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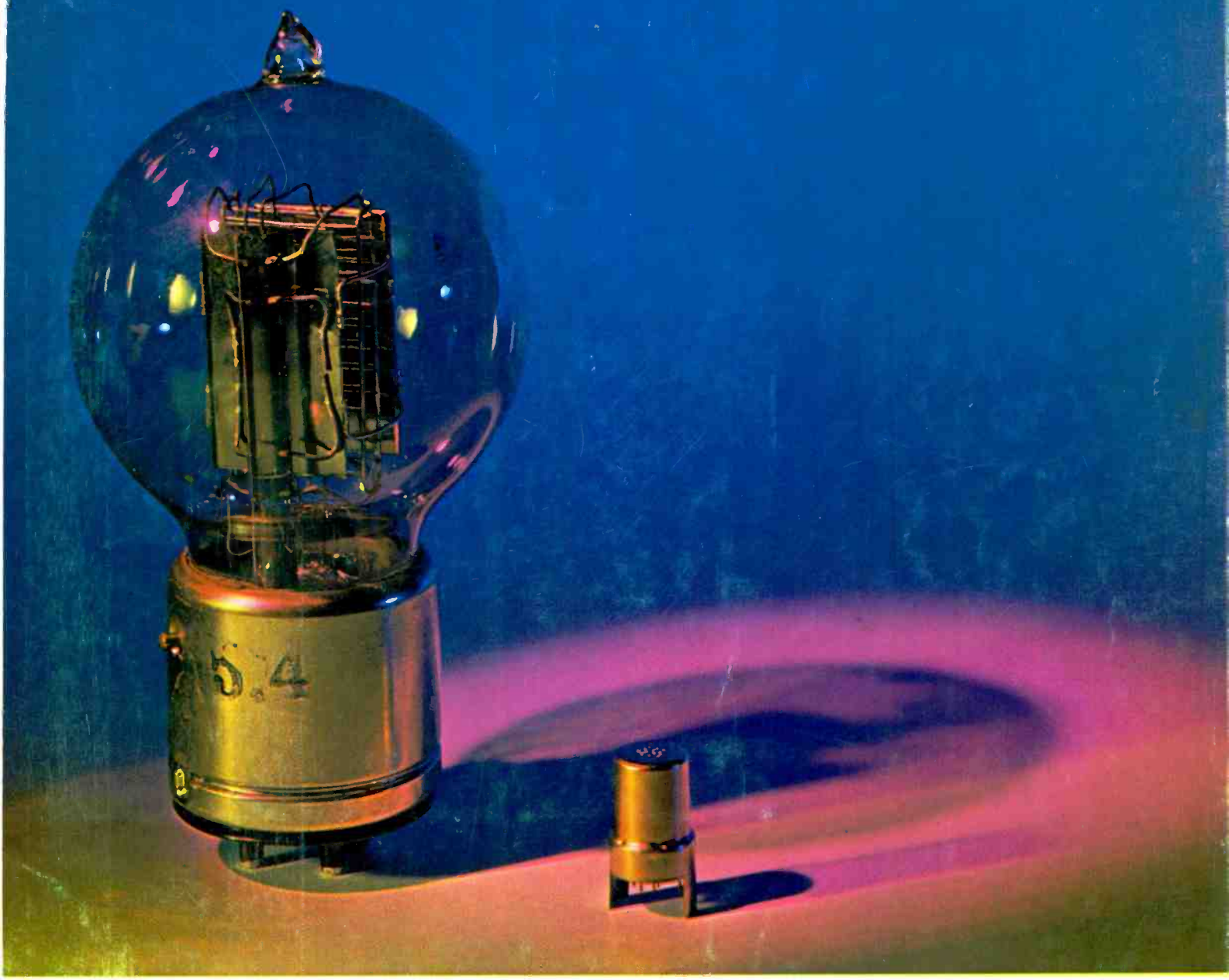
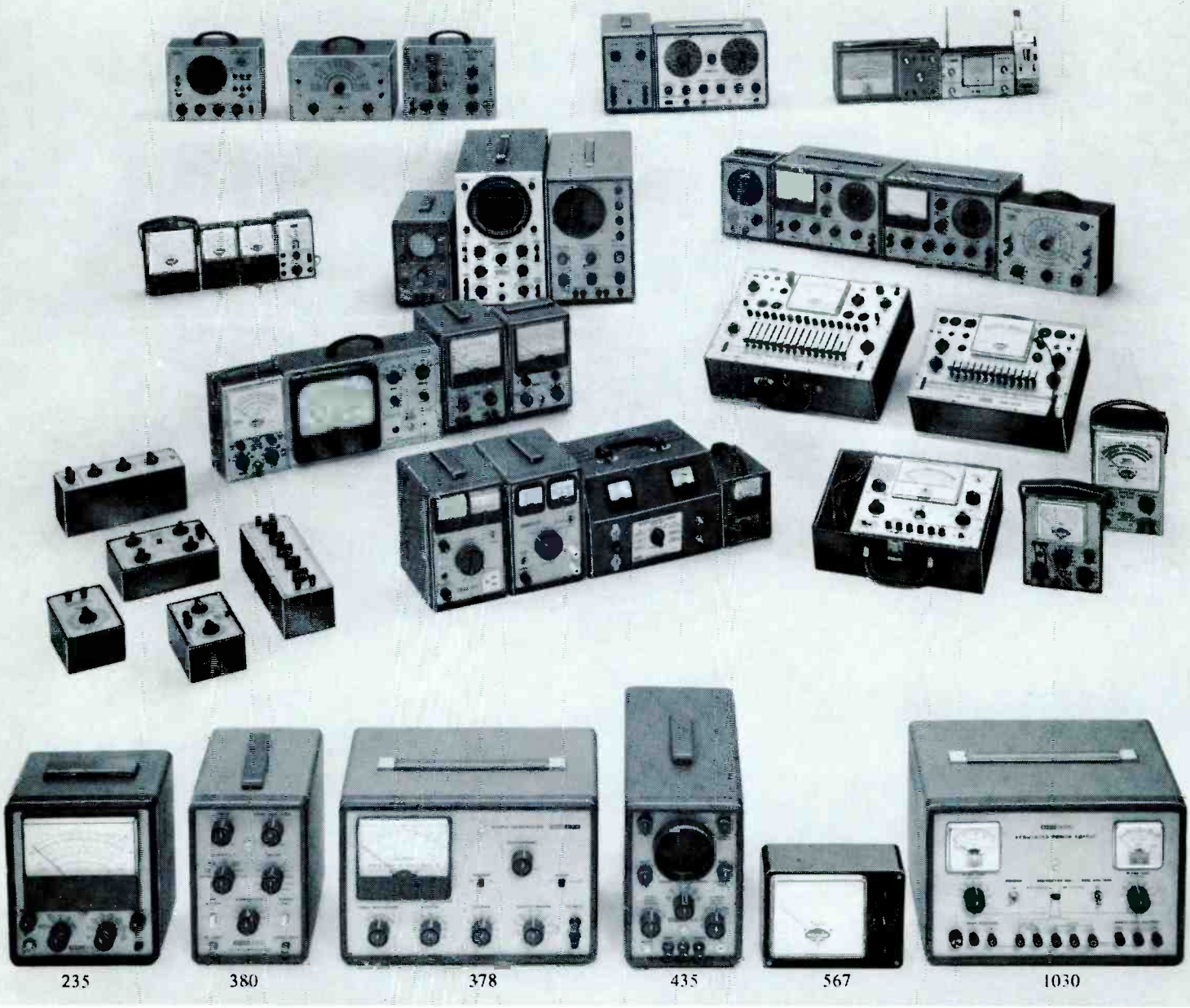


- Troubleshooting With the Scope
- Picture Tube or Chassis—Which
- Antennas Can Add Profits
- TV Tube Stock Guide
- Meet a CB Specialist



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TROUBLESHOOTING RF IF & VIDEO with the Oscilloscope

Modern electronic equipment demands the use of an oscilloscope. These critical circuits can be checked effectively with the information contained here.

Robert G. Middleton

Troubleshooting modern electronic circuits literally demands the use of an oscilloscope, yet many service technicians experience difficulty in learning how to use this versatile instrucent.

Of the numerous service technicians who have difficulty in employing an oscilloscope, many own or have used one, but really don't understand its functions well enough to set it up for proper waveform displays. On the other hand, technicians who fully understand the workings of a scope rate it among their most valuable instruments.

Use of the scope is divided into two general categories — signal-tracing circuits supplied with external signals, and checking waveforms in signal-generating stages which operate independently of external signals. Signal tracing is the procedure by which the progress of an applied signal voltage is checked, stage by stage, through the signal channels of a television receiver. The signal channels comprise an RF amplifier, mixer, video-IF amplifier, video amplifier, sound-IF amplifier, and audio amplifier.

Troubleshooting RF Amplifier

When the symptom is "no picture and no sound," signal tracing starts logically at the front-end — after tubes have been checked, of course. A typical front-end configuration is shown in Fig. 1. The *test point* (often called the *looker point*) is a convenient terminal from which to make a preliminary signal-tracing test. A low-capacitance probe and scope are connected to it, and the front-end input terminals energized from a TV antenna or from a pattern or signal generator. If the scope has good sensitivity, about an inch of vertical deflection will normally be obtained from a fairly strong input signal. When a pattern generator is used, the video waveform in Fig. 2 will normally be observed.

If the scope sensitivity is low, a direct probe can be applied to the looker point — although the increased circuit loading will add to the waveform distortion. Even with a low-C probe, the reproduced video waveform has appreciable distortion because the looker point is a tap on the mixer grid-leak. Thus, between the mixer grid and the probe there is a series resistance, which acts as a low-pass filter. The horizontal-sync pulses are attenuated considerably, and the high-frequency components of video information are lost. Nevertheless, the significant consideration is the *presence or absence* of the signal. If absent, the front-end components

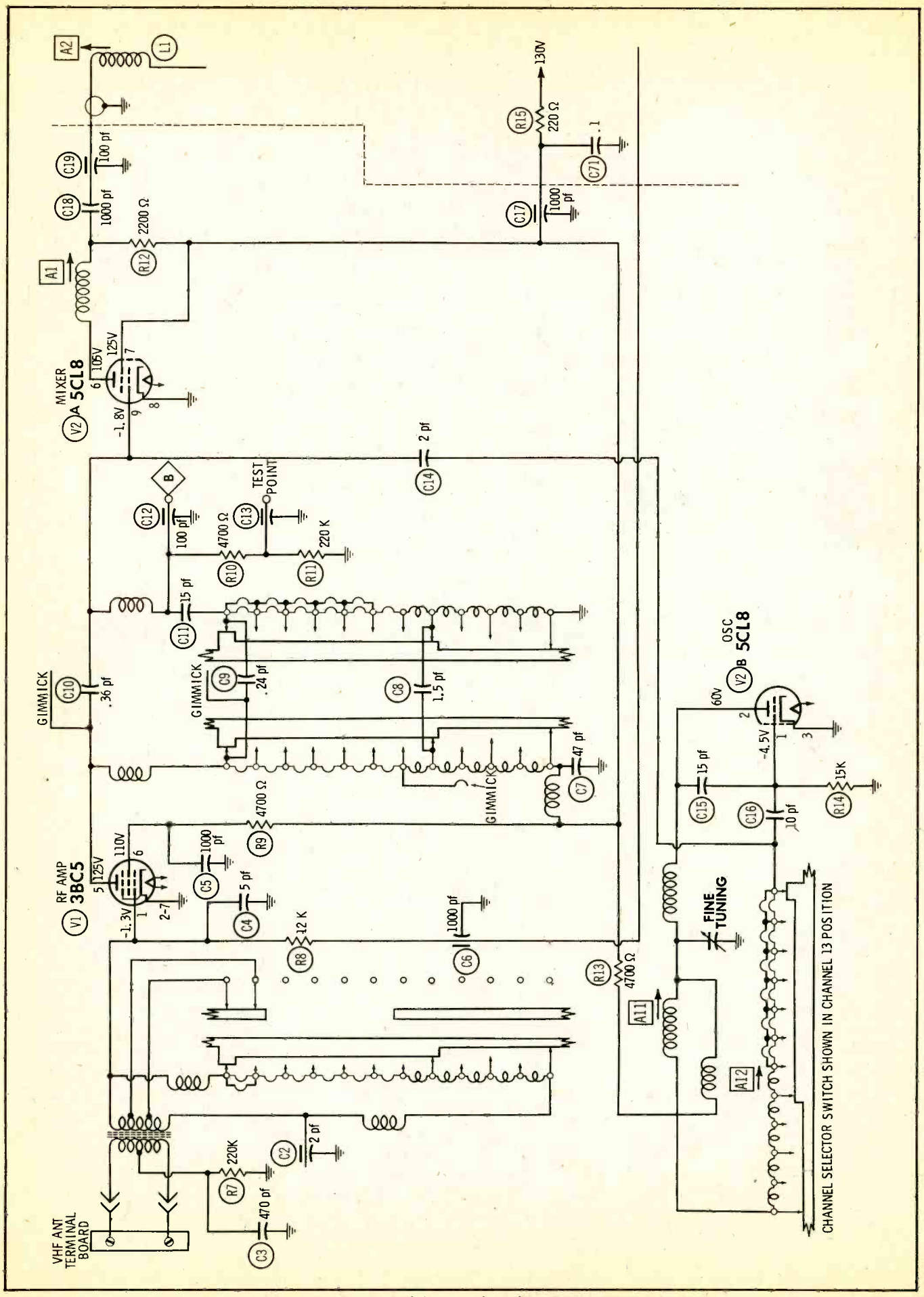


Fig. 1. Typical front-end configuration.

Fig. 2. Video waveform present at the looker point.

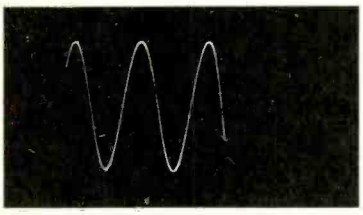


Fig. 3. AM generator displays a sinewave signal.

must be checked. DC voltages can be measured with a VOM or VTVM, and resistors with an ohmmeter. Capacitors must be removed from the circuit and checked on a tester (or by substitution). When components are inconveniently "buried" in a front-end, many technicians prefer to send it to a specialty shop for repair.

There is a reason for using a low-C or direct probe at the looker point, instead of a demodulator probe. The mixer is a heterodyne configuration in which the grid circuit operates basically as a rectifier, and not as an amplifier. (There is a small gain through the mixer stage, but this is not its primary function). The grid normally operates at zero bias (or contact potential). Should a DC bias voltage be fed to the grid, the tube would be biased to the midpoint of its characteristic and operate as an amplifier instead of detector. No IF signal would appear at the plate and, for all practical purposes, the mixer would be dead.

A substantial negative bias will appear on the mixer grid during normal operation. It is generated by grid-current flow during positive peaks of the oscillator signal, which is injected into the mixer grid circuit. This signal-developed bias provides a good check of oscillator operation. If a VOM or VTVM measures zero volts or only the contact potential (about −0.5 volt), the oscillator stage is dead.

When no signal is found during a scope check at the looker point, do not forget to measure the AGC voltage to the RF amplifier. AGC trouble can bias off (cut off) the RF-amplifier tube, and thereby give a false appearance of front-end trouble. The AGC voltage should measure nearly zero volts with no signal input to the front end. With an applied signal, several volts of negative bias will be measured when the signal level is turned up.

If a TV station signal is used, a changing video waveform is normally displayed at the looker point. The signal has the basic appearance shown in Fig. 2. If an AM signal generator is used to drive the front end, a sine-wave signal is normally observed at the looker point. (Fig. 3.). The waveform may or may not appear distorted, depending upon the signal generator being used. Some AM generators have a good sine-wave modulation, while others have a highly distorted waveform. Distorted modulation is not of concern; only the *presence* of a signal is checked.

The detector action of a mixer tube is indicated in Fig. 4. Partial rectification is illustrated. The modulated RF input signal has an average value of zero, because the positive and negative half cycles have equal excursions. The output signal however, does not have an average value of zero. It has a DC component on which the modulating frequency component is superimposed. The modulating frequency is comparatively low, and falls within the response range of the scope. Hence, the modulating frequency waveform is seen on the scope screen.

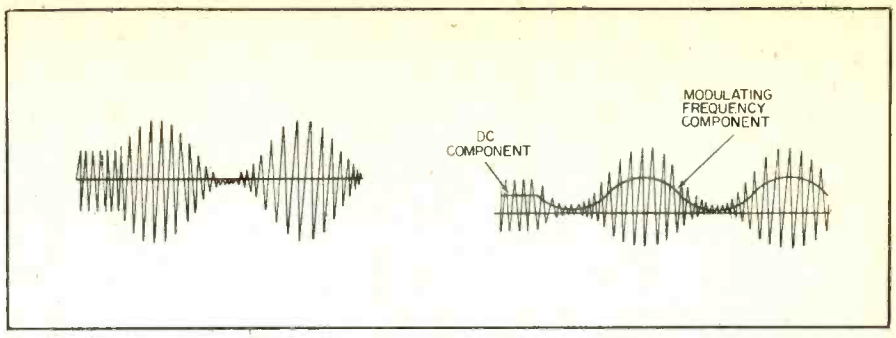


Fig. 4. Detection process in mixer tube.

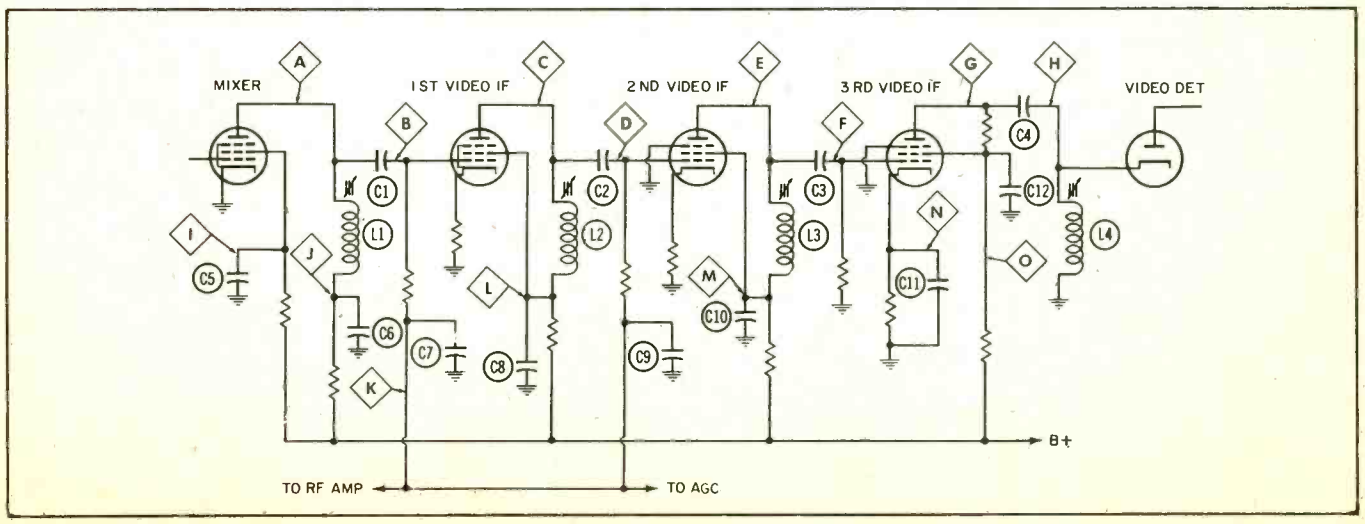


Fig. 5. Diagram of a three-stage video-IF amplifier system.

Fig. 6. Typical pattern obtained in an IF signal-tracing test.

Signal Tracing in the IF Section

A demodulator probe is used to signal-trace the video-IF section. Fig. 5 shows a simplified video-IF circuit, with successive test points lettered. The lowest signal level occurs at point A, and the highest at point H. The normal signal level at point E will be greater than the normal level at point D, due to the stage gain. However, when making demodulator probe tests, the reverse may *seem* to be the fact. Input capacitance of the probe causes circuit detuning.

IF amplifiers are staggered-tuned. In case L3 is tuned to a lower frequency than L2, application of the probe at Point E temporarily makes it resonant frequency still lower. The impedance of the L3 plate-load circuit becomes abnormally low. The stage may appear to have a loss instead of a gain. Hence, do not consider apparent gain indications as meaningful, and look merely for the presence of a signal. A typical pattern is shown in Fig. 6. The scope is deflected at a 30-Hertz rate, because the pattern is distorted (due to limited probe bandwidth), and the vertical sync pulse is the most prominent element in the pattern.

In the example cited, wherein L2 is tuned to a higher frequency than L3 (Fig. 5), applying the probe at point D may cause the IF stage to break into oscillation. This occurs when the probe's input capacitance lowers the resonant frequency of L2 to about the same value as L3. The stage then operates as a tuned-plate tuned-grid oscillator. No pattern appears on the scope screen, because the stage is blocked by the high signal-developed bias resulting from oscillation. Thus, the stage may *seem* to be dead when tested at point D, but the false conclusion is avoided by observing that a signal is found at point E.

If a signal is found at point C, but not at point D, this indicates that coupling capacitor C2 is open. Little or no signal is normally found at decoupling points, such as I, J, K, etc. Do not be misled by the presence of a *small* signal at decoupling points. It is difficult to get a perfect AC ground at 40 MH3, because of the series inductance of connecting leads. Thus, unless the leads of the decoupling capacitor are very short, bypass action is somewhat incomplete. When a stage does not check out satisfactorily in the signal-tracing test, individual components in the stage are tested next. DC voltages and resistances are measured and compared with values specified in the receiver service data. Capacitors are tested on a capacitor checker, or by substitution.

Poor Picture Quality

Trouble in the IF amplifier can cause a poor picture-quality symptom, as illustrated in Fig. 7. If a laboratory-type (wideband) demodulator probe is available, the defective stage can be located directly by a signal-tracing procedure. The video signal is inspected for distortion as the probe is moved progressively through the IF-amplifier section. If a service-type demodulator probe is used, the video signal is so severely distorted that the needed indication is masked. Therefore an indirect troubleshooting method must be used.

A sweep generator is used, instead of a pattern or signal generator. For details of application, the

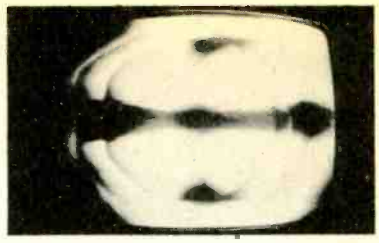


Fig. 7. IF defect causes poor picture-quality symptom.

reader is referred to *101 Ways to Use Your Sweep Generator*. Good picture quality depends upon adequate bandwidth and a reasonably flat-topped frequency response. Fig. 8 shows how bandwidth is measured between the 6-dB)half-voltage) points. A bandwidth of at least 3 MHz is required for acceptable picture quality. If the top is not reasonably flat, but sharply peaked, as in Fig. 9, picture quality is poor even when bandwidth is adequate. A sharp peak causes ringing in the picture (circuit ghosts).

Ringing appears as illustrated in Fig. 10. When you turn the fine-tuning control, the pattern changes rapidly. This occurs because the picture-IF carrier is being moved up or down on the IF-response curve. If you bring your hand near the IF tube(s) which are in the regenerative circuit, the pattern again changes rapidly. Because the IF response curve is so sharply peaked (Fig. 9), a small change in stray capacitance shifts the ringing frequency considerably. Regeneration is also responsive to signal-level (AGC bias) changes. The reason for this dependency is that the sharpness of the peak depends greatly on the amount of IF signal which is being fed back. When the IF gain is reduced less IF voltage is fed back. This reduces the amplitude of the peak and increases its bandwidth.

When the distorting stage is localized, the DC voltages and resistances in the circuit are measured, capacitors are checked, and the

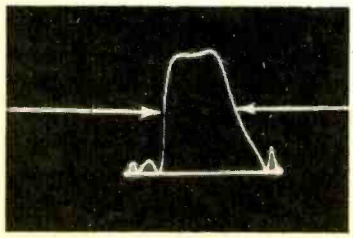


Fig. 8. Bandwidth is measured between the half-voltage peak points.

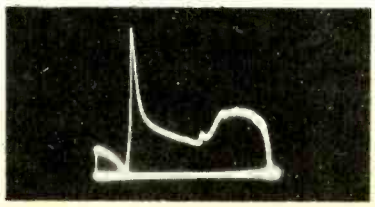


Fig. 9. A sharp peak on a response curve causes ringing.

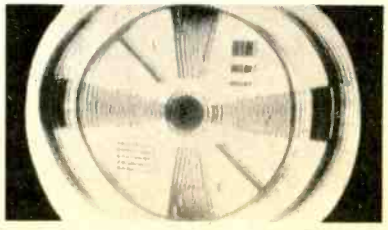


Fig. 10. Ringing distortion caused by IF regeneration.

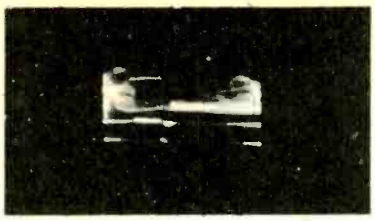


Fig. 11. Undistorted video signal.

stage alignment is investigated. Alignment of the tuned circuits is usually checked last, because poor picture quality is most likely to be caused by a defective component. There is usually only one defective component to be localized. If a screen-bypass capacitor is shorted, however, it sometimes damages the screen resistor also, because of excessive current drain.

Picture Pulling, or Loss of Sync

When an IF tube is overloaded, the sync pulses are always compressed or clipped, as seen in Fig. 12. Overloading is usually caused by the grid or cathode bias being too low. Thus, if C11 or C9 becomes shorted (Fig. 5), sync compression can be expected. Of course, it is assumed that IF-amplifier tubes are good. Vertical-sync punching is often observed when bias on an IF tube is too low. The vertical-sync pulse is depressed below the level of the horizontal pulses. Sync punching causes unstable vertical sync, or complete loss of vertical lock.

Severe overloading in an IF stage can cause a negative picture, when the grid-leak resistance is comparatively high. When a picture is completely negative, all the tones are reversed. When it is partially negative, the deep grays and blacks are reversed in tone, while medium and light grays are reproduced normally. Negative picture reproduction is caused by modulation reversal, whereby positive modulation is converted to negative modulation. Excessive grid-current flow, with suitable circuit constants, results in this conversion.

Hum in the IF Signal

There are two types of hum voltage which can enter the video signal. Power-supply hum may be either 60-Hertz or 120-Hertz frequency, depending on the type of power supply. Heater hum has a 60-Hertz frequency. A scope is a sensitive indicator of hum, and shows clearly the presence of hum voltage at levels below the point at which hum bars appears in the picture. When the hum level is high, the video signal appears typically as shown in Fig. 13, and the picture contains hum bars as in Fig. 14. Sync stability is often affected when the hum level is high.

Basically, 60-Hertz hum produces one cycle of sine-wave curvature in the video signal, while 120-Hertz produces two cycles. The pattern is not always simple. AGC action tends to smooth out the hum, and amplification becomes nonlinear when the hum level is high, distorting the hum waveform. Only heater hum has a sine source waveshape; power-supply hum usually has a distorted sawtooth waveshape.

To trace hum voltage to its source in an IF amplifier, it is usually necessary to clamp the AGC line with a bias box or battery. Doing so eliminates the confusion of AGC reaction, and the video signal will be normal until the stage injecting the heater hum voltage is reached. Thus, heater hum is easily and definitely localized in a signal-tracing test.

Power-supply hum, however, is a generalized source which feeds into all the IF stages. The hum component increases from stage to stage,

Fig. 12. Sync pulses compressed.

and has its lowest amplitude at the first IF grid. When power-supply hum is suspected, use a low-C probe with the scope, and check for hum on the B+ supply line. There is always some hum voltage present, but it should not be greater than the value specified in the receiver service data.

If normal reception resumes when the AGC line is clamped, the hum voltage is entering the IF amplifier via the AGC line. The trouble then will be found in the AGC section, and not in the IF section. Do not confuse hum voltage on the AGC line with 60-Hertz variations stemming from sync-section trouble. For example, if a fault in the AFC circuit causes the picture to pull considerably at the top, a loss of phase occurs between grid and plate pulses in a keyed-AGC tube, and a 60-Hertz voltage simulating hum appears on the AGC line.

Low Contrast Versus Stage Gain

Low contrast in the picture (Fig. 15) is due to low gain. It is sometimes necessary to localize a low-gain IF stage, to clear up a symptom of low contrast. Localization is uncertain with a demodulator-probe test, because of the erratic nature of circuit loading imposed by ordinary probes. However, by using the picture detector as the demodulator, and using an IF signal-injection technique, a low-gain stage can be quickly localized.

The test setup illustrated in Fig.

Fig. 13. Hum in the video-IF signal.

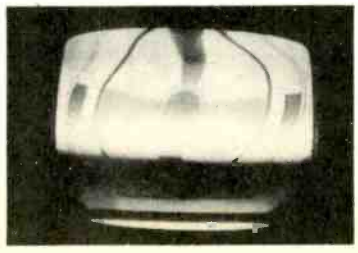


Fig. 14. Strong hum bar in picture.

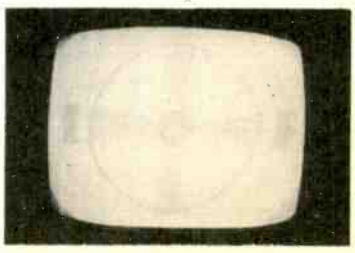


Fig. 15. Picture has low contrast.

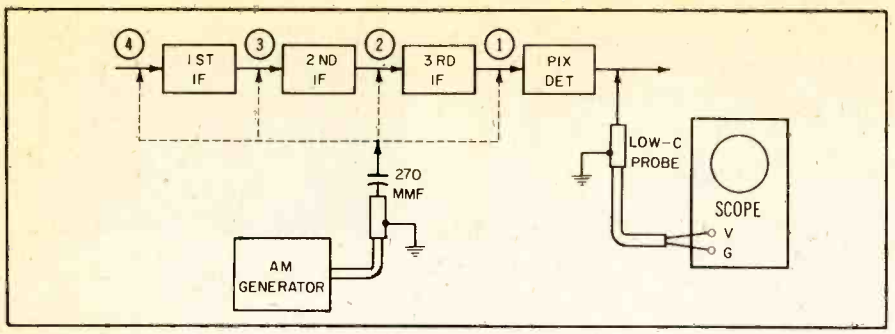


Fig. 16. Stage-gain test setup.

