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SPECIAL COLOR ISSUE

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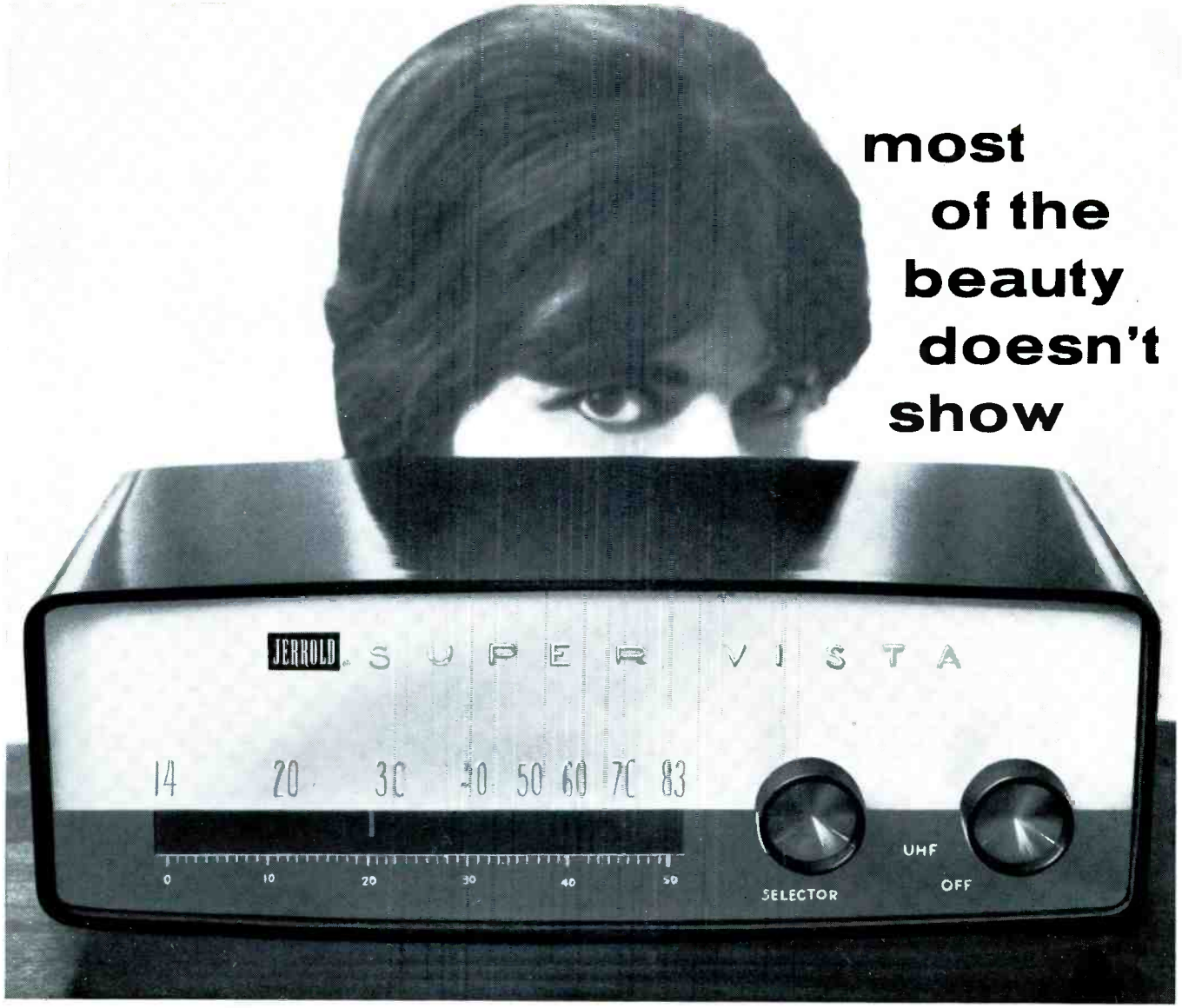

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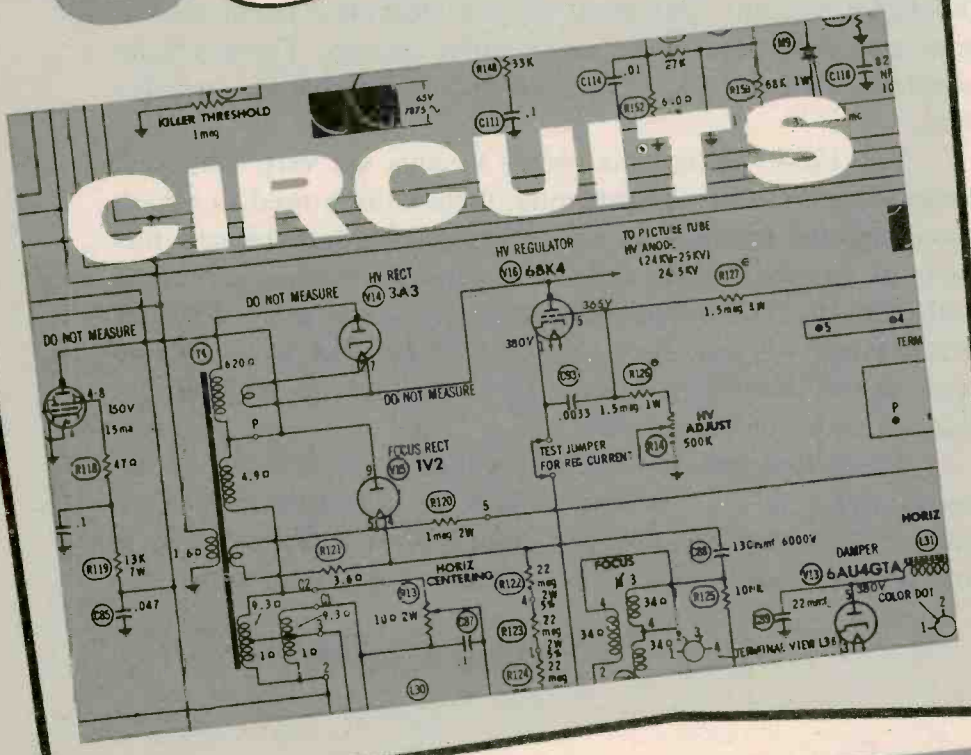

PREFACE

"How can I keep up with circuitry? Things are moving so fast, it is virtually impossible to know what the set designers are going to do next!"

This is the common cry of many color TV servicemen, as well as those in other fields. And it is a problem. Without attending service clinics for every color-set manufacturer (and now there are quite a few), an ordinary technician finds it difficult to know what new innovation to expect when he goes out on a color-TV service call.

During the past year, a special series titled "Know Your '63 Color Circuits" described in great technical detail the design and operation of the major color chassis. These articles covered all the major sections of each color chassis, one at a time.

For 1964, we find that many circuits are very similar to those in the '63 sets; consequently, there is little need to rehash those circuits. Instead, we are going to point out the *new* features of circuits that have been covered in past issues, along with the special circuits introduced by come-lately color-set manufacturers. Also, this way, the information is all in one spot, so you don't have to wait for later issues to get information on some of the circuits.

You'll find this book section valuable in your day-to-day encounters with the new sets. This is the very first such information to be published in one comprehensive feature. File it and keep it. You'll be using it for many months to come.

The Editor

Staying abreast of the changes made in color receivers is one mainstay of the service technician's business, particularly since more manufacturers are producing their own color receivers (see Table 1). Understanding the newer circuits, and knowing which have been revamped from previous color chassis, is always advantageous when "service time" rolls around. Less time will be spent in locating which circuit is causing a particular trouble and deciding on the exact spot to initiate your troubleshooting procedure.

For example, how is the color burst signal processed in this or that make of color receiver? Must it pass through a particular color stage before it can reach the color sync stages? Or, is it taken directly from the plate of a video amplifier stage? Being aware of how a circuit handles a signal, and what signal(s) it *must* handle, permits you to diagnose and isolate color troubles more quickly.

So you'll be better able to service the new color sets, we're introducing here the circuits that *are* new, and those that have had major changes this year. Along the way, we'll mention some of the "warmed-over" versions, and become better acquainted with those, too.

Luminance Channel

The video (luminance) stage shown in Fig. 1 was first used in RCA's CTC12 chassis last year, and has been carried over to the new CTC15, with very little change. Incidentally, you'll find similar video stages in color sets produced by DuMont, Emerson, General Electric, Magnavox, Muntz, Philco, Silvertone, Sylvania, and TraVler.

This second video amplifier replaces the cathode-follower arrangement used by RCA for a number of years to match the delay-line impedance. The plate circuit of the first video amplifier is still the takeoff point for AGC, sync, and color-circuit signals, and now it also feeds a luminance signal to the grid of a 6AW8A. The purpose of this new stage is still to match the impedance of the delay line—the circuit has very little gain. You'll notice a DC path exists from the plate of V1 to the grid of V2; thus, DC reference level is maintained from the video detector, through the first and second video amplifiers, the video output, and all the way to the cathodes of the picture tube.

You'll find a 12BY7A, a familiar type in RCA chassis, functioning as the video output tube. The circuit (Fig. 2) is still basically the same as last year's, with the addition of a three-position video peaking switch in the cathode circuit. The cathode bias of this stage is not affected by rotating the contrast control or by changing the switch setting. Stage amplification remains constant, but the video level (contrast) is controlled by increasing or decreasing the video signal with electrolytic bypass capacitor C1, connected to the arm of the control.

The video peaking switch is located on the rear apron of the chassis, and should be adjusted to please the viewer. The upper position is satisfactory for most people. Before adjusting this switch, set the tuner to a station signal containing high-definition video. You can see the action of the switch a bit better if the contrast control is advanced slightly more than normal.

The plate of the 12BY7, in addition to supplying video to the cathodes of the CRT, is also the mixing point for vertical blanking. Pulses from the vertical circuit are inserted prior to the peaking network, via R1-C2.

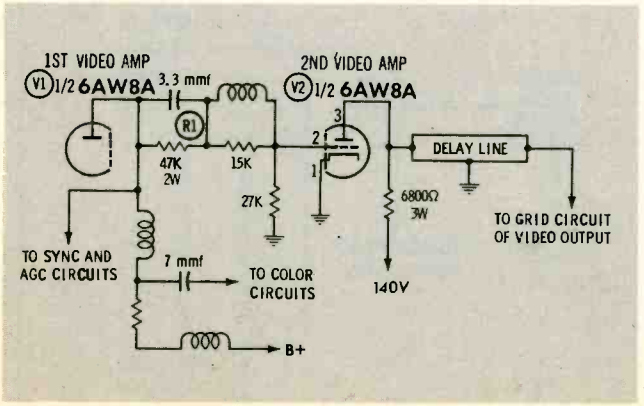

Fig. 1. Second video stage is used in RCA's '64 color set.

Table 1

Admiral	Muntz
Andrea	Olympic
Clairtone	Packard Bell
Color Electronics Corp.	Pilot
Curtis Mathes	Philco
Delmonico	RCA
DuMont	Setchell-Carlson
Electrohome	Silvertone
Emerson	Sylvania
General Electric	Transvision Electronics (kit)
Heath (kit)	TraVler
Magnavox	Wells-Gardner
Motorola	Zenith

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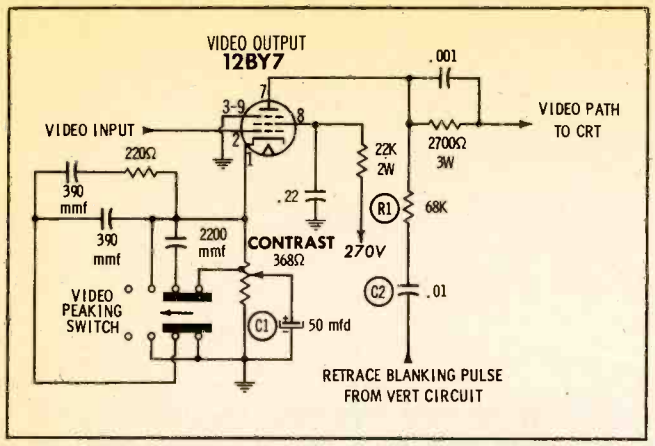

Fig. 2. Video output receives vertical retrace blanking pulse.

Also new in the CTC15 is a portion of the picture-tube circuit—shown in Fig. 3. The big difference here is the deletion of the CRT bias control—fixed bias is now used in the cathode circuits. (For comparison, the circuit used last year is shown in the inset.) However, drive controls are still used to set the operating bias of individual guns in the tricolor tube.

Fig. 4 is a simplified schematic of the blanker circuit used in the CTC15. In the plate circuit you'll find a three-position switch that selects three different values of plate-load resistance for the blanker tube. Switching the value results in a proportional change in the pulse amplitude at the output. This negative pulse, coupled via C1 to the cathodes of the color difference amplifiers, sets their average conduction. Since the plate circuit of each amplifier is DC coupled to its respective CRT grid, a change in the average plate voltage of the amplifiers also affects the operating bias of the picture tube.

Other New Luminance Circuits

The luminance channel used in Motorola's TS-908 chassis (for 23″ rectangular CRT), is the familiar "bootstrap" video circuit, similar to many of those in modern color receivers. In the 21″ TS-912 chassis, however, you'll find a luminance path to the CRT unlike that in most color sets.

The partial schematic in Fig. 5 shows this new video input circuit used in the TS-912. Look familiar? It should, for quite a few *black-and-white* sets use a similar circuit. The video signal is AC coupled to all three cathodes of the picture tube; the brightness control is an ordinary divider network, used to set the cathode-voltage level of the picture tube. You'll notice DC coupling is not used in this circuit.

The color difference signals (from the demodulators) are coupled to the control grids of the CRT, and each grid is returned to a separate background control (G1). This particular chassis has no "service" switch, so gray-scale tracking adjustments are made by using only the background and screen controls.

Admiral is using a peaking switch in the cathode of its 6HB6 video output circuit. The video amplifier is the familiar cathode follower type. Incidentally, even though many of the circuits in this receiver are electrically similar to those in last year's Admiral color sets, you'll find the chassis is physically different—using three printed-circuit boards.

Packard Bell's new 98C7 color chassis is another radically different physical design. This is a vertically mounted chassis, using dip-soldered joints—no printed circuits. The luminance channel, however, is similar to the circuit used in RCA's earlier CTC11 chassis.

Setchell-Carlson's new color receiver, the Model U800, is using a three-stage video of a different design. You'll find one 6AU6 and a pair of 6GK6's in those stages. The set also features a hand-wired chassis, with *Unit-ized* construction.

Zenith is sticking with the luminance channel first used in the 26KC series. It also uses a cathode-follower circuit (with a 6HL8 tube) to match the delay-line impedance. The video output tube is a 12GN7, and the CRT setup procedure for gray-scale tracking remains basically the same as in other Zenith chassis.

Bandpass Stages

One of the most novel color IF (bandpass) arrangements to appear in the 1964 color sets is the two-stage circuit shown in Fig. 6. Motorola is using this system in their 23″ TS-908 chassis. A 6BL8 functions as the first and second color IF, providing the necessary 1 mc bandwidth at color frequencies near 3.58 mc.

The waveform at the grid of V1A is the composite color signal, including the color burst. V1A also receives ACC (automatic color control) voltage from the color phase detector. The color signal from the plate

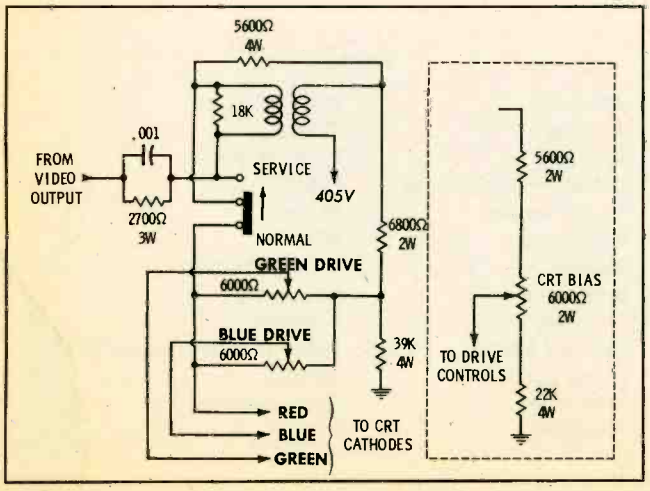

Fig. 3. Switch takes video drive from picture tube cathodes.

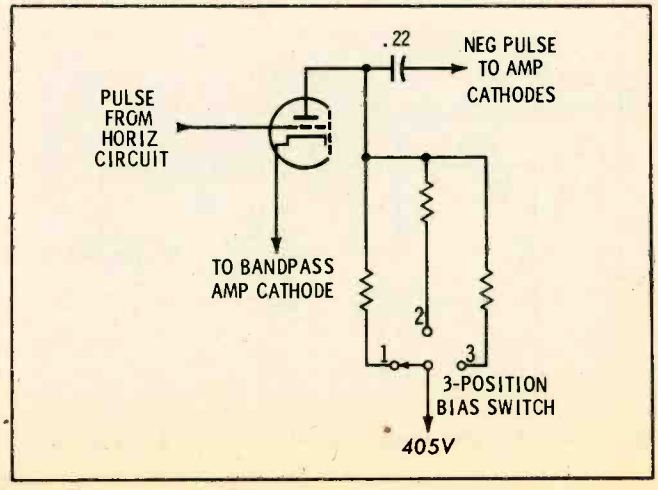

Fig. 4. Bias switch changes plate-load values in blanker.

circuit of V1A is transformer-coupled to the grid of V1B. Note the takeoff point for the color burst signal, also located at the plate of V1B; the burst must pass through the first color IF stage before it is sent to the burst amplifier and separated.

Conduction in the second color IF is controlled by a negative voltage from the killer stage. If the killer is operating, a high negative voltage is impressed on the grid of V1B, holding it at cutoff.

The cathode of V1B returns to the blanker stage, and a pulse developed by the blanker also cuts V1B off during horizontal retrace time. This prevents the burst signal from leaking through this stage and causing contamination in the color picture.

One other feature of this circuit is the color indicator light in the plate circuit of V1B. Anytime a color signal is being received, plate current will flow, lighting the indicator. Remember, when no color signal is present, V1B is cut off by negative bias from the killer.

The color IF stages in Motorola's 21" TS-912 chassis are also new and unfamiliar (Fig. 7). Two stages of amplification are used in this chassis, but they are considerably different from those in the 23" version.

First, the tube is a 15DQ8 triode-pentode, a new tube designed for series-filament operation. The color signal is transformer-coupled (and that's new) from the plate of the video amplifier to the triode section of the 15DQ8. The first section of the circuit is a cathode follower, with the color signal fed to the grid of V1B via the color intensity control. The burst signal for the color sync stage is also taken from this cathode.

The second IF stage is rendered inoperative by negative voltage from the killer stage, unless a color signal is present—as in almost every color chassis. The chroma signal from the plate of V1B is transformer-coupled to the demodulator stages.

Other Bandpass Amps

Admiral's new 24A,B,C series uses bandpass circuits that are basically the same as those we described in recent "Know Your '63 Color Circuits" features.

Packard Bell's latest color receiver has a two-stage bandpass system that is familiar to most color technicians. The circuits are very similar to those in the RCA CTC7AA series, with a 6AU6 as the first bandpass amplifier, and the triode section of a 6AW8A as the second amplifier.

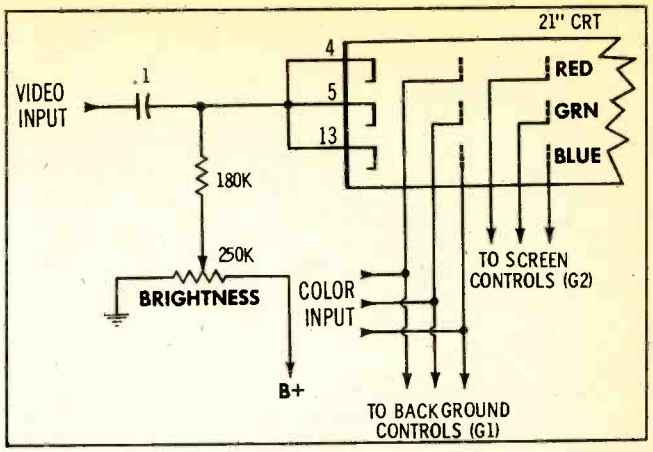

Fig. 5. AC coupling to CRT is used in Motorola's TS-912.

The new RCA CTC15 chassis has basically the same bandpass arrangement as in last year's CTC12 chassis. The January, 1963 issue of PF REPORTER contains a detailed description of those stages.

Zenith's '64 color chassis, the 25LC series, is again using the pentode section of a 6HL8 as the first bandpass amplifier, and the pentode section of a 6KT8 as the second bandpass amplifier. These tubes were also used in last year's Spring chassis, the 26KC series.

Color Sync Stages

Most of the color sync stages used in this year's color receivers are very similar to those used last year. Among these warmed-over versions are those in the CTC15 chassis, and those in Zenith's 25LC series. Both sets were discussed in "Know Your '63 Color Circuits" in the September issue. Zenith's circuit is changed only in the use of the newly introduced 6JU8 (four diodes); circuit operation remains the same.

Packard-Bell is using a 6BN8 as the color phase detector (two diodes) and the killer detector (triode wired as diode), and the circuits operate like those in RCA's CTC7 chassis. The 3.58 mc oscillator circuit is also similar, except that a 6GH8 displaces the 6U8 used previously.

Motorola has two unusual types of color sync stages

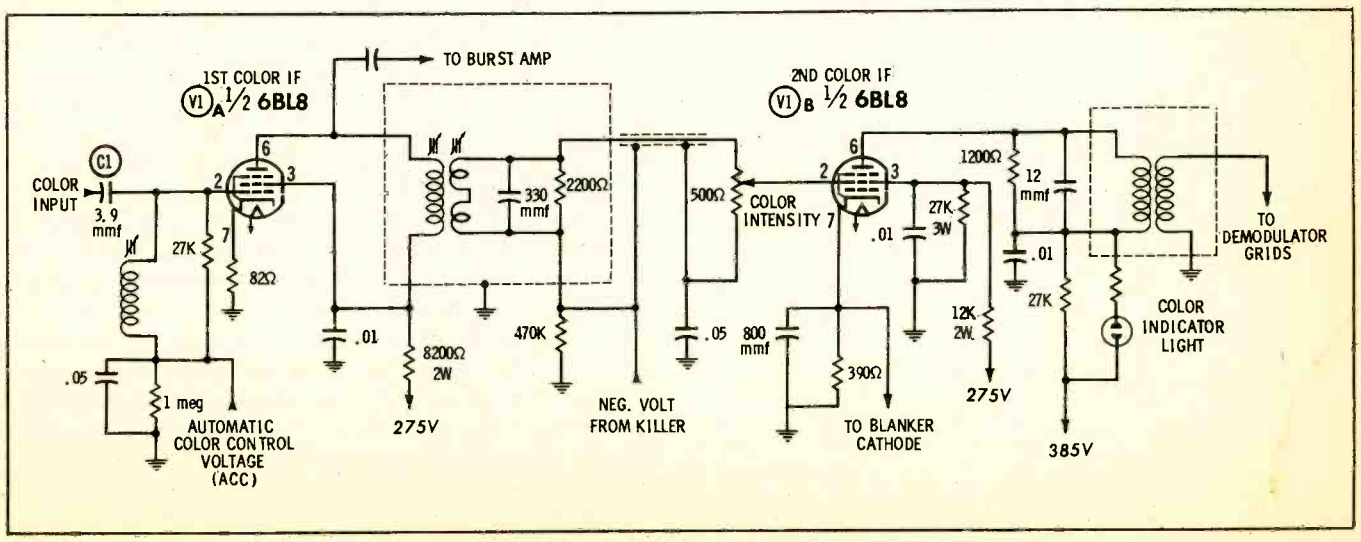

Fig. 6. TS-908 has two stages of color IF amplification.

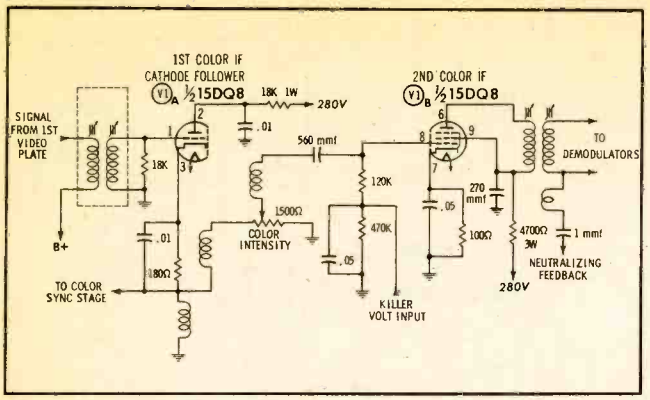

Fig. 7. Color and burst information is available at cathode.

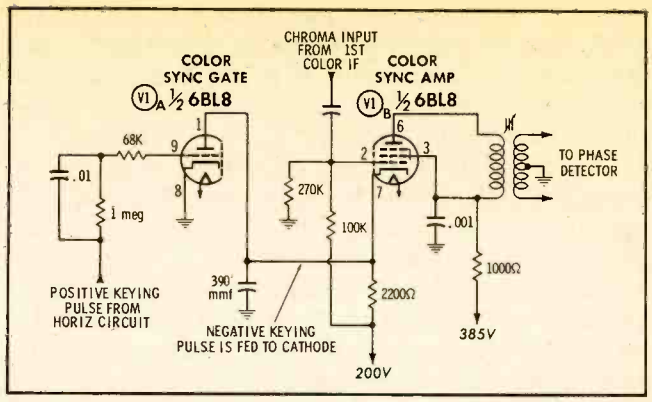

Fig. 8. Negative keying pulses are applied to the cathode.

—one in the 23″ set and another in the 21″ receiver. Fig. 8 shows the color-sync gate and amplifier circuits used in the TS-908 chassis. Although these stages may look unfamiliar to you, their purpose is the same as in other sets—to separate and amplify the burst signal. V1A is a gating tube, inverting and coupling a keying pulse from the horizontal circuit to the color sync amplifier cathode. V1B is biased into cutoff, and can conduct only during the time interval of the keying pulse —during horizontal retrace time. The incoming chroma signal, coupled to the amplifier grid via C1, contains both color video information and burst. Only the burst signal occurs during horizontal retrace time, so only the burst appears in the output of V1B; color information is not permitted to pass. As in other color sets, the burst signal is transformer-coupled to a phase detector that feeds a reactance stage and controls the 3.58 mc reference oscillator.

The equivalent gating stages in Motorola's 21″ receiver are shown in Fig. 9. This circuit differs from the one just described in that the chroma signal is inserted at the cathode of the sync gate tube.

This tube is keyed into conduction during horizontal retrace time by the positive keying pulse fed to its control grid; therefore, only the burst signal appears in the output. Transformer T1 is tuned to 3.58 mc, and couples the burst (sync) signal to V1B. This tube is used to amplify the burst signal; since it's also keyed by the positive pulse applied to the screen grid from the horizontal circuit, no video can creep through this stage, either. This double gating of the burst stages is necessary to prevent capacitance between sections of V1 from "leaking" video information through these stages.

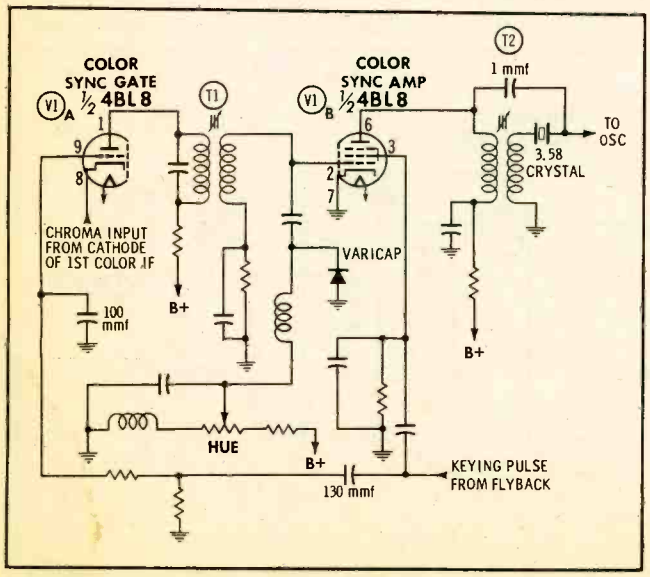

Fig. 9. Motorola 21″ uses double-gated color sync circuit.

The plate circuit of V1B, like V1A, is tuned to 3.58 mc. The hue control is located in the grid circuit of V1B, and shifts the phase of the burst signal coupled through T2. Adjusting the hue control varies the bias voltage across the varicap; this changes the capacitance of the varicap, resulting in a phase shift.

You'll probably notice there is no phase detector or reactance stage in this receiver; the burst signal is coupled directly to the 3.58 mc crystal.

Look at the simplified schematic in Fig. 10. A free-running oscillator is operating at or close to 3.58 mc. When a burst signal is not present, the output from this oscillator is low in amplitude. However, when a burst signal is coupled through T2, this added energy causes the circuit to oscillate strongly at 3.58 mc. The output from the stage is a CW signal of sufficient amplitude for demodulation. This signal is reinserted in the demodulators to recover the color difference signals.

Demodulators

Although some of the tube types have changed, demodulator stages used in the RCA CTC15 operate like those described in "Chroma Demodulator and Matrix Stages" in the November, 1962 issue. Similar circuits are also used in Admiral's color receiver and Motorola's TS-908 chassis. Motorola's 21″ chassis has a new circuit we'll discuss presently.

Packard Bell's demodulator section uses 6CG7's, in circuits similar to those of the RCA CTC9 chassis.

Zenith is continuing to use a high-level demodulator system, as in previous chassis. (See "What's New in Color TV" in the November, 1961 PF REPORTER.)

Motorola has something really new in the demodulator line. Combine color demodulators and difference amplifiers, toss in a 3.58 mc oscillator, and you'll have the unusual circuit shown in Fig. 11. Motorola is using a 15LE8 for all these functions n their TS-912 chassis.

T1 couples the chroma signal from the second color IF stage. This signal passes to the demodulator grids (nearest the plates) through phase-shifting networks consisting of R1, C1, C2, L1, and R3. The phase difference between the signal fed to the red grid and that fed to the blue grid is 87.5°. The phase of the reference signal injected into the electron stream at the control grid (pin 9) is the same for both demodulators.

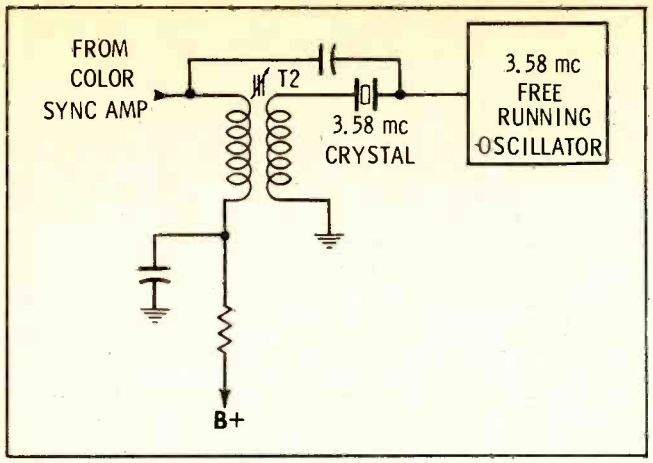

Fig. 10. Incoming burst is applied directly to 3.58 mc crystal.

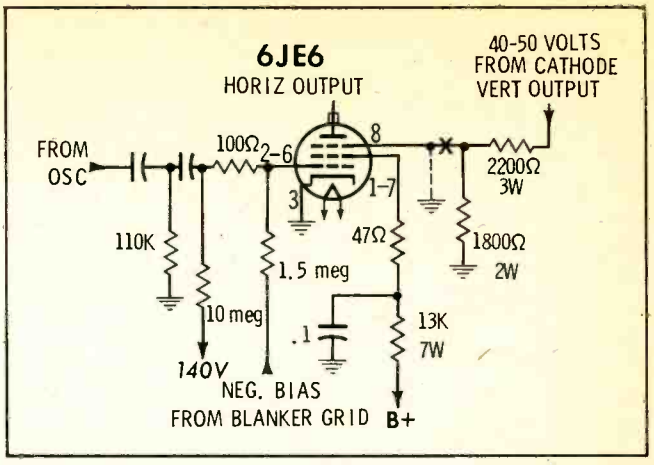

Fig. 12. New 6JE6 has external suppressor-grid connection.

The result is R-Y and B-Y demodulation in the respective sections of the tube.

The G-Y signal is also developed in this same tube. When plate current flows in either the red or blue demodulator, screen (pin 8) current will diminish, and the screen voltage will rise. The sum of the alternate excursions of red and blue plate currents produces a G-Y output signal at pin 8.

Horizontal Sweep and High Voltage

The tube complement used in Admiral's horizontal circuit sounds familiar—6DQ5, 6DW4, 3A3, 1V2, and 6BK4. One notable circuit difference is the addition of a boosted-boost circuit, using a diode rectifier. This increased voltage supplies B+ for the vertical circuit and the CRT accelerating anodes.

Packard Bell's latest sweep circuits are similar to those in RCA's CTC11 chassis. You'll find that Zenith's horizontal circuits follow closely those used previously—see the April, 1963 issue for a rundown. RCA's entire horizontal sweep section has been revamped, so let's see what's new.

Fig. 12 shows the new arrangement, designed around the recently introduced 6JE6 output tube. A feature of the new tube is an external pin 8 connection for the suppressor grid; a slight positive voltage—obtained from the vertical output cathode—is applied to this grid to prevent snivets or other spurious oscillations. You may find pin 8 grounded in most VHF-only versions, although a few do have the divider network. Also new in this circuit is the obtaining of negative grid bias from the blanker tube, via R1.

Another big change is the use of a diode rectifier in place of the 1V2 focus rectifier used previously (see Fig. 13). A special diode is used for this purpose, so be sure you have the correct replacement if one fails. Another diode (also a special type) rectifies a pulse from the flyback, and adds the resultant DC to the 850 volt boost voltage, forming a 1200 volt boosted-boost for the vertical circuit and CRT accelerator grids.

Rounding out the list of changes in the RCA horizontal circuit is the regulator stage shown in Fig. 14. The "old faithful" 6BK4 still fills the main socket, but a slight refinement has been added. Notice that R2, a 12-meg resistor in the regulator grid circuit, is also connected to the video output plate. When a prolonged current increase in the CRT, due to bright scenes, tends to load the high-voltage supply, a slight video signal is fed via R2 to the regulator grid for compensation. This action helps regulate the high voltage during

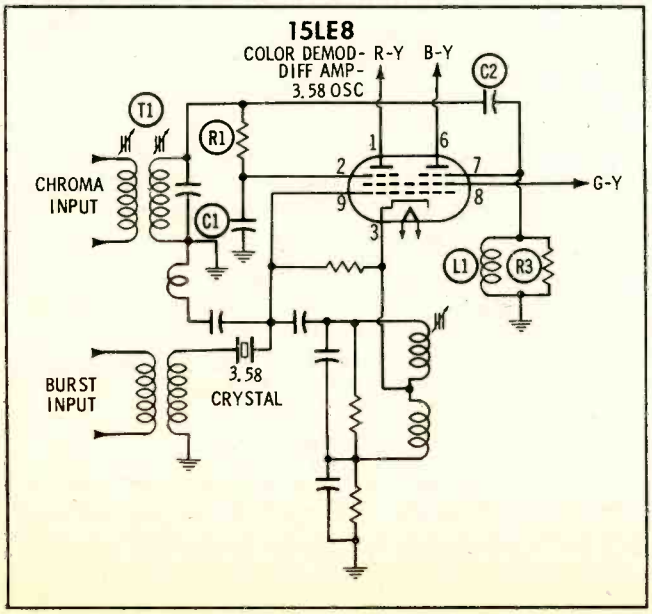

Fig. 11. Single tube develops all color difference signals.

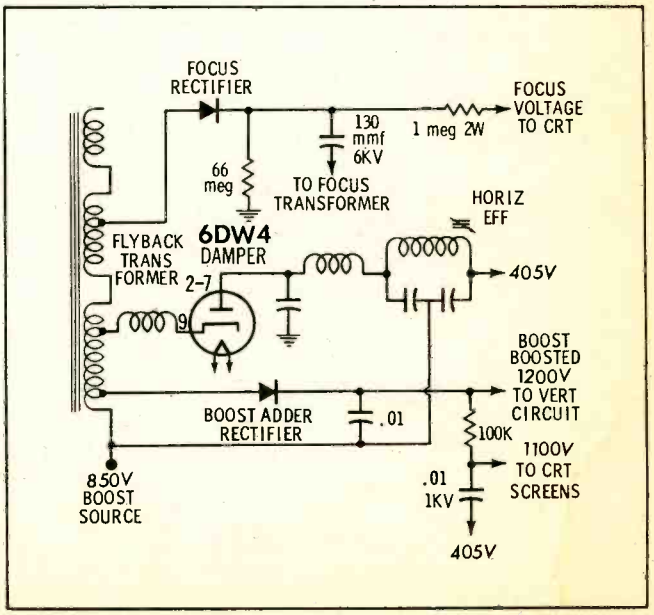

Fig. 13. Two special rectifiers are used in RCA's CTC15.

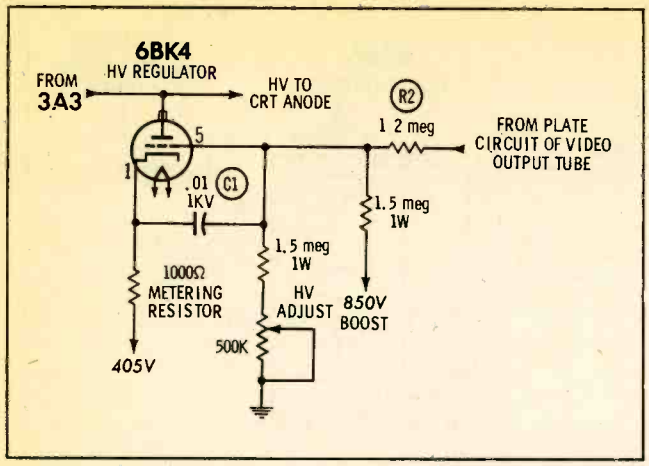

Fig. 14. Regulator circuit samples video output signal.

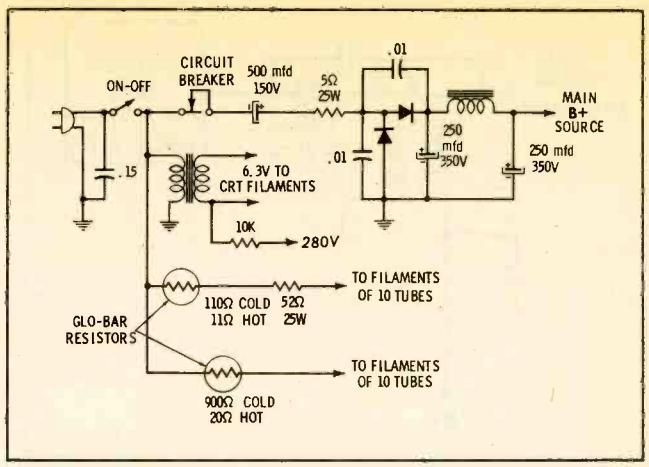

Fig. 15. Diode is used to regulate and maintain sweep.

video peaks. The time constant of R2-C1 prevent short-duration peaks from affecting the regulator circuit.

Motorola's TS-912 has several new horizontal sweep features. First is the use of two 12GC6 output tubes (see Fig. 15) wired in parallel.

We mentioned that this receiver doesn't have a regulator tube; however, the horizontal sweep *is* held constant by a diode that controls the bias voltage in the grid circuit of the output tubes. The grid resistance is divided into two separate paths—R1-R2 and R3-X1. X1 is a germanium diode; its cathode is connected to an adjustable DC voltage source and its anode to a pulse from the flyback.

The action of the regulating diode is quite simple: With the horizontal bias control set to produce normal sweep, diode conduction depends to some extent on the DC voltage applied to the cathode, but largely on the pulse voltage applied to the anode. If the pulse increases (less load on the high-voltage supply), more negative voltage is developed in the grid circuit, bringing the sweep back to normal. When the load increases (during a bright scene, for instance), the opposite occurs—less negative voltage is developed in the grid circuit, and sweep output is increased.

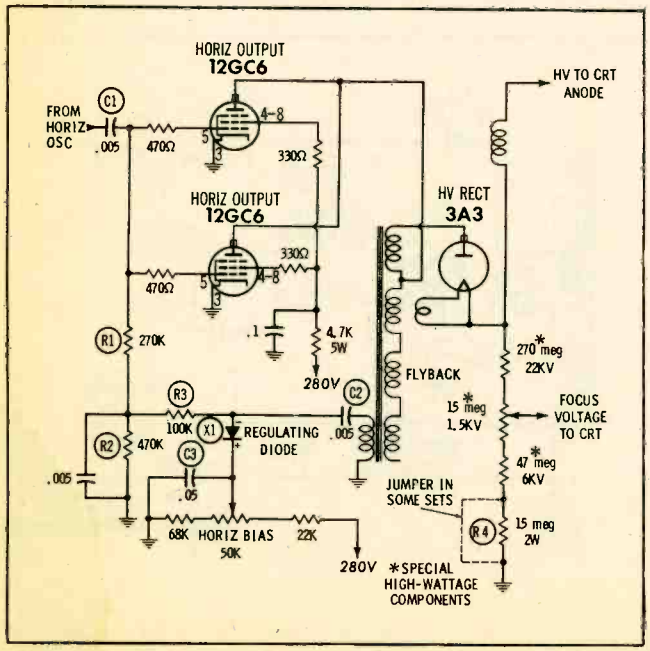

Fig. 16. New color set has 21 tubes and series filaments.

This horizontal stage also lacks a focus rectifier circuit; focus voltage is obtained by tapping the high voltage developed by the 3A3. You'll find that special high-wattage components are used throughout the high-voltage divider network. R4, located at the end of the divider, may be shorted with a jumper to improve focus in the middle range of the control.

Power Supply

Most of the new color sets are transformer powered, and B+ is developed by a full-wave voltage doubler using silicon rectifiers. This circuit is basically the same as those found in many black-and-white sets, but has greater output; the voltage on the main B+ line is usually in the vicinity of 400 volts, and DC current drain on the B+ supply may be as high as 500 ma. Where higher voltages are needed throughout the receiver, boost and boosted-boost arrangements supply them.

On the other hand, the transformerless power supply in Motorola's 21" receiver is one of the newest features among the 1964 crop of color sets. Shown in Fig. 16 is a schematic showing the filament sources and the circuit used to develop the main B+ voltage.

Each of the filament strings has a temperature-sensitive resistor in series; one has a cold resistance of 110 ohms, and the other, 900 ohms. You'll find an extra 52 ohm, 25 watt dropping resistor in one of the strings. Each filament circuit supplies a total of ten tubes. (This chassis has a total of only 21 tubes—counting the picture tube.)

The 6.3 volts for the picture-tube heaters is obtained from a stepdown transformer. To lessen the chance of internal arcing between the heaters and cathodes of the CRT, a bias connection is returned to the 280 volt source via a 10K resistor.

B+ is developed by two silicon rectifiers, wired as a half-wave doubler. The power-supply circuit is protected by a circuit breaker and a 5 ohm, 25 watt surge-limiting resistor.

Summary

Many of the circuits used in the '64 color receivers will be familiar. Others have major improvements, and a few are being used in color receivers for the first time. It's best, from a servicing viewpoint, to keep in touch with the changing designs as they appear. Familiarity can be a key to easier color-TV repair. ▲

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CS-124-63

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PF REPORTER

including Electronic Servicing

VOLUME 13, No. 11 NOVEMBER, 1963

CONTENTS

ABOUT THE COVER

Our annual Color TV Special Issue is becoming a tradition in the electronics industry. This one is jam-packed with hints and solutions for color servicing problems, starting with the special circuit information on page 1.

LETTERS TO THE EDITOR

Dear Editor:

I wish to express my appreciation for PF REPORTER and PHOTOFACT. In 10 years of being active in radio-TV service work, I've never seen any publications that keep me abreast of technical developments as yours do; I cannot think of one thing that is more valuable to a shop. You have a permanent subscriber, as far as I'm concerned—and I'm sure if any technician tried your publications for one month, he would never go back to any other. May you never stop printing!

H. S. ATCHLEY

Sheboygan, Wis.

We'll drink to that . . . make ours printer's ink, without a chaser.—Ed.

Dear Editor:

"When Cable TV Comes to Town," on page 36 of your July issue, is a most enlightening article, and we would like to secure more copies of it. Is it possible to obtain 50 reprints of the complete article?

LOU ANGELL

Television Cable Co.

Myrtle Beach, S. C.

There has been such a demand for reprints of the CATV article that we've started the presses rolling again, and can offer four-page reprints (on heavy stock) at a cost of 10¢ each in quantities of less than 100, or at $8.00 per hundred. —Ed.

Dear Editor:

Out here, I don't receive my PF REPORTER until past the deadline for Free Literature. I am particularly interested in a New Product advertised in the July issue. Can you provide me with the address of companies that offer free literature and catalogs?

R. FARRINGTON

TV Service Co.

St. Thomas, Virgin Island

This'll surprise you, but even some stateside technicians forget to send the card till too late. When this happens, we can't process the request. However, if they'll just look at a more recent issue, they may find the same piece of literature still being offered. Thus, they can get the information they need simply by marking the card and sending it before the deadline. In your special case, we'll be more than happy to obtain for you any item of literature that is still available. —Ed.

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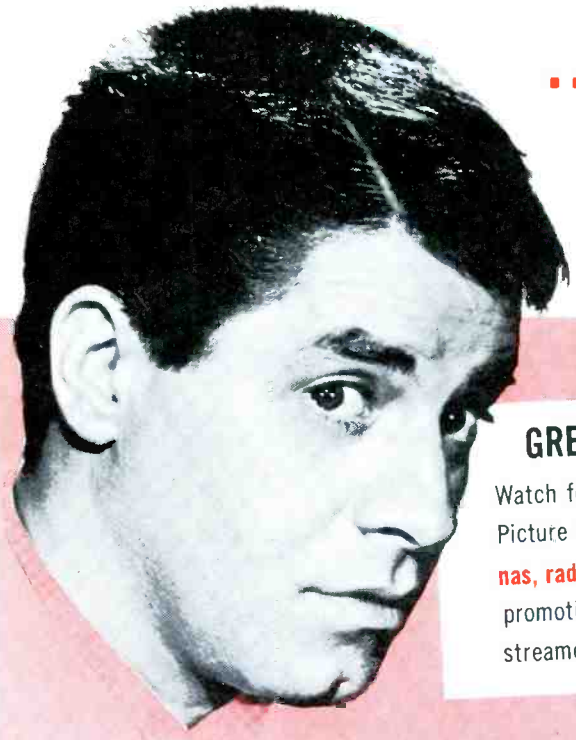

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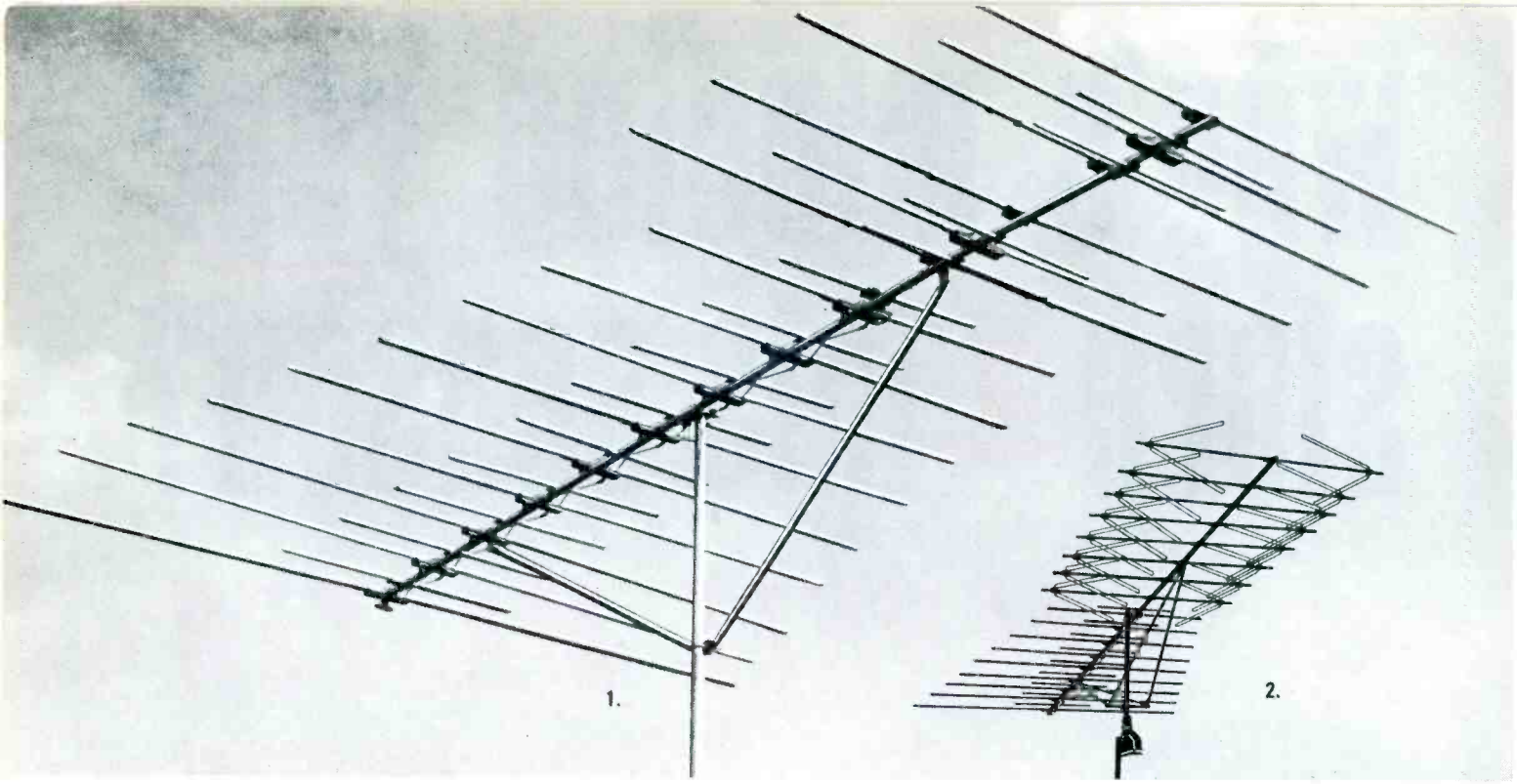

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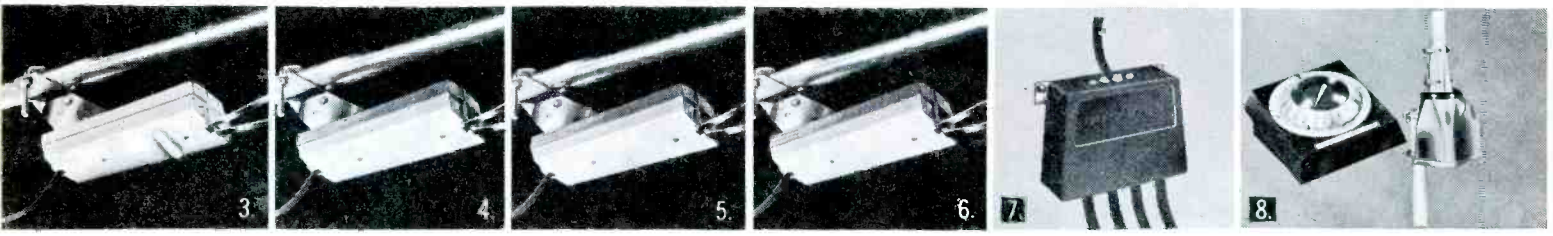

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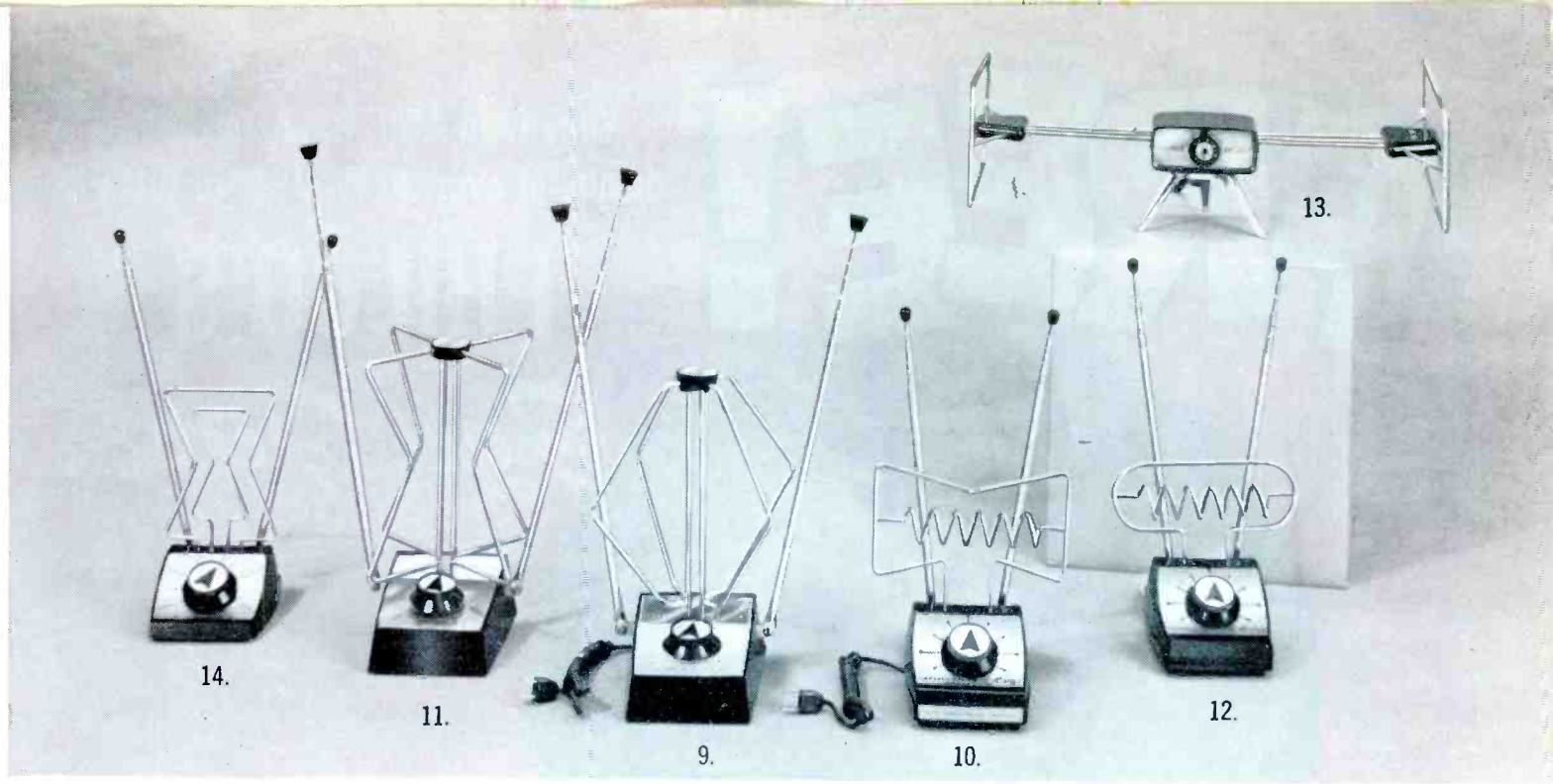

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11. **Golden CANAVERAL** Model 3720 **(Non-Amplified)**

YOUR MARKET: METROPOLITAN AREA VIEWERS WHO WANT TOP TV/FM RECEPTION UP TO 15 MILES FROM STATION. Same features as Apollo.

12. **NEW! FM/STEREO INDOOR ANTENNA** Model 3730 **(Non-Amplified)**

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16. **Model 6701. YOUR MARKET:** FRINGE-AREA LISTENERS WHO WANT TOP QUALITY AT A MODERATE PRICE! Inductive Tuning, 2 long-life Nuvistors.

17. **Translator Model 6703.** Same as above but covers only channels 70-83.

18. **Model 6702. YOUR MARKET:** METROPOLITAN AND SUBURBAN AREA LISTENERS WHO WANT TOP QUALITY AT A MODEST PRICE! Your most profitable UHF conversion market. Inductive Tuning, 1 long-life Nuvistor.

19. **Translator Model 6704.** Same as above but covers only channels 70-83.

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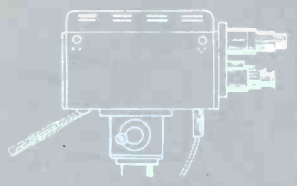


The Electronic Scanner

New Sales Manager Chosen

The appointment of Floyd Makstein as General Sales Manager of **Precision Apparatus Inc.** has been announced by that company. Mr. Makstein will supervise sales representatives' activities, maintain dealer-distributor relationships, and develop new products and territories. In announcing the appointment, Sol Sparer, president, emphasized that Mr. Makstein will work very closely with the servicing trade and pay close attention to its needs and requirements.

Slide-Tape Lectures

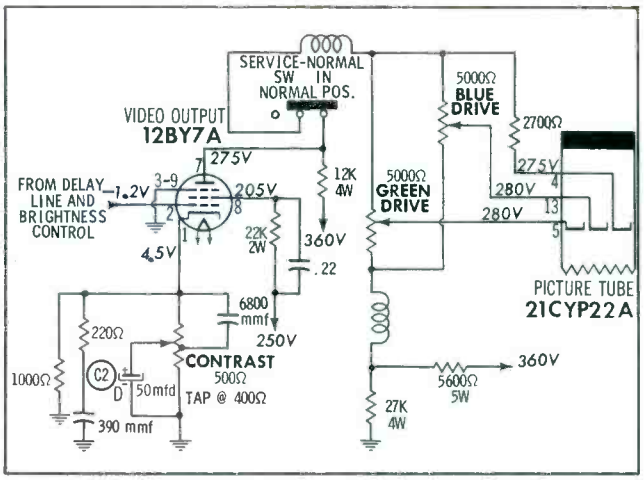
As a continuing aid to the service profession, for some time now **Howard W. Sams & Co., Inc.** has been offering groups of electronics personnel slide-tape lectures which are designed to assist the TV technician and shop operator in meeting the everyday problems of their business. The lectures, available on a no-charge basis, consist of professionally-recorded tapes which can be played on any 7½ ips player, and 35 mm color slides which can be shown via any slide projector. A variety of lectures on management and technical subjects are available—the latest being a continuation of the "Transistor Review Series" titled "Circuits and Associated Components."

New National Service Manager

The new National Service Manager of **Zenith Sales Corp.,** Mr. Brian Maronic, is a veteran of 29 years with Zenith. In his new assignment, Mr. Maronic is responsible for coordinating the company's service program for all home entertainment products. In addition, the job of maintaining close liaison between Zenith distributors and dealers will depend directly on Maronic.

Deluxe Video-Tape Home-Recording System

A luxury home television recording system includes a compact videotape recorder, camera, and receiver—not to mention a stereo audio-tape system. Developed by **Ampex Corp.,** this complete audio-visual home recording system can record TV programs off the air or make complete home TV tapes for playback. A built-in timer can be preset to record a program during the operator's absence; or, it will record a program on one channel while another is being viewed on he screen. Like the tape used in stereo systems, the video tape can be erased for reuse, or stored without losing the information. The deluxe system, equipped with video and audio tape systems, an AM/FM multiplex tuner, a record system, and a color TV receiver, will sell for $30,000.



basic cause of such symptoms as blooming, variable width, and poor focus.

If you don't find any more clues in the video circuit, the next step is to check the setup adjustments in the CRT and high-voltage circuits. Simple misadjustments account for a great many raster troubles in color receivers. One common mistake is to set the screen and drive controls too high in an effort to increase brightness. Generally, it's best to leave these controls at the lowest settings that will permit correct gray-scale tracking. The receiver will then have only a moderately bright picture, but it will be sharply focused and will have little tendency to bloom when the brightness control is turned up high.

The high-voltage rectifier may be excessively loading the horizontal output circuit. If so, you may be able to remedy this condition by adjusting the HI VOLTAGE ADJUST *pot and the horizontal linearity slug, exactly as specified in service data.*

I hate to bring it up—but the dim, poorly focused picture

THE TROUBLESHOOTER

answers your service problems

Dull Color Pix

I'm having quite a problem with a color set—RCA Chassis CTC10 (PHOTOFACT Folder 517-2). As the brightness control is advanced, the picture shrinks by 1½" on each side, and the focus gets progressively worse. The light on the screen must be almost completely extinguished to obtain sharp focus. I've checked and substituted all tubes in the horizontal, high voltage, focus, and regulator circuits.

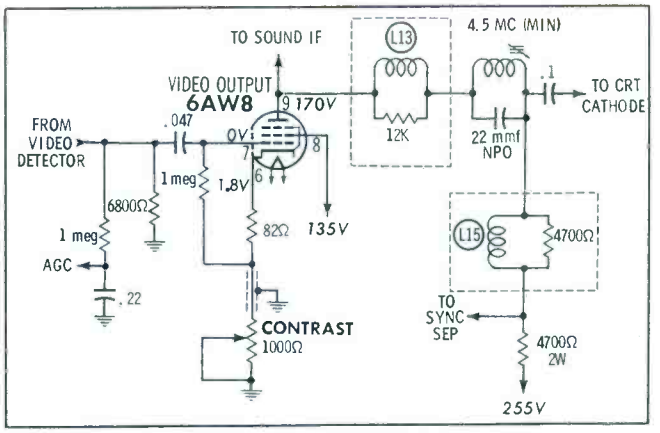
This trouble may have some connection with another symptom: fluctuation of the contrast level after a half hour of operation. The effect is the same on either black-and-white or color pictures.

GEORGE VAN DURME

Chicago, Ill.

I'm almost certain replacing C2D, the electrolytic bypass capacitor in the cathode circuit of the video output stage, will cure the intermittent changes in contrast. Be sure to replace the entire can, not just the one section.

Top off this repair with a complete check of operating conditions in the video output circuit, this might show you the answer to your brightness and focus problems. Since the video stage is DC coupled to the cathodes of the picture tube, errors in its plate voltage can affect CRT bias enough to cause overloading of the high-voltage supply—which is often the



picture, this could indicate a fault in the boost circuit. Since the vertical oscillator obtains plate voltage from the boost source, it's possible that a decrease in boost voltage might cause vertical rolling as well as the expected loss in brightness.

Herringbone

I'm having peculiar troubles with an RCA Chassis KCS136 (PHOTOFACT Folder 585-2). The set operates okay for a few minutes, and then the picture breaks into a herringbone effect. When I first took the set in for service, the trouble would also cause it to lose both vertical and horizontal sync, and it would produce such a terrific tearing noise that you'd think it was going to explode.

After I thoroughly worked over the AGC circuit and replaced the RF amplifier, the picture returned to normal. But, after a few weeks, the same old herringbone trouble turned up —without the tearing, this time. Sometimes it can be stopped with the fine-tuning control; other times, no. Switching off

• *Please turn to page 92*

could be caused by a bad CRT! If adjustments don't help solve the problem, better check the picture tube before getting deeply involved in troubleshooting the high-voltage, flyback, and CRT gun circuits.

Roll—You're Faded

A Sonora Model 560 (PHOTOFACT Folder 358-8) operates normally for about 10 minutes; then the picture dims out and begins to roll vertically. The trouble often straightens itself out after a short period, and may not reappear for the rest of the time the set is in use.

Some new electrolytic filter capacitors got rid of the original complaint on this set—a bad vertical jitter with frequent rolling.

FRANK HURSTAK

Berwyn, Ill.

The basic trouble is evidently in the picture-signal circuits. You'll probably find the video signal becoming so weak that the sync pulses lack sufficient amplitude to keep the vertical oscillator locked in. This condition might be complicated by a poorly operating sync stage or a touchy vertical circuit.

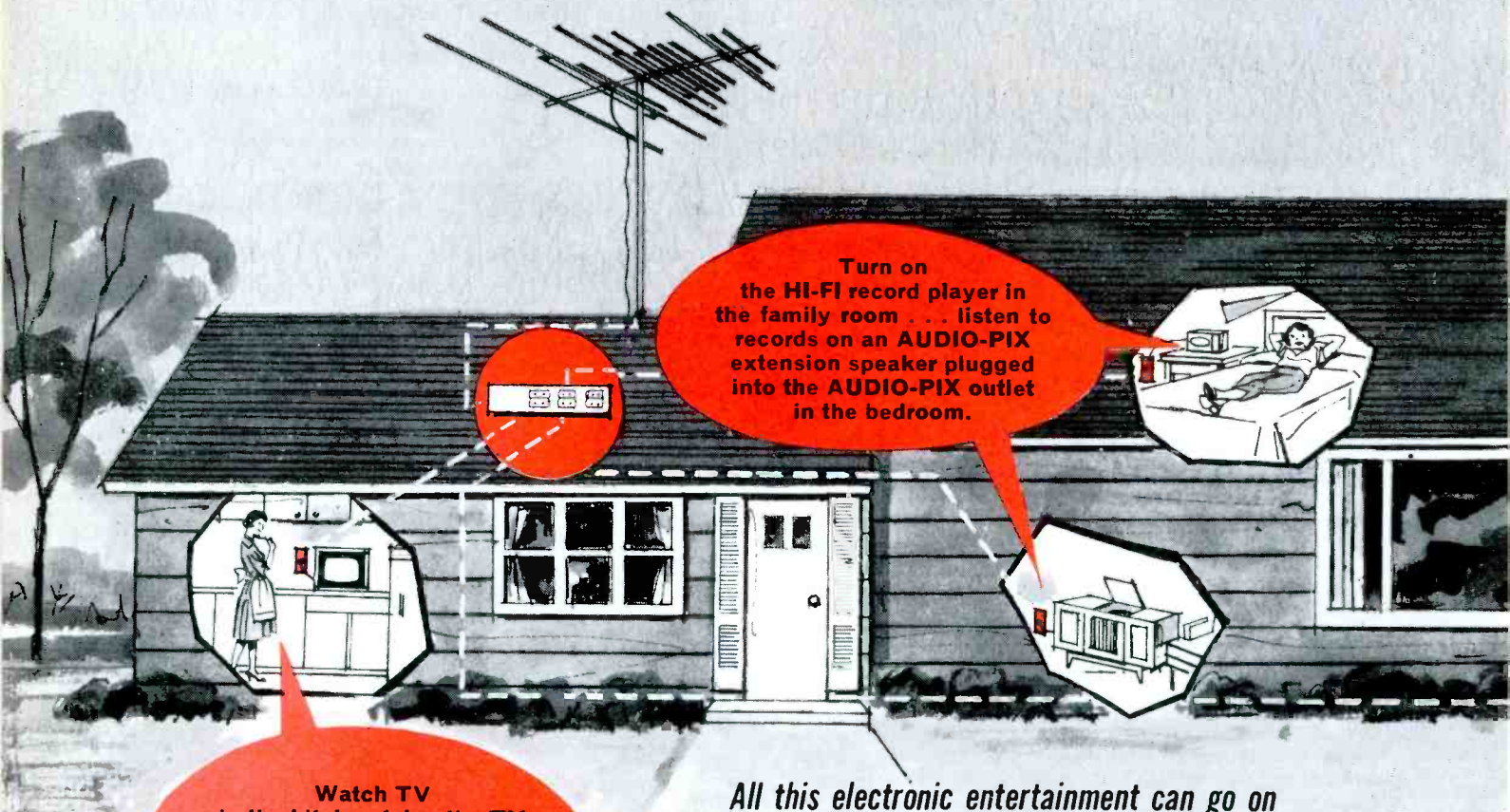
A video fault is relatively easy to isolate in this set, since there's no keyed AGC circuit, and thus no feedback from the video output stage to the front end. As the trouble develops, watch the waveform at the video detector. A drop in amplitude points to a crippled stage in the IF, or even in the tuner—and further monitoring checks are called for. Here's one idea: Check the cathode voltages in the IF strip, one at a time, to find out if conduction of any stage decreases when the picture fades.

If the signal at the detector is constant, the trouble is pretty well pinned down to the video output stage. One especially likely fault is an intermittently open peaking coil in the plate circuit. You can check L13 and L15 by measuring voltages at all points in the immediate area, and watching for a suspiciously high voltage drop across one of the coils.

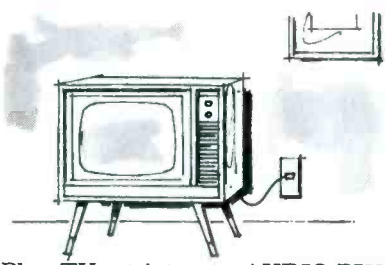
If the dimming effect is actually in the raster instead of the

NEW IDEA

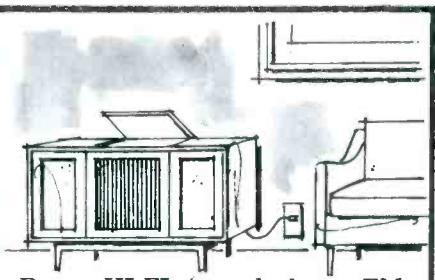
Winegard Introduces An Amazing New Home TV and Music Outlet System



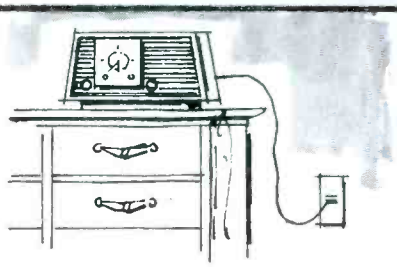
All this electronic entertainment can go on simultaneously over a single wire without interference! That's the amazing new AUDIO-PIX system by Winegard.



Plug TV set into any AUDIO-PIX outlet. Run one or more sets simultaneously from a single antenna.



Run a HI-FI (record player, FM or AM, or tape recorder) and feed the sound into the system to be picked up at any AUDIO-PIX outlet.)



Plug an FM receiver into the AUDIO-PIX. The AUDIO-PIX serves as an FM antenna signal source, and at the same time automatically feeds the FM sound back into the system to the extension speakers.

AUDIO-PIX delivers TV, FM or HI-FI

Anywhere Inside or Outside the House Over a Single Wire

Watch TV on the patio (the portable TV set is plugged into an AUDIO-PIX outlet and is receiving TV signals from the same antenna.)

Audio-Pix comes beautifully packaged in a Winegard selling display carton with built-in carrying handle.

AUDIO-PIX is two systems wrapped into one simple, inexpensive installation. It is both a TV-FM system (distributes TV/FM antenna signals) and a HI-FI music system at a price any home owner can afford. No new home is truly modern without AUDIO-PIX.

The AUDIO-PIX is a revolutionary new electronic entertainment convenience for the home which—

(1) . . . feeds TV (Ch. 2-83) and FM antenna signals to each AUDIO-PIX outlet.

(2) . . . feeds sound from a HI-FI (record player, FM and tape recorder) to the same AUDIO-PIX outlets.

The complete Winegard AUDIO-PIX system comes in a kit which contains a special AUDIO-PIX 6-outlet coupler*, 4 AUDIO-PIX outlets and plugs (any number of additional outlets may be added if desired), special AUDIO-PIX HI-FI extension speaker, a special AUDIO-PIX attachment for FM or HI-FI system, and 100 ft. of lead-in wire. Model APK-360, list price $49.95.

Start selling AUDIO-PIX to your customers now. Write for spec sheets or ask your distributor.

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3009-11 Kirkwood, Burlington, Iowa

Circle 10 on literature card

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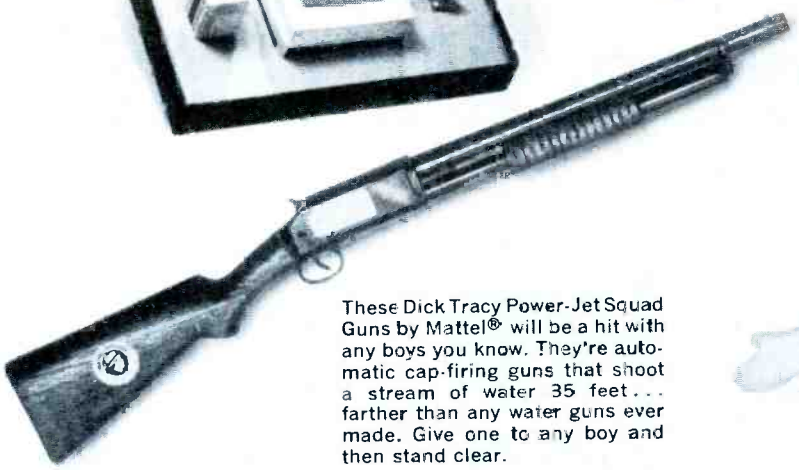
Do your Christmas shopping early at your G-E Distributor's. He has lots of wonderful gifts that you can get with the purchase of General Electric tubes . . . gifts for your family, friends and favorite customers. And there're some you'll want for yourself . . . such as a tube caddy that looks like fine luggage. You can also get Christmas cards designed only for service dealers . . . to mail to customers and friends.

See your General Electric Distributor and start packing your bag *today*. You're going to be a sensational Santa!

Start packing your bag!

Be good to yourself this Christmas. You can get these Armor Clad® tube caddies when you purchase G-E tubes. They look like fine pieces of luggage and the special vinyl coverings are longer lasting. They are reinforced with nickel plate at all stress points.

These Kodak Flashfun camera outfits include everything that young photographers need: Hawkeye camera, film, clip-on neck strap, batteries, flash bulbs and instruction manual. They're yours when you buy G-E tubes.



These Dick Tracy Power-Jet Squad Guns by Mattel® will be a hit with any boys you know. They're automatic cap-firing guns that shoot a stream of water 35 feet . . . farther than any water guns ever made. Give one to any boy and then stand clear.

Little girls will go wild over these Mattel® Sister Belle talking dolls. They're 17" tall and have a rag body and plastic head. Each one says eleven different things that little girls like to hear . . . like "Let's play house," "Give me a kiss." No batteries needed.

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Get these Christmas cards . . . prepared especially for you. They're in color on heavy, high-gloss stock and show a cartoon of you adjusting a TV set to say "Happy Holidays." 50 cards and 50 envelopes to a box. Get yours now for early mailing.

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With the Analyst, you inject your own TV signals at any time, at any point, while you watch the generated test pattern on the picture tube of the television set itself. This makes it quick and easy to *isolate, pinpoint, and correct* TV trouble *in any stage throughout the video, audio, r.f., i.f., sync and sweep sections* of black & white and color television sets—*including intermittents.* No external scope or waveform interpretation is needed. Checks any and all circuits—solves any performance problem. Gives you today's most valuable instrument in TV servicing—*proved by thousands of professional servicemen everