its accessories will enable you to speed your servicing and increase your shop's efficiency.

For further information, circle 61 on literature card.

Color Bars in Kit Form

The PACO Model G-36 Color Bar Generator (Fig. 4) offers the color TV serviceman a chance to acquire a useful instrument and save a few dollars by building it himself. The Model G-36 is nearly identical to the Precision Apparatus Model E-450 Color Generator; the kit form of the G-36, however, helps the manufacturer attain a lower price.

Simple operation has been stressed in the design of this generator, with only three controls and the RF-output connector on the front panel. The first control is a switch marked DISPLAY and selects the video pattern desired (H BARS, V BARS, CROSSHATCH, DOTS, or COLOR BARS); the second is a potentiometer marked CHROMA and sets the color-saturation level of the color-bar pattern; the third is a switch marked SELECTOR and provides one of five desired output functions (POWER



Fig. 4. Kit-built instrument provides stable patterns for servicing color TV.

OFF, STANDBY, DISPLAY OFF, DISPLAY, and DISPLAY + SOUND). The varied video patterns and output functions provide the necessary signals for convergence and deflection linearity adjustments as well as for chroma alignment.

Ten color bars are generated by the keyed-rainbow method using a 3.563-795-mc crystal-controlled oscillator to provide a signal that is 15,750 cps lower in frequency than the 3.579545-mc chroma-reference oscillator in the color receiver. The frequency difference between the two reference oscil-

lators produces a signal that varies in phase from 0° to 360° during the period of one line, in which the three electron beams from the red, blue, and green guns trace one horizontal scanning line on the face of the color CRT. This phase shift is repeated for each scanning line. Since color is generated by varying the phase of the receiver's subcarrier oscillator in reference to the transmitted color-burst signal, the 0° to 360° phase shift noted above provides a continuous spectrum, from yellow (through red and blue) to green, across the face of the color CRT.

To establish separate bars of color for adjustments in the phase-shift and matrix circuits of a receiver, the main 189-kc crystal-controlled oscillator is used to key (or blank) the 3.563795-kc oscillator (see Fig. 5) at regular intervals during each scan period. This keying action produces 12 bars of color, 10 of which appear on the CRT (of the other two, one is blanked during retrace time, and the other serves as the reference burst).

The various black-and-white video patterns available from the Model G-36 are produced by using a series of blocking oscillators as dividers to re-

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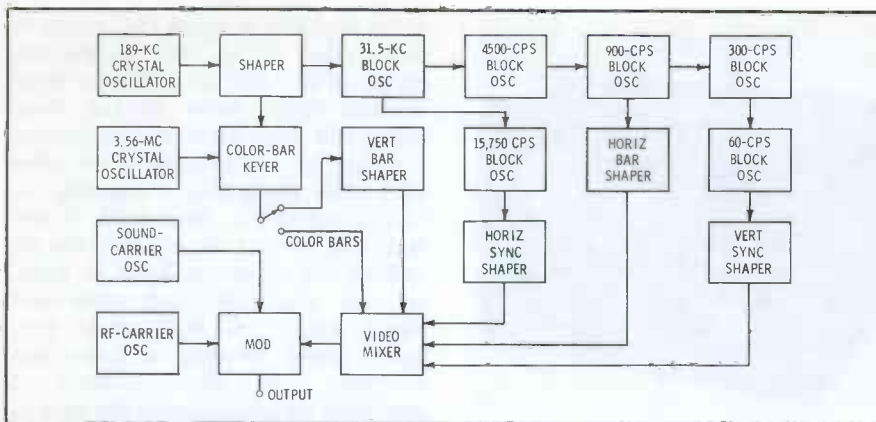
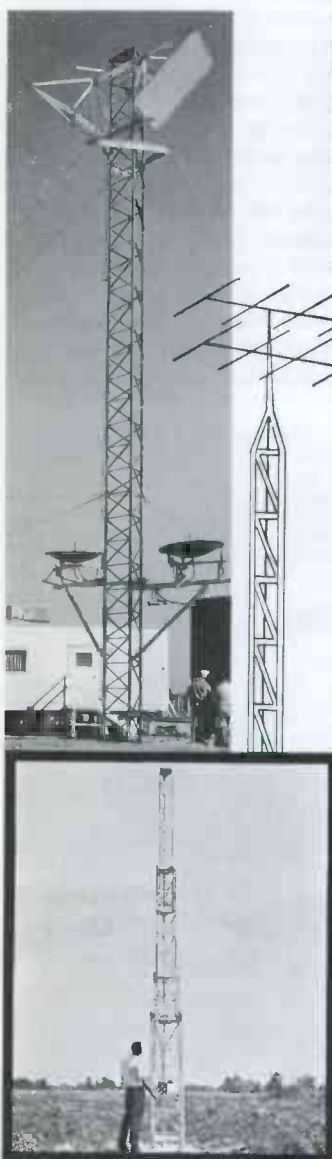


Fig. 5. Blocking-oscillator stages provide bars and pulses for synchronization.



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PACO Model G-36 Specifications

RF Output Frequency:

Either channel 3 or channel 4 (for unused local channel). Video and sound carriers are both provided.

RF Output Level:

Approximately 20,000 microvolts video and 2000 microvolts 4.5-mc (unmodulated) audio.

Output Impedance:

Balanced 300-ohm output for direct connection to antenna terminals of receiver using output cable and clip leads.

Patterns available:

Keyed rainbow bars, vertical lines, horizontal lines, crosshatch, dots, white raster (carrier only).

Size (HWD):

8" x 13" x 7".

Weight:

12 lb.

Power source:

105-120 volts AC, 60 cps, 60 watts.

duce the frequency of the 189-kc reference signal to give 15 horizontal or 10 vertical white lines, or a combination of the two simultaneously (crosshatch). The vertical lines are formed by the same keying action of the 189-kc reference oscillator that generates the color bars, except that, before being fed to the video mixer, the keyer output is fed through a shaper circuit that develops narrow pulses. As in the case of the color bars, 12 lines are generated, but 2 are lost during retrace and blanking.

To provide horizontal lines, the 189-kc signal is fed from the shaper to the 31.5-mc blocking oscillator, where every sixth pulse triggers the divider. The signal is further divided by the 4500-cps (by 7) blocking oscillator and the 900-cps (by 6) blocking oscillator to provide, after further shaping, 15 pulses during the receiver's 60-cps vertical-scanning period; these pulses form the 15 horizontal lines.



Horizontal and vertical lines are combined for the crosshatch pattern. Dots are developed from crosshatch; a diode is used to eliminate or clip out the crosshatch interconnection, leaving only the intersected points, providing a pattern 10 dots wide and 15 dots high.

Horizontal- and vertical-sync pulses are provided by the G-36 to assure a stable video presentation on the receiver under test. Horizontal sync pulses come from the 15,750-kc blocking oscillator (once again, see Fig. 5). The signal is shaped by the horizontal-sync shaper and fed to the video mixer. Vertical sync pulses are derived in an identical manner from the 60-cps blocking oscillator at the end of the long divider chain.

The signals that provide all video displays pass through the video mixer to the modulator stage where they are impressed on the RF carrier generated for channel 3 or 4, depending on the user's choice. The modulated carrier output of the Model G-36 is fed to the set through the panel-mounted connector and the clip-lead cable.

A 4.5-mc crystal oscillator generates a sound-carrier signal which is mixed (in the modulator) with the RF carrier to provide a signal displaced 4.5 mc from the RF carrier.

This signal can be used to align the set's sound-IF and detector circuits.

In our lab, where the unit was assembled, we found that the construction procedures outlined step-by-step in the instruction booklet were easy to follow and accurate. An errata sheet listed several changes that had to be made before construction was begun. Assembly of the kit required about 10 hours from plugging in the iron to using the generator for alignment checks.

Stability of the video patterns is very good, and the range of color saturation provided by the chroma control was satisfactory. ▲

For further information, circle 62 on literature card.

now in our lab . . .

The latest test instruments being analyzed for future "Notes" columns:

Lectrotech Model V7 Color Vector-scope

RCA Model WT-115A Color CRT Tester

SENCORE Model PS127 Oscilloscope

Triplet Model 3490A Transistor Analyzer

Sprague Model TO-6 Capacitor Analyzer

Jackson Model 825 CRT Tester



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- **Gold Finished**—for weather protection.

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SIMPLIFIES SWEEP CIRCUIT TROUBLE SHOOTING

SS117 SWEEP CIRCUIT ANALYZER

For Color and Monochrome Testing

A professional trouble shooter that helps you methodically walk the trouble out of "tough-dog" sweep circuits in monochrome and color receivers. The SS117 provides a positive but simple push button test on all circuits indicated in the block diagrams. These time-consuming circuits are checked step-by-step with tried and proven signal injection and substitution methods. All checks can be made from the top of the chassis or from under the chassis when it is removed from the cabinet.

TV horizontal oscillator check is made by substituting a universal oscillator known to be good. Horizontal output check consists of a cathode current and screen voltage test. The TV horizontal yoke is checked by substituting a universal yoke from the SS117 and viewing brightness or restoration of 2nd anode voltage. Horizontal flyback is checked dynamically in circuit by measuring the power transfer to the yoke when TV is turned on. TV horizontal sync can be used to control the SS117 horizontal oscillator, providing a positive check on sync from the video amplifier to the TV oscillator. Vertical circuits are tested by simple signal injection from vertical yoke to oscillator for full height on CRT. The SS117 with the CA122 Color Analyzer provides a complete TV analyzer for virtually every stage in monochrome or color receivers.

External checks for AC, DC, peak to peak voltage readings and DC current in the upper right hand corner save using a separate VTVM. Accurate 2nd anode measurements up to 30,000 volts are made with a sensitive 300 microamp meter and the attached high voltage probe. AC outlets, all steel construction and mirror in the cover makes every servicing job easier.

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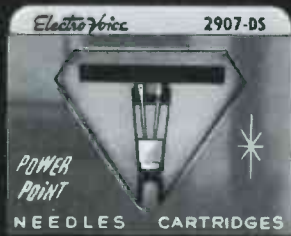


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Product Report

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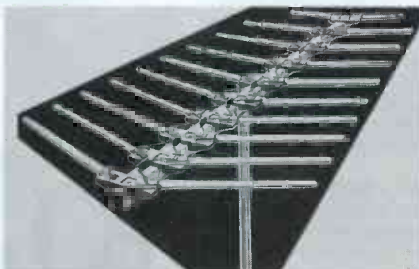
Whisper Fan (127)

A fan that will cool and extend the life of television sets and hi-fi equipment is being offered by **Rotron**. Known as the "Whisper Fan," it is extremely quiet and will move 60 cubic feet of air per minute. The fan can be installed to operate in any position. Prices range from \$8.15 to \$14.10, depending upon the quantity purchased. Accessories such as filter, grill, guards, etc. are additional.



Color-Bar Generator (128)

This new color-signal generator provides numerous video test patterns: gray raster, rainbow, keyed color bars, dots, cross-hatch, vertical lines, and horizontal lines. The **Seco Model 990** also features several variable patterns. The operator can select 54 or 144 dots, a crosshatch pattern of 6 or 16 horizontal bars with 9 vertical bars, and 6 or 18 horizontal bars. The RF-output frequency is factory adjusted to channel 3 but can be retuned to either channel 2 or 4. Net price is \$149.50.



VHF-FM Antenna Line (129)

The sweptback element design of a new series of antennas by **Finco** provides im-

proved reception of color, black-and-white, and FM signals—both monaural and stereo. The **Finney Co.** has incorporated several features in the construction of these antennas to make them as trouble-free and weatherproof as possible. All carry an unconditional guarantee.



8-Track Stereo Head (130)

A new 8-track stereo-head for 1/4" tape offers twice as much playing time as a standard 4-track stereo tape system operating at the same speed. A 100 micro-

NOW...
**you can sell Hallicrafters
COMMAND LINE**



NEW FM 3-WAY RADIO
for industry and commerce

This is an excellent opportunity for experienced electronic sales and service companies to represent Hallicrafters **COMMAND LINE FM 3-way radio**. New sales concept. No inventory. No financing problems. Complete factory back-up. Equipment for all frequencies, competitively-priced, up to \$100 less per unit. Lead-producing national advertising; comprehensive technical literature; plus Hallicrafters 31-year reputation for quality through craftsmanship help you sell.

For details, contact Norman A. Sholseth

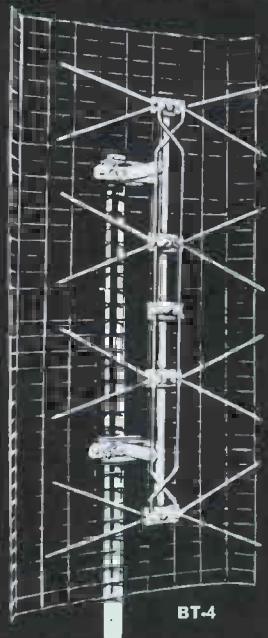


hallicrafters

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Phone: 312-826-6300

Circle 52 on literature card

IT'S RMS
FOR OUTDOOR & INDOOR
UHF ANTENNAS
OF ENGINEERED EXCELLENCE



BT-4

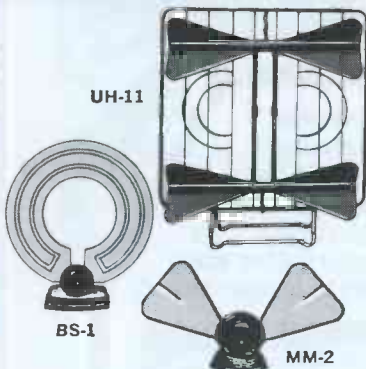
OUTDOOR ANTENNAS...

BT-4—Four-bay model, solidly assembled and wired. Engineered with outstanding high gain and excellent front and back ratio. ALL ALUMINUM Front with unitized screen reflector. Has optimum line-matching on all UHF Channels. Ideally suited for best color and black-and-white reception. Considered the best by those who know.

BT-2—Double-bay model. The same high quality characteristics as above.

BT-1—Single-bay model, as above.

UH-11



BS-1

MM-2

INDOOR ANTENNAS — Uniquely designed to blend with current room decor... requiring minimum space for a maximum of reception perfection.

UH-11—Two black "bow ties" set off by attractive golden grid, both durably finished. Attaches to back of any TV set. Clear, sharp reception assured.

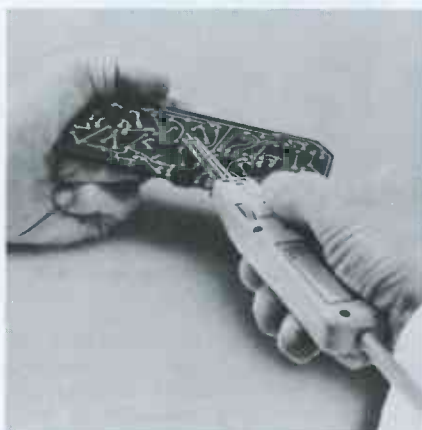
BS-1 and **MM-2**—Two attractive units with wide adaptability. Economically priced to stimulate sales in both the new and old UHF market. Ideal for promotional type selling.

PFR-1

RMS ELECTRONICS, INC.
 2016 Bronxdale Avenue, Bronx, N.Y. 10462
 Telephone: (212) TYrone 2-6700

Circle 54 on literature card

inch gap assures quality performance at 3.75 ips. The **Nortronics** head is mechanically indexed to four discrete positions to provide four stereo, or eight mono channels. Available in either solid or laminated core versions, the Model B2L head is available in various impedances to accommodate all types of circuitry.



Probes for PC Boards (131)

Two new tri-contact probes for making tests on printed circuit boards are adaptable to all types of in-circuit semiconductor testers. The probes from **American Electronic Laboratories**, have stainless-steel tips whose vertical and lateral positions are controlled by individual thumb wheels. They are available with a standard connector, or with optional connectors to meet MIL specifications.



Contact Cleaner (132)

A new "dry" cleaner, Relay Kleen, is a degreaser and general solvent for cleaning gummy deposits from relays and contacts. **GC Electronics'** new chemical is nonoily, nonflammable, leaves no residue, and does not contain carbon tetrachloride. Each 6 oz. pressurized can is furnished with an easily attached pin-point spray attachment for servicing hard-to-reach areas. Net price is \$1.89.



Can you service
mobile radio
and CB?

It's a big business . . . and getting bigger every day. There are thousands of mobile radio systems now in use plus thousands more marine and CB sets. **BUT . . . ONLY MEN WITH COMMERCIAL FCC LICENSES ARE LEGALLY AUTHORIZED TO SERVICE THEM.** Don't let this profitable new business get away from you. At home, in your spare time, a Cleveland Institute training program will prepare you for the tough new FCC License Exam . . . is backed by this remarkable offer: "If you complete the CIE program yet fail the FCC License Exam specified, all tuition will be refunded". Get details. Send coupon for our book "How to Get a Commercial FCC License". No obligation. Cleveland Institute of Electronics, Dept. PF-20, 1776 E. 17th St., Cleveland, Ohio 44114.

Cleveland Institute also offers the following Electronics courses: Electronics Technology, Industrial Electronics, Broadcast Engineering, and Electronic Communications.

ACT NOW . . . SEND COUPON FOR FREE BOOK

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 Cleveland, Ohio 44114

Please send me your free brochure "How to Get a Commercial FCC License".



Occupation _____ Age _____

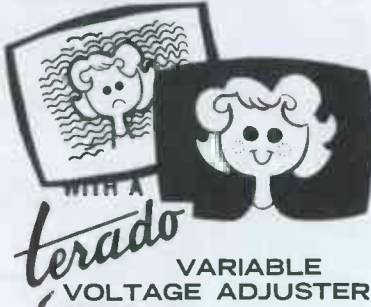
Name _____
 (Please Print)

Address _____ County _____

City _____ State _____ Zip _____

Now training over 15,500 students through Electronics Home Study.

FOR COLOR TV PROBLEMS CORRECT LOW VOLTAGE



WITH A *terado* VARIABLE VOLTAGE ADJUSTER



Electronic equipment, including TV, operates best at the 115-120 volts for which it is designed. Where high or low voltage affect the performance and operating life of tubes and other components, use a Terado Voltage Adjuster on your service

calls. Will correct any voltage within a 95 to 135 range to a normal 115-120. You'll sell 'em too! Great for TV, hi-fi, and universal A.C. motors in low or high voltage areas.

Saturn (shown; to 500 Watt)

Dealer Net.....\$14.65

Polaris (same without meter)

Dealer Net.....\$ 9.20

Planet (up to 300 Watt) Dealer Net. \$ 7.80

See your electronic parts jobber, or write:

terado CORPORATION
1073 Raymond Ave.
St. Paul 8, Minnesota
In Canada, Atlas Radio Corp., Ltd., Toronto, Ont.

Circle 56 on literature card



March 22-26, 1965

ELECTRICAL-ELECTRONICS

Exhibit hours (4 days):

Monday & Thursday, 9:45 a.m.—9 p.m.

Tuesday & Wednesday, 9:45 a.m.—6 p.m.

Technical sessions (5 days)

HILTON & COLISEUM

10 a.m.—5 p.m.



**NEW YORK COLISEUM
and the N. Y. HILTON**

Buses every few minutes

Members \$2.00; Non-Members \$5.00

Circle 57 on literature card

78 PF REPORTER/January, 1965



Portable Communications Kit (133)

Instant 2-way radio communication is the purpose of this compact, lightweight, completely self-contained communications kit. Each E. F. Johnson kit contains two hand-held transceivers with rechargeable batteries, leather carrying cases, and flexible fiberglass antennas—plus two extra batteries. The units each contain 11 transistors and four diodes and operate in the 25- to 50-mc range. All items are packaged in a rugged carrying case that is 5" wide, 11" high, and 17" long. Fully equipped, the case weight only 10 lbs.

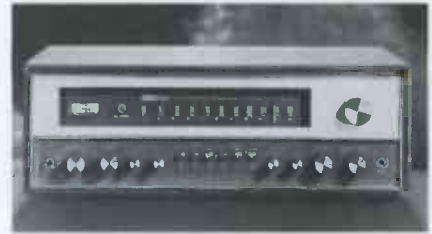


Rebuild Picture Tubes (134)

Owners of television repair shops can obtain the equipment required to set up their own low-cost picture-tube rebuilding plant. Picture tubes can be rebuilt, using techniques and equipment obtained from Windsor Electronics, with a cost for materials of \$1.50, and one hour's labor. Complete plants are priced from \$2990.00, including training on how to operate the equipment.

Solid-State Stereo (135)

An all-transistor FM stereo receiver with an extended frequency response (5 to 60,000 cps) is Harmon-Kardon's Model SR900. This unit features a stereo logic circuit which automatically switches the



receiver from stereo to mono operation, if the stereo signal becomes too noisy. This one-chassis receiver has fingertip rocker switches for selection of contour, tape monitor, tone control defeat, and mono-stereo. Music-power output is 75 watts and harmonic distortion is less than .2%. List price is \$469.00.

new AKTRON visual pack

Instant visual
identification
Dirt and dustproof
seal Easier to stock •
display • carry Same
superior Oaktron quality
Available in popular models



For complete information,
write for Catalog No. 1064

AKTRON INDUSTRIES: MONROE, WISCONSIN

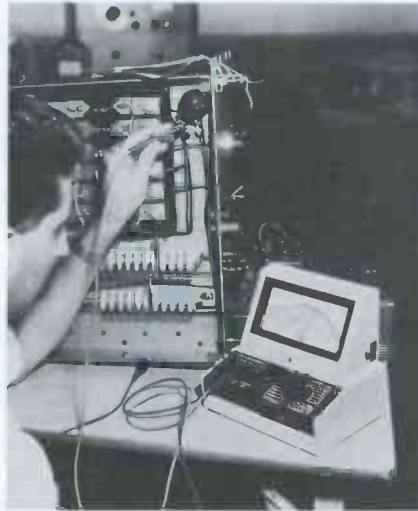
Circle 55 on literature card



CB Communications (136)

A completely transistorized 11-channel Citizens-band transceiver that is only one half the size of tube models, and

uses only one fourth as much power, is Raytheon's Ray-Tel TWR-5. The front panel location makes numerous installations possible: under a dashboard, on an overhead, against a side wall, or on top of a desk. The use of 14 transistors and 5 diodes contributes to its compact size (8¼" x 3¼" x 10¼").



Multipurpose Meter (137)

This portable volt-ohm-milliammeter, packaged in a console-type case, has a tilted meter face and refractive antiparallax scale. The Weston Model 80 has DC voltage scales from .25 to 5000 volts; AC voltage scales from 2.5 to 5000 volts; and DC current scales from 50 uamps to 10 amps. A reversing switch on the side panel enables the user to change polarity under load without changing lead terminations. List price is \$79.50; carrying case is optional.



Speaker Enclosure (138)

This compact speaker system, consisting of a 6" woofer and a high-frequency tweeter, is capable of handling 40 watts of continuous power. The enclosure, 14½" x 10½" x 7¼", is constructed of high-stress, nonresonant panels and is finished in hand-rubbed walnut veneer. Known as the Sonomaster®, the Sonotone Model RM-1 has a consumer net price of \$42.50. ▲

Winegard

DEALER of the month

No. 32 of a Series



Winegard salutes Muskegon Engineers for Television, Muskegon, Michigan, and their distributor, Fitzpatrick Electric Supply Co., Muskegon Michigan.

Ralph Warner says: "We find Winegard Colortron Antennas are profit-making partners for color TV."

"Operating a successful business demands use of only the best quality products . . . that's why we *always* recommend Winegard. Fact is, we recommend Colortron C-43's to every color customer. We find they're the only antennas that give us the power to pull in Channel 8 out of Grand Rapids (over 60 miles away) with perfect color pictures."

Ralph Warner also uses other Winegard products. "Whenever more than one outlet is installed, we use model BC208 or EC230 boosters. This insures our customers of perfect reception even when many sets are in use at the same time."

The confidence Ralph Warner has shown in Winegard comes from installing Winegard products and seeing them in action. He is one more important serviceman who knows Winegard's standards of excellence first hand.

 **Winegard Co.**
ANTENNA SYSTEMS

D3009A Kirkwood • Burlington, Iowa

Circle 58 on literature card

January, 1965/PF REPORTER 79

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FREE Catalog and Literature Service

*Check "Index to Advertisers" for further information from these companies.

Please allow 60 to 90 days for delivery.

ANTENNAS & ACCESSORIES

65. **ANTENNACRAFT** — Latest information on FM antennas, featuring new omnidirectional model for multiplex or monophonic broadcasts.
66. **ALLIANCE** — Colorful 4-page brochure describing in detail all features of the famous *Tenna-Rotors*.
67. **FINNEY**—Catalog No. 20-291 gives information on single-channel couplers.*
68. **G. F. WRIGHT**—Catalog sheets on guy wire used with outside antenna installations.
69. **GC ELECTRONICS**—Complete TV antenna brochure No. FR-632-G representing latest *Colormagic* antennas.
70. **JFD**—Literature on complete line of antennas for VHF, UHF, FM, and FM-stereo. Brochure showing converters, amplifiers, and accessories; also complete '64-'65 dealer catalog.
71. **MOSLEY ELECTRONICS** — Illustrated catalog giving specifications and features on large line of antennas for Citizens band, amateur, and TV applications.*
72. **MULTITRON**—Illustrated literature on FM-stereo antenna No. MA-44 and Multituner Model M-11.
73. **SPAULDING**—Specification booklet on all types of antenna towers for TV, ham, and commercial applications.
74. **STANDARD KOLLSMAN** — Catalog sheet on UTC-051 transistor UHF converter kit with IF amplifier.
75. **TRIO**—Brochure on installation and materials for improving UHF translator reception.*
76. **ZENITH**—Informative bulletins on universal loudspeakers and a new line of log-periodic vee-type antennas for FM and monochrome or color TV.

AUDIO & HI-FI

77. **ADMIRAL**—Folders describing line of '65 equipment; includes black-and-white TV, color TV, radio, and stereo hi-fi.*
78. **ATLAS SOUND**—Illustrated data sheet describing C-46 and C-66 sound columns, two-way wall speaker system, and bidirectional baffle speaker combinations.
79. **BENJAMIN**—Brochure on *Miracord* record changers and *Elac* phono cartridges.
80. **CADRE**—Bulletin No. CM-84 gives features and specifications on "Consort" FM wireless microphone.
81. **GIBBS SPECIAL PRODUCTS**—Folders describing principles of sound reverberation and *Stereo-Verb* reverberation units for automobiles.
82. **OAKTRON**—"The Blueprint to Better Sound" an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.*
83. **OXFORD TRANSDUCER** — Product information bulletin describing complete line of loudspeakers for all types of sound applications, including replacements for public address and intercom systems.
84. **PERMA-POWER** — New catalog sheet describing *Ampli-Vox* Model S-300 and *Sound Cruiser* sound system Model S-310.*
85. **QUAM-NICHOLS**—Catalog No. 64 listing over 30 speakers and transformers for sound system applications.*
86. **SONOTONE** — Cross-reference crystal cartridge replacement chart.*

87. **SWITCHCRAFT**—New product bulletin No. 147 describing new slimline and compact 4-pin connectors.
88. **UNIVERSITY** — Guide to high fidelity and new catalog on line of "Mustang" loudspeakers.

COMMUNICATIONS

89. **MULTITONE**—New 8-page color brochure on pocket-paging system for instant communications.
90. **PEARCE-SIMPSON** — Specification brochure on *Companion II, Escort, and Guardian 23* Citizens-band transceivers.
91. **SONAR RADIO**—Specification sheet on Model FM-40 business radio.
92. **TURNER**—Brochure No. 1025 on new line of microphones for base-station and mobile use; includes list prices.

COMPONENTS

93. **AMPHENOL** — Complete comprehensive catalog of microminiature, rack and panel, and printed-circuit connectors.
94. **ANTRONIC**—Catalog sheet on new products being introduced to the industry; includes tube and continuity checker.
95. **BUSSMANN** — Bulletin SFUS listing complete line of Buss and Fusetron small-dimension fuses by size and type. Indicates proper fuse holders and gives list price.*
96. **IEH**—Data sheet on *Vi-Tran* transistorized vibrator eliminator.
97. **MASTRA**—Information concerning "Totemaster" tube caddy; four layers convert to any desired size.
98. **PERMACEL** — Product specifications on plastic tapes listing types, technical data, uses, and product features.
99. **SPRAGUE** — Latest catalog C-616 with complete listing of all stock parts for TV and radio replacement use, as well as *Transfarad* and *Tel-Ohmike* capacitor analyzers.*

SERVICE AIDS

100. **CASTLE**—How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included.*
101. **CHEMTRONICS** — Colorful catalog No. 64 contains information on chemicals as aids to the electronics serviceman.
102. **MID-STATE TUNER** — Information on rebuilding tuners—VHF, UHF, or combination types. Special get-acquainted offer is now in effect.*
103. **PRECISION TUNER**—Literature supplying information on complete, low-cost repair and alignment services for any TV tuner.*
104. **YEATS**—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight-aluminum construction.*

SPECIAL EQUIPMENT

105. **ATR**—Descriptive literature on selling new, all-transistor *Karadio* Model 707, having retail price of \$29.95. Other literature on complete line of DC-AC inverters for operating 117-volt P.A. systems and other electronics gear.*

106. **GREYHOUND** — The complete story of the speed, convenience and special service provided by the Greyhound Package Express method of shipping, with rates and routes.
107. **STACO**—Information on Adjust-A-Volt type T1520U variable transformer.
108. **VOLKSWAGEN**—Large, 60-page illustrated booklet, "The Owner's Viewpoint," describes how various VW trucks can be used to save time and money in business enterprises, including complete specifications on line of trucks.
109. **WALLIN-KNIGHT** — Folder on Reflect-O-Scope, an effective tool for static convergence of color TV receivers.
110. **WORKMAN** — Catalog on transistorized products—battery chargers, power converters, CB vibrators, and test equipment.

TECHNICAL PUBLICATIONS

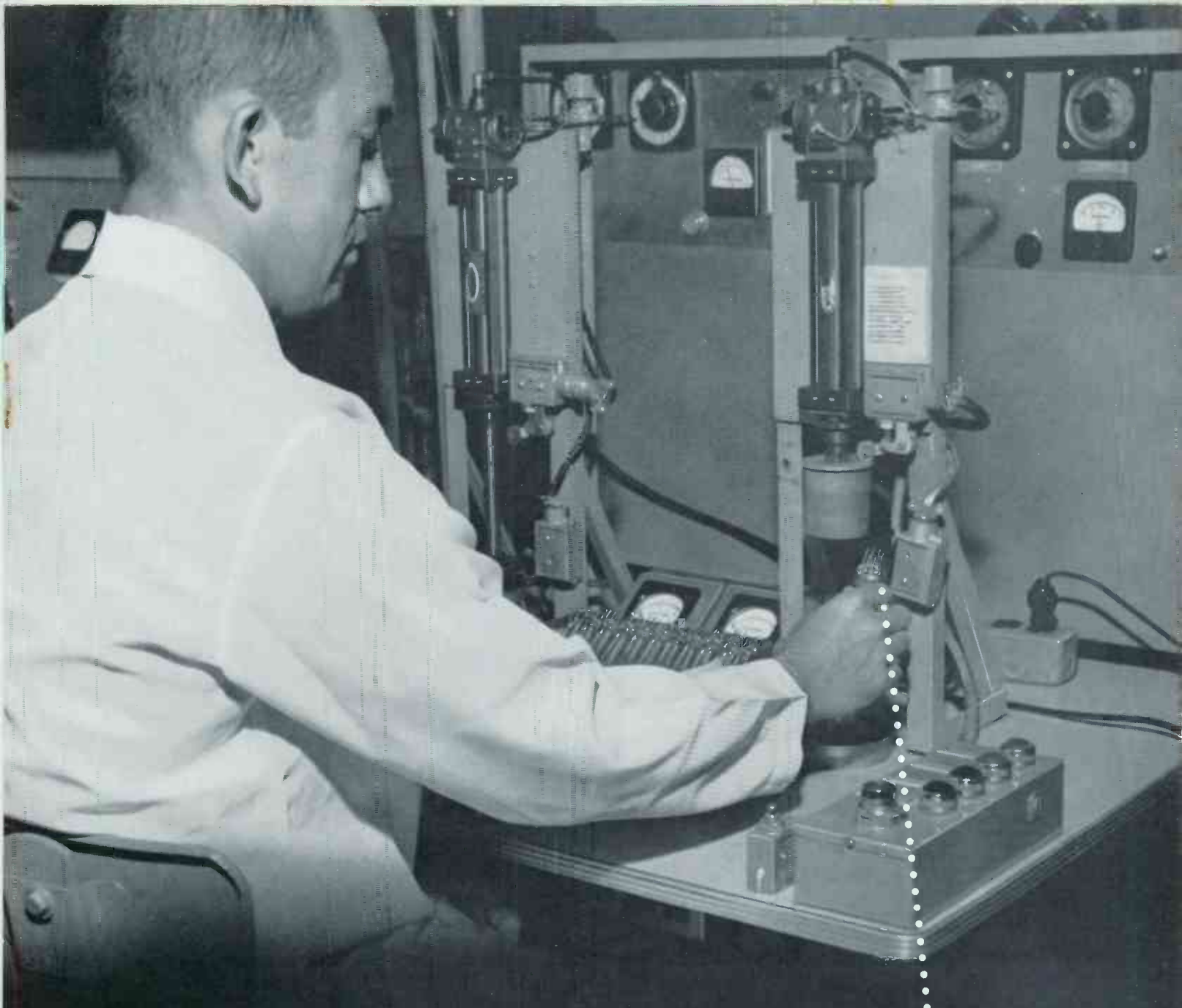
111. **CLEVELAND INSTITUTE OF ELECTRONICS** — "Pocket Electronics Data Guides" and handy conversion factors, formulas, tables, and color codes. Additional folder, "Careers and Opportunities in Electronics," describes home-study electronic training program, including preparation for FCC license exam.*
112. **RCA INSTITUTES**—64-page book, "Your Career in Electronics," detailing home study courses in TV servicing, communications, automation, drafting, and computer programming; for beginners and experienced technicians.*
113. **HOWARD W. SAMS** — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1964 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

114. **B & K**—Bulletin No. 124-R on new Model 1240 color generator. Catalog AP-21R describing uses for and specifications of Model 1076 Television Analyst, Model 1074 TV Analyst and Color Generator, Model 700 and 600 *Dyna-Quik* Tube testers, Model 445 CRT Tester-Rejuvenator Model 960 Transistor Radio Analyst, Model 360 *V-O-Matic* VOM, Model 375 *Dynamic* VTVM, Model 1070 *Dyna-Sweep* Circuit Analyzer, and Model 230 Substitution Master.*
115. **EICO**—New 1965 catalog listing over 200 products including color bar generator, oscilloscopes, and others; all available in kit form.*
116. **HICKOK**—Complete description and specification information on newly introduced Model 662 installer's color generator, portable FM multiplex generator, Model 235A VHF-UHF field strength meter, and Model 800 tube tester.*
117. **JACKSON** — Complete catalog describing all types of electronic test equipment for servicing and other applications.*
118. **MERCURY**—Complete catalog on line of test equipment to help the serviceman.
119. **SECO**—Data sheets on self-service tube testers and caddy-pack tube testers that carry over 200 tubes.
120. **SENCORE**—New color catalog on complete line of company products; oscilloscopes, generators, testers, and many others.*
121. **SIMPSON**—Complete 16-page brochure on entire line of electronic test equipment; also, catalog on line of panel meters.*
122. **TRIPLETT**—All new test-equipment catalog No. 46-T showing complete line of VOM's, tube testers, transistor analyzers, and signal generators.*

TOOLS

123. **ENTERPRISE DEVELOPMENT**—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.*
124. **LUXO LAMP**—New catalog No. 114-2 showing illuminated magnifiers and low voltage lights.
125. **ONEIDA**—Brochure on soldering-gun attachment that cleans printed-circuit terminals in seconds.
126. **VACO**—Folders on complete line of hand tools and solderless terminals.



A GOOD TV PICTURE STARTS HERE

It Depends on a Leakproof Stem Seal

The slightest leakage of air weakens the high vacuum of a TV picture tube...resulting in a costly callback and a dissatisfied customer for you. This is why RCA takes extra precautions to maintain the vacuum in Silverama picture tubes.

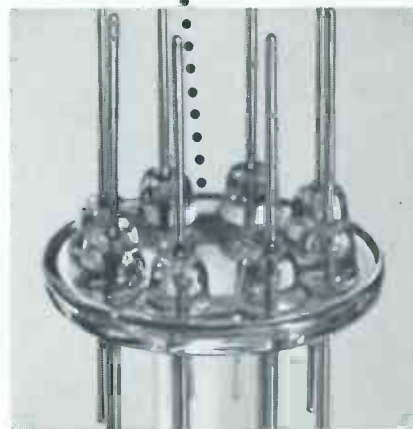
Potential trouble spots are the glass-to-metal lead-wire seals in the electron-gun stem assembly (below). At RCA, stem assemblies are batch tested for leakage in a supersensitive leak detector *before* they go into electron guns.

So sensitive is this detector that it can pinpoint a leak that would not affect tube performance for years...a leak so tiny that no other inspection method could hope to find it.

Yet the slightest sign of a leak is cause for rejection of a stem. This extra precaution is one more example of the care that goes into every phase of Silverama manufacture...and one more reason why RCA Silverama should be your first choice in replacement picture tubes.

Silverama is made with an all-new electron gun, finest parts and materials, and a glass envelope that has been thoroughly cleaned and inspected prior to re-use.

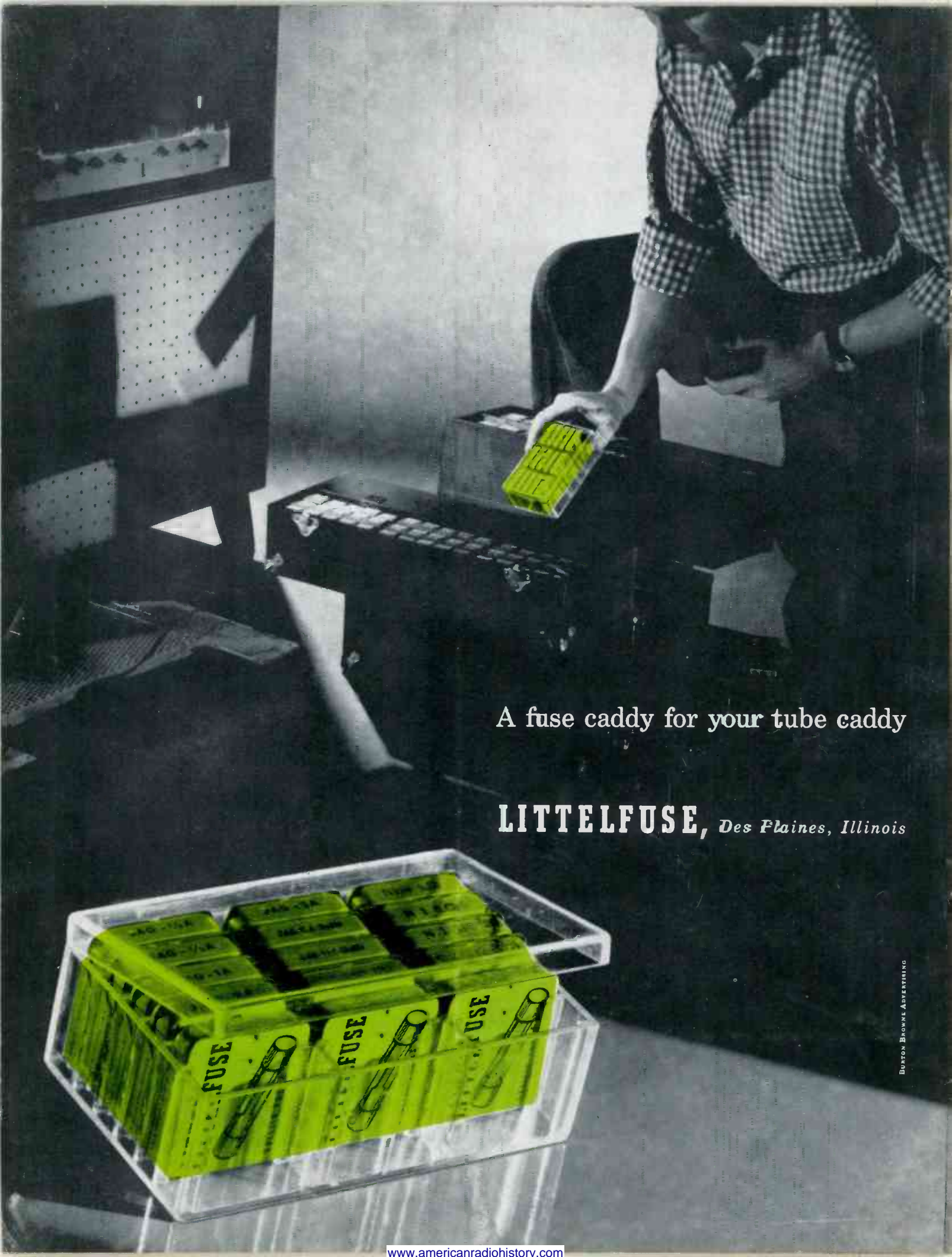
RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.



Stem assemblies are tested on a special high-vacuum leak detector. Detector is a helium mass-spectrometer, detecting passage of helium "tracer" gas through any of the glass-to-metal seals. A stem assembly passing this rigorous test is ready to become a vital part of an RCA Silverama® Picture Tube.



The Most Trusted Name in Electronics



A fuse caddy for your tube caddy

LITTELFUSE, *Des Plaines, Illinois*

BURTON BROWN ADVERTISING