16 can be used. Connect a scope and low-capacitance probe to the picture-detector output, to serve as an indicator. Use an AM generator as a signal source, and connect a 270-mmf blocking capacitor in series with the "hot" lead, to avoid drain-off of DC bias. Clamp the AGC line with −1.5 or −3 volts DC from a bias box or battery, and apply the generator signal first at point 1 to drive the input of the picture detector. Operate the generator on its modulated-output function, tune to the mid-frequency of the IF band, and advance the generator output to produce about a half inch of vertical deflection on the scope screen. (This is a sine-wave pattern.)

Next, transfer the "hot" lead from the generator to point 2, the grid of the third IF tube. In case the third IF stage is operating normally, the sine-wave pattern on the scope screen will increase in height considerably. With −1.5 volts bias, a gain of 5 is typical; however, the exact stage gain differs depending upon the tube type and circuitry details. If the third IF stage is faulty, the pattern will increase only a small amount in height, or may even decrease. In such case, check out the components in the third IF.

The next test is made by connecting the "hot" generator lead to point 3, the grid of the second IF amplifier. If the pattern is off-screen vertically, go back to point 2 and reduce the generator output for a suitable pattern height, such as .5 inch. Then, transfer the generator lead to point 3, and observe how many times the pattern height increases. Again, a substantial gain should be found. Otherwise, there is a defective component in the second IF stage.

The first IF stage is checked for gain by transferring the generator lead to point 1, the grid of the first IF amplifier. This progressive test procedure will show definitely whether a low-contrast picture symptom is due to IF trouble, and if so, which stage is at fault. Each time the generator lead is moved back one stage, the true gain of the stage is determined, for the particular grid-bias voltage to which the AGC line is clamped.

This procedure gives a true gain figure, because the AM generator has low output impedance (the output cable is terminated usually in either 50 or 75 ohms). When the generator signal is applied to the grid of an IF tube, the low impedance of the source "swamps out" the resonant response of this grid circuit, and the following IF circuitry operates normally.

Ground-Circuit Difficulties

Although ordinary low-impedance demodulator probes are not susceptible to stray-field interference, application problems can arise in low-level circuits due to extended ground loops. In signal-tracing the first-IF stage, e.g., when the signal is checked at point A in Fig. 17, a different pattern may be observed if the probe is grounded at point 2, instead of at point 1. The reason is that the separated ground points have appreciable reactance between them at 40 MH3. If the probe is grounded at point 2, the voltage difference between points 1 and 2 is added to the grid waveform. Obviously, if the demodulator probe is connected between grounds 1 and 2, the probe input is not short-circuited. Instead, a waveform is seen on the screen when the scope is operated at high gain. The farther a pair of 40MH3 grounds are separated, the greater the ground-circuit interference.

Some IF amplifiers have a common ground point for all components within a given stage. In such case, the possibility of ground-circuit pickup is not present. However, this is not true of all IF strips, as ground points for grid and plate circuits may be separated several inches, in some chassis. The most troublesome ground-circuit interference occurs when the probe is moved from one stage to the next, without transferring the probe ground lead. That is, the signal is being checked in the first IF stage, for example, but the probe ground is connected to the chassis at the output of the second stage. This is very poor practice, because the ground-circuit drop may introduce

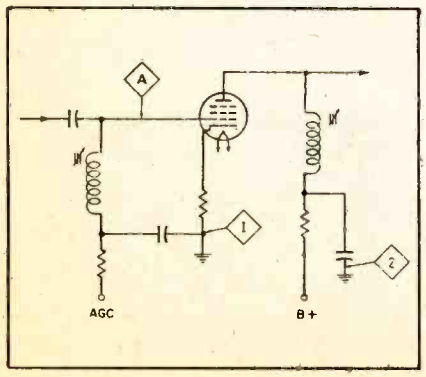


Fig. 17. Grounds (1) and (2) are at different 40-mc potential.

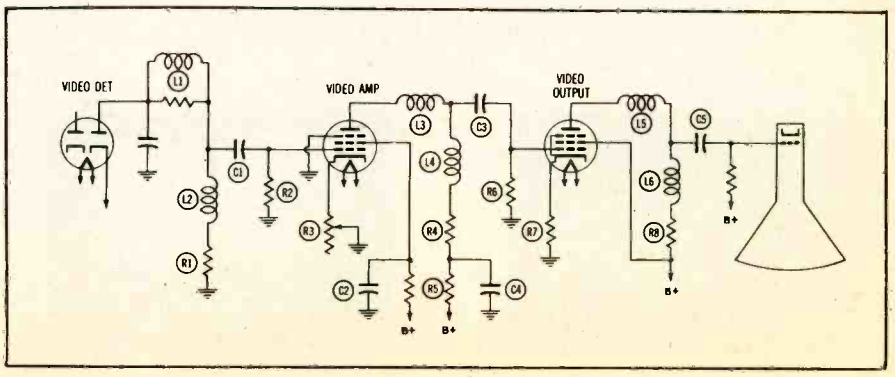


Fig. 18. Typical video-amplifier circuit.

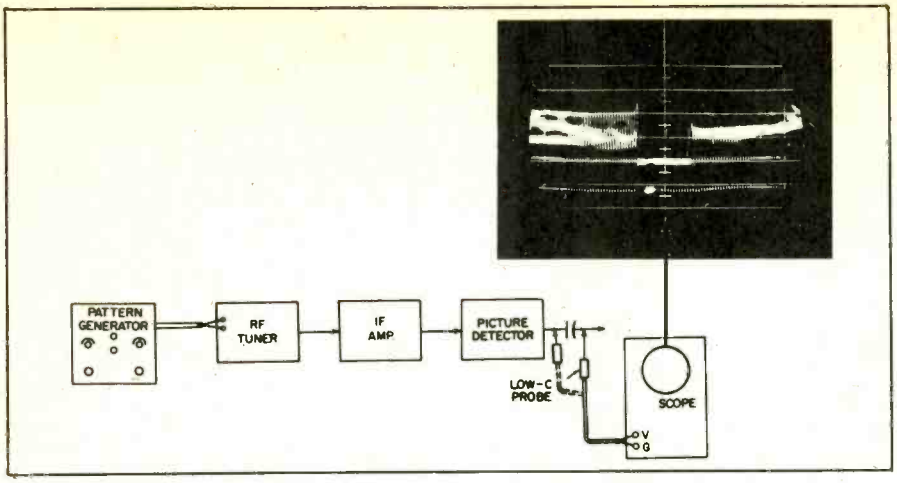


Fig. 19. Signal tracing across a coupling capacitor.

more signal voltage than is present at the first IF grid.

Signal Tracing in the Video Amplifier

A low-C probe is used when signal-tracing in the video-amplifier section. Fig. 18 shows a typical circuit for the video-amplifier section. This is an AC-coupled amplifier. Some video amplifiers are DC coupled, and many utilize only one stage. The coupling capacitors in AC-coupled amplifiers are checked easily in the signal-tracing procedure. Fig. 19 shows how a low-C probe is shifted from input to output of a coupling capacitor in this test. Practically the same undistorted video signal is found normally at either end of the capacitor.

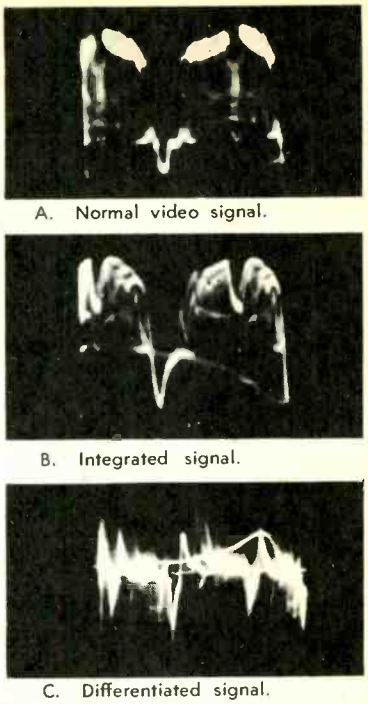
If the capacitor is open, or nearly open, the video signal is normal at the input end, but differentiated at the output, as shown in Fig. 20. If a good capacitor is bridged across the open unit, the output waveform is restored to normal. Thus, the scope and low-C probe serve as an efficient in-circuit capacitor checker.

In case an integrated video signal is observed, as shown in Fig. 20B, decoupling capacitor C4 (Fig. 18) would be the suspect. The suspicion is confirmed by checking across C4 with the probe. If video signal is present, the capacitor is open. An open decoupling capacitor causes integration of the video signal because the plate-load resistance is thereby increased to an abnormally high value. In turn, high video frequencies are attenuated and shifted in phase. Phase shifts in the video signal cause picture smear.

In order to see clearly the nature of frequency distortion and phase shift in a video signal, it is helpful to observe a simplified waveform consisting of a hybrid sine and square wave, as seen in Fig. 21. This waveform normally consists of a section of sine wave followed by a section of square wave. When differentiated, the flat top becomes curved downward, showing the loss of low frequencies. Also, the sine-wave section is shifted in phase, and leads the normal wave. The flat top becomes curved upward when integrated, showing the loss of high frequencies. The sine-wave section is shifted in phase, and lags the normal wave.

White Compression

When incorrect operating voltages cause a video-amplifier tube to compress or clip the video signal in the white region (Fig. 22), the picture appears muddy and filled up. On the other hand, compression or clipping of the sync tips causes impaired sync lock. Although sync clipping can occur in either the video amplifier or the IF amplifier, white compression occurs only in the video amplifier.



A. Normal video signal.

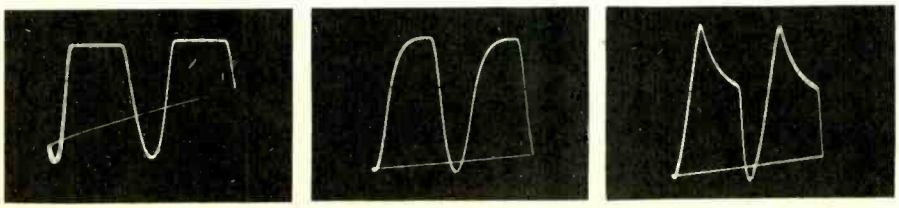
B. Integrated signal.

C. Differentiated signal.

Fig. 20. Normal and abnormal video waveforms found in circuit of Fig. 18.

If white compression is localized to a stage, check the DC voltages at the video-amplifier tube(s). Incorrect grid or cathode bias is the most common cause, although off-value plate and screen voltages are sometimes responsible. A leaky coupling capacitor, or a shorted cathode-bypass capacitor changes the grid and cathode bias voltages, respectively. Off-value plate or screen voltages are usually caused by resistors increasing in value (although a resistor occasionally decreases in value). A leaky screen-bypass capacitor reduces the screen voltage, and a leaky plate-decoupling capacitor reduces the plate voltage. An open screen-bypass capacitor causes a greatly reduced gain figure, and the picture has low contrast.

Gain is checked quickly by com-



A. Normal waveform. B. Integrated waveform. C. Differentiated waveform.

Fig. 21. Hybrid sine and square waves.

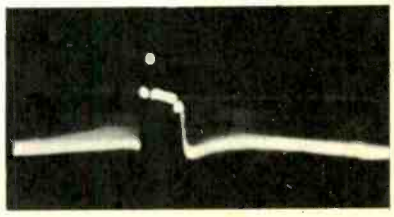


Fig. 22. Video signal with white portions compressed.

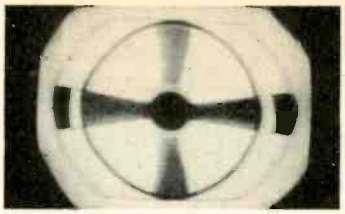
paring vertical deflections at the input and output of the video amplifier. Since normal gain figures vary considerably from one chassis to another, check the receiver service data. Peak-to-peak voltages at the video-amplifier output and input are specified. If the gain is normal, but the peak-to-peak voltages are low, the trouble is in a stage ahead of the video amplifier.

Poor Definition

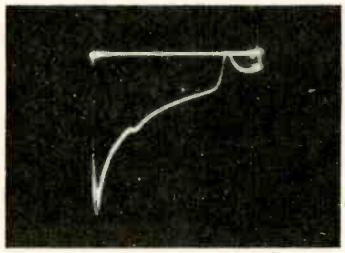
If poor picture definition occurs in the video amplifier, a signal-tracing test with square-wave input will disclose the faulty circuit. The output from a square-wave generator is applied at the video-detector output terminal, and a low-C probe is connected to the video-amplifier output terminal. Poor-definition picture, sweep-frequency response, and 100-kHz square-wave symptoms are shown in Fig. 23. The attenuated high-frequency response in the sweep-frequency pattern and the rounded corners in the 100-kHz square-wave pattern correspond to the "wiped out" vertical wedges in the test pattern.

The symptoms shown in Fig. 23 throw suspicion on the load resistors or peaking coils in a branch of the video amplifier. Remember that the video-detector output circuit is also the video-amplifier input circuit. Therefore, if the video-detector load resistor increases in value considerably, the symptoms seen in Fig. 23 appear. The square-wave signal-tracing procedure is useful because the distorted response is first found at the defective circuit branch.

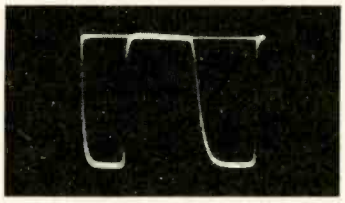
A peaking coil is sometimes shunted by a damping resistor, as indicated in Fig. 18. If the peaking coil opens, the circuit is still operative through the damping resistor. However, high-frequency distortion is severe, square-wave corner rounding is very evident, and the



A. Picture



B. Sweep-frequency response.



C. Square-wave response.

Fig. 23. Picture, sweep-frequency, and 100-kHz square-wave symptoms.

picture is badly smeared. If a damping resistor opens up, or increases greatly in value, the usual symptom is square-wave overshoot (Fig. 24). A small amount of overshoot is not objectionable, and has the effect of sharpening the edges of objects in the picture, particularly when old movie films are being televised. However, excessive overshoot causes an objectionable "outlining" of sharp edges in an image.

When the chassis has a one-stage video amplifier, the tube must be driven to maximum output to obtain normal picture contrast. Unless adequate screen and plate voltages are supplied to the tube, full contrast may require driving the grid into grid-current flow on positive peaks. In that case, any overshoot arising in the grid-circuit branch appears as an unsymmetrical overshoot (Fig. 25). On positive peaks of drive signal, the low grid-circuit impedance damps the peaking-coil response excessively, and the leading corner of the square wave is rounded. On the other hand, during negative peaks of drive signal, the grid-circuit impedance is high and the peaking coil response is undamped by the tube.

Ringing and Circuit Ghosts

In case the plate-load resistor of a video-amplifier tube decreases in value considerably, the high-frequency response rises excessively. In turn, a square wave of pulse shows both overshoot and ringing, as in Fig. 26. Here, the ringing is more prominent on the trailing edge, due to grid-current flow on the leading edge. Ringing produces "repeats" or circuit ghosts in the picture.

Excessive high-frequency response implies subnormal low-frequency response. This results in more or less tilt in the top of the square wave. Tilt also can be caused by a nearly open coupling capacitor. The picture symptom is lack of a solid tone across an image, or smear. Severe tilt is apparent in Fig. 26, along with the overshoot and ringing.

A valid check for ringing cannot be made unless the square-wave generator has a sufficiently fast rise time. The generator rise time should be at least as fast as the video amplifier. According to a rough rule of thumb, the rise time of an amplifier is given by one-third of the period corresponding to the frequency 3 dB down at the high end In other words, if a video amplifier has a 4-MHz bandwidth, the corresponding period is 0.25 microsecond, and the rise time will be about 0.08 microsecond. Hence the square-wave generator should have a rise time of 0.08 microsecond, or less, for a useful ringing test. ▲

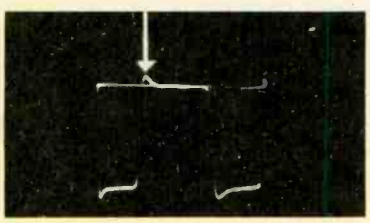


Fig. 24. Square wave with overshoot.

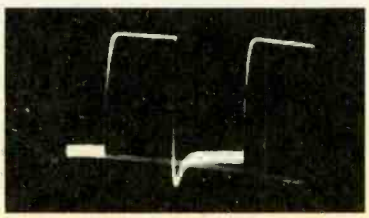


Fig. 25. Square wave that has an unsymmetrical overshoot.

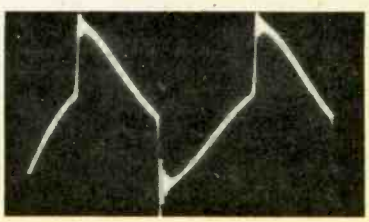


Fig. 26. Differentiation, ringing, and overshoot in a square wave.

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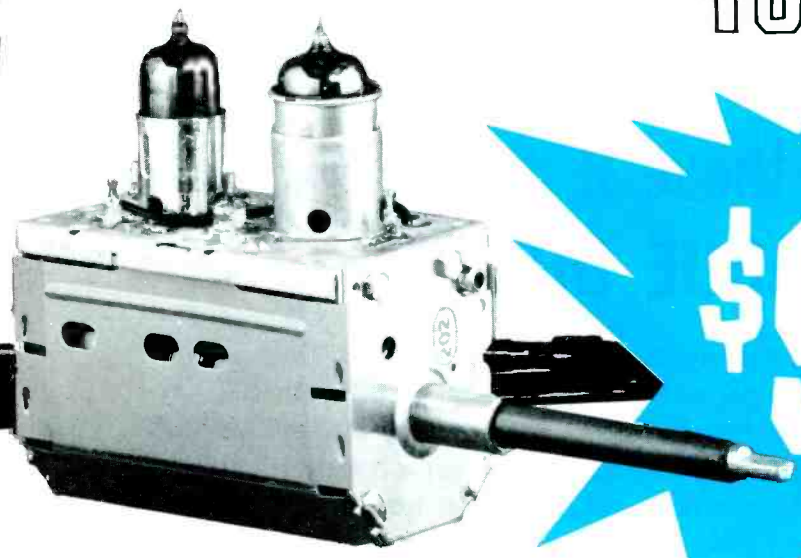

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PF Reporter

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the magazine of electronic servicing

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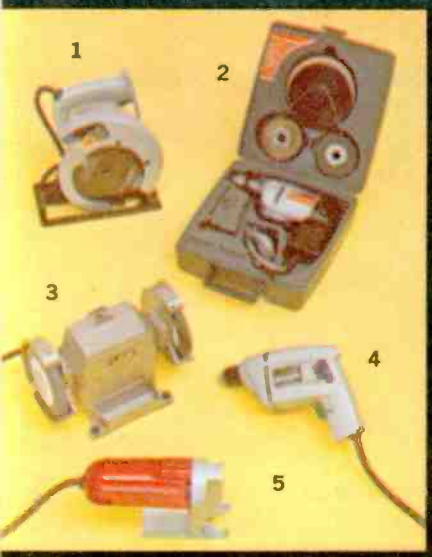
CONTENTS

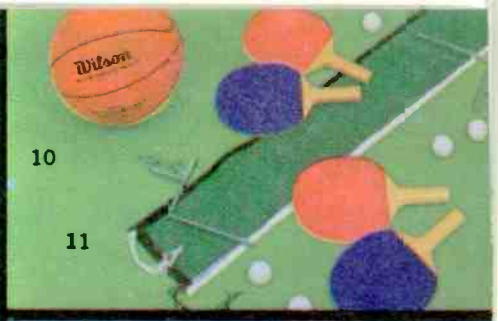
ABOUT THE COVER

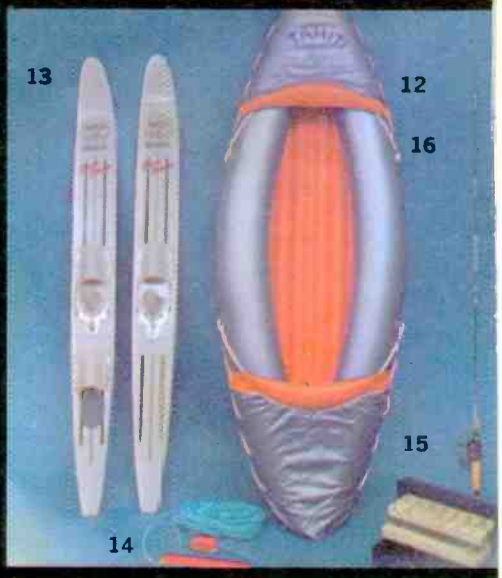
The physical and electrical design of electron tubes has changed drastically since Professor A. J. Fleming developed the Fleming Valve in 1896. Our cover this month provides graphic evidence of this change. The large tube on the left is a WE-205B general purpose triode, patented in 1916. On the right is a 6DS4 Nuvistor type high-mu triode of more recent vintage (1961). Imagine the size and weight of those 1916 tube caddies. Thanks to progress, the tubes listed in the annual TV tube stock guide on page 24 of this issue are smaller and lighter.

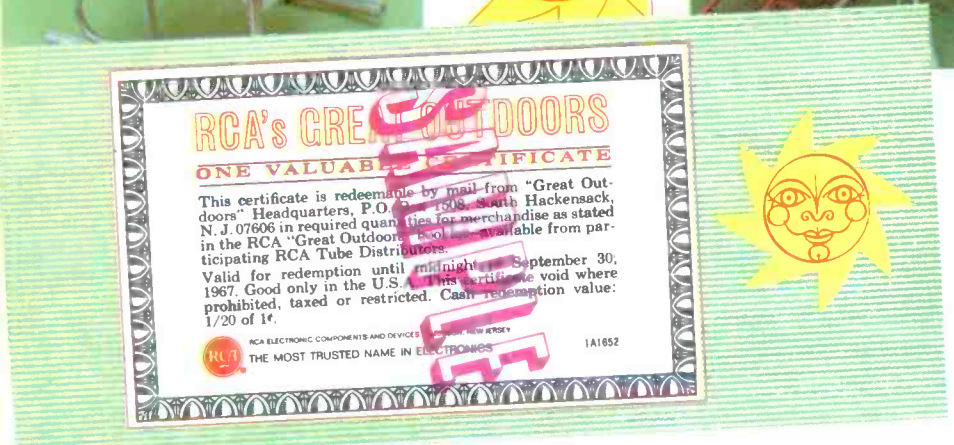
RCA brings you a marvelous array of prizes for

THE GREAT OUTDOORS









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LETTERS TO the EDITOR

Dear Editor:

I would appreciate any tips you con offer to help me free frozen iron cores in small coils.

Horizontal oscillator coils, quadrature coils, etc. do drift a little and need a touch up once in a while.

Today I had to pull a chassis and replace a coil because I tried to eliminate a little buzz. This slug was to tight that I twisted the entire coil form out of its mounting.

I just received a new coil from an original manufacturer — after a 1-month wait. The original coil was ruined when I tried to adjust it. The authorized dealer for this brand had advised that tuner cleaner sprayed in the coil form would loosen the slug. Needless to say, it didn't.

Over the past years, I have tried soldering irons, oil, and cement solvent. The only way I can get some of them out is to break them out piece by piece and then insert new slugs.

Help!

A DuBUSLEY

Riverdale, Md.

Do any readers have a solution for Mr. DuBusley?—Ed.

Dear Editor:

Thank you for printing in the Troubleshooter in the October, 1966 issue of PF REPORTER the trouble I had with the yoke in a Philco TV.

The trouble turned out to be a short between the horizontal and vertical windings of the yoke, just as you had answered me and printed in the column.

Thanking you once again.

FRANK SPZPIECH

Newark, New Jersey

This long-distance troubleshooting is difficult, but due to the years of experience represented on our staff, we have compiled an excellent average of correct solutions.—Ed.

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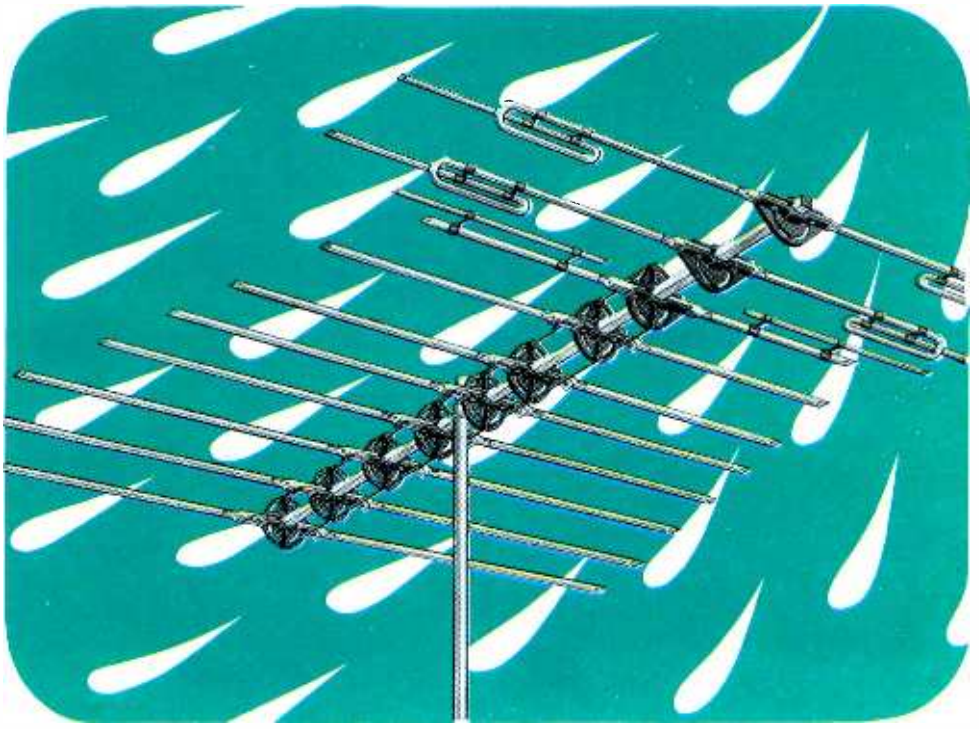
Circle 6 on literature card

New Jerrold Colorpeak™ VHF Antenna weathers any reception problem



Here's one outdoor antenna that stays put—even in a howling storm. The new Jerrold Colorpeak 300-ohm VHF-FM Antenna.

Colorpeak is a high gain antenna with unusual flatness across the entire VHF-FM band. It picks up strong, clear signals—even in difficult reception areas—because of its excellent front-to-back ratio. And it's built as rugged as a tank. Vibration-proof point-contact element locks, corrosion-resistant Golden Armor Coating and tough Cycolac insulators make each insulating mount a strong point. No shorting out because of icing. No wavering image as wind whips through the antenna. No flimsy criss-cross conductors for transfer of the signal. Jerrold Colorpeak quality construction sees to all that.

Jerrold Colorpeak antennas, like Jerrold VUfinder, Paralog Plus and Pathfinder antennas, assemble faster than any other antenna made today. All parts snap into place—anywhere—on the ground or on the roof. For hook-up ease, Colorpeak lead connections are made close to the mast.

For more details on the Jerrold Colorpeak antenna, see your Jerrold distributor.

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Focusing on one thing—better reception.

Circle 7 on literature card

THE ELECTRONIC SCANNER

news of the servicing industry

1966 Was Record Year

Final tabulation of December distributor sales by the **Electronic Industries Association's** Marketing Services Department confirms industry estimates of sales records in all major product categories.

While all consumer electronic products have participated in the rise, attention has centered on color television. Only 100,000 color sets were sold in 1956 along with 7.4 million black-and-white units. In 1966, 4.7 million color sets were sold out of a total of nearly 12 million units. While color has increased nearly 370% in the decade, black-and-white has stabilized at about 7 million sets. Predictions for 1967 look for color TV sales of over 7 million units, with black-and-white at only slightly lower levels than last year.

In the last 10 years radio has grown spectacularly despite television. The total U. S. radio market is estimated to have grown from sales of 15 million units in 1956 to 44 million in 1966, including imports, a large percentage of which are produced abroad for U. S. manufacturers.

FM has added another dimension to the radio renaissance. FM or AM/FM sales to dealers in 1956 were a negligible quantity. In 1966 estimates are that FM or AM/FM factory sales amounted to 11.7 million units, approximately 27% of the total U. S. radio market. The growth in FM has paralleled the increase in FM stations from 530 in 1956 to over 1,500 in 1966.

Total sales of phonographs (excluding TV-phonograph combinations) in 1966 were 6.1 million units, 50% above the 4 million units sold in 1956. Stereophonic sound, both in records and radio, has been the chief factor of growth, literally adding a new dimension to reproduced sound.

The real gainers in the phonograph field were radio-phonograph combinations. 450,000 such units came out of U. S. factories in 1956 (11% of the total that year). In 1966 sales had increased fourfold to 1.8

(please turn to page 69)

Color them green

Channel Master's Crossfire Antenna Series has

...More dealers prefer Channel Master to any other brand (2 to 1 by survey of leading trade magazine).

...More have been sold (and are still being sold) than any other antenna in the history of television. And dealer acceptance is still growing.

...More dealers bought Crossfire antennas in January and February than in any previous first two month period.

No wonder other antenna manufacturers try so hard to re-work their own designs along the famous Channel Master Crossfire lines.

But it just can't be done.

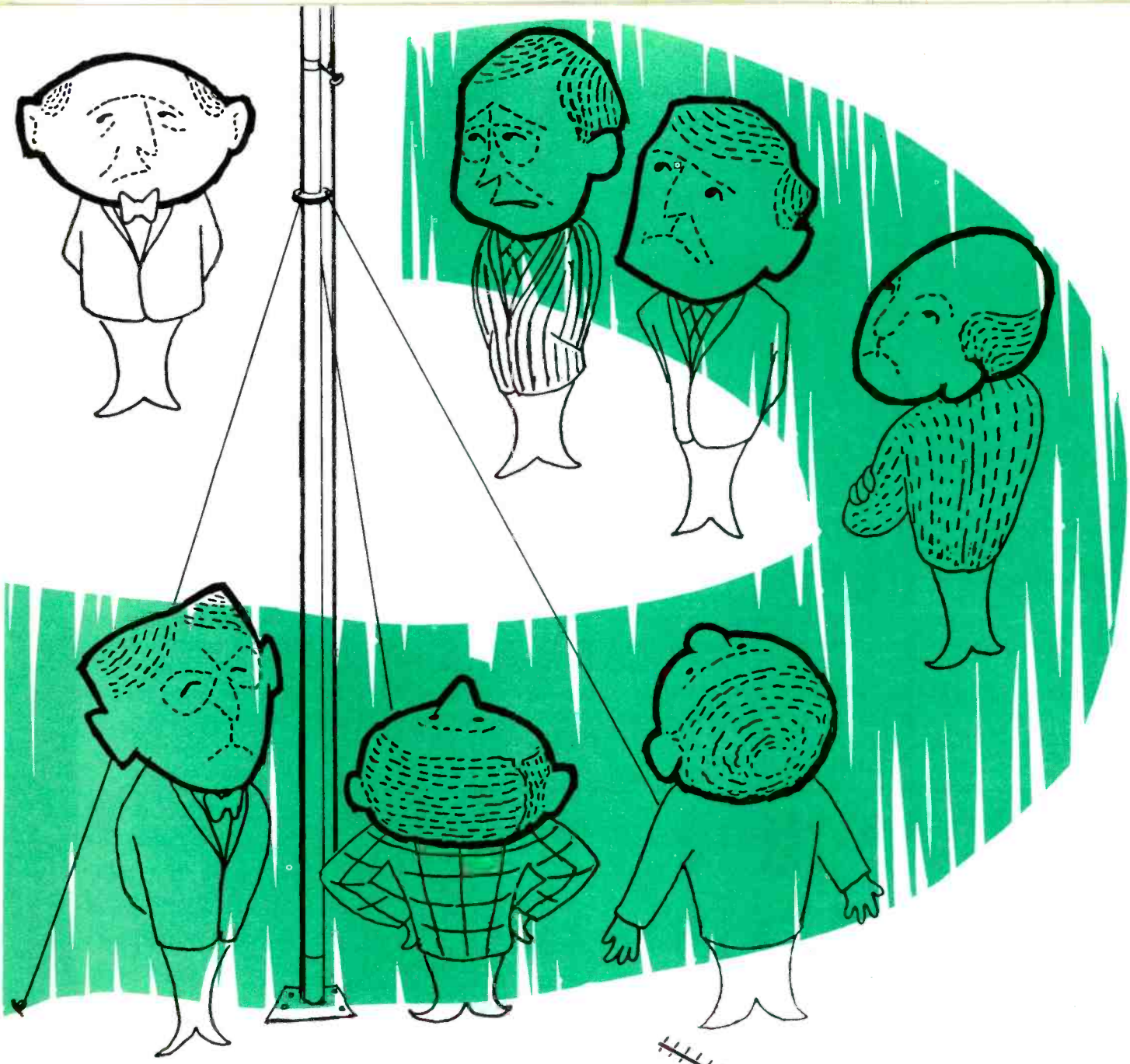
Legally, the Crossfire series is protected by five U.S. patents or patents pending.

And, in terms of mechanical and electronic design, the Crossfire series maintains a standard that has never been equalled.

Take mechanical design, for instance. Crossfire antennas have weathered six tough winters, verifying structural superiority originally proven in wind tunnel tests at the University of Miami hurricane test labs. Channel Master dealers ...who have just recorded the biggest first-two-months Crossfire sales in history...can tell you many of those antennas went up to replace less rugged makes that couldn't take the winter storms.

Most, of course, were teamed up with new set sales to meet the critical demands of color reception. Because, when it comes to electronics, Channel Master Crossfire Series antennas set the industry pace for clean, crisp color as well as outstanding black and white and FM Stereo.

In seven VHF models of Color Crossfires, electronic leadership takes the form of Proportional Energy Absorption



our competition green with envy.

and gain-boosting Tri-Band Directors. Then there are the 82-channel Ultradyne Crossfires...6 of them...with the most advanced, self-coupling, UHF section ever developed, plus all the Color Crossfire features. Finally, the Coloray group provides television's first electronic ghost-killing service in an 82-channel model and two VHF/FM models. All are finished with Channel Master's famous golden E.P.C....the coating that has been adopted by the military because of its weather protection.

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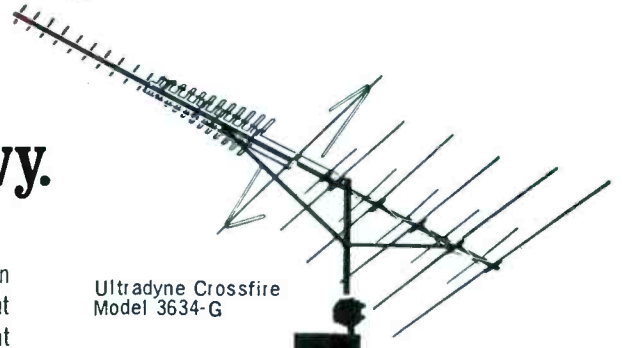

Ultradyne Crossfire
Model 3634-G

CHANNEL MASTER®

ELLENVILLE, N.Y.

The House of COLOR

picture tube or chassis / WHICH?

Are you at a loss to pinpoint the trouble in a color receiver? Read the guideposts defined here.

Jack Darr

The saddest words a customer ever hears are these: "I'm sorry, Mrs. Jones — your picture tube's out in this color set." I don't know who it was that said, "I'd rather be right than be President," but he wasn't in any trouble at all compared to you. You've got to be right. If you're not, you'll be in pretty bad shape—Nice new picture tube all installed, degaussed and ready to set up (and charged to your open account at the local parts supermarket) and here you still have the same old trouble! It was in the set and not the tube! Therefore, let us discuss some ways of making sure that it is that big tube and not chassis trouble.

The first, and probably the most frequent symptom of this kind of trouble is "miscoloration"; green, red or blue pictures. This can show up suddenly, or gradually over a long period of time. Or, just to make life more exciting, it can be intermittent. There are three guns in the tube, so we can have trouble with any one while the others are good. We'll have the same troubles we've been having in B-W tubes for a long, long time. They're not too hard to pin down—if we use our heads (and a good picture tube tester's a lot of help, too.)

If you don't have a CRT tester, there are some tests that can be made with meters and the calibrated eyeball that will produce a lot of information. I still like to use the CRT checker, too. You can't have too much information, not in this business. There are about three or four different tests we can make, and it's better to use 'em all, just to make sure. Our business is to know the things that could cause the symptoms we see on the screen, and not overlook any possibilities, no matter how remote they may seem. These tests will be discussed in turn with the symptoms on which they are most effective.

CRT Troubles

There are two kinds of CRT troubles: One, the grid-cathode short which turns the gun full-on. We get the classic "Can't turn the drive down at all" symptom. Two, some trouble that can kill one gun entirely; for instance, an open screen. (Don't tell me it can't happen, either.) While all we get in a B-W tube is an "uncontrollable picture" or "no raster," we get a lot of lovely symptoms in color picture tubes. If we short one gun, that color goes full-on, and the picture turns a bright green, red, or blue. If we lose one gun completely, the picture is a combination of the remaining two colors. For example, losing a green gun would leave the picture purple. (magenta, shmagenta—it's purple to me!) No blue gun, the picture's yellow, etc. So there's our first clue. Look for a color that is either wide-open, or completely gone.

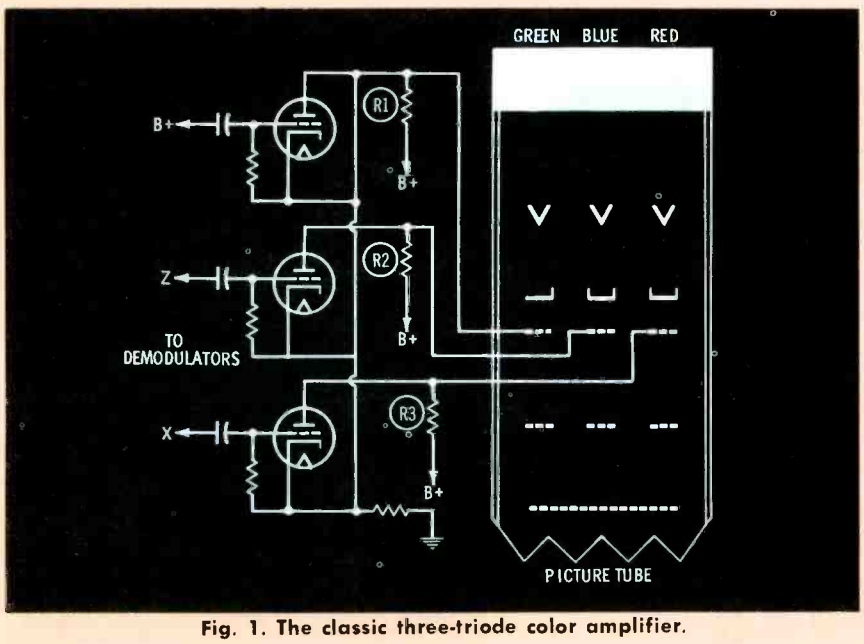

Fig. 1. The classic three-triode color amplifier.

In a color set, if a gun is shorted, and full-on, we can turn the screen control down and reduce the brightness. This means nothing! Ab-so-lutely nothing! We could do the same thing in a B-W tube, *IF* we had a screen voltage control. So, don't be fooled by this reaction. The "control" of the tube is in the variable voltage between the grid and the cathode. The video varies the cathode voltage and the color varies the control grid voltage. If these elements are shorted, that gun isn't going to work.

The 'Built-In Fake'

Our business is to know all of the possible defects that could look

like a bad picture tube. Remember that we have in the color amplifier circuits something that can fake a bad color picture tube so exactly that there's no way of telling which is which unless we dig into it. Fig. 1 shows a basic schematic of the 3-triode color amplifier/matrix circuit used in RCA, Motorola, and many other sets. These triode tubes, three plate-load resistors, three coupling capacitors—all kinds of possibilities for trouble.

The control grid voltage for each gun of the picture tube depends on the voltage drop across the three load resistors R1, R2, and R3. This is controlled by the tube's plate current, which is controlled by the grid bias, which is affected by any small leakage in the coupling capacitors, and on and on! A one milliampere change in plate current can cause a change of 15 volts across a 15K plate load resistor, and it doesn't take much leakage in a coupling capacitor to cause a 1-ma change in plate current. Since the plate voltage will go less positive as the plate current increases, this makes the grid voltage for that gun less positive, down goes its output, and the associated color. So, out goes one gun, the typical "bad picture tube" symptom.

Other sets use different color amplifiers, many using high level demodulators that drive the color picture tube grids directly. Fig. 2 shows a circuit used in Motorola's TS-914D chassis. As you can see, the two plates each drive a CRT grid, and the green grid is controlled by the –LE8's screen grid. When the green signal arrives, both plates conduct at the same time and the screen current falls (the tube is designed to do this). So, the screen voltage goes up, or more positive, and the green gun conducts. If the screen resistor should open up, we'd have a "no screen, no green" symptom. There is no limit to the odd conditions you can find from various combinations of faults in any of these circuits. So there is always the possibility of having some tube or part defect that will kill one gun or kick it wide open, thus faking a bad picture tube. To make sure, check all operating voltages in demodulator and color amplifier stages before you make that final judgment.

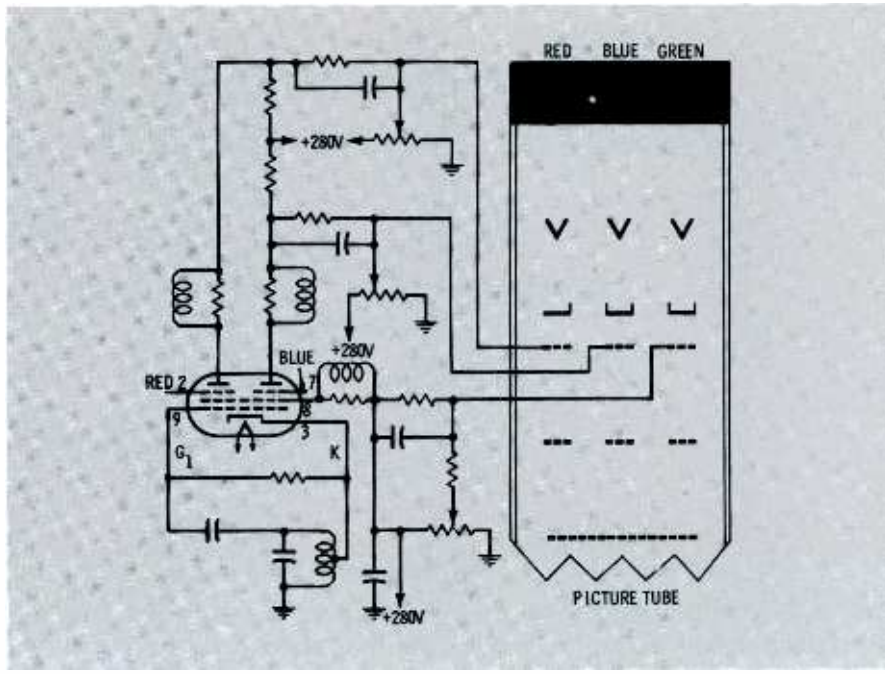

Fig. 2. —LE8 tube used as high-level demodulator.

In several of the older RCA chassis such as the CTC4 and CTC5, watch out for plate load resistors in the color amplifiers which have changed in value. These will be a pair of 1-watt 56K's in parallel in the CTC4's (in most runs; some of them are different), and 10K's in the CTC5's. If one of these goes down in value, it will cause the corresponding color to come up, and you get a false "one-color" symptom.

Grid emission in these color amplifier tubes—12BY7's in the CTC4 and 12BH7 in CTC5—can also cause some odd troubles. Check them thoroughly to make sure, or replace. Incidentally, if you have a tube tester that can read grid-emission reliably, check all of the tubes in the color section; you can clear up some very mysterious cases of trouble this way.

'Fake 'em Out' Yourself

It isn't a bad idea to do a little bit of faking yourself, especially when you run across a new circuit. See just what symptoms certain defects will cause. You can lift resistors to kill voltages, simulate leaky capacitors by bridging them with a resistor, and so on. Pulling tubes simulates what would happen if that tube went dead. Sometimes, the results will come out the exact opposite of what you expected, but there will always be a logical reason for it.

The Video Amplifiers?

We're most apt to get faked out by troubles in the color amplifiers. While the video amplifiers can affect the picture in several ways, they will always affect all three guns at once. A genuine picture-tube trouble will almost always affect only one gun or color. Not in 100% of the cases, as we'll see, but in by far the majority.

The video amplifier controls the picture contrast and brightness. Usually there is direct coupling all the way back to the video detector, and sometimes you'll find the brightness control hiding way back in the first video grid circuit. Often though, it's in the cathode circuit of the video output tube, as in Fig. 3. Note that the contrast control is a feedback or degeneration control, since it puts in or takes out more of the big electrolytic capacitor. This doesn't change the bias voltage since it doesn't vary the resistance. The brightness control is the 'bias adjustment' for this tube—and the CRT too, since the CRT cathodes are direct-coupled to the video amplifier plate.

Therefore, we can have video amp troubles that might fake CRT trouble. For example; "slow-heating picture tubes" have turned out to be slow-heating *video* tubes! If

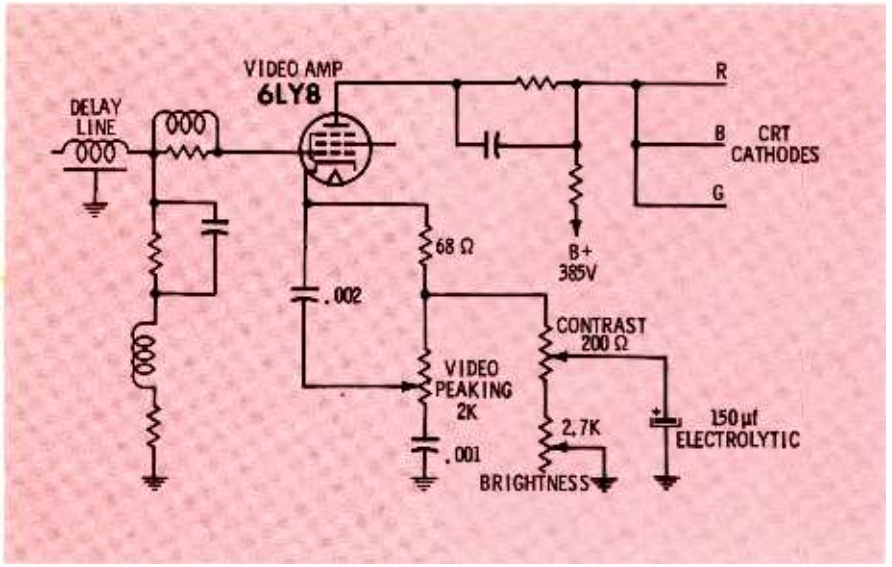

Fig. 3. Many parts in video amp affect CRT voltages.

you get a set with a slow-warm-up complaint, always check the high voltage, bias on the CRT, and the B+ voltages. Put the video output tube in a tube tester and check the warm-up time with a watch. A great many tubes now have a standard warm-up time of 11 seconds. This same test can be applied to the picture tube, to settle any doubts. It should be warmed up and ready to go inside of not more than 15 seconds. Actually, a slow-heater isn't too bad, when you consider what it woud cost to cure it! I'll sit and wait for quite a while before I'll replace a picture tube just to get the raster on ten seconds sooner! (Incidentally, quite a few color sets have automatic delay devices, like the old RCA CTC7's).

Permanent Impurities

Once in a while you'll find permanent impurities in a color set. These are small areas of color on the screen, usually near the edges. First, of course, degauss very thoroughly; the problem might be some kind of residual magnetism that the automatic degausser can't handle. If the impurity remains, and you can't find any large pieces of metal that could be the cause, it may be a defective picture tube.

In some stubborn purity cases, you may find that each raster (R,B,G) is pure, but the overall B-W raster shows faint impurities of a complementor color; yellow, cyan, or magenta. This is caused by weak phosphor areas. For instance, if the red raster has a small area where the phosphor is weak, the B-W raster will show a cyan impurity. The only cure is to replace the CRT. Impurities of this nature are usually very weak, almost unnoticeable on color transmission, and most customers prefer to live with it, rather than buy a new tube.

In rare cases, impurity may be caused by an internal arcover from the HV terminal on the bell to the mask. In one case I worked on, there were two very small areas of red and green about 2 inches wide, in the upper left corner. But these areas only showed up when the brightness was turned full-up. This tube was known to have arced internally before this appeared, and it didn't bother normal viewing, so the tube was not changed. However, in serious cases, the tube would have to be replaced.

Down to Cases

You'll find all kinds of assorted symptoms. So, be sure to check them all out thoroughly before you make that final decision. For instance:

In an RCA CTC12, the trouble was very intermittent; one of those nice "once every day or two" defects. Green flashes, but they would not stay there. The screen turned a greenish blue, lost focus and showed heavy retrace lines. So, we thoughtfully checked the base connections and found that they were in fine shape, confound it. Picture tube checked fine on the CRT tester, hot and cold.

We checked the color amps, demods and all controls, of course. To make a long story a lot shorter, this *was* a bad picture tube! After protracted cooking at high line voltage, we could tap the neck of the tube and make it act up. We removed the chassis and hooked the set up with extension cables, putting the chassis on the bench so that the tapping couldn't possibly affect any of the chassis parts. Then, we banged on both of them. A new picture tube cured the trouble.

In the typical picture tube defect, only one gun will be affected, and this will help in spotting it. At least this is true in a majority of cases, but every now and then you'll have to turn around and "back into the diagnosis." A Zenith came on green and changed to black-and-white in about 15 minutes. It did, too. The picture had a very distinct green tinge on turn-on, but after about 15 minutes it was a nice black-and-white. Someone suggested adding a timer to turn it on 15 minutes earlier, but this idea was rejected, and we started checking. We checked all of the green-amp circuits, controls, etc. No result. Tubes were replaced. No help.

What I was looking for was bias trouble in the green gun, which made it run above normal. The picture tube wasn't too old. So, I made up a gadget out of push-on connectors, and jerked the CRT cathodes loose from the terminal board on the back of the chassis. Putting a microammeter in each cathode, I found that the green gun drew about 150 microamps and the red and blue guns drew about 50 microamps each. Hmm. After the set had warmed up and gone B-W, the guns all drew the same at average brightness; about 100 microamps.

I sat back and looked at it. I had checked the picture tube, but then it dawned on me that I'd checked it *hot*. It was good, of course. No short, no nothin'. So, I rechecked—same results. Leaving the picture tube tester hooked up but turned off, I took the opportunity to go gitta cuppa cawfee. After the group in the drug store had run out of old jokes and gossip, I came back.

• *Please turn to page 47*

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Annual TV TUBE STOCK GUIDE

This list omits more than 100 of the rarest TV tube types, which many shops find impractical to stock. To simplify the chart as much as possible, common radio and hi-fi tube types used in TV combinations are omitted.

New tube types introduced this year are listed in the separate chart; to help you decide whether to stock these tubes, each listing specifies receivers using that particular type. If you're specializing in one or two brands, you'll pick new tubes listed for those sets and stock your shelves and caddy accordingly.

In the main chart, the figures under "Caddy Stock" suggest a stock of approximately 400 tubes (other than tubes for color sets) which should account for close to 90% of your replacement needs. As with the rare-tube listings, you may want to carry more of a particular type if it is used in receivers you service often. We've removed some of the older types, such as 6V6, 6W4, and 6BZ7, and replaced them with more current types; also included are some that appeared in last year's new-tube list—if they were used in sets again this year. Most used UHF tubes are also included. Tubes marked with an asterisk (*) are used also in color sets.

The figures under "Shelf Stock" are a suggested backup stock. if you're located near a parts distributor. If you can replenish your tube supply only once a week, you may wish to stock extra of the more common types. Your volume of business will naturally determine your actual shelf stock, too. Keep in mind three main factors that will influence the demand for various tubes:

1. Relatively high failure rate of power-output and similar tubes.
2. Your specialization in certain makes of sets.
3. Average age of sets containing a particular tube type.

Temporary substitution of available types for rare types, as outlined in the Howard W. Sams book, *Tube Substitution Handbook, Vol. 10,* can also help you reduce stock requirements.

Another way to ease tube-stock headaches is to use only the latest -A or -B versions of various tubes. Types in common use are listed in the chart.

TUBE TYPE	SHELF STOCK	CADDY STOCK	TUBE TYPE	SHELF STOCK	CADDY STOCK	TUBE TYPE	SHELF STOCK	CADDY STOCK
1AD2	1	1	3GS8	1	1	5JV8	1	1
1AU2*	1	1	3HA5	1	1	5KD8	1	1
1B3GT	4	2	3HG8	1	1	5KE8	1	1
1G3GT	4	2	3HM6	1	1	5U4GB*	6	2
1J3A	2	1	3HQ5*	1	1	5U8	2	1
1K3	5	2	3HT6	1	1	5V3	1	1
1N2A	1	1	4AU6	1	1	6AC7	1	1
1S2A	1	1	4BL8*	1	1	6AF3	1	1
1V2*	2	1	4BQ7	1	1	6AF4B*	2	1
1X2B*	3	2	4BU8	1	1	6AF11	1	1
2AF4	1	1	4BZ6	5	2	6AG5	1	1
2AH2	1	1	4CB6	1	1	6AG7A*	1	1
2AS2	2	1	4CS6	1	1	6AH5	2	1
2CW4	1	1	4DK6	2	1	6AH6	1	1
2CY5	1	1	4DT6*	2	1	6AK5	1	1
2DS4	1	1	4EH7	2	1	6AL3	1	1
2DZ4	1	1	4EJ7	3	1	6AL5	2	1
2FH5	1	1	4GK5*	1	1	6AL11*	1	1
2FS5	1	1	4GM6	1	1	6AM8A	2	1
2GK5	2	1	4GZ5	1	1	6AN8*	1	1
2GU5	1	1	4HA5*	1	1	6AQ5A*	5	2
2GW5	1	1	4HM6	1	1	6AR11	1	1
3A3A*	2	2	4HS8	1	1	6AS5	1	1
3AF4	1	1	4HT6	1	1	6AS8	1	1
3AJ8	1	1	4JC6	1	1	6AU4GTA*	2	1
3AL5	1	1	4JD6	1	1	6AU6A*	3	1
3AT2*	2	1	4KN8	1	1	6AU8A*	1	1
3AU6	2	1	5AM8	1	1	6AV6*	2	1
3AW3	1	1	5AQ5	2	1	6AW8A*	4	2
3BN6	2	1	5AT8	1	1	6AX3	1	1
3BU8	1	1	5AU4	1	1	6AX4GTB	2	1
3CB6	2	1	5BC3	1	1	6AY3B	4	1
3CS6	1	1	5BR8	1	1	6AZ8*	1	1
3CY5	1	1	5CG8	3	1	6BT0	1	1
3DG4	2	1	5CL8A	1	1	6BA6	2	1
3DK6	2	1	5DJ4	1	1	6BA11*	2	1
3DT6A*	1	1	5EA8	1	1	6BC8*	1	1
3DZ4	1	1	5EW6	1	1	6BD11	1	1
3EH7	1	1	5FG7	2	1	6BE3A*	2	1
3EJ7	1	1	5GH8	1	1	6BE6	2	1
3FS5	1	1	5GM6	1	1	6BF11	1	1
3GK5	4	2	5HG8	1	1	6BG6GA	1	1

TUBE TYPE	SHELF STOCK	CADDY STOCK	TUBE TYPE	SHELF STOCK	CADDY STOCK	TUBE TYPE	SHELF STOCK	CADDY STOCK
6BH8	1	1	6GK6*	2	1	8JV8	2	1
6BH11*	1	1	6GL7*	1	1	8JZ8	1	1
6BJ3	2	1	6GM6*	5	2	8KA8	1	1
6BJ8	1	1	6GN8	2	1	9A8	1	1
6BK4B*	3	2	6GT5	1	1	9AU7	1	1
6BK7B	1	1	6GU5	1	1	9GV8	1	1
6BL7GTA	2	1	6GU7	5	2	10AL11	1	1
6BL8*	3	1	6GV5	2	1	10CW5	1	1
6BM8A*	1	1	6GW6	1	1	10DE7	2	1
6BN4	1	1	6GW8*	2	1	10DX8	1	1
6BN6*	3	1	6GX6*	2	1	10EG7	1	1
6BN8*	1	1	6GY5	1	1	10EM7	1	1
6BQ5*	3	1	6GY6*	3	1	10EW7	1	1
6BQ6GTB*	4	2	6GZ5	1	1	10GK6	1	1
6BQ7A*	2	1	6HA5*	3	1	10HF8	1	1
6BR8A	1	1	6HA6	1	1	10JA8	1	1
6BU8A	2	1	6HB5	2	1	10JY8	1	1
6BX7GT	1	1	6HB6*	2	1	10KU8	1	1
6BY6*	1	1	6HB7*	1	1	11AR11	1	1
6BZ6*	11	3	6HD5	1	1	11JE8	1	1
6C4*	1	1	6HE5*	3	1	11KV8	1	1
6CB5*	1	1	6HF5*	2	1	12AF3	2	1
6CB6A*	3	1	6HF8	1	1	12AL11	1	1
6CD6GA	2	1	6HG5	1	1	12AT7*	1	1
6CG7*	5	2	6HG8	1	1	12AU7	1	1
6CG8A*	7	3	6HJ8	2	1	12AV5GA	1	1
6CL6*	1	1	6HK5	1	1	12AX4GTB	2	1
6CL8A*	1	1	6HL8*	1	1	12AX7A*	2	1
6CM7	2	1	6HQ5*	1	1	12AY3	1	1
6CN7*	1	1	6HS8*	3	1	12AZ7A*	1	1
6CQ8*	1	1	6HZ6*	3	1	12B4A	2	1
6CS6*	2	1	6HZ8	1	1	12BE3	1	1
6CU5	2	1	6J6	2	1	12BH7A*	2	1
6CW4*	1	1	6J10*	1	1	12BQ6GTB	2	1
6CW5*	2	1	6JB6	2	1	12BY7A*	3	1
6CX8	1	1	6JC6*	3	1	12C/CU5	2	1
6CY5	1	1	6JC8	1	1	12CA5	2	1
6DA4A	1	1	6JE6A*	4	2	12DB5	1	1
6DE4	2	1	6JE8	1	1	12DQ6B	2	1
6DE6*	2	1	6JH6*	4	1	12DT5	1	1
6DE7	2	1	6JH8*	3	1	12FX5	1	1
6DK6*	2	1	6JM6*	1	1	12GC6*	1	1
6DM4	2	1	6JN6	1	1	12GN7A*	2	1
6DN7	1	1	6JN8	1	1	12GT5	1	1
6DQ5*	2	1	6JS6A*	1	1	12GW6	2	1
6DQ6B*	4	2	6JT8*	2	1	12SN7GTA	1	1
6DR7	1	1	6JU8A*	4	2	12W6GT	1	1
6DS4*	2	1	6JV8	2	1	13CM5	1	1
6DT5	1	1	6JZ8	1	1	13DE7	1	1
6DT6A*	3	1	6K6GT	1	1	13DR7	1	1
6DV4*	1	1	6KA8*	2	1	13EM7	2	1
6DW4B*	3	1	6KD8	2	1	13FD7	1	1
6DX8*	1	1	6KT8*	2	1	13GB5	2	1
6DZ4*	1	1	6KU8	1	1	13GF7A	2	1
6EA8*	4	1	6KZ8*	2	1	13J10	1	1
6EB8	2	1	6LN8	1	1	15BD11	1	1
6EH7*	5	2	6Q11	1	1	15CW5*	2	1
6EH8	2	1	6RK19	1	1	15DQ8*	1	1
6EJ7*	5	2	6S4A	1	1	15HB6*	2	1
6EM5	1	1	6SL7GT	1	1	15KY8	2	1
6EM7*	2	1	6SN7GTB*	2	1	15LE8*	1	1
6ER5	1	1	6T8*	1	1	16A8*	1	1
6ER7	1	1	6U8A*	1	1	16AQ3	1	1
6ES8	2	1	6U10	1	1	16GK6	1	1
6EV7*	1	1	6X8A	2	1	17AX4GTA	1	1
6EW6*	4	2	7AU7	1	1	17AY3A	4	1
6EW7*	2	1	7GU7*	1	1	17BE3	2	1
6EZ5*	1	1	7GV7	1	1	17BF11	2	1
6FD7	1	1	8AW8A	2	1	17BS3A	2	1
6FG7*	2	1	8B8	1	1	17C5	1	1
6FH5*	1	1	8B10	1	1	17DE4	1	1
6FM7*	2	1	8BE8	1	1	17DM4A	1	1
6FQ7*	7	3	8BQ5	2	1	17DQ6B	2	1
6FS5	1	1	8CG7	1	1	17GJ5	2	1
6FV8	1	1	8CW5	1	1	17GV5	1	1
6FY5	1	1	8CW8	1	1	17JB6A	1	1
6FY7	1	1	8CX8	1	1	17JZ8	3	1
6GB5	1	1	8DX8	1	1	19AU4GTA*	1	1
6GC5*	1	1	8EB8	1	1	21GY5	2	1
6GE5	2	1	8EM5	1	1	21HJ5	1	1
6GF7A*	4	2	8ET7	1	1	22BH3	2	1
6GH8A*	9	3	8FQ7	5	2	22DE4	1	1
6GJ5	1	1	8GJ7	1	1	22JG6A	2	1
6GJ7*	2	1	8GN8	1	1			
6GK5*	3	1						

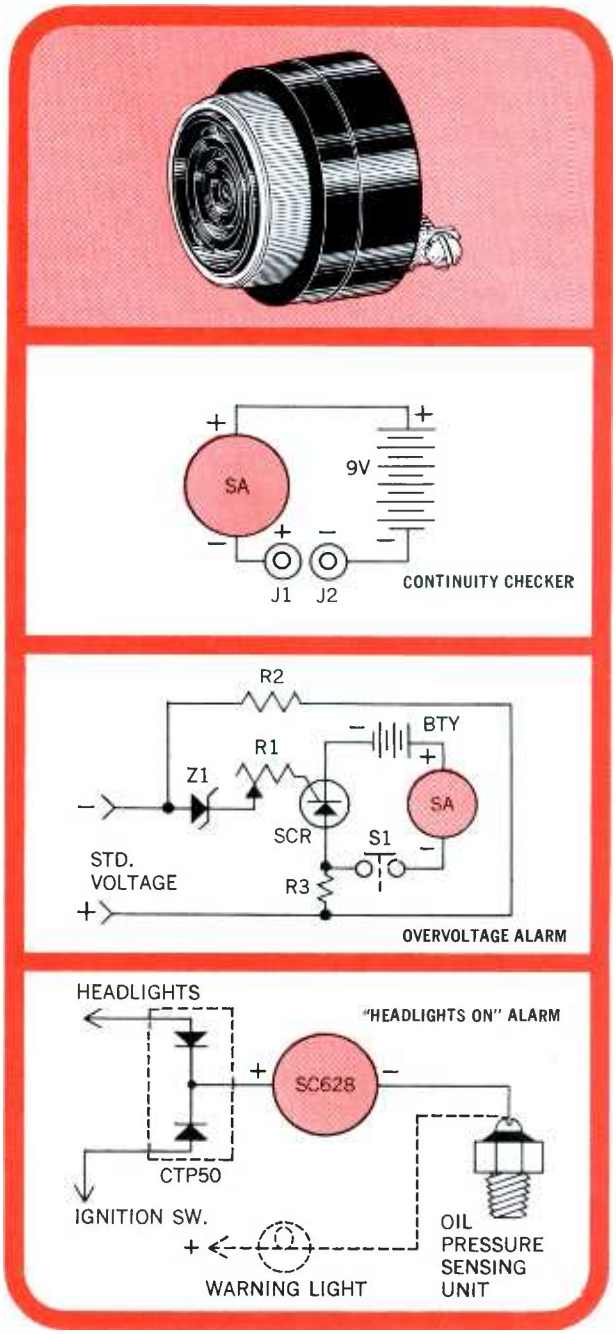
TUBE TYPE	SHELF STOCK	CARDY STOCK
25AX4GT	1	1
25BQ6GTB	1	1
25CD6GB	1	1
33GT7	1	1
33GY7A	2	1
50C5	3	1

NEW TUBE TYPES INTRODUCED IN '67 TV

1BC2	Admiral
	General Electric
1BG2	Electrohome
1BH2	General Electric
1DK27	Hitachi
	Sharp
1DK29	Airline
	Andrea
	Sears
	Truetone
1SK2	Sony
2AV2	Curtis Mathes
	Packard Bell
	RCA
3AW2	Philco-Ford
3CA3	Electrohome
	RCA
4HQ5	Motorola
4M-P26	Coronado
5JL6	Sylvania
5KZ8	General Electric
5MB8	Sylvania
5U9	Admiral
6AC10	General Electric
6AD10	Admiral
6CG3	Admiral
	General Electric
	Philco-Ford
6CK3	RCA
6EA4	General Electric
6EH5	RCA
6JD8	Zenith
6JF6	RCA
6KD6	Philco-Ford
6KE8	RCA
6KM6	RCA
6LF8	Andrea
	Curtis Mathes
	Emerson
	General Electric
	Hoffman
	RCA
	Wells Gardner
6LJ8	Admiral
	General Electric
	Olympic
6LQ8	RCA
6LT8	General Electric
6LY8	Motorola
6M11	General Electric
6R-P22	Sears
6U9	Admiral
6Z10	Zenith
8AC9	Sylvania
8AR11	General Electric
8BA11	Zenith
8BN8	Packard Bell
8BQ11	General Electric
8BU11	General Electric
8LT8	Admiral
	General Electric
9AQ8	Panasonic
9KZ8	Motorola
9R-AL1	Peerless
9R-HR2	Panasonic
10BQ5	Philco-Ford
10GV8	Arvin
	Panasonic
10JZ8	Olympic
10LB8	Sylvania
10LZ8	Bradford
	Westinghouse
11BM8	Arvin
	Panasonic
11BQ11	General Electric
11BT11	General Electric
11FY7	General Electric
11R3	Panasonic
12AE10	General Electric
12AX3	General Electric
12B-B14	Peerless
12BF11	General Electric
12GE5	General Electric
12R-LL5	Panasonic
12T10	Motorola
13V10	Magnavox
13Z10	Zenith
14BL11	General Electric
14BR11	Admiral
	General Electric
17AB10	Zenith
17B-B14	Sears
17BZ3	Philco-Ford
17CK3	RCA
19BJ11	General Electric
21JV6	Motorola
21JZ6	Olympic
	Philco-Ford
	Westinghouse
21KQ6	Arvin
	Panasonic
21LU8	Sylvania
34CE3	Sylvania
38HK7	Admiral
	General Electric
42KN6	Sylvania
PL521	Panasonic

MALLORY **Tips for Technicians**

Sonalert®...
versatile signal for service shops



Ever hear of the audible signal that works on only a few milliamps? We have one. It's called the Sonalert, and it's a solid-state tone device that you can find lots of uses for in your shop, your car and your home.

For instance, it makes a wonderful continuity checker. Just hook it to a 9-volt battery . . . a Duracell® TR-146X mercury battery is ideal. You can test circuits having resistance up to about 1000 ohms, with complete safety against accidental burn-out of fine-wire components such as coils and transformers. At 9 volts, Sonalert draws only 3 milliamps. Its distinctive 2800 Hz tone helps make circuit tracing easy. A convenient way to put this useful gadget together is described in our booklet "How to Use Sonalert".

Or maybe you'd like an alarm that will sound when voltage gets too low or too high. If your equipment already has an over- or under-voltage signal light, it's easy to convert a Sonalert in parallel to give you a tone alarm that can't be ignored. Just make sure to choose a Sonalert with the right voltage rating. You can also rig a high or low voltage alarm circuit using a zener diode as the reference. The signal circuit illustrated here will keep sounding once an overvoltage has happened, until you open the switch.

And here's an idea for your service truck. A guy in a hurry will sometimes forget to turn off the headlights when he leaves the truck . . . and find the battery dead when he returns. It's easy to connect a Sonalert to sound a warning when headlights are left on when the engine is turned off. One side of the Sonalert goes to the oil pressure sensing unit, which actuates the low pressure warning light. The other goes to both the headlights and the ignition switch, through a pair of silicon rectifiers which prevent coupling those two circuits (a Mallory CTP50 package fits this job ideally).

If you'd like some more tips on how to use Sonalert, ask your Mallory Distributor for "idea folder" No. 9-406. Or write Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Indianapolis, Indiana 46206.

DON'T FORGET TO ASK 'EM—*"What else needs fixing?"*

Circle 11 on literature card

INDUSTRIAL ELECTRONICS NOTEBOOK

PART II

Another resume of familiar electronic circuits as they are used in industry.

Ed Bukstein

The field of industrial electronics holds no mysteries for the technician who has a thorough understanding of electronic components and their functions. Part I of this two-part article (January '67 PF REPORTER) helped confirm this point through an analysis of the basic circuits associated with industrial electronics. Part II is a continuation of that analysis.

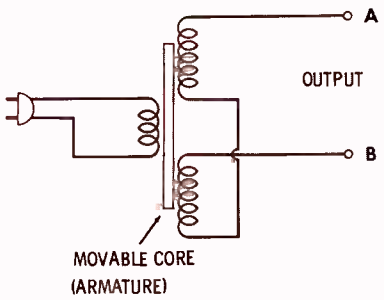


Fig. 1. Differential transformer has series opposing secondary.

The Differential Transformer

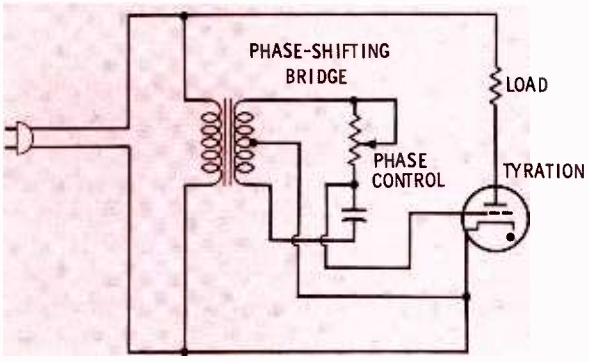
The differential transformer is a position-measuring transducer commonly employed in servomechanisms, thickness gauges, remote positioning devices, machine tool controls, etc. As shown in Fig. 1, the two secondaries of the transformer are connected so that they are series-opposing. As a result, the output voltage across A and B is zero. However, if the movable iron core (armature) is moved away from its center position, the coupling to one secondary will be *increased*, while the coupling to the other secondary will be *decreased*. Therefore, one secondary will have more voltage than the other, and the output across A and B will be the difference voltage of the two secondaries. This output is a sine wave whose amplitude depends on the *amount* of displacement of the armature. The phase of the output is determined by the *direction* in which the armature is moved. Thus, the output of the transformer is a measure of the armature position.

When used as a thickness gauge, the armature of the differential transformer is linked to a stylus that rests on the surface of the piece to be gauged. The armature assumes a position determined by the thickness of the piece. The transformer output across A and B is then amplified and measured by a meter calibrated in thousandths of an inch, or some other convenient unit of measure.

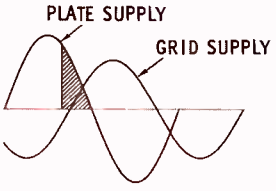
Phase-Controlled Rectifier

The phase-controlled rectifier is a current regulating device. As shown in Fig. 2A, the load is connected in series with a thyratron. A phase-shifting bridge in the grid circuit of the thyratron causes the grid sine wave to lag behind the AC plate supply. As a result of this lag, each positive alternation of grid voltage begins at a time when the positive alternation of plate voltage is nearly completed (Fig. 2B). The thyratron ionizes near the end of each positive half cycle of plate voltage, and current flows through the load only briefly during each cycle.

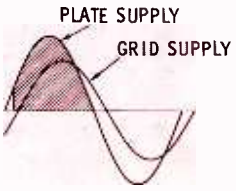
If the grid voltage lag is reduced (Fig. 2C), the positive alternation of grid voltage will occur earlier



(A)



(B) Thyratron fires late.



(C) Thyratron fires early.

Fig. 2. Phase-controlled rectifier using thyratron.

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with respect to the plate voltage cycle. The thyratron will ionize earlier in each cycle, and load current will flow for a longer interval. In this manner, the average load current can be controlled by adjusting the phase-shifting bridge. Motor control circuits often employ this technique for varying armature current, and therefore, motor speed. Thus, the RPM of the motor can be adjusted without using gear or pulley changes.

Saturable Reactor

The saturable reactor is a control device which also permits adjustment of the current flow through a load. As shown in Fig. 3, this load may be the heating element of an electric furnace. Coil L2 of the reactor functions as a variable inductance in series with the load. Thus, load current depends upon the reactance of this coil, which can be varied by changing the current flow through coil L1. If the control current through L1 is increased, the core of the reactor will become more saturated. As a result, the reactance of coil L2 will decrease, and more current will flow through the heating element. Since a small amount of current in coil L1 can control a much larger current in L2, the saturable reactor is referred to as a magnetic amplifier.

Energy-Storage Welding

The continuing trend toward miniaturization and microminiaturization has created new problems of assembly and lead attachment. Components have become so small and densly packed that conventional soldering techniques are no longer satisfactory. Even a *midget* soldering iron may cause overheating and damage to nearby components. In these situations, enery-storage welding is sometimes employed. This type of welding is accomplished by passing a brief pulse of current through the wires to be joined. The heat developed by the current fuses the wires together. Since the current pulse is very brief (typically one millisecond), the welding operation is completed before the heat can spread to adjacent components.

A typical energy-storage welder circuit is shown in Fig. 4. With the relay de-energized, capacitor C charges from the full-wave power supply. When the operator clamps the welding head to the leads to be joined, a microswitch closes and energizes the relay. Capacitor C discharges through the primary winding of the welding transformer, and the pulsed current induced in the secondary produces the weld.

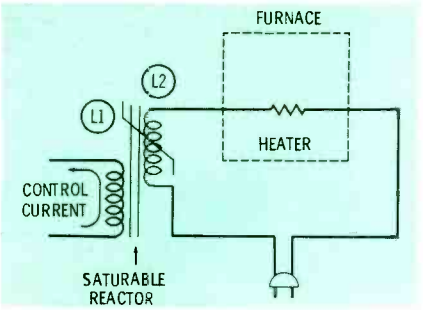

Fig. 3. Saturable reactor controls current through heating element.

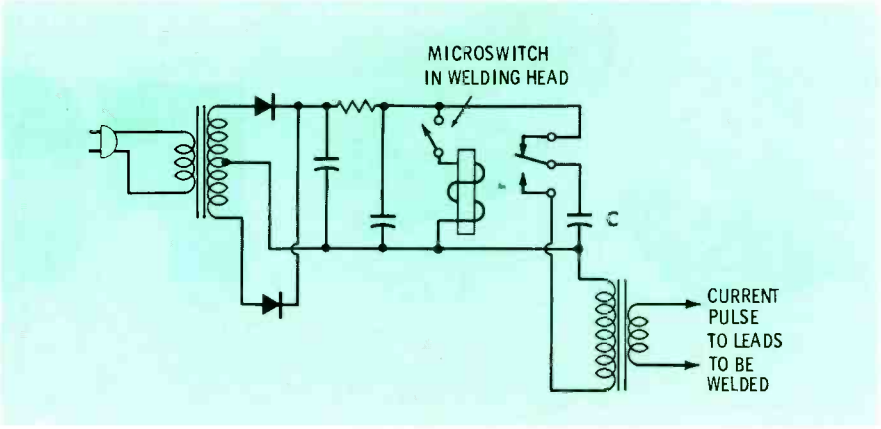

Fig. 4. Energy-storage welding circuit provides brief current pulse.

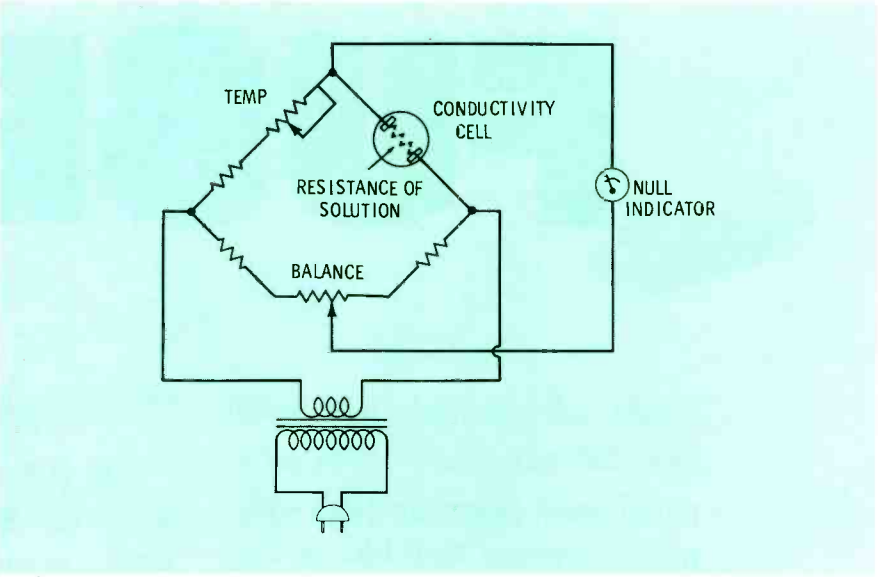

Fig. 5. Conductivity circuit determines concentration of liquid.

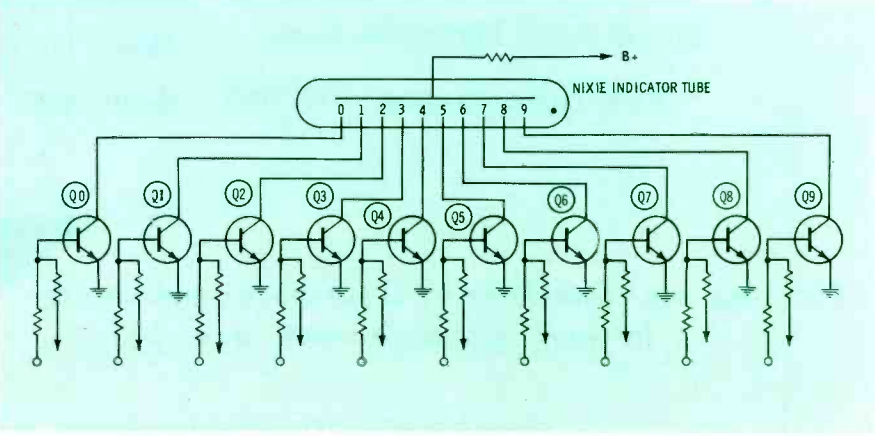

Fig. 6. Ten cathode neon bulb used as numerical display.

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TUBE DEPARTMENT

GENERAL ELECTRIC

288-06A

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Conductivity Meter

Since the electrical conductivity of a solution is determined by its chemical ingredients, conductivity measurements are useful for determining the concentration of dissolved chemicals. Food, paper, textile, metal, and various other industries employ conductivity measurements to maintain the correct concentration of processed liquids, to guard against leakage of process materials into steam lines, to forestall chemical damage to boilers and turbines, etc.

Conductivity is measured by immersing two electrodes in the solution to be checked. The effective resistance of the solution between the electrodes (the conductivity cell) is connected to one leg of a Wheatstone bridge, as shown in Fig. 5. The bridge is then adjusted to a balanced condition as indicated by a null meter. A dial on the balance control now indicates the conductivity in micromhos, or the concentration in terms of grains-per-gallon, percentage by weight, or other appropriate unit of measure.

Because conductivity also varies with temperature, a compensating control is included in the bridge. Before the bridge is balanced, this control is set according to the temperature of the solution.

Nixie Readout

Numerical display tubes such as the *Nixie* (trademark of Burroughs Corp.) are replacing dial-and-pointer indicators in many instruments. Digital voltmeters, frequency meters, and counters are examples of instruments which commonly employ numerical display tubes.

The *Nixie* indicator is a ten-cathode neon bulb in which the cathodes are wires bent into the shape of the numerals 0 through 9. Because the ionization glow surrounds the cathode, the characteristic orange glow takes the shape of one of the numerals.

A typical circuit configuration is shown in Fig. 6. The transistors in the cathode leads are initially biased off, and there is no ionization glow in the *Nixie* tube. If a positive input is now applied to one of the transistors. Q4 for example, the transistor will conduct, and the *Nixie* tube will ionize. The orange glow now takes the form of the numeral 4. If the positive input had been applied to Q9, the ionization glow would have been around the 9-shaped cathode, etc.

Bin-Level Control

This type of circuit is commonly used to control the level of a liquid or granular material in a bin, tank, or other enclosure. The photoelectric type of level control employs a light source and a photocell mounted on opposite walls inside the bin. When the level of the material in the bin rises to the level of the light source, the beam to the photocell is blocked. A relay in the photocell circuit now stops the filling process, or initiates an emptying operation. Two controls positioned at different levels may be used to establish maximum and minimum levels.

The circuit of a photoelectric level control is shown in Fig. 7. The output of a half-wave rectifier is applied to a series combination of a photocell and a relay. The cell is a photoresistive type whose ohmic

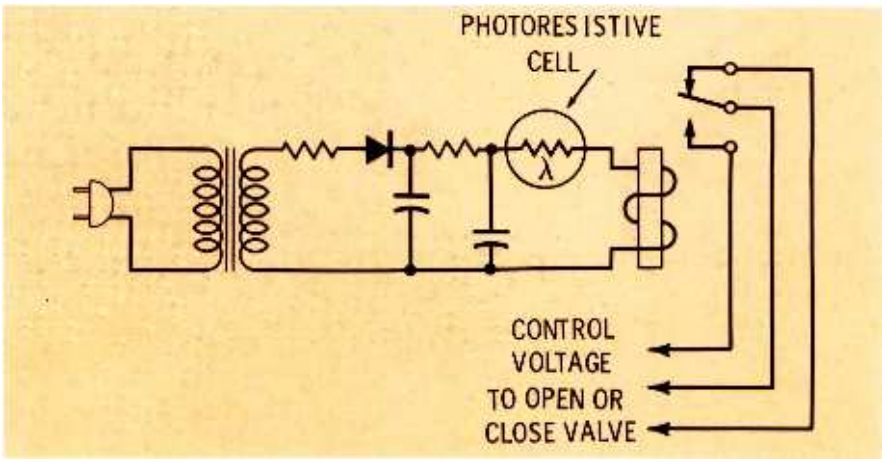

Fig. 7. Level control circuit employing a photocell.

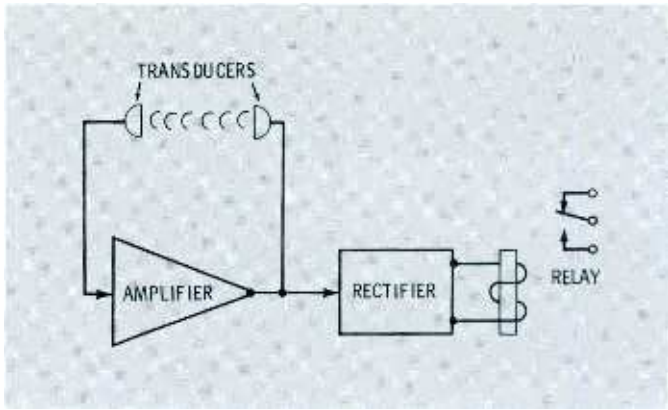

Fig. 8. Ultrasonic sensor is used as a control device.

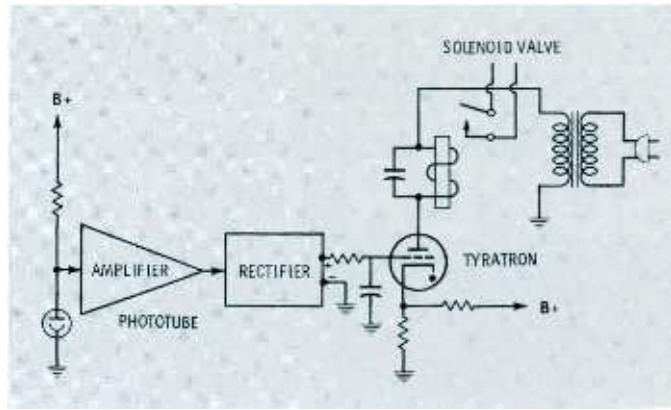

Fig. 9. Pilot provides light for phototube.

value decreases with an increase of illumination. Thus, cell resistance is low under illumination, and current flow is sufficient to energize the relay. When the light beam to the photocell is blocked, the cell resistance increases and the relay drops out.

Ultrasonic Sensor

A beam of ultrasonic vibrations can be used in a manner similar to the beam of light in photoelectric controls. An instrument of this type, the Delavan Company's SONAC, is illustrated in Fig. 8. Two piezoelectric transducers are connected to an amplifier, one to the input terminals and the other to the output. The two transducers are mounted facing each other, so that ultrasonic vibrations from the output transducer are picked up by the input transducer. This feedback from the amplifier output to the input maintains oscillations in the circuit. The amplifier is tuned so that the oscillations occur at a frequency of approximately 38 KHz. The output of the amplifier is rectified and applied to a relay, causing the relay to energize.

If an object is interposed between the two transducers, the feedback path will be blocked, and oscillation will cease. The relay will now de-energize. If the two transducers are mounted on opposite sides of a conveyor belt, each passing object will cause the relay to momentarily de-energize; thus, objects on the conveyor can be controlled.

Flame-Failure Safeguard

Industrial furnaces are protected by flame-failure safeguards, which automatically shut off the fuel supply if the pilot burner fails. This

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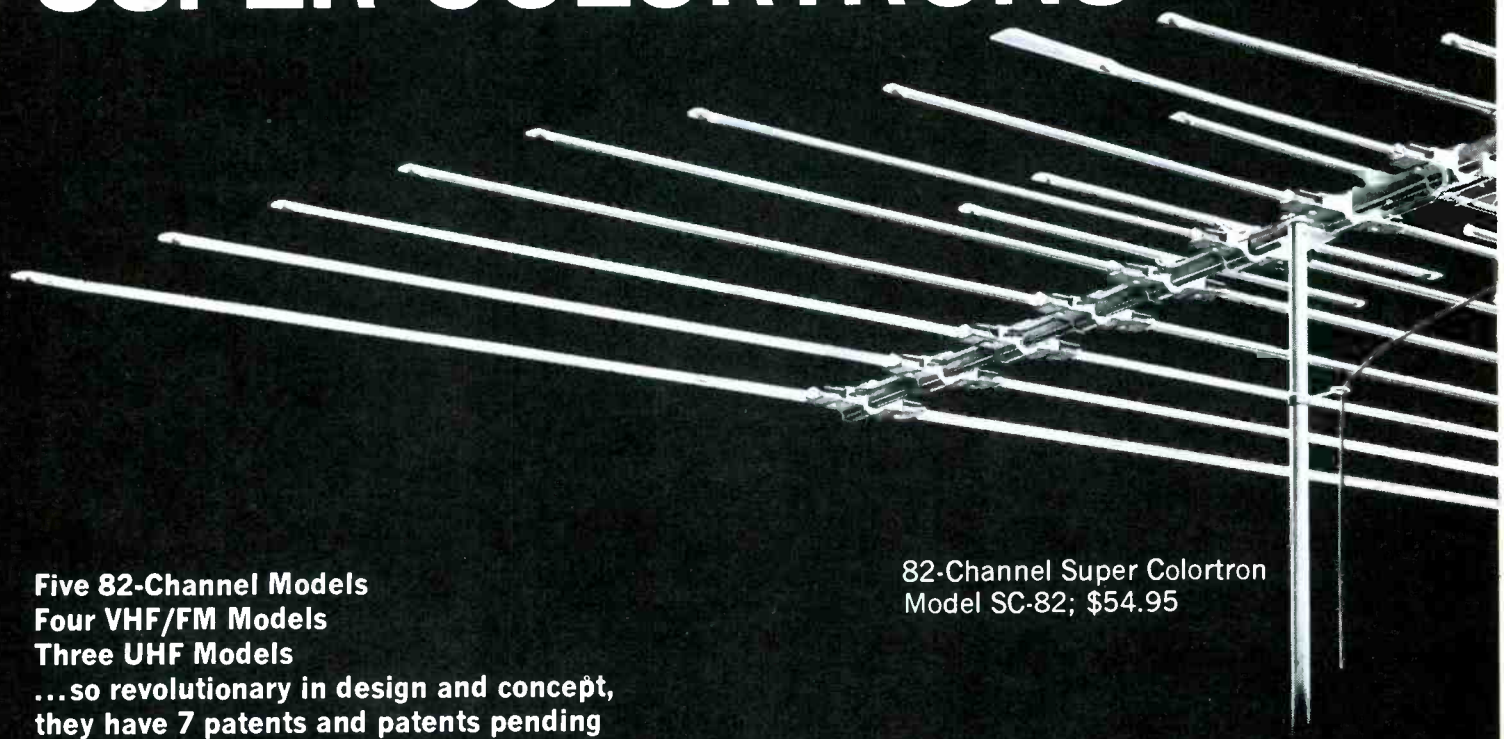

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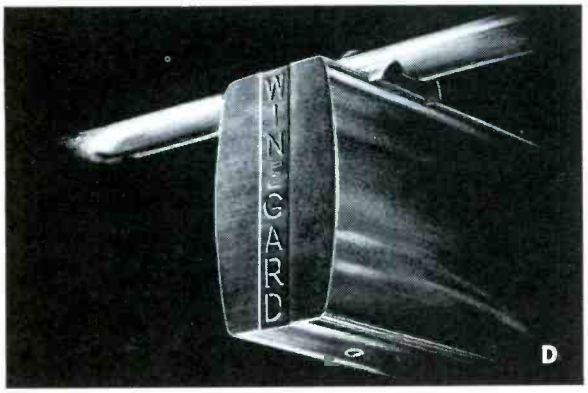

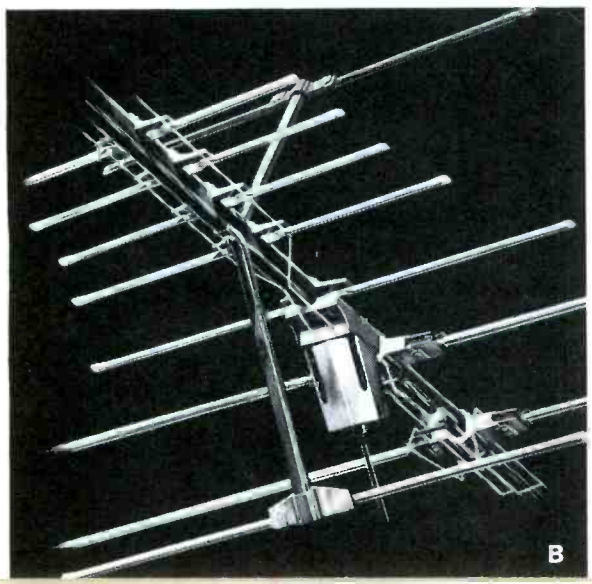

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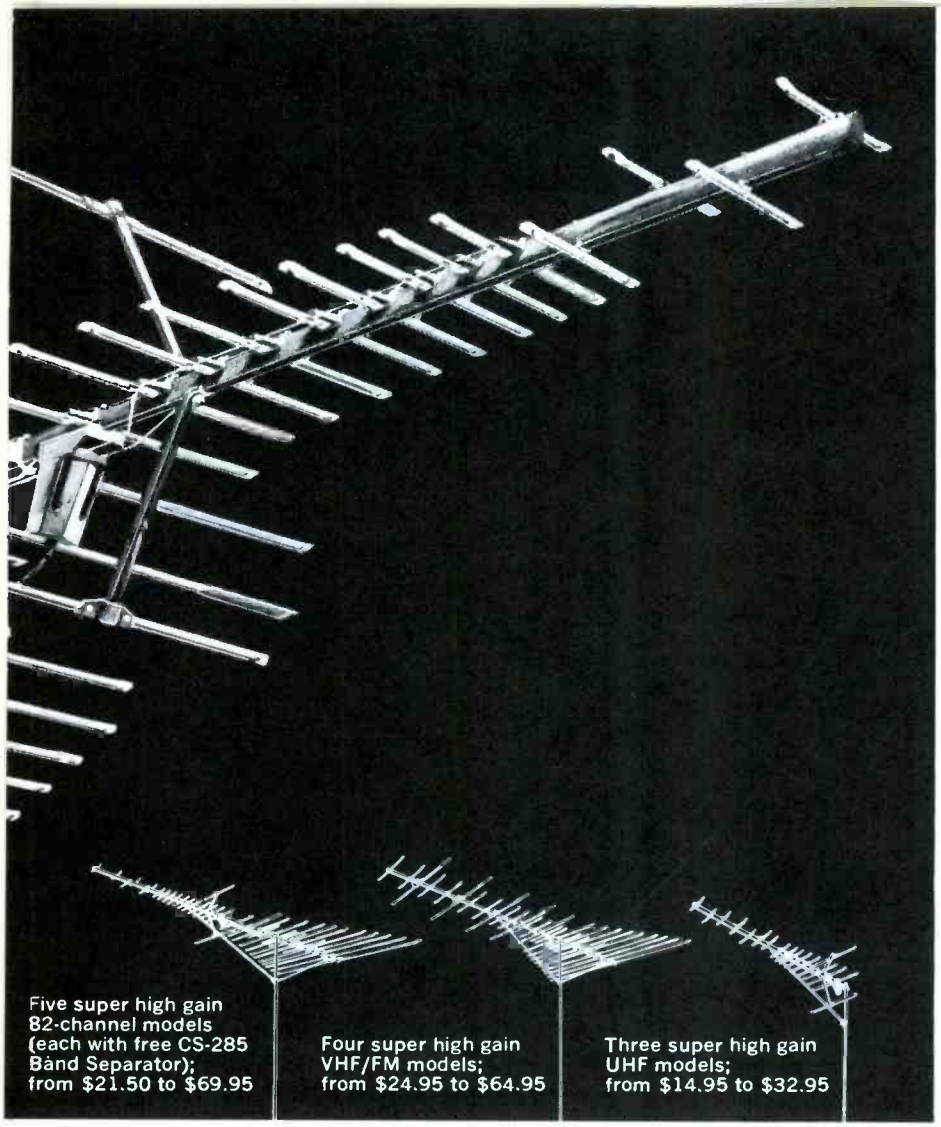

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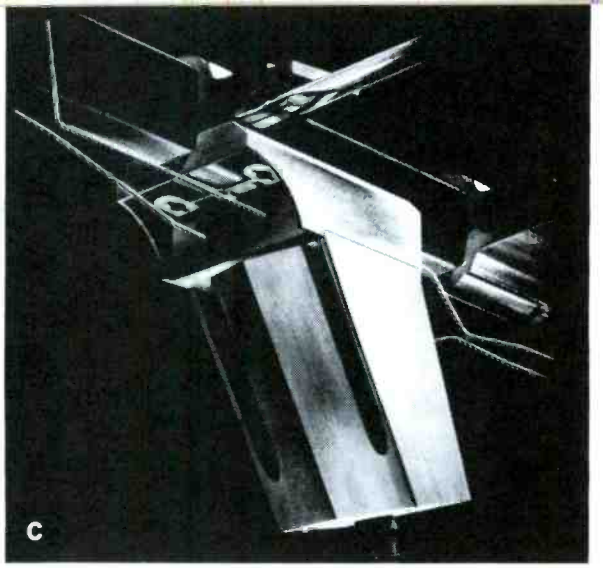

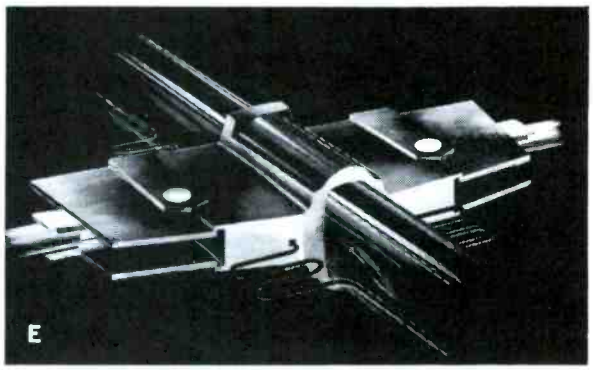

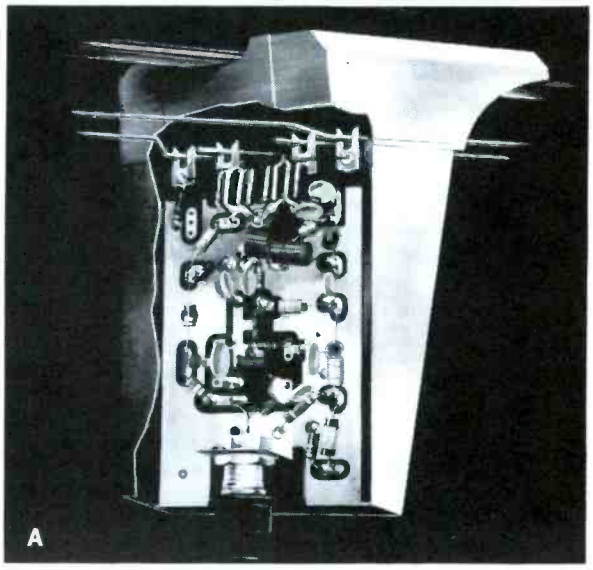

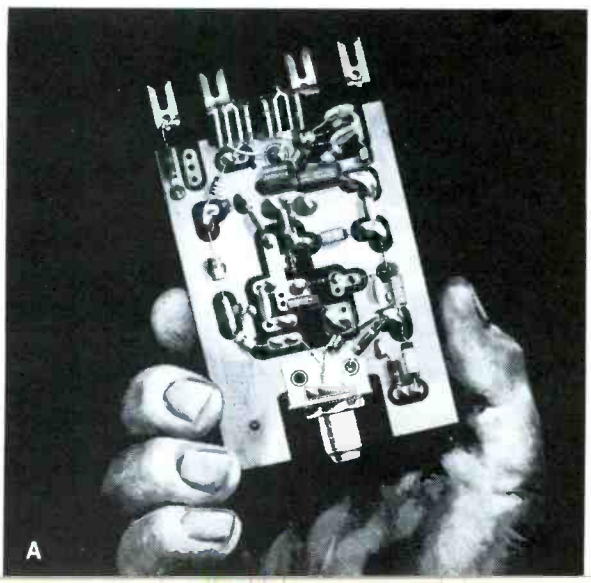

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(D) Total Design Ellipsoidal Boom: Exclusive boom is the first aluminum tubing shape engineered especially for antenna use. Proved far stronger than any other existing boom design.

(E) Total Design Wrap-Around Insulators: Exclusive low loss dielectric insulators completely encapsulate and weatherproof elements and correlators at point of electrical contact. Hi-impact polystyrene. Provide perfect alignment of elements and eliminate sagging and loosening.

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Total Design Wrap-Around Mast Clamp: Exclusive mast clamp has 4 pair of locking jaws (not just 2) to automatically align antenna on mast and for greater strength and durability. Requires only one U bolt.

Total Design Gold Anodizing: Exclusive Gold Anodizing is the only permanent gold finish used on any antenna—the only positive protection against corrosion and fading.

Total Design Assembly: Exclusive construction makes the Super Colortron truly easy-to-install—unfolds in seconds—completely factory pre-assembled.

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ANTENNA SYSTEMS

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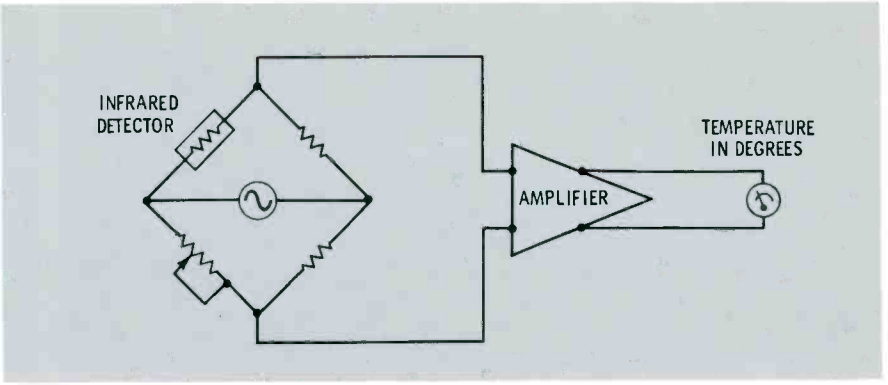

Fig. 10. Infrared pyrometer measures temperature.

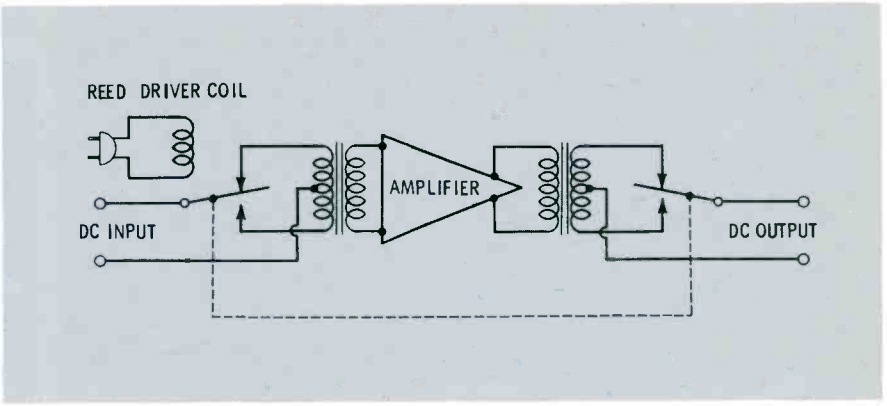

Fig. 11. Chopper amplifier responds to low-level DC signals.

prevents the dangerous accumulation of unignited fuel in the furnace.

The circuit arrangement shown in Fig. 9 uses a phototube which is illuminated by the pilot burner. The plate current of the phototube varies according to the flickering illumination from the pilot. The resulting signal is amplified, and then rectified. The DC output from the rectifier is applied to the control grid of a thyratron. As a result, the thyratron ionizes and the relay energizes. A solenoid in the fuel line is energized through the relay contacts, allowing fuel to flow into the furnace. In the event of pilot failure, the thyratron de-ionizes and the relay drops out. The solenoid in the fuel line now de-energizes, stopping the flow of fuel.

Infrared Pyrometer

The infrared pyrometer permits temperature measurement of hot surfaces at a distance, and can be used for both moving and stationary objects. It is a noncontacting instrument that responds to the infrared radiation emitted from the object whose temperature is to be measured (*all* objects with a temperature above absolute zero emit infrared radiation).

In the circuit shown in Fig. 10, the infrared detector is connected in one leg of a bridge circuit. A system of lenses focuses the infrared onto this detector. Since the resistance of the detector depends upon the amount of infrared reaching it, the bridge is unbalanced to an extent determined by the temperature of the object. The bridge output is then amplified and displayed on a meter calibrated to read temperature directly in degrees.

Chopper Amplifier

Industrial applications frequently require the use of amplifiers which will respond to low-level DC signals. Because the input level may change very slowly or remain constant for long periods, conventional RC or transformer coupling cannot be employed. Direct-coupled stages may be used, but these tend to be critical with respect to temperature and supply voltage variations. The chopper amplifier shown in Fig. 11 is designed to compensate for these disadvantages.

In this type of amplifier, the DC input signal is converted to AC by the action of the chopper. As indicated in Fig. 11, the vibrating reed of the chopper alternately con-

• *Please turn to page 56*

Will the coming age of solid state TV catch you half ready?

Not if you take advantage of our new "Professional Technician Program." Read on and see how Motorola's "PTP" can help.

Home entertainment products are changing—fast. There's more transistorization . . . and more advanced solid state technology each year. This means great opportunity for service organizations that keep abreast, because, well-informed technicians will be in even greater demand than they are now.

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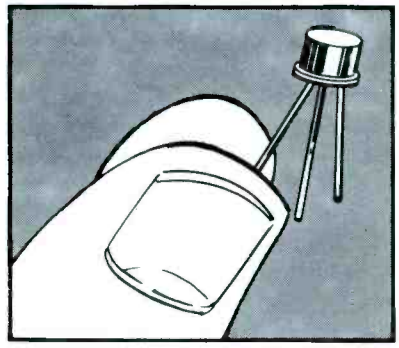

Get full information on availability of this training for your shop. Just call your Motorola Distributor.

MOTOROLA

Circle 18 on literature card

Fig. 1. A place for everything and everything in its place.

MEET A CB SPECIALIST

John D. Lenk

Come along with us as we visit a shop specializing in Citizens-Band equipment. Many shops can enter this field on a profitable basis.

HAL GURETZKY of L.A. Communications is a CB and business radio specialist in Los Angeles, California, and has been for the past 3 years. What's more, he is succeeding in this spot despite some obvious drawbacks. Let's take a look.

Although the sales and service shop is properly housed, it's location is not a prime contributing factor to the business success. Since a good percentage of the work is on mobile equipment, it is essential for any CB shop to have an adequate drive-in area. The south Fairfax address was chosen because of its central location and rear parking facilities rather than for a consideration of foot traffic or drive-in trade. There is considerable traffic on Fairfax, but these are mostly retail shoppers, not customers for a specalized service such as CB installation. Hal feels that his location is good, however, "for this type of business."

What might be considered a lack of space is overcome by proper use of the space available (Fig. 1). The quarters provide for a complete service shop, a small office, and enough storage space for several thousand dollars worth of spares and stock. Everything in the shop was designed for efficiency. For example, the two service benches are placed so that a technician can sit between them and move from one to another without taking more than one or two steps. There is no need to run the length of a long bench. All of the test equipment is located on shelves above the benches (Fig. 2). This way the meters are eyelevel, and the equipment takes up no room. There is no need to dig out some special piece of equipment from a storage area.

Hal keeps a good supply of tubes on hand at all times in the store room. As an added convenience, he keeps a complete set of pretested tubes on the bench. Since tube failure accounts for a good percentage of trouble in any electronic equipment, Hal feels that a stage-by-stage replacement with tubes known to be in good condition is the first logical step in rapid, profitable troubleshooting.

An extension telephone is located next to the benches. Since Hal is often alone, he must answer service calls while working. Some one-man shops let their answering service take calls while they are very busy

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All devices and kits are packaged in easily identifiable see-through packs for your convenience. Included with each device is broad performance data or specific ratings and characteristics where applicable.

RCA Solid-State Center Includes:

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- RCA SK-Series "Top-of-the-Line" Devices: 17 Transistors, 2 Rectifiers, and 2 Integrated Circuits, for experimenter or replacement use.
- RCA Technical Manuals. Four manuals include: RCA Experimenter's Manual, RCA Transistor Manual, RCA Linear Integrated Circuits Fundamentals Manual, and RCA Tunnel Diode Manual.
- RCA Solid-State Replacement Guide. Lists all RCA SK-Series "Top-of-the-Line" Transistors, Rectifiers, and Integrated Circuits and the more than 7,300 types which they replace.

Keep RCA Experimenter's Kits and the RCA SK-Series in mind when you're shopping for solid-state devices. Look for the RCA Solid-State Center. Now at your RCA Distributor. Do it today!

RCA Electronic Components and Devices, Harrison, N.J

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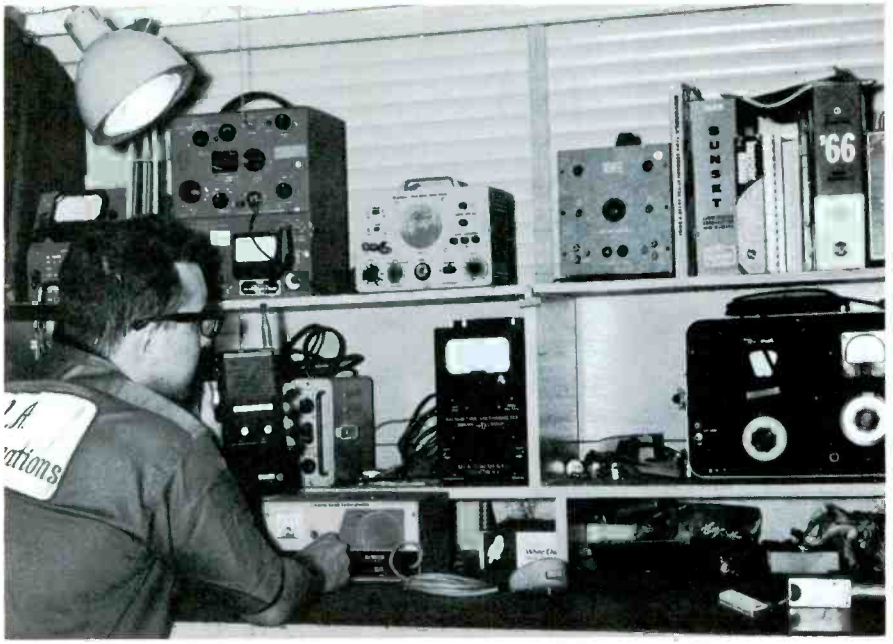


Fig. 2. Equipment shelves save space and improve efficiency.

on the bench. Hal feels that this is not good for customer relations—it gives the impression that the caller is dealing with a part-time business. Hal prefers to take each call in person, if at all possible.

One time-saving feature is use of the intercom loudspeaker that covers the parking service area. A frequency meter can be patched into the intercom so that you can hear the zero beat signal of a mobile transmitter while working in the area. (Fig. 3.) Although the idea is not new, it does save many steps (and dollars) when working alone.

As shown by the photos, Hal is a great believer in test equipment. The shop has at least two of everything. Hal is the first to admit that a good techician can work wonders with an accurate VOM, and that he has more test equipment than any shop of the present size will ever need. But he also adds: "Why spend a lot of time on a tough CB service problem when proper test equipment will give you an immediate answer." Also, he is looking forward to an expansion of his service facilities. When he has to hire in full-time techncians he wants to have the very best equipment on hand.

Besides the basic meter and scope, the minimum tools for any CB service operation include a frequency meter, wattmeter and signal generator. The technicians at L.A. Communications have this and more, in depth (Fig. 4.).

What about competition? Certainly in Los Angeles there is no lack of CB sales or service facilities. There are several full time mobile communications sales and service organizations, plus other retail outlets that sell or service CB as a side line. And, like all major cities, there are the usual backyard operators who work in their spare time. When asked about this competition Hal replied "I simply don't worry about it. There is no real price cutting among the competent service businesses. I charge $10 per hour for all service and installation, inside or out. My fixed charges are based on this figure. A competent organization can not charge less and make a living. Of course, another technician can come under this price, but he will not make money, and won't remain in business. If a mobile communications business charges substantially less than this figure, they cannot pay competent technicians. And if they hire unqualified technicians, I don't consider them competition. Likewise, if they are good men working for themselves, there is no point in their charging less. There are too many good jobs available in other phases of electronics, for top technicians."

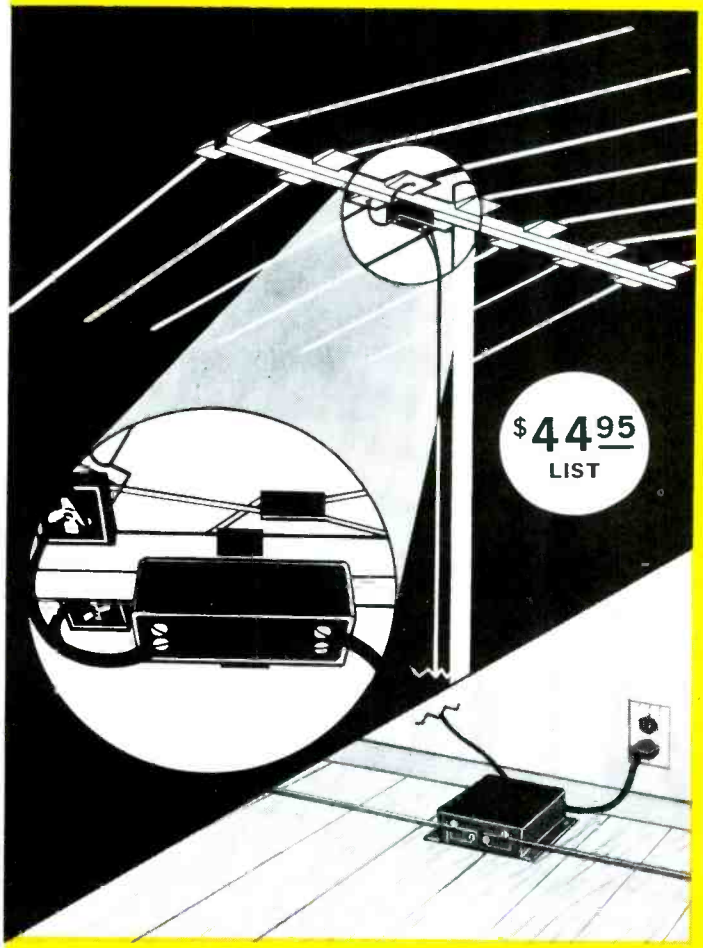
L.A. Communications offers a wide variety of CB equipment for installation. They are authorized

Fig. 3. Intercom speakers (arrow) in the parking lot save time and steps.

Fig. 4. Plenty of test equipment here.

NEW POWER

FROM FINCO



Model 65-3 VHF-TV ANTENNA AMPLIFIER

improves reception of WEAK VHF-TV signals in FRINGE AREAS even where strong local TV or FM signals are present. AMPLIFIES UP TO 7 TIMES for Better Color and B/W

A two-transistor—high and low band—amplifier in one compact weather-resistant housing. Engineered to provide the lowest noise and highest amplification with the most desirable overload characteristics. Designed for easy and convenient installation on antenna boom, mast, or under roof eave.

Amplifier used in conjunction with dual outlet power supply for one, two, or multiple set installations (with Finco 3003 coupler). 117 V 60 cycle input. AC power up to amplifier: 24 volts - 60 cycle. Metal enclosed with easy keyhole mounting. Amplifier and power supply provided complete with mounting hardware. Each unit tested and inspected prior to shipment.

Let Finco solve your Color and B & W reception problems. Write for complete information, schematics and specifications. Form #20-357.

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MAKER OF THE WORLD FAMOUS COLOR FINCO BLACK / WHITE TV AND FM ANTENNAS

THE FINNEY COMPANY

34 West Interstate Street • Bedford, Ohio 44014 • Dept. 310

Circle 20 on literature card

service stations for Hallicrafters, Johnson, and COMCO. They also sell Midland, Regency, and Metrotech. Hal works factory direct with some lines, and through distributors with others. The distributors can often prove a help since they provide sales/service leads, and are in a good position to sense trends in the area. On the other hand, the factory-direct lines offer the greatest margin of profit.

L.A. Communications prefers direct-mail advertising. He sums it up this way. "There are two types of CB buyers—the general public, would-be hams, experimenters, hobbyists, etc.—and the business buyer. The general buyer will buy his equipment at the electronic parts houses. We can't possibly compete with their tremendous walk-in trade no matter how much we spend on advertising. So we concentrate on the business buyer with direct mail advertising. Some CB sales are an alternate to business radio, but most are a supplement—an example of this is walkie-talkie paging.

"Likewise, we find that the executives of companies using busiess radio make excellent prospects for CB installations." It is interesting to note that many business radio users were first CB customers. They bought CB because of its low price. Once they found the advantages of radio communications to their business, they switched to the business radio and took advantage of the better communication range, less crowding, etc.

All direct mail advertising is followed up with in-person calls by a salesman. At present, Hal employs one salesman to follow up all direct mail leads. For a new customer, the sales pitch is supplemented by a working demonstration of CB operation. All sales work is on a straight commission basis. Hal does not believe in salary for salesmen. On the other hand, servicemen are paid on an hourly or salary basis. Where a salesman is given incentive by a commission basis, the same system tends to make a serviceman do fast, sloppy work, or to pad charges.

With the basic $10 figure for all service, the usual charge for a mobile CB installation is $15, while a base station is $30. Hal spends at least 80% of his time in service or installation work, with the remaining 20% in sales, paper work, etc. At present, the income or profit breaks down along this same percentage. The business radio end of the operation makes most of its money from rental of equipment (mobile telephone systems) rather than from straight sales or service. A typical business radio system includes 4 or 5 mobile installations plus the base station. Most of these are on yearly lease contracts. The CB equipment, on the other hand, is sold and serviced, but it is rarely rented.

This commentary on Hal Guretzky's operation gives an insight as to how he is making CB sales and service a paying business. Not everyone has the same philosophies about running their business, but this is one that's a proven success. ▲

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Circle 23 on literature card

NOTES ON TEST EQUIPMENT

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

by T. T. Jones

New Tube Tester Does Double Duty

SENCORE'S NEW MP-140 tube tester brings a new style to the service industry. It's housed in a black-vinyl-covered steel attache case. If you are among the technicians who are joining the trend toward white shirts and ties rather than blue collars, the MU-140 should complement your new image. The impressive styling is continued inside the case too, as can be seen in Fig. 1.

Styling is not the end of the story for the MU-140 though. It's been engineered too. Starting right at the set-up book, this instrument was designed to be used—and used often. The set-up book is printed on plastic-impregnated paper. This paper is strong as cardboard, yet light and flexible so the pages turn easily. When it gets dirty, just wipe it off with a damp cloth. Setups are listed for over 2600 tube types, including Japanese and European.

Two set-up choices are given for most tubes. The first is a cathode emission test. This is the same circuit as that used in the "Mighty Mite" series of Sencore testers.

In addition to the emission test, the MU-140 has a G_M tester built in. This is the real heart of the instrument, the incentive to pay that premium price. (As compared to a straight emission tester. Actually the price is lower than many G_M-type testers).

In the G_M circuit, Sencore has again brought some new features. First, the AC signal applied to the grid is a 4-kHz squarewave. The high frequency and high harmonics of this signal closely duplicate actual operating conditions of the tube under test. This signal is developed in a transistorized multivibrator circuit.

DC bias for the tube under test is developed by an interesting circuit Sencore calls the "ABC" circuit—Automatic Biasing Control. The circuit is really rather simple as can be seen in Fig. 2. R7 and R3 can be thought of as a single plate load resistor. Assume a cathode current of 25 ma, which would cause a 100-volt drop across R7 and R3, resulting in a plate voltage of +110 volts. This would also cause a 326-volt drop across R2 and R6. By Ohm's law we can compute −7 volts at the grid of the test tube. An increase of cathode current to 30 ma will increase the drop across R7 tnd R3 to 120 volts, and the plate voltage drops

Fig. 1. New G_M-Emission tester has radical styling.

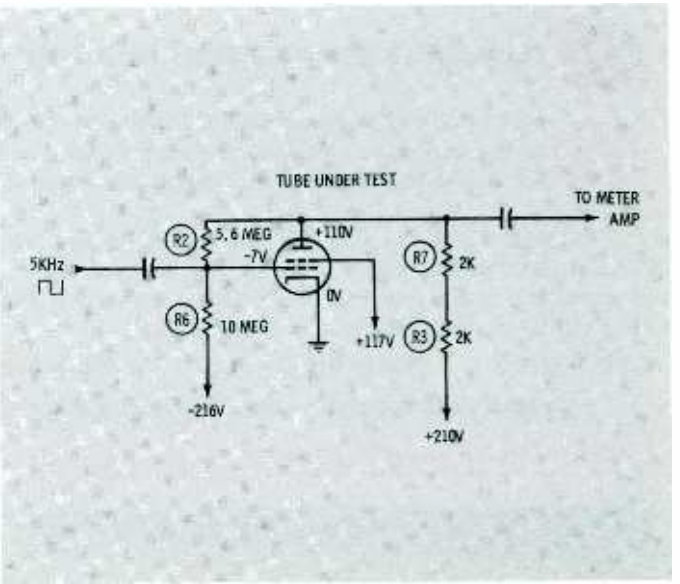


Fig. 2. The ABC circuit.

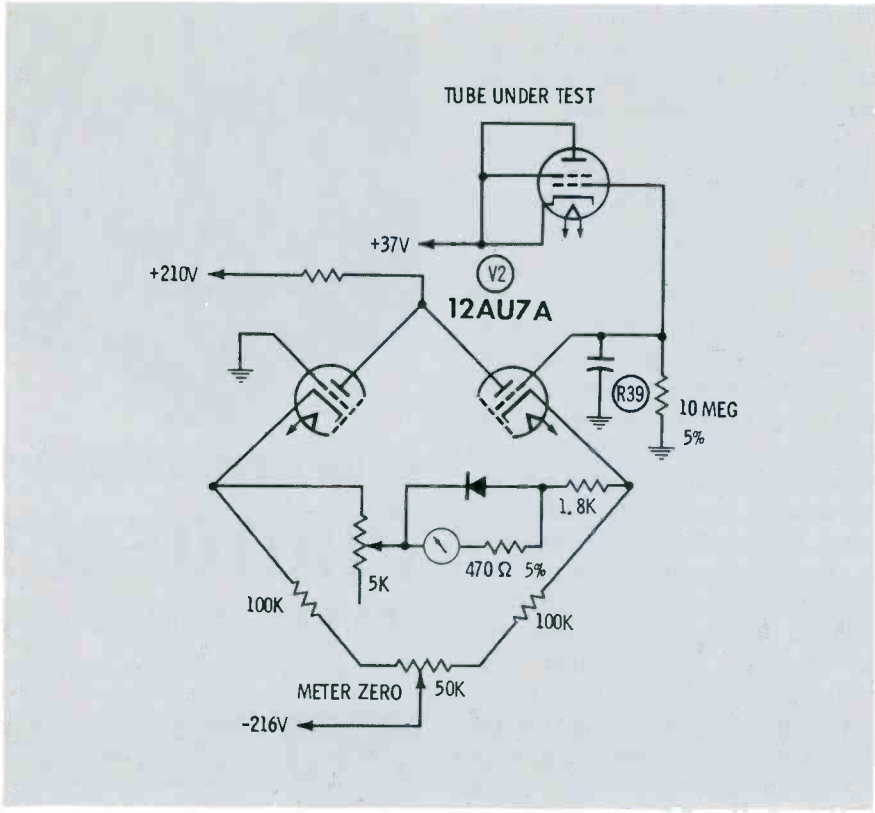


Fig. 3. Meter bridge and Grid Test circuits.

to +90. Now there will be 306 volts across R2 and R6, and the grid voltage will be −20. This increase in bias will tend to cutoff the tube and return the cathode current to the original value.

The value of R3 is selected by the Load switch to produce 3 choices of plate current—2, 7, or 25 ma, with plate voltages about +100. Regardless of the tube plugged in, the ABC will bias the tube so that it draws the current selected. The G_M reading is then dependent on the amount of 4-kHz signal. This is determined by the setting of the Signal control.

The grid leakage test (Fig. 3) is also similar to that in the Mighty Mite. The grid of the tube under test is grounded through R39. A positive voltage is applied to all other tube elements, including the cathode. Any grid emission or gas will allow a current to flow through the tube, causing a voltage drop across R39. This voltage is then read by the meter circuit. The grid test is extremely sensitive; about 35 na grid current will move the meter needle out of the "GOOD" area.

The meter circuit itself is a bridge. It has to have a very high input impedance, due to the sensitivity desired in the grid circuit tester. For this reason, a 12AU7 tube was chosen for the amplifier

legs of the bridge, though the rest of the instrument is solid-state. Insulated gate FET's could have been used in the bridge circuit but this would have added greatly to the cost of the instrument.

As can be seen in the photo, there are quite a few sockets on the MU-140. By putting in a few extra sockets, Sencore has kept setup switches to a minimum. Every known configuration of heater and suppressor grid has its own socket. For the emission test there are only 3 controls—heater voltage, cathode current (LOAD), and grid. The grid is used as the anode in the emission test. Additional controls are needed for screen, plate, and signal in the G_M test—6 switches in all, but this still allows a very fast setup.

There are pre-punched holes under the name plate so that more sockets may be added later if necessary. This helps to insure that the MU-140 will give many years of efficient service. ▲

For further informaton circle 56 on literature card

Sencore MU-140 Specifications

Tube-socket complement:
8-pin Octal
8-pin Loctal
7-, 9-, and 10-pin Miniature
9-pin Novar
9 pin Magnoval
12-pin Compactron
5- and 7-pin Nuvistor

Tests performed:
Grid leakage, shorts, emission, transconductance, and life.

Sensitivity:
Grid leakage; 100 megohms.
Shorts; 180K ohms.

Power Requirements:
117 VAC 25 watts.

Size (HWD):
4⅜" x 17¼" x 12⅜".

Weight:
16 pounds.

Price:
$179.50.

Color Tube

(Continued from page 22)

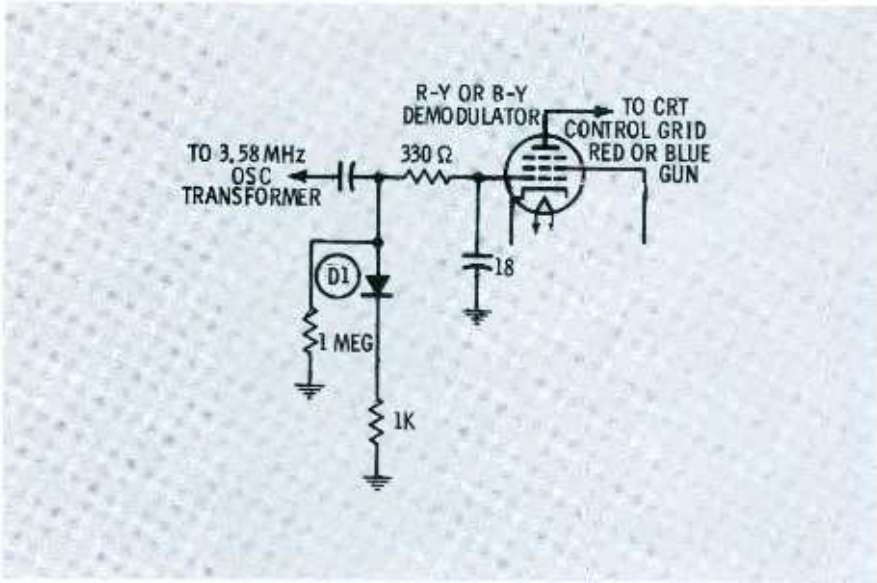


Fig. 4. Shorted diode can cause loss of one color.

Lit up picture tube tester. Checked all three guns very quickly, for emission. Green gun—OK. Normal emission. Red gun? Blue gun? *Both* very low in emission! Hooked the set up again, and warmed it up, then rechecked. Fine; equal emission. Now, I could see the trouble (after it hit me over the head). I hooked up the picture tube tester again, set it to "Rejuv," and shot both red and blue guns. I hoped that this would blow off the scale on the cathode, or whatever it was that was keeping these two guns cool for too long. Somewhat to my surprise, it worked!

When I took the set home, I told the owner exactly what had happened, and what had been done (to cover my tracks if the trouble came back). However, it didn't; this set is still performing well.

You can get similar symptoms from slow-heating tubes in color amplifiers, as well as from thermally changing resistors. In all cases, these possibilities should be checked out before you make the final diagnosis. Check the grid-cathode voltage at the base of the picture tube in all cases like this, and don't overlook the screen voltages. A bad resistor anywhere in the screen network, or a slightly low boosted-boost rectifier could affect screen voltage.

A Sylvania DO3 color portable had to be serviced twice in the home for shifting color temperature. The second time, the color shifted again before I got the rear cover back on the set. When I pulled the set in the shop, it gave me no end of fits 'till I finally found the bias clamp diode (D1 in Fig. 4) was intermittently shorting out. This caused a loss of bias on the demod, since the grid was then only 1K ohm above ground.

I remember another that happened while I was watching the set. The screen suddenly turned a very bright green and there was a sound like "GZLEEPF!" (This wasn't in the set—it was me. I was remembering the line in the service data under possible causes of trouble where it said "Bright green screen—defective kine") However, this turned out to be nothing more than a shorted 12BY7 in the green amplifier stage. Since this just happened to be MY set, I was highly relieved. In fact, I heaved such a sigh of relief that I blew all the dust out of the cabinet. ▲

"The Boss told him he should be more relaxed in dealing with the customers."

Are you eligible for the Bright Guy Awards?

It's easy to get them—and to get all the business they'll bring you. New customers. More sales. More money.

The Bright Guy Awards is the big program Sylvania's running this year to boost your sales.

Your Sylvania distributor can put your name and address in up to four

TV Guide ads in your area. The ads call you "the brightest serviceman in town"—and tell people in your town why they should call you.

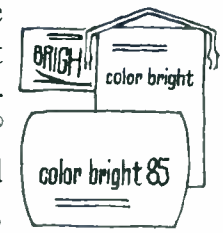
You'll get into the Yellow Pages, too, under the heading "TV Service and Repairs."

Once again this year you'll be eligible for over

one hundred valuable, interesting SMB-Bright Guy gifts, just for buying the Sylvania TV replacement parts you normally buy anyway.

And you'll get window displays proclaiming you "the brightest"—the TV serviceman everyone's reading about.

You're eligible for the Bright Guy Awards just by buying Sylvania's famous *color bright 85*® color picture tube. And our other picture tubes, and our receiving tubes. So see your Sylvania distributor.



Sylvania Electronic Tube Division, Electronic Components Group, Seneca Falls, New York 13148.

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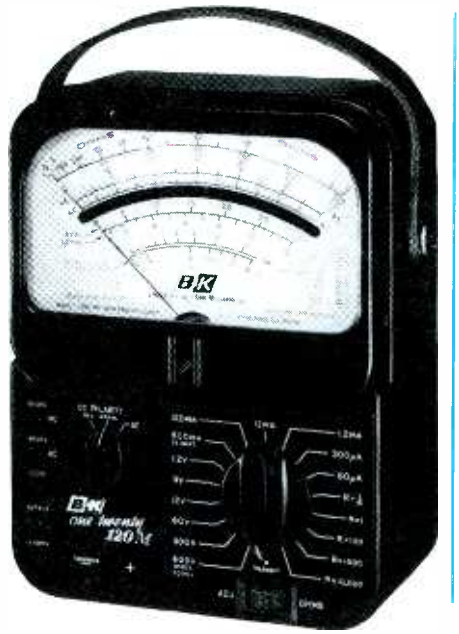

Leave it to B & K engineering know-how to create a Volt-Ohm-Milliammeter that puts you a jump ahead of your competition—helps make your job more rewarding and profitable. Only B & K Model 120 VOM offers a 2 ohm center scale, burnout-proof meter movement, a polished mirrored scale plus a total of 61 ranges! Model 120 VOM ranges start lower . . . and go higher than other instruments of similar size and type, making transistor servicing far easier. It's true. B&K brings you the industry's outstanding VOM value—Model 120 VOM, and prices it right! Only $51.95, net.

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Export: Empire Exporters, 123 Grand St., New York 13, U.S.A.

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Only the B & K Model 175 VTVM has a built-in battery eliminator —no ohmmeter battery required! B & K Model 175 features Transit-Carry — reducing possibility of a bent meter indicator. In addition, B&K built into this VTVM a totally reliable protection system. The meter movement cannot be damaged from application of a wrong input voltage. Looking for the industry's outstanding value in VTVM application? Look to B&K Model 175, only $59.95, net.

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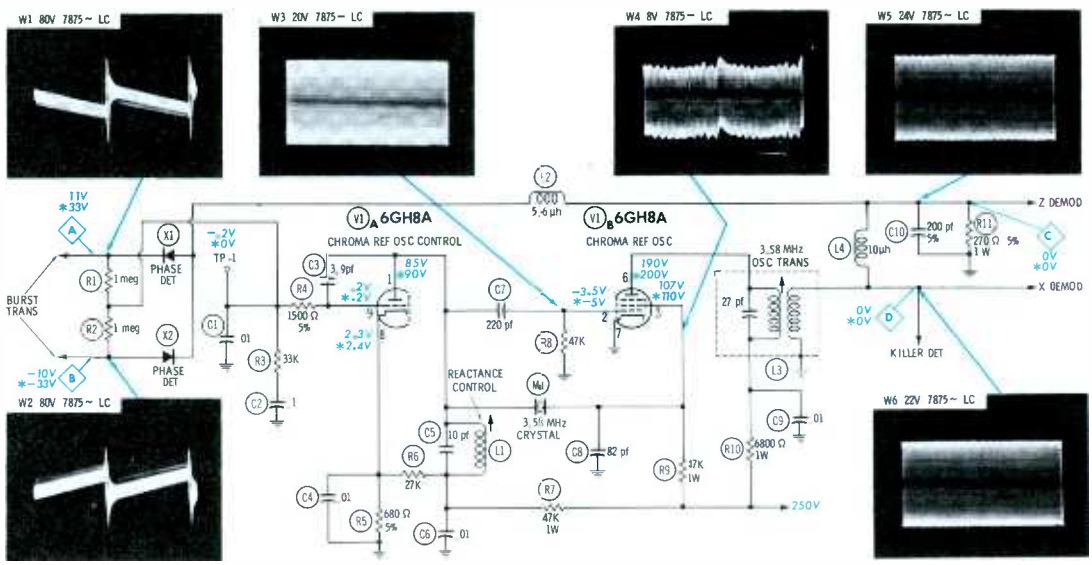
Chroma Oscillator



DC RESISTANCES taken with VTVM with interconnecting cable unplugged from main chassis. All controls set for proper convergence.

WAVEFORMS taken with wideband scope; low-capacitance probe (LC), connected across convergence yoke windings, used to obtain all waveforms shown.

Normal Operation

Purpose of chroma reference oscillator is to generate 3.58-MHz subcarrier that was used for chroma signal modulation at transmitter (subcarrier canceled at transmitter and not transmitted). The receiver 3.58-MHz CW signal must have exact same frequency and phase as station subcarrier. Sample of station subcarrier (burst signal) used to control receiver oscillator. Burst signal removed from chroma signal, amplified by burst amplifier, and coupled to phase detectors through burst transformer. Phase detectors compare burst and output of 3.58-MHz oscillator. Burst at X1 cathode 180° out of phase with burst at X2 anode. Output of reference oscillator coupled to common connection of detectors. If reference oscillator drifts so that burst and reference oscillator signal are not same frequency and in phase, one diode will conduct more than other, developing a positive or negative correction voltage at junction of R1 and R2. Correction voltage then applied to grid of V1A, which functions as an electronic variable capacitor across 3.58-MHz crystal. Positive correction voltage increases capacitance, thus lowering oscillator frequency—negative correction voltage causes opposite reaction. 3.58-MHz oscillator composed of screen grid (acting as oscillator plate), control grid, and cathode of V1B. L1 sets the free-running frequency of the oscillator and compensates for any inherent capacitance in V1A. 3.58-MHz Cw signal is electron coupled to V1B plate and fed through oscillator transformer to X and Z demodulators. The X signal, coupled directly to X demodulator, is in phase with chroma signal, while Z signal, coupled to Z demodulator through phase shifting network, is 85° out of phase with X signal.

Operating Variations

A, B DC voltage is determined by amplitude of burst (varies with station signal) and amplitude of feedback from oscillator (relatively stable with or without station signal). DC voltage at A varies from about 10 volts (–10 volts at B) with no signal, to 42 volts (–42 volts at B) with strong local signal. More important, voltages at A and B must be balanced (if A is 35 volts, B must be –35 volts). If not, phase detector not operating correctly, or oscillator drifting.

TP1, Pin 9 and 1 of V1A Voltages depend on how close oscillator is running to proper frequency—if oscillator drifts, correction voltage develops at TP1 and appears at grid of V1A. Change in grid voltage changes conduction of V1A, and plate voltage varies accordingly. V1A plate voltage also dependent on setting of L1. V1A grid voltage varies from about + 1 volt to − 1 volt, causing plate voltage to vary from about 70 to 90 volts.

V1B Element voltages remain fairly constant since oscillator runs all the time (with or without color signal). Grid measures about –3.5 volts with color signal, –5 volts without. Plate increases to about 200 volts with color signal, decreases to 190 volts without. Voltage at screen grid increases slightly with color signal.

Waveforms Amplitude of W1 and W2 depends upon level of station signal. Other waveforms remain constant, with or without station or generator signal.

Color Sync Weak

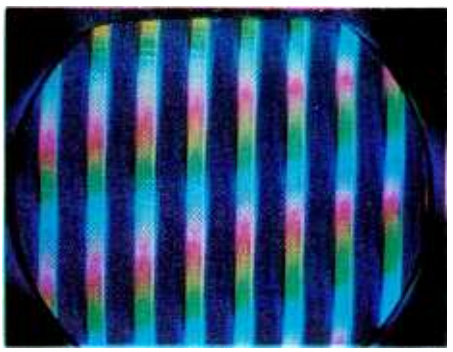
Possible Loss of Color

Symptom 1

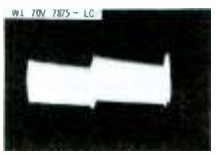
X1 and X2 Unbalanced

(Phase Detector Diodes)

Symptom Analysis



Color picture missing — b-w picture normal. Misadjusting color killer produces barber-pole effect on both strong and weak station signals. Readjusting reactance control coil produces color picture on strong station signal, but loss of color sync on weak signal.



Waveform Analysis

Amplitude of waveforms W1 and W2 only slightly low (70 volts p-p, normally 80 volts p-p), but unwanted "hash" present in content — burst is not clean. Indicates trouble in burst amplifier or phase detector circuitry. Amplitudes of other waveforms are also within normal tolerances, but excessive burst appears in content, as shown in waveform W5. Phase of signal is as important as amplitude, but cannot be determined from waveforms shown here.

Voltage and Component Analysis

Voltages at A and B best clue (voltages should be within one or two volts of each other, but opposite polarity). In this case, A is 35 volts, B is −25 volts—creates positive voltage at TP1, causing V1A to alter frequency of oscillator. If condition not too severe, frequency can be corrected by L1. Change in frequency causes killer detector to think no color received, cutting off bandpass amplifier, unless killer control misadjusted. Symptom similar with R1 and R2 unbalanced. Resistance measurements of X1 and X2 confirms trouble.

Best Bet: VTVM for voltage and resistance

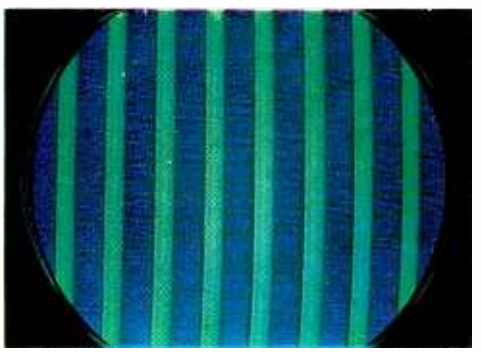
All Color Bars Green

Only Green On Station Signal

Symptom 2

M1 Open

(3.58-MHz Crystal)

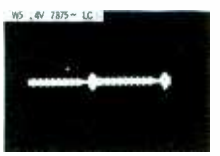


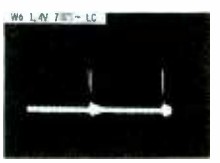
Symptom Analysis

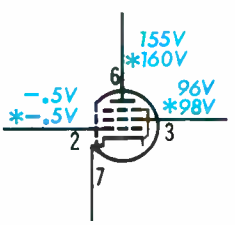
Station color signal produces no color. Misadjusting color killer produces green where other colors should be—more predominant in areas that should be red. Generator signal produces 10 green bars. Hue control has little effect. Color control varies amount of green.

Waveform Analysis

Waveforms W5 and W6 show only small amount of burst feeding thru diodes X1 and X2, with slight amount of chroma from grid of demodulators. Although not shown, W3 at oscillator grid measures only .2V p-p. W4 (oscillator plate) indicates only small amount of horizontal information. Waveforms W1 and W2 (not shown) appear normal in content, but slightly high in amplitude. All waveforms in oscillator circuit indicate oscillator not running.







Voltage and Component Analysis

Grid, plate, and screen voltages of V1B below normal —grid extremely low—confirms oscillator not operating. With killer control correctly adjusted, failure of 3.58-MHz oscillator will produce no color symptom since output of oscillator needed to cut off killer and allow bandpass amplifier to conduct. Misadjusting killer control allows bandpass amplifier to conduct, but without 3.58-MHz signal applied to demodulator grids, color cannot be properly demodulated. Component substitution best troubeshooting procedure in oscillator.

Best Bet: Scope; VTVM; component substitution

Colors Not Stable

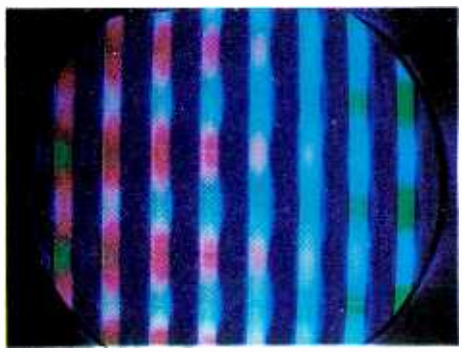
Color Bars Drift Through Picture

Symptom 3

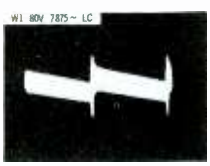
C2 Open

(Noise Canceller Circuit—.1mfd)

Symptom Analysis



Station color signal produces true colors, except horizontal bars of wrong color drift through picture from top to bottom. B-W picture normal. Generator color bars predominantly blue, with effect similar to barber pole, except colors in sync. Controls operate normally.



Waveform Analysis

Burst transformer output (not shown) stable. W1 and W2 have correct amplitude but indicate excessive noise between burst signals. Normally, only pure DC control voltage at TP1, with amplitude dependent upon amount needed to correct oscillator frequency—waveform shown here indicates AC component present at this point. Waveform at grid of V1A (not shown) measures 5 volts p-p (normally about 1 volt p-p)—probe causes loss of color sync.

Voltage and Component Analysis

NO SYMPTOM

All DC voltages within tolerance, indicating that phase detector circuit balanced and operating correctly. Since open C2 does not upset DC voltages, best clue is AC component present in waveform at TP1. C2, R3, and C1 form noise cancelling filter to remove any noise present in burst amplifier output. With C2 open, noise is applied to grid of V1A, varying conduction of this tube, and altering phase of 3.58-MHz oscillator at noise rate—noise signal is impressed on 3.58-MHz input to demodulators, upsetting chroma demodulation.

Best Bet: Scope; circuit analysis

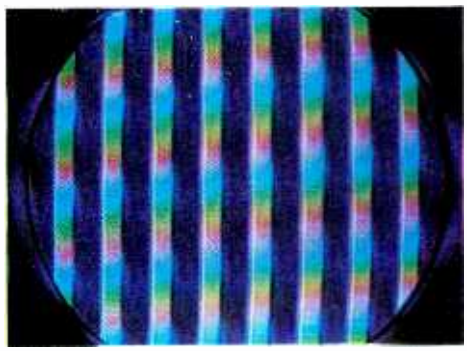
No Color Sync

Possible Loss of Color

Symptom 4

R7 Increased In Value

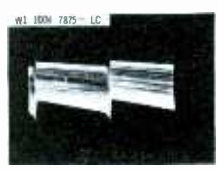
(V1A Plate Load Resistor—47K, 1W)

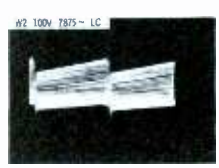


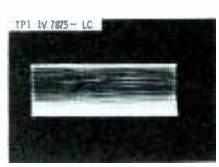
Symptom Analysis

First symptom is no color. Misadjusting color killer control produces color—but out of sync. Shorting TP1 to ground and adjusting L1 brings color bars into sync, but when short removed from TP1, color bars again lose sync—barber-pole effect.

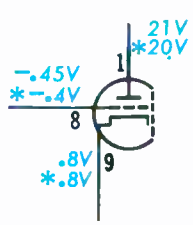
Waveform Analysis







Amplitude of W1 and W2 at input of phase detector is good, but content—along with presence of unwanted signal at TP1—indicates that oscillator is off frequency. W3 (not shown) measures 26 volts p-p. Waveforms W5 and W6, at output of reference oscillator, can be checked to confirm that oscillator is running when no color is observed — aside from these observations, waveforms little help in diagnosing trouble since phase cannot be determined.



Voltage and Component Analysis

Best clue is decreased DC plate voltage of V1A (20 volts, normally 70 to 90 volts). Reactance tube plate current leads oscillator voltage by 90°, adding capacitance across L1. Normally, correction voltage at grid of V1A varies plate current to compensate for frequency shift of oscillator. Increase of R7 decreases plate current, causing less capacitance across L1, increasing oscillator frequency. Also, plate voltage lowered beyond point at which grid voltage can cause enough change in plate current to offset error.

Best Bet: Preliminary checks; VTVM

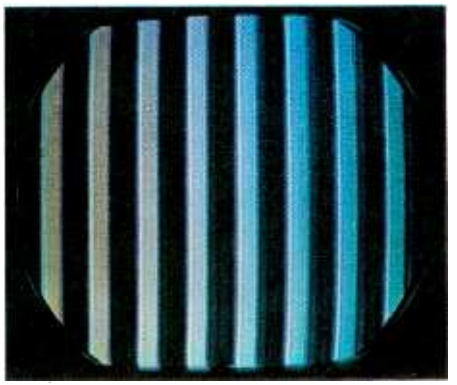
Weak Color

Color Sync Unstable

Symptom 5

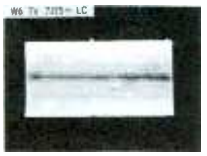
C9 Open

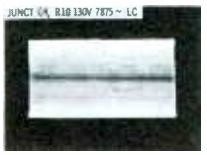
(Bypass Capacitor—.01mfd)



Symptom Analysis

Colors on strong station, even with color control wide open. Weak stations don't produce enough color—sync unstable. Generator with output higher than normal produces only weak color, although sync is stable with lower output. Hue control produces proper hues.

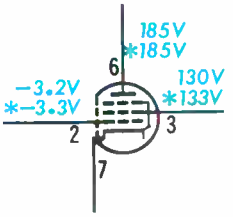




Waveform Analysis

Amplitude of waveforms W5 and W6 extremely low (7 volts p-p, normally about 22 volts p-p)—indicates demodulators, phase detectors, and killer detector not receiving enough 3.58-MHz signal. Although waveform W3 (not shown) is low (13 volts p-p, normally 20 volts p-p), it does show oscillator running. Obvious clue to trouble is waveform at junction of C9, L13, R10—should be nearly pure DC instead of AC shown here.

Voltage and Component Analysis



DC voltages at A and B low, but balanced. V1B grid voltage slightly low. V1B screen (oscillator plate) voltage high (133 volts, normally 110 volts). C9 is RF ground for output of V1B. Open C9 causes signal to be dissipated along B+ line, reducing amount of signal applied to L3. Weak signal at C and D reduces effectiveness of demodulators, resulting in weak colors. Leaky C9 causes same symptoms by reducing V1B plate voltage—shorted capacitor kills color. Increase in R10 causes same symptoms by reducing W5 and W6.

Best Bet: Scope will solve.

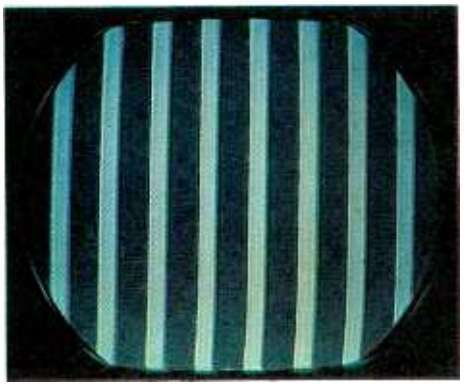
Color Sync Unstable

Phase Error Slight

Symptom 6

L2 Open

(Oscillator Feedback—5.6 μh)

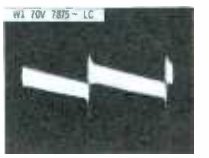


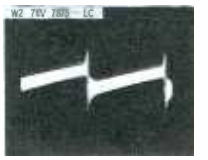
Symptom Analysis

No color when set first checked. Grounding TP1 and adjusting L1 produces color, but not stable—hue keeps changing—not complete loss of color. Generator signal produces color, but phase constantly changes until sync or color is lost.

Waveform Analysis

Amplitude and content of W1 and W2 near normal — along with preliminary check (grounding TP1 and adjusting L1 for color), eliminates phase detector input as source of trouble. W5 and W6 (not shown) are normal and indicate oscillator is running, with or without sync or color. Waveform at junction of L2, X1, and X2 is obvious clue to trouble—should be similar to W5, but only trace of rectified burst is observed.





Voltage and Component Analysis

Preliminary checks indicate oscillator capable of running on correct frequency. DC voltages at A and B unbalanced—would normally indicate X1, X2 or R1, R2 unbalanced or defective; however, absence of correction voltage at TP1 does not support this assumption—normally, such unbalance would produce large correction voltage. Another clue is absence of even small voltage (−.1 to .1 volts) normally present at junction of L2, X1, and X2 with signal—best clue is waveform at this junction—resistance checks verify trouble.

Best Bet: Scope; then VTVM.

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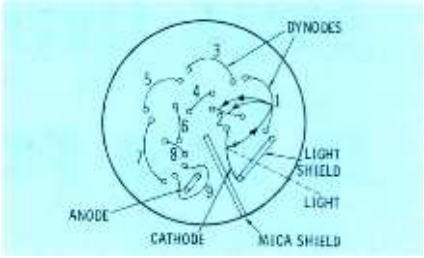
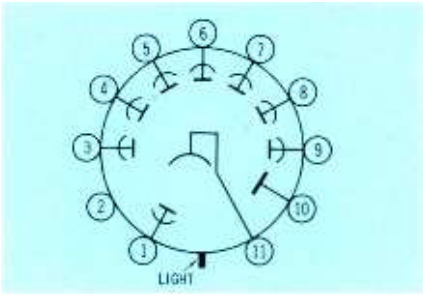
Electronic Notebook

(Continued from page 36)



(A.) Physical construction.



(B.) Schematic symbol.

Fig. 12. Photomultiplier provides greater sensitivity.

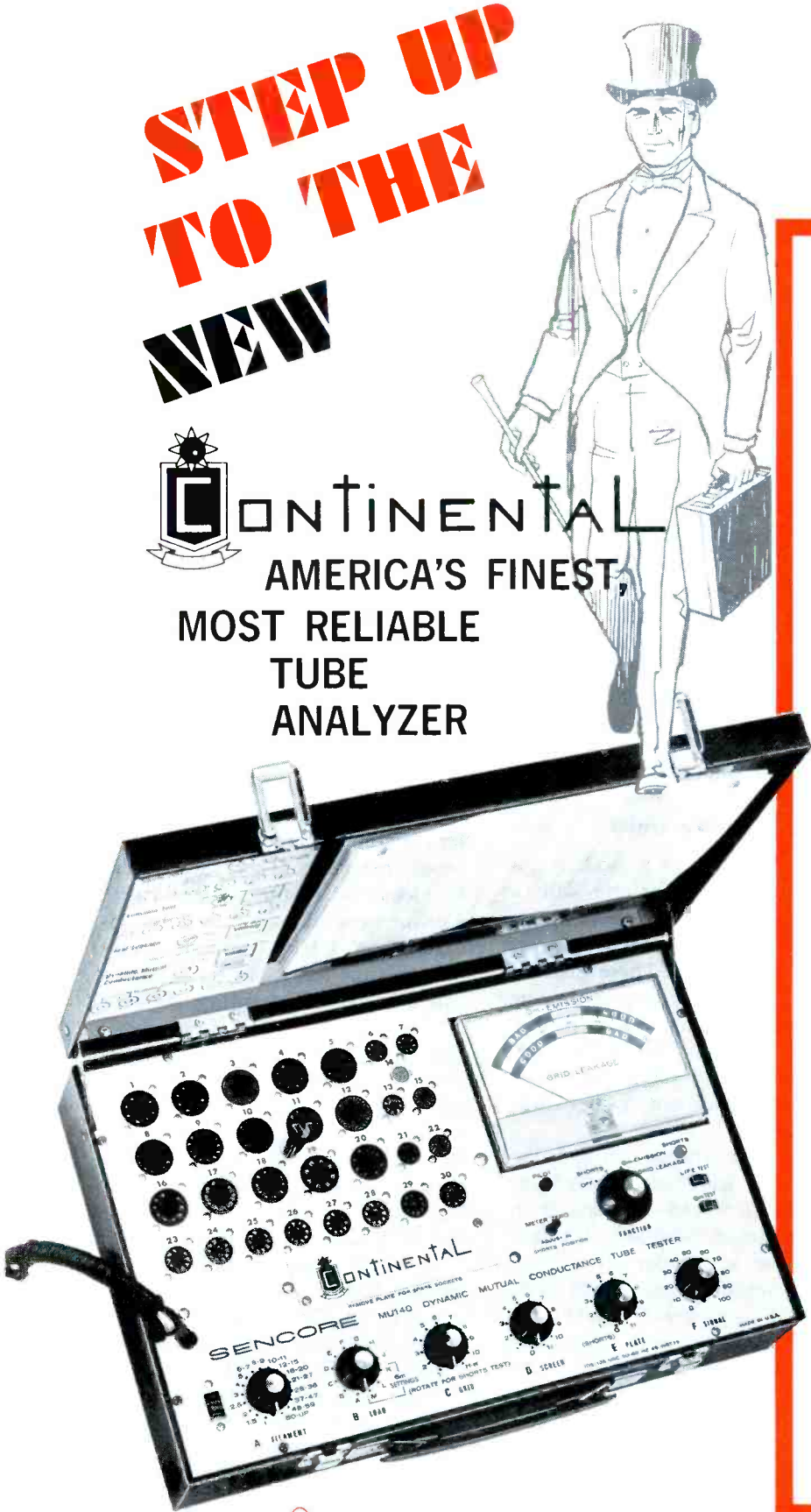
nects the DC input to opposite ends of the transformer primary. The resulting AC signal from the transformer can now be amplified in conventional RC or transformer-coupled stages. Another reed, driven in synchronism with the input reed, demodulates the output to provide a DC voltage which is an amplified reproduction of the DC input signal.

Photomultiplier

The photomultiplier shown in Fig. 12 is used for applications requiring a phototube of extremely high sensitivity. This tube is so sensitive it can be driven to saturation by a level of illumination too low to produce a response from a conventional phototube. This high level of sensitivity is achieved by utilizing the phenomenon of secondary emission.

Electrons emitted from the light-sensitive cathode are attracted to an adjacent element known as a dynode. This action is shown in Fig. 12A. As a result of the impact, secondary electrons are knocked off of the first dynode, and in turn, are attracted to the second dynode. Similarly, secondary electrons from the second dynode are attracted to a third dynode, etc. Each dynode is made more positive than the preceding one so that electrons will flow from dynode to dynode in succession. ▲

STEP UP TO THE NEW



CONTINENTAL

AMERICA'S FINEST, MOST RELIABLE TUBE ANALYZER

A "MUST" FOR MODERN SERVICING . . . PRODUCTION LINE TESTING . . . QUALITY CONTROL . . . LABORATORY.

A True Gm Tester

- **5000 Cycle Gm Test**
- **Full Cathode Emission Check**
- **100 Megohm Grid Leakage Test**

and Still the Speediest Tester in Town

In a nut shell . . . here is how Sencore does it. Using only the first three controls, the MU140 becomes a speedy "Mighty Mite" cathode emission tester with grid leakage sensitivity checks up to 100 megohm . . . for fast on the spot service. Flip the last three switches into operation from the set-up data and the MU140 becomes a true mutual conductance tube tester using 5000 cycle square wave to completely analyze any tube. You can't go wrong. No more need to mess around with time-consuming old fashioned tube testers with up to fourteen knobs and a rough 60 cycle sine wave test. The Continental tests them all including foreign tubes . . . over 3000 in all. And, it's guaranteed against obsolescence too with replaceable "new socket" panel and controls so standard that the switch numbers correspond to the pin numbers shown in any tube manual. You can actually set up the Continental without the set-up data in the cover if the need should arise. Here is everything that you could want. Its famous four way independent tests make you a master of the art of tube testing . . . internal shorts test; full cathode emission test; 100 megohm grid leakage test; and to back you up on critical tubes . . . a superb mutual conductance test. The beautiful Continental is housed in a vinyl-clad solid-steel attache case with lustrous all-chrome front panel. Yet at a price below all competition.

$179.50

SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

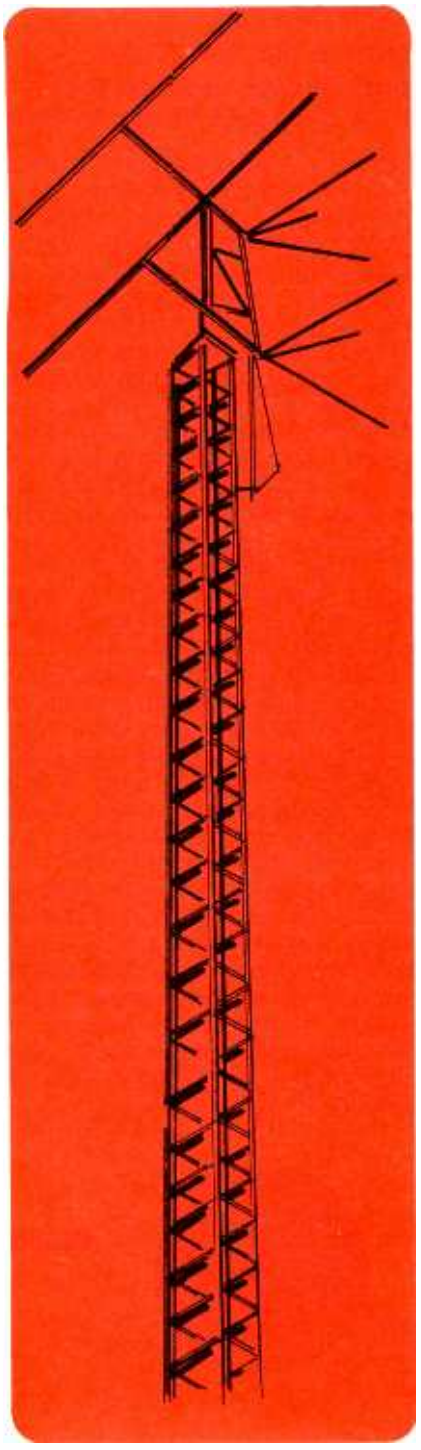
426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 31 on literature card

ANTENNAS can add PROFITS

Spring and summer antenna sales can put dollars in your pocket. Apply the practices outlined here.

Jack Graham



With warm weather just around the next page of the calendar, now is the time to make your plans for the big push to sell antenna instalstallations this year. Industry forecasts place color receivers in 40 million homes in the U.S. by 1970. This could mean 40 million potential customers for antenna installations. Furthermore, there is a potential market of staggering proportions for replacement antennas.

Quality Units

The installation of a modern antenna, particularly for use with a color receiver, is not a low-end, inexpensive unit such as we all remember in the past. These installations require quality, top-of-the-line merchandise calling for a professional installation. This is basically the reason the new set owner should contact a serviceman, rather than "do it himself."

During our travels around the country, we have encountered innumerable problems resulting from the improper installations of antennas for use with color sets. These improper installations, usually done by "do-it-yourselfers," make the best advertising for you, the professional installer. To paraphrase Confucius: One bad picture on TV worth one thousand newspaper ads.

As previously indicated, the installation of an outdoor antenna today is much more critical than it was in the early days of television. Some of the problems encountered today are the results of:

1. Increasing number of UHF stations broadcasting color.
2. Intereference, ghosts, and snow are much more irritating on a color picture. This requires more attention to the choice of lead-in wire and the manner in which the wire is installed, as well as the qualiyt of the antenna.
3. Installations using poor mounting materials.

UHF

Fifteen years ago, a UHF station was somewhat of an oddity in most areas. In most cases it was an experimental educational station or a translator. There were very few locations in the country where a prime network affiliate was broadcasting on UHF. Virtually every metropolitan area in the country was a solid VHF territory. As tuners became more and more sensitive, the need for high-quality, high-gain, directional antennas diminished. The inexpensive conical became the standard in almost every area. As is the case in most diminishing markets, the profit margin for those servicemen working in the field became smaller.

As UHF stations came on the air, the tendency was to install another inexpensive antenna to pick up the additional signal. Of course, if there were two UHF stations in different directions, either a rotator installation or still more antennas were required. We have seen as many as three knife switches mounted on the back cover of a console in order to connect different antennas. The FM stereo market was also on the upswing at this time, and that called for still another antenna, since neither the conical nor the UHF antenna could give satisfactory stereo reception.

hats off to the new king...

...THE NEW SENCORE COLOR KING

CG141 DELUXE COLOR GENERATOR

This is it . . . the KING of all standard color bar generators. It is standard in every respect but has new regal features that tower over any other color generator on the market. Check these new royal features before you dare let yourself look at any other color equipment.

Two new color patterns: The Color King has all five standard patterns plus two **new** patterns; a single dot and a single cross. The dot and cross can be centered or moved to any spot on the screen. Truly a Sencore exclusive.

Temperature Controlled Circuits: No more worry about timer jump in cold weather or on hot days. Sencore's new "Temp Control" maintains a thermostatically controlled temperature above 80 degrees.

The Color King will maintain stability anywhere from 20 degrees below zero to 140 degrees in the shade. Another Sencore first.

New Snap Tuning: Eliminates troublesome tuning between channels. It's just like tuning in a channel on your TV. You know that you are "on the nose" with the Color King.

New Analyzing Features: Increased output of Chroma and Sync signals for new TV sets make the job of tying down Chroma troubles a snap.

Check all these features, the price, and appearance. Then compare with other color generators. You, too, will say "hats off" to the new Sencore COLOR KING. **THE KING OF VALUE AT ONLY $149.95**

See America's most complete line of professional test instruments—at your Distributor now.

SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

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Circle 32 on literature card

You will probably recognize the "aluminum jungle" look that most of our cities and suburbs began to develop. That "aluminum jungle" is still there and has not improved.

New Antennas

In most cases, the antennas in one of these multi-multi-antenna installations were placed so close together that interference resulted and considerable signal was lost.

To eliminate these disadvantages, the antenna engineers had to develop antennas that would provide uniformly good reception throughout the entire television spectrum and also have sufficient emphasis on the FM band to allow for stereo reception. Such antennas are now available from many manufacturers, and you can sell them.

When a new color receiver is installed with the existing black-and-white antenna as the only method of receiving a signal, the new set loses almost 50 percent of its value to the owner. The ills inherent in the old antenna can completely block out any real fidelity in the color reception. Also, the conical antenna will pass all kinds of spurious transmissions.

Obviously this customer is now ready for a new antenna. However, since he has just paid in the neighborhood of $500 for his color set, he might pick the antenna as the spot to start economizing. This is your opportunity to point out the troubles he can incur by relying on the old antenna. If there are no UHF stations operating in the area you are probably trying to sell a VHF antenna. However, you can upgrade your sale by pointing out that UHF stations may be scheduled for future operation. Stress the beauty of FM stereo and have a receiver installed in the salesroom so the customer can hear it. He may now be in the market for a UHF-VHF-FM combination antenna. Don't forget the possibility of a rotator if stations in your area are widely scattered.

Each and every house call provides an opportunity to sell a replacement antenna. As you approach the house, give the antenna a once-over. When you have the receiver repaired, mention that you do make antenna installations and that the antenna is really due for replacement. Have a reminder card ready to hand to the customer. Ask if they are having trouble receiving any stations. If they are, point out that the antenna is a likely cause. Explain how corrosion and old age cause an antenna to deteriorate gradually, along with a corresponding decrease in picture quality. Such an explanation may help the customer realize that his reception isn't as clear and solid as when the antenna was new. Thus, the prospect of restoring good reception may sell the antenna installation for you.

The Installation

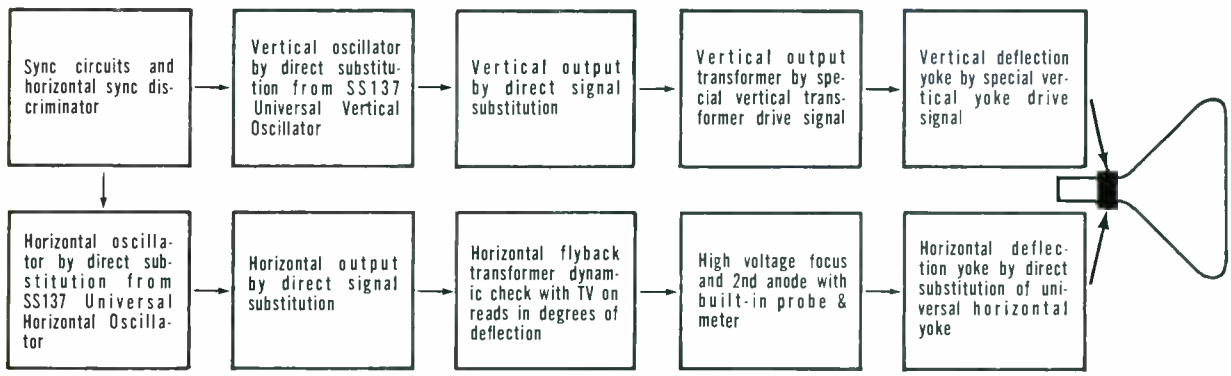
Of course, all of the black-and-white "do's and don'ts" are still valid; however, they are even more important with a color antenna installation. *Do* use the shortest pos-

ISOLATE ANY SWEEP PROBLEM IN SECONDS COLOR OR B/W

NEW!

ALL NEW SENCORE SS137 SWEEP CIRCUIT ANALYZER

Sweep circuit defects cause the toughest dogs, especially with color. Simplify them in seconds with the All New Sencore Sweep Circuit Analyzer. The only **complete** Sweep Circuit Analyzer available. The SS137 trouble shoots each and every stage in both the vertical and horizontal sweep sections of the receiver, by either signal injection or direct substitution of the entire stage. Using tried and proven methods, the Sencore SS137 takes the sweat out of sweep circuit trouble shooting. All tests are with the set on, dynamically in the circuit . . . to insure the most reliable and accurate check on each component.



In addition, a built-in VTVM and milliampere meter to back you up when setting regulator currents and measuring current through the horizontal output stage. Measures AC peak to peak and DC voltages up to 1000 volts. There is even a clip-on high voltage probe and a meter circuit for measuring and monitoring the second anode up to 30,000 volts in two ranges at the flick of a switch. An absolute MUST for color.

ALL FOR ONLY $94.50

PLUS — These Special Sencore Extras

- Glass mirror in the lid to setup linearity and height adjustments.
- Removable hinged cover that can be left right on the unit for protection to and from the job.
- All steel construction for maximum durability.

See America's most complete line of professional test instruments — at your Distributor now.

SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 33 on literature card

sible length of lead-in to do the job. *Don't* let the wire touch a metal surface. *Do* make certain all connections are solid. *Don't* make unnecessary loops in the lead-in, etc.

UHF installations require the following additional considerations:

1. *Do* use UHF lead-in.
2. *Do* seal foam-filled line where it is exposed to the weather.
3. *Do* maintain maximum allowable spacing from metallic objects.
4. *Don't* use "wrap-around" stand-offs.

The use of light-weight, somewhat flimsy materials for mounting an antenna had also become prevalent in many areas. The fact that the antenna shook and vibrated in the wind could be overlooked with b-w reception because tuner bandpass was broad and signals were quite strong. However, with the advent of color, a firm, substantial mounting arrangement must be employed.

One of the most neglected group of items involved in a quality antenna installation is the accessories. This includes the couplers, splitters, and transformers. The splitter is a must with a combination UHF/VHF antenna. Many of the combination antennas now on the market have a splitter packed in the box.

The two-set home has become as common as the two-car garage; the need for good reception at all locations can be a powerful tool for spurring the sale of a multi-set coupler. Here too, the stereo fan can be sold. That new combination antenna will feed the FM signal to the stereo tuner through a coupler.

In the final analysis we can only repeat the opening statement. By 1970, approximately forty million homes will have color television. This means potential customers for antenna installations and that means $ $ $ $ for you. ▲

THE TROUBLE-SHOOTER

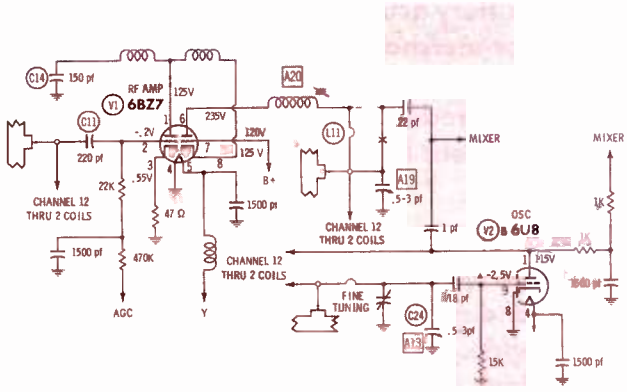
answers your servicing problems

Tuner Trouble and CRT Replacement

Heavy snow and distorted sound are the trouble symptoms plaguing a Motorola TS-408A Chassis (PHOTOFACT Folder 11-13). Reception is weak on all channels. Resistance and voltage readings in the tuner are normal. The only trouble I have found is a broken C24. However, replacing this thrimmer has had no effect on the trouble symptoms. I have checked the 6BZ7 RF amplifier and the 6U8 oscillator-mixer—both are good. While troubleshooting, I accidentally touched a short clip lead to L11, and the picture and sound returned to normal—no snow or distortion. When the clip lead was removed, the snow and distorted sound returned. I also have another problem: A bad picture tube (17QP4) in an RCA 72A chassis. According to the parts list in PHOTOFACT Folder 184-12, a 17LP4 can be substituted for the original CRT, but will involve circuit changes. I have a good 17LP4 and would like to use it. What are the circuit changes referred to in PHOTOFACT?

WILLIAM L. SMALLEY

Philadelphia, Pa.



The symptoms associated with the Motorola Chassis indicate a dead RF amplfiier stage. The short clip lead you attached to L11 acted as an antenna, applying the incoming RF signal to the mixer grid. Since you have already eliminated the 6BZ7 as a possible source of trouble, I suggest that you look for an open coupling or decoupling capacitor—C11 and C14 are good suspects.

Substitution of the magnetically focused 17QP4 picture tube with an elecrostatically focused 17LP4 can be accomplished by performing the following changes:

1. *Remove the focus magnet (not needed with 17LP4).*
2. *Change the CRT tube socket to match the 12L basing of the 17LP4 (the 17QP4 has a 12N base).*

Want to catch all the action this year?

1P1279
Full-Line Blister-Pack
Pegboard Floor Display

You'll catch all the battery action you can handle with RCA's new floor merchandiser. For greater sales appeal, greater self-service, better inventory control, and reduced handling of products, you can't beat this Full-Line Blister Pack Floor Display.

Designed to hold a full complement of RCA blister pack batteries (up to 180 blister packs), this attention-demanding unit measures 72" high by 31" wide. And the attractive "Catch All The Action" header will stop them in their tracks!

So contact your RCA Battery Distributor and find out how easily you can catch all the battery action this year...and the profits that go with it!

RCA Electronic Components & Devices, Harrison, N.J.

The Most Trusted Name in Electronics

3. *Connect pin 6 (focus electrode) of the tube socket to either ground or any one of the low-voltage sources (whichever gives the best focus).*
4. *After installing the 17LP4, be sure to replace the ion trap magnet and adjust it for maximum screen brightness.*

If you decide that the foregoing changes are too involved, a 17UP4 or 17YP4 can be used as a direct replacement for the 17P4 (no circuit changes necessary).

An article titled "Selecting a CRT Replacement", in the May '61 issue of PF REPORTER, *provides a CRT substitution chart, along with a description of the various circuit changes required for tubes that are not directly interchangeable. Also provided is a list of the CRT characteristics to be considered when selecting a substitute picture tube. Currently available CRT replacements are listed in Volume 10 of Howard W. Sams "Tube Substitution Handbook" (20534).*

CRT Arcing

After replacing the flyback and yoke in an Olympic Model 6P25 (PHOTOFACT Folder 682-2), severe arcing started at the CRT anode connection. The set operates normally as long as the chassis is not close to the picture tube; however, as soon as the chassis is reinstalled in the cabinet, the arcing starts at the picture tube. Voltages are normal in the damper and horizontal output circuits. All tubes and capacitors in the high-voltage and horizontal output circuits have been changed. The area surrounding the picture tube anode connection has been recoated with insulating compound, the high-voltage lead has been replaced, and the centering magnets have been removed. The only discrepancy I have noted is that the width control does not have any effect on the width.

W. B. McDONIE

Ironton, Ohio

The arcing you are experiencing at the CRT anode connection is probably caused by inadequate grounding of the picture tube aquadog coating. Check the grounding spring(s) for proper contact with the CRT. Also, be sure the anode connector prongs fit into the anode button tightly, providing a good connection. It may be necessary to spread the prongs slightly. Another item worth noting when such arcing is present is the rubber shield covering the anode connection. Because of moisture and a chemical decomposition of the rubber, the cap can become conductive, resulting in a leakage path across the glass surrounding the button. However, it seems you have eliminated this possibility by replacing the high-voltage lead (provided you also replaced the cap at the same time) and applying corona dope around the anode button.

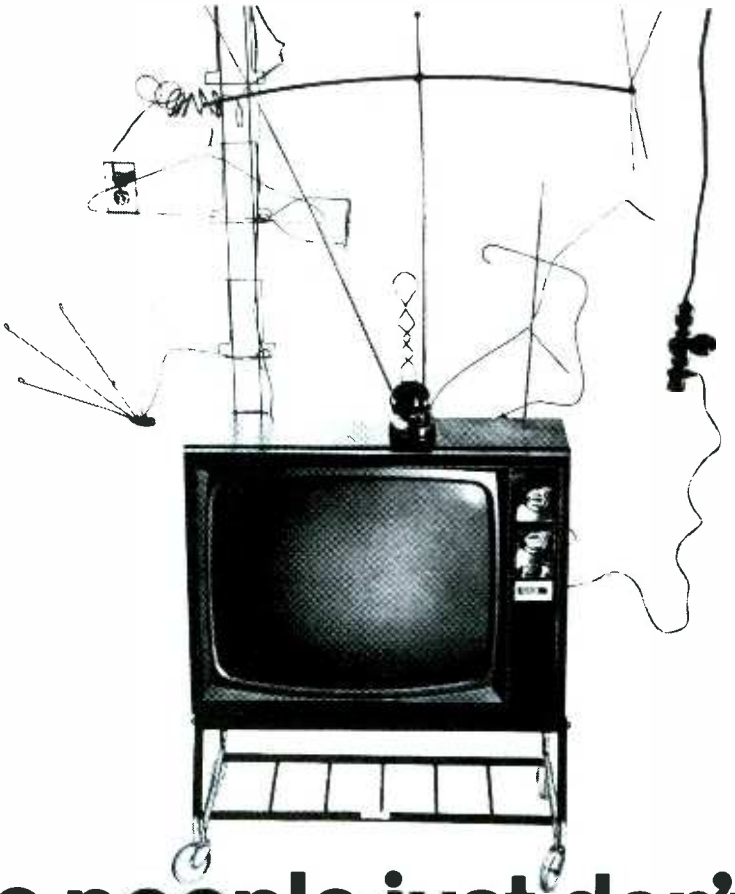
Adjustment Color Coding

Occasionally I service AM/FM transistor receivers and do not have a schematic for locating the oscillator and IF transformers. Do you have any information concerning the color coding of the adjusting screws associated with these transformers?

F. L. MILLER

Pittsburgh, Pa.

Color coding of the adjusting screws of IF and oscillator transformers used in AM/FM transistor receivers is not standardized and varies from manufacturer to manufacturer. Complete coverage of this type of equipment can be found in Howard W. Sams Transistor Service Manuals (TSM series). ▲



Some people just don't like to admit they need a service man.

They know they're going to have to pay bills for something they don't really understand. They feel a little uneasy, a little helpless.

That's why millions of Philco owners automatically choose their local Philco Qualified Service Center when they need something fixed. They feel safer with the specialist. There's a lot of new business waiting for you when you hang out the Philco sign.

Qualified PHILCO SERVICE CENTER

Your service technicians can get all the training they need right there in your area. And when they're through, our Tech Data Service keeps them in the picture with all the new developments and service short cuts.

When your shop appears in our Yellow Pages listings you become the headquarters for Philco Service in your area. You can get new business you'd probably never have uncovered. And you get the fastest parts delivery in the industry.

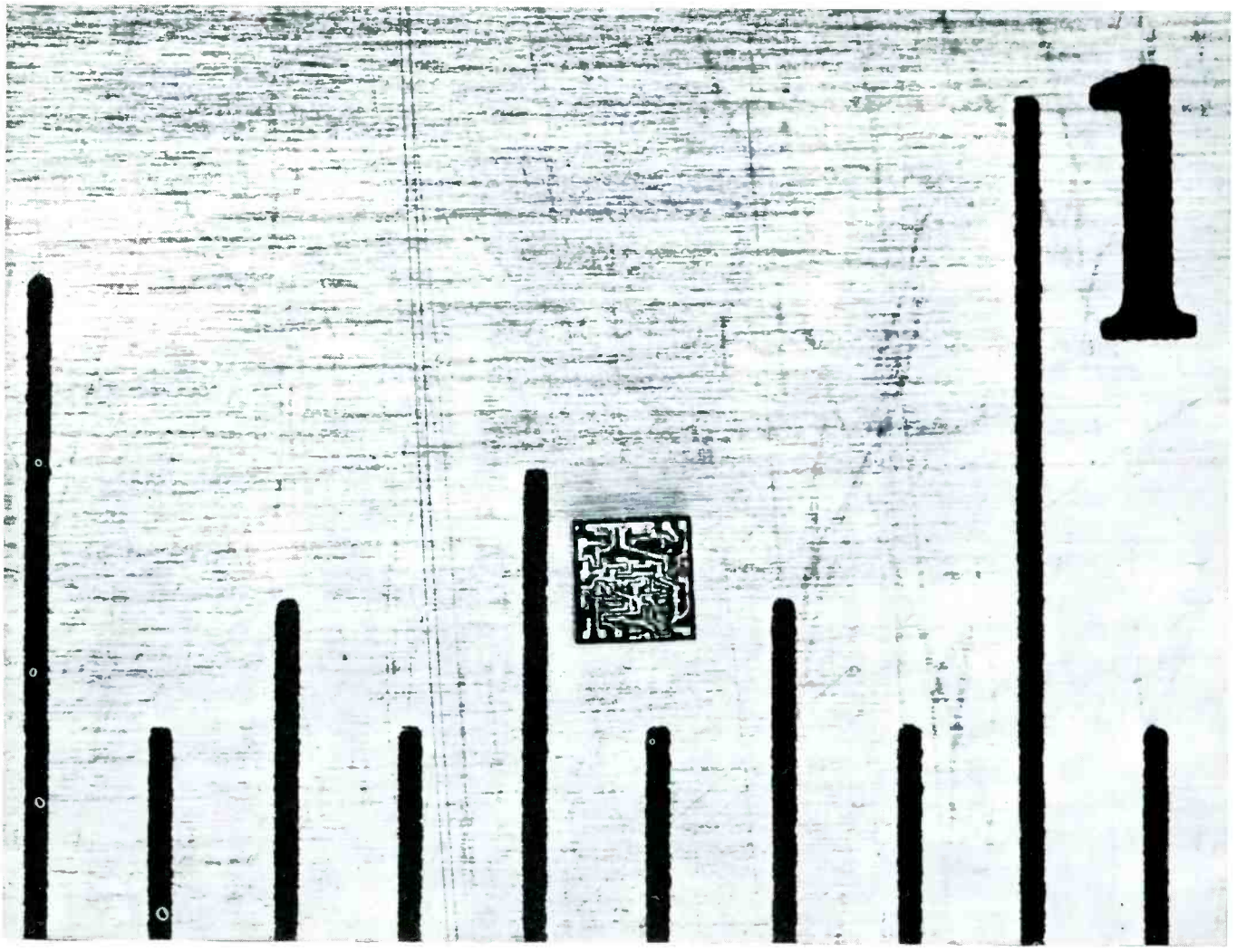
That's briefly how it works—how it'll mean more business for you. Your local Philco-Ford Distributor will give you all the details. Call his Service Manager.

PHILCO Ford

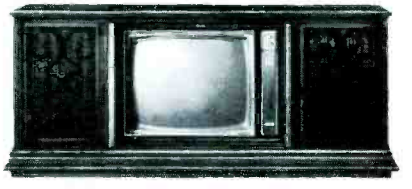
FAMOUS FOR QUALITY THE WORLD OVER

Philco-Ford Corporation
Philadelphia, Pa. 19134

Circle 38 on literature card



At 1/20th of an inch square it's the biggest thing in electronics



(And RCA Victor is using it now)

RCA Victor was first to use integrated circuits in home entertainment products. Why? Because the integrated circuit is the most reliable circuit ever made for a consumer product. It's made in a room continuously cleansed of microscopic particles · Computer-controlled tests assure that it functions properly · Each is firmly mounted and connected to leads by ultrasonic bonding to enhance reliability (and that's what helps you sell). See your RCA Victor distributor today.

RCA The Most Trusted Name in Electronics

SCANNER

(Continued from page 17)

million units, and this represented 30% of the year's total phonograph sales. Portable and table phonograph sales increased from 3.3 million units in 1956 to 4.3 million units in 1966.

Distributor Sales of Television

	Total	Monochrome	Color
'66	11,652,207	6,949,744	4,702,463
'65	10,774,599	8,027,981	2,746,618

Distributor Sales of Radios

	Home	FM	Auto
'66	13,601,781	3,702,829	9,389,288
'65	13,281,698	3,088,574	10,021,549

Distributor Sales of Phonographs

	Total	Portable/Table	Console
'66	6,102,918	4,310,309	1,792,609
'65	5,754,681	4,046,015	1,708,666

The U. S. tape recorder market has increased to an estimated 5 million units in 1966, up from approximately 200,000 in 1956. The advent of cartridge systems, for auto and home, will give continued impetus to this as yet undetermined market. Magnetic tape equipment could become the most outstanding growth area in an industry that has been setting records in nearly every product line for the past 10 years.

The growth of consumer electronics has been accompanied by a gratifying downward trend in price structures. The latest Department of Labor Wholesale Price Index (covering all prices within the American economy) shows all commodities to be at 106.2 of the 1957-59 base period. The television, radio receivers and phonograph section of the index, however, was at only 83.8, one of the best performances recorded by any American industry.

—Tube & Transistor Sales Also Rise

Receiving tube sales to initial equipment manufacturers (end equipment producers) amounted to 283 million units during the year 1966, increasing by 21.4% from sales of 233 million units during 1965, the Electronic Industries Association disclosed.

EIA's Marketing Services Department reported that total sales of receiving tubes climbed 11.7% to reach 443 million units during 1966 compared to sales of 397 million units during 1965. At 19.3 million units, sales of receiving tubes to foreign countries were up 12.4% during 1966, while direct sales to Government agencies increased by 9.2% to 17.6 million units. Sales of receiving tubes for renewal purposes were off 5.4% at 123 million during 1966.

The EIA also announced that U. S. electronics manufacturers sold $476 million worth of transistors during 1966, an increase of 18% from sales of $404 million during 1965. As average values declined 15.2%, unit sales of transistors climbed 41% to reach 856 million during the 1966 period.

—And Further Rise is Forecast

Vice President John B. Farese, of **RCA Electronic Components and Devices** forecast that industry sales of electron tubes and solid-state components are expected to reach a new peak of $3 billion in 1967.

"During 1967, we anticipate that the industry will achieve electron tube sales totalling more than $1.7 billion. The greatest gains will be in sales of color television picture tubes, entertainment receiving tubes, and industrial tubes," Mr. Farese said. "In the solid-state components business, sales will exceed $1.3 billion this year. Major growth will take place in integrated circuits, industrial and power transistors, as well as silicon-controlled rectifiers."

8-Year Warranty

Curtis Mathes now offers an eight-year adjustment warranty on the picture tubes in its color TV sets to retail purchasers.

Each color set shipped to dealers will have an eight-year adjustment warranty attached. The dealer will sell this agreement to the retail purchaser for $12.00. During the first year, a tube that fails would be replaced free under the standard warranty. During each succeeding year under the agreement, the picture tube will be replaced on a sliding schedule of cost—$25 during the second year, $50 the third year and so on up to $175 during the eighth year.

Accepted

Accreditation of **Sams Technical Institute** at Indianapolis and Evansville has been announced by the Accrediting Commission of the National Association of Trade and Technical Schools.

This national organization established and maintains rigid standards for private trade and vocational schools, Along with other requirements, a school must meet established curriculum standards, conform to acceptable advertising practices, and follow ethical tuition policies. The STI Centers at Indianapolis and Evansville are two of only 24 currently accepted for accreditation by this organization.

Radio Watch

A new, nationwide public service program to help communities of all sizes encourage residents to support the police has been announced by the communications division of **Motorola.**

The new program calls for special cooperation from all personnel who drive vehicles equipped with two-way radios. They are asked to observe and report the suspicious and unusual to their offices by two-way radio. Their offices then relay the reports to the police for further action.

The new program, which is named "Community Radio Watch," has grown from a spark of an idea to a nation-wide crusade, with Motorola furnishing all materials necessary to interested communities.

Motorola vice-president William J. Weisz commented: "Community Radio Watch is our way of lending a helping hand to the nation's law enforcement officers. Quite frankly, we find it hard to believe that being a good guy and helping your fellow man is going out of style. We hope that a large segment of the American public feels the same way. If they do, and if they will help their police—they will help themselves, their community and their country."

Expansions

Zenith announced plans for a 650,000 square foot facility to manufacture color and black-and-white television receivers in Springfield, Missouri.

Joseph S. Wright, Zenith president, said that the new TV plant, to be operated by a Zenith subsidiary, will represent an investment of nearly $10,000,000 when completed.

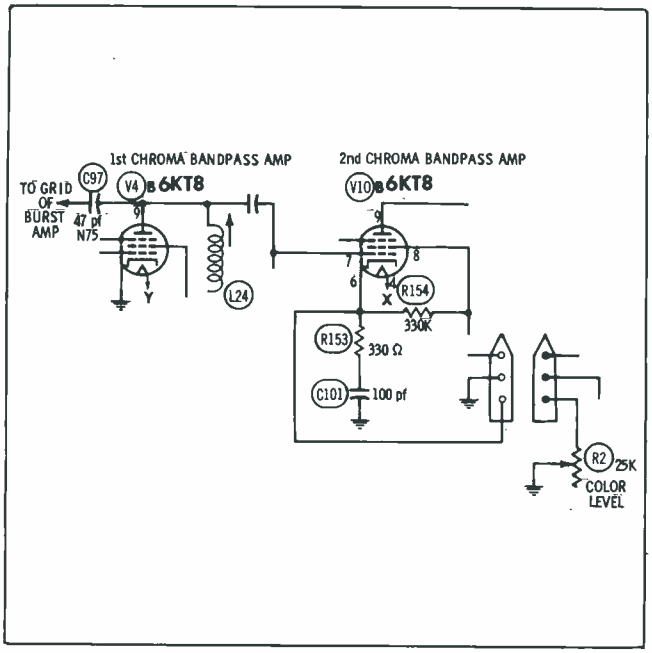
Wright said that the demand for Zenith color TV receivers "continues to grow, and that the company's Chicago plants are running on an extra shift basis. This new facilities expansion program is required to meet the further anticipated color sales increases expected in 1967 and the years ahead."

Due to continued diversification and broadening of supplier and industrial contacts, **The Finney Company** has under way an extensive program of enlarging and remodeling their General Offices. Seven new private offices and an additional area for Research Engineering and Design Development are included in the plans. The FINCO main plant facilities in Bedford now total over 100,000 square feet.

IRC has announced plans to purchase a new building to handle an expected threefold growth of its Semiconductor Division sales by the early 1970's. The new plant is near the Semiconductor Division's present facilities in West Lynn, Massachusetts. Production will be carried on in both plants. ▲

COLOR COUNTERMEASURES

SYMPTOMS AND TIPS FROM ACTUAL SHOP EXPERIENCE



Chassis: Zenith

Problem: To construction extension cables for Zenith convergence panels.

Tip: Order following parts from your distributor
29JC20 chassis: 1 ea. 43-418 plug, 1 ea. 43-421 plug, 18 ea. 86-334 lug.
All other chassis: 1 ea. 43-571 plug, 9 ea. 86-390 lug, 1 ea. 43-574 plug, 9 ea. 86-389 lug.

Chassis: Zenith 23XC36, 23XC38

Symptom: Horizontal overscan of blue raster.

Tip: Move convergence yoke assembly forward or back for best convergence.

Chassis: 23XC36, 23XC38,Z

Symptom: Hue changes with rotation of color level control.

Tip: Delete C97. Change R153 to 2.2 K ohms. Add a Zenith part # 20-2008 peaking coil in parallel with R153.

PRODUCT REPORT

for further information on any of the following items, circle the associated number on the Catalog & Literature Card.

Wide-Band Sweep Generators
(57)

A series of wide-range portable sweep generators (Models 601 and 602) and their rack-mounted counterparts (Models 601-5BR and 602-5BR)) for testing and alignment of RF circuits in the frequency range from 4 Hz to to 225 MHz, are offered by **Jerrold Electronics.** Additional measurement features of the rack-mounted units include a built-in RF detector. 70-dB attenuator in 10-dB steps, and a built-in marker inserter and amplifier.

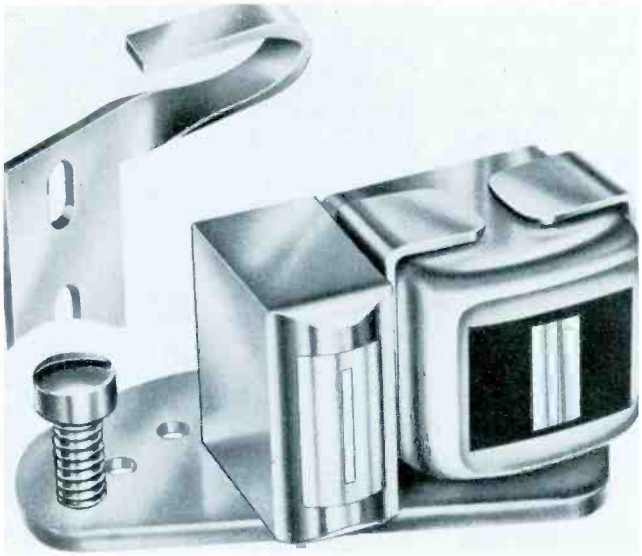
Models 601 and 601-5BR provide 11 ranges from 20 MHz maximum on the lowest range to 113 MHz minimum on the highest range. Sweep-width in any range is continuously variable from a minimum of ±1.0% of center frequency to a maximum of ±60% of center frequency.

Models 601 and 601-5BR have been designed to produce an output response of 0.5 rms, flat within ±¾ dB. The output response of Models 602 and 602-5BR is 2.5 volts rms, flat within ±½ dB. Frequency linearity for both portable and rack models correspond to the instantaneous horizontal deflection voltage within ±4½ of the p-p voltage at 2:1 sweep width.

Model 601-7F (shown here) is designed for 75-ohm test applications and uses "F" type connectors. Price is $350.

Full Track Conversion
(58)

A revised kit to convert the new monophonic Wollensak and Revere transistorized tape recorders from half-track to full-track recording is announced by **Nortronics Company, Inc.** Advantages of the full-track system in-



clude better frequency response, improved sound definition, and greater recording range. Called the WR-30, the new conversion consists of a full-track erase head and a full-track record-play head mounted on a brass plate to permit full-track recording. It fits the new 1500SS and 1400AV Wollensak recorders, as well as the older T1500 models. The all-metal erase head has a double gap for complete erasure, while the record-play head has laminated cores and a very narrow gap for optimum high-frequency performance. Price is $75.00.

Paging and Talk-Back Speaker
(59)

A new "Cobra" wide-angle paging and talk-back speaker has been introduced by the **Oxford Transducer Company.** Sectoral diffraction grating, placed at three positions on the bell of the horn, eliminate the usual "fall-off" of energy at the extreme ends of the polar pattern. This new design offers flat, wide-angle dispersion and minimum vertical dispersion. Designated Model No. COP-8, the speaker can be mounted either vertically or horizontally, and its position can be easily changed through the use of the exclusive "Lever-Lock" bracket. The bell of the speaker is made from "Implex A" a material which has the color molded in, and is impervious to all weather conditions. The Cobra has a frequency response of 250 to 13,000 Hertz, a power rating of 30 watts, dispersion angles of 120° by 60°, and a microphone sensitivity of −23dBm.

The unit is priced at $32.64 without a line transformer, and $36.62 with a 20-or 70-volt line transformer.

Universal Tool
(60)

A new universal "Crimp-Master" terminal attaching tool (Model 10002) is announced by **Aerovox.** The new tool can be used to attach both insulated and non-insulated terminals with all wire sizes from 22 to 10. It will also attach ignition terminals, strip wire sizes from 10 gauge to 22 gauge, cut wire, and cut all bolts ranging from 4-40 to 10-24 in diameter. The tool has insulated handles, and is useful for electrical/electronic applications. Price of the Crimp-Master is $5.99.

Radio Analyzer
(61)

A new, all solid-state instrument for complete servicing and troubleshooting of all types of AM and FM radios has been announced by **The Hickok Electrical Instrument Company.** Designated Model 860 Injecto-Tracer, the new instrument combines signal injection, signal detection, and a power supply source in a single light-weight, portable instrument. The generator output includes 1000 Hertz of audio, 240kHz to 1750kHz of RF, and a 10.7MHz FM IF for "injection-type" service work. The signal tracer circuitry incorporates a light-loading probe, along with a tuneable amplifier covering 240kHz to 1750kHz, and a built-in audio amplifier and loudspeak-

er. High gain permits tracing, even in radio antenna circuits.

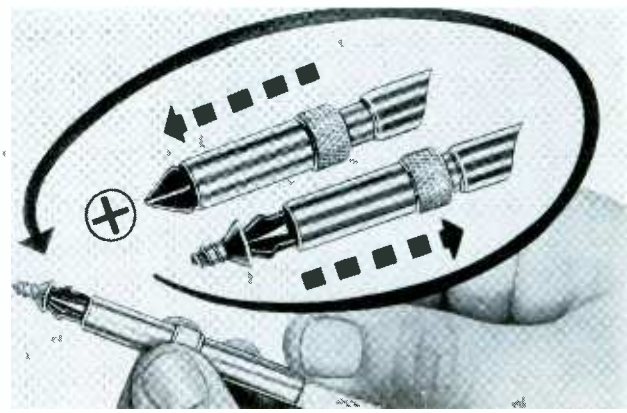
A fully-regulated, metered, high-current power supply is continuously variable to permit checks on audio distortion, AGC faults, oscillator drop-out, etc. A voltage output of 0 to 15 volts and current ranges of 0 to 100ma are available with the unit. Price is $149.50.

Tape Care Kit
(62)

Designed especially for the booming auto stereo field, this new Tape Care Kit (No. 30-636) from **G. C. Electronics** contains a liquid head cleaner and a liquid head lubricant. Two 6" brushes are included in the kit to aid in reaching the heads of the auto stereo player. Also included are 10 plastic cartridge pouches to protect the tape cartridges from dust and dirt. The kit is packaged in a handy plastic box that can be stored in the glove compartment of the car. The kit is priced at $3.49.

Coaxial Cable & Matching Transformer
(63)

A new, low-loss, 82-channel coaxial cable for color and black-and-white TV, and FM/stereo installations has been announced by **JFD Electronics Co.** Called Color-Shield-82 Coaxial Cablematch, it comes with a 300- to 75-ohm matching transformer attached. The transformer ties directly to the 300-ohm output of the antenna. The cable system is recommended for multiple-dwelling installations —hotels, motels and apartment houses—as well as homes and stores. It is equally effective for color or black-and-white reception, VHF, UHF or FM/stereo. It comes in three lengths and is priced as follows: Model CS82-50 (50'), $11.25; Model CS82-75 (75'), $14.25; and Model CS82-100 (100'), $17.00.



Phillips Screw Launcher
(64)

A launcher tool for starting Phillips screws is the newest addition to the line of screw launchers manufactured by **Vaco Products Company.** Available in four lengths —3", 5", 7" and 9"—the Vaco Phillips Screw Launcher will grip and start any cross-slot screw. A simple push-pull operation of a sliding aluminum sleeve (which is part of the tool) causes the tough spring-steel blades of the launcher to expand in the cross-slot of the screw head and grip it firmly. This makes one-hand placement and starting of a screw a simple undertaking in virtually any hard-to-get-at location. Removal of a Phillips screw from such locations is accomplished in the same way. The 3" launcher sells for $1.75; the 5" for $2.05; the 7" for $2.15, and the 9" for $2.20.

Color Generator
(65)

A new, deluxe color generator featuring an automatic timer heating element and movable single dot and single vertical and horizontal line patterns has been announced by **Sencore.** Compact and completely portable, the CG141 "Color King" is AC operated and solid state throughout. The automatic timer heating element is thermostatically controlled to maintain a minimum operating temperature of 80°. This assures the most favorable temperature changes. Stability is assured whether the outside temperature is 20° below zero or 140° in the shade.

The new, movable, single patterns make it possible to follow the set manufacturer's convergence recommendations to the letter, without the confusion sometimes caused by multiple lines and dots. The single dot and single vertical and horizontal line patterns can be positioned at any point on the CRT screen. To compensate for component aging, the timers are adjustable like the horizontal and vertical holds on a TV receiver. All adjustments are located on the front panel under the hinged pattern strip.

Additional features of the instrument include an interlace control to stop dot bounce, tuning of channels 2 through 6 at the flip of a switch, all standard patterns, and color gun interruptors. Also included is a picture phase switch which provides either a positive or negative 7-volt composite video signal.

The unit is housed in a mar-resistant vinyl-clad steel case with a removable protective lid. A plate glass mirror is shock mounted in the lid for convenient set-up and convergence in the home. Price of the unit is $149.95. ▲

Tube/Battery/Continuity Tester
(66)

Designed for quick-testing 800 types of radio and TV vacuum tubes, this new **Eico** unit also has provisions for load testing of batteries and continuity tests. Features of Model 636 include transformer isolation, a three-color meter, and a neon lamp short indicator. The unit measures 8⅝" high by 7½" wide by 3⅛" deep and is operated from 117 volts AC, 60 Hz. Price is $34.95, complete with bakelite case, handle, and tube data manual covering 800 tube types.

Coming in May

- **Previews of New Sets**
- **Video Speed Servicing**
- **Great Blobs of Color**
- **Getting Started in Electronic Organ Servicing**
- **Sheet-Beam Demodulators**
- **Measuring the Results of Advertising**
- **and many more!**

INDEX TO ADVERTISERS

April, 1967

$FREE$ CATALOG AND LITERATURE SERVICES

*CHECK "INDEX TO ADVERTISERS" FOR FURTHER INFORMATION FROM THESE COMPANIES

ANTENNAS

75. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of Tenna-Rotors.
76. *ANTENNACRAFT* — 12-page catalog listing complete Antennacraft line of UHF, VHF & FM antennas for all types of installations.
77. *BLONDER-TONGUE* — Compact brochure detailing a line of all-channel products expressly designed to improve reception in the home and small MATV systems.
78. *CORNELL-DUBILIER* — 16-page booklet illustrates color, black-and-white TV, and FM-stereo reception problems that are eliminated by the installation of a CDE antenna rotor system.
79. *FINNEY* — Forms 20-338, 20-356, and 20-357 describing distribution amplifiers and antenna amplifiers for 300-Ohm and 75-Ohm TV and FM systems.*
80. *JERROLD* — New 4-page full-color catalog describes the new Paralog Plus antennas.*
81. *JFD* — Color Laser and LPV antenna brochures. New 1967 dealer catalog covering complete line of log-periodic out-door antennas, rotators, and accessories.
82. *MOSLEY* — Information on new Mosley MATV system for up to 8 TV/FM sets. Includes TV antenna, distribution system and outlets.
83. *SPAULDING* — Information on Strato Towers, tubing, ladder mast, Ham Towers, and 8′ x 16′ self supporting towers for roof top installations.
84. *WINEGARD* — 8-page color brochure on new Super-Colortron antennas: 5 VHF-UHF-FM, 4 VHF-FM, 3 UHF. Includes information on 6 new solid-state preamplifiers and 82-channel booster-couplers.*

AUDIO

85. *ATLAS SOUND* — Catalog 556-67 illustrates and describes many new models of public address loudspeakers, microphone stands, and accessories for commercial sound applications.
86. *ELECTRO-VOICE* — Brochure illustrating a line of component loudspeakers. Lists five budget-priced speakers for use in built-in home speaker systems or economy public address installations. Form 1088.
87. *OXFORD TRANSDUCER* — Catalog sheets featuring speaker systems for automobiles.
88. *VIKING* — Brochure about Model Studio 96 tape transport.

COMMUNICATIONS

89. *AMPHENOL* — 2-color spec sheets on new Model 650 CB transceiver and Model C-75 hand-held transceiver.
90. *CUSH CRAFT* — Brochure on the new "Ham Stik" 6-20 meter dipole.
91. *MOTOROLA* — New brochure tells how to reach people on-the-move through use of personal two-way radio.*
92. *PEARCE-SIMPSON* — Brochures and flyers on the complete line of CB transceivers.
93. *POLYTRONICS* — Brochures on the Carry-Comm and Duo-Com 120 CB transceivers.

COMPONENTS

94. *BUSSMANN*– New 1967 16-page car and truck fuse list. Shows what fuse protects —proper fuse to use and where fuse is located. Also shows what BUSS fuse to use in servicing foreign cars and trucks. Ask for BUSS Form AWC.*
95. *CENTRALAB* — Catalogs offered on electrolytic capacitors, PEC's, and auto radio shafts and bushings.*
96. *CLAROSTAT* — New 32-page illustrated catalog of potentiometers, field-assembled controls, power rheostats and resistors.
97. *GC ELECTRONICS* — FR-029-E Electrocraft wall chart, FR-250-WS phono drive wall chart and cross reference, and replacement knob cross-reference.*
98. *LITTELFUSE* — Pocket-sized TV circuit breaker cross-reference gives the following information at a glance. Manufacturer's part number, corresponding Littelfuse part number, price, color or b/w designation. A second glance gives trip ratings and acquaints you with a line of caddies. Ask for CBCRP.*
99. *QUAM-NICHOLS* — Quam-auto radio speaker replacement guide. Complete replacement information on front and rear-seat speakers for automobile radio models from 1955-1966.
100. *SONOTONE* — New revised cartridge replacement manual SAC-25.
101. *SWITCHCRAFT* — Distributor bulletin D-816 describes Switchcraft's new "traffic-tailored" audio dealer and distributor accessory merchandiser program.

SERVICE AIDS

102. *CASTLE TUNER* — 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.*
103. *CHEMICAL ELECTRONIC ENGR.* — Brochure of contact cleaners for TV tuners and controls.
104. *CHEMTRONICS* — Flyer about a new cleaner especially for Nuvistor and transistor tuners.
105. *ELECTRONIC CHEMICAL* — Catalog sheet on aerosol sprays for servicemen.
106. *ILLINOIS BRONZE*—Flyer sheets and sample chips about metallic, hammertone, and wrinkle-finish spray paints.
107. *MIDSTATE TUNER* — 24-hour tuner service is described in a colorful brochure.
108. *QUALITY TUNER SERVICE* — Introductory letter describing costs and service on all makes of TV tuners. Repair tags and shipping labels included.
109. *RAWN*—Bulletins on repair ideas using Plas-T-Pair knob and plastic repair kits. Also, bulletins on tuner cleaners and circuit coolers. Includes price sheets.

SPECIAL EQUIPMENT

110. *BAY PRODUCTS*—40-page catalog of steel shop equipment featuring convert-a-bench.
111. *ELECTRONIC ALARMS*—Complete "do it yourself" installation instructions and material lists for burglar alarms.
112. *SONIC INDUSTRIES*—Bulletins on 2 new Police-band to AM-band converters. Small, solid-state, and low-priced.

TECHNICAL PUBLICATIONS

113. *PHILCO*—Information about Tech Data & Business Management service. Also, free parts catalog.*
114. *RCA INSTITUTES* — New 1967 career book describes home study programs and courses in television (monochrome and color), communications, transistors, industrial, and automation electronics.*
115. *JOHN F. RIDER*—Latest catalog listing practical technical paperbacks for the ham, hobbyist, and industrial technician.

TEST EQUIPMENT

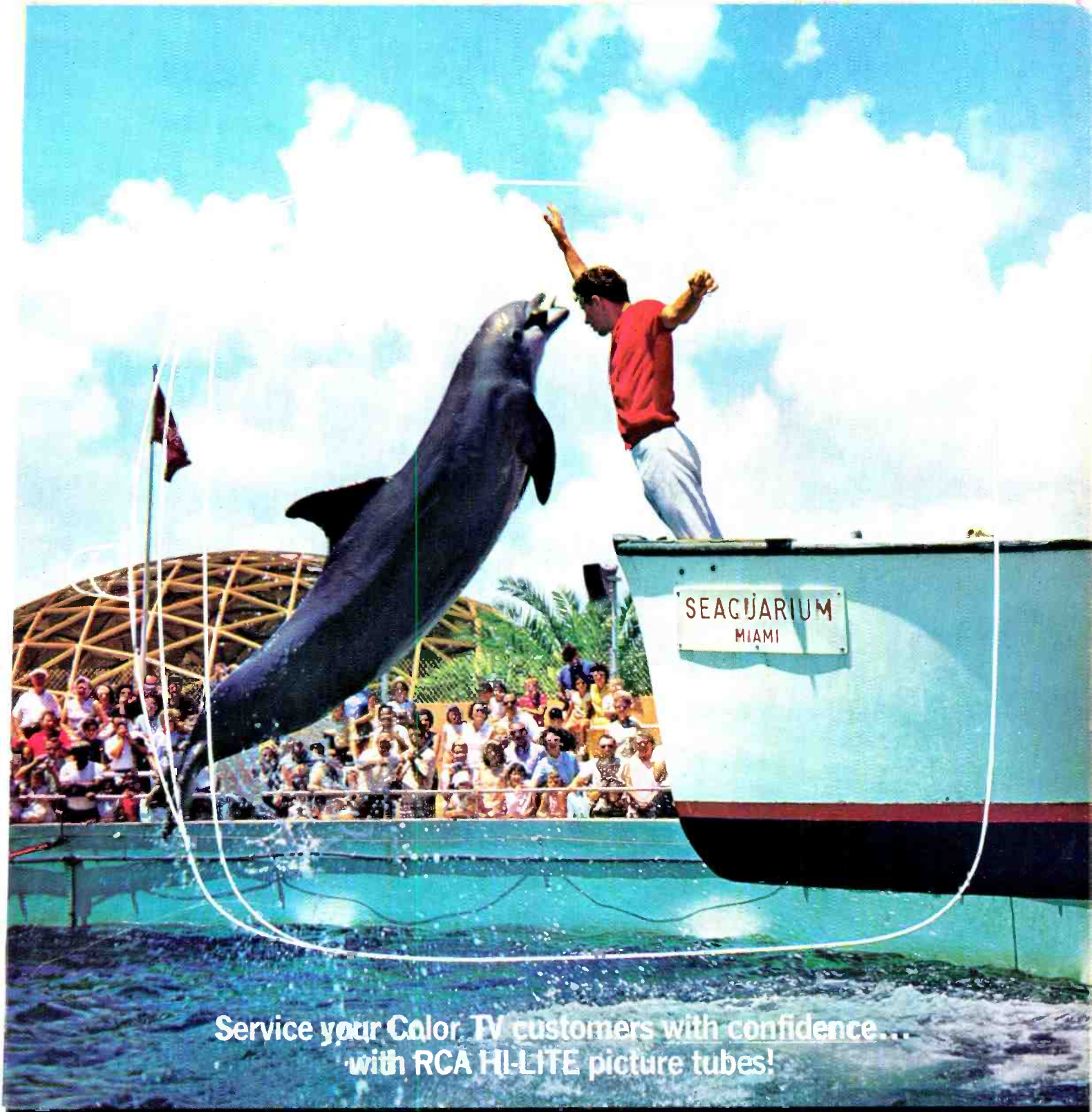
116. *B & K*—New 1967 catalog featuring test equipment for color TV, auto radio, and transistor radio servicing, including tube testers designed for testing latest receiving tube types.*
117. *EICO*—1967 short-form catalog is 48-pages long. Describes a complete line of test instruments, CB and ham equipment, Hi-Fi components, and miscellaneous electronic equipment.*
118. *HICKOK*—Specification information on new Models: CR-35 CRT rejuvenator tester, GC-660 solid-state color bar generator, and 860 AM/FM signal tracer.
119. *JACKSON*—New line folder or "Service Engineeed, test equipment includes push-button-operated color-dot/bar generator.
120. *LECTROTECH*—Two-color catalog sheet on new Model V6-B color bar generator, the latest improved model of the V6. Gives all specs and is fully illustrated.*
121. *MERCURY*—1967 16-page booklet features the full line of test equipment for servicing color and black/white TV, radio, Hi-Fi, and communications equipment. Includes the new Model 1900 color generator and Model 2000 mutual conductance tube tester.*
122. *PHILMORE* — Flyer sheet of Philmore equipment and accessories featuring a new solid-state grid-dip meter.
123. *PRECISION APPARATUS*—Illustrated catalog describing signal generators, oscilloscopes, and meters.
124. *SECO*—Operating manual for the new Model 107C tube tester.
125. *SEMITRONICS*—Brochure on the new Model 1000 transistor tester.
126. *SENCORE*—8-page full color catalog plus a new 4-page supplement catalog.*
127. *SIMPSON*—New 1967 16-page test equipment brochure featuring a palm-sized VOM, Model 160.
128. *TRIPLETT*—All test equipment catalog #50-T featuring VOM's, VTVM's, transistor analyzers, tube testers and accessories.

TOOLS

129. *ARROW*—Catalog sheet showing 3 staple gun tackers designed for fastening wires and cables up to ½" diameter.
130. *DIAMOND TOOL AND HORSESHOE* —Brochure about new Copaloy pliers.
131. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstarte improved desoldering and resoldering methods for speeding and simplifying operations on PC boards.
132. *LUXO*—Flyers on counterbalanced and magnifying bench lamps.
133. *OWATONNA*—74-page two-color catalog with complete details on 2,500 OTC products including pullers, industrial maintenance sets, testers and accessories, and standard hand tools and chests.
134. *VACO PRODUCTS*—Catalog No. SD-123 on self-adjusting nut driver which selects right hex size from ¼" to 7/16" automatically.

TUBES AND TRANSISTORS

135. *IR*—Transistor cross reference guide—22 pages of detailed specifications on universal silicon and germanium transistors and a complete listing of more than 5000 devices which they replace.
136. *RADIO CORP. OF AMERICA*—PIX 300, a 12-page product guide on RCA picture tubes covering both color and black-and-white. Includes characteristics chart, terminal diagrams, industry replacement, and interchangeability.*
137. *WORKMAN*—Two new cross-references in vest pocket size—Miracle Five transistors and circuit breakers.



Service your Color TV customers with confidence... with RCA HI-LITE picture tubes!

Customer satisfaction...and consequently your service reputation... can very often depend on the quality of the replacement parts you use. When it comes to replacement picture tubes, you can depend on an RCA HI-LITE for picture brightness and color fidelity at its finest. Install them and you literally "up-date" your customer's set with the same quality... the same tubes...that go into today's original equipment sets.

Enjoy the confidence of offering the finest. Rely on RCA picture tubes to protect your service reputation. They are designed to protect the biggest reputation in the Color TV industry.

RCA Electronic Components and Devices, Harrison, N. J.

RCA **The Most Trusted Name in Electronics**

Introducing a Complete Line of Littelfuse Quality Circuit Breakers

Actual Size
1¾" x 13/16" x ½"

Exact replacement from factory to you

Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines, small fractional horsepower motors and all types of electronic or electrical control wiring.

LITTELFUSE DES PLAINES, ILLINOIS

Circle 55 on literature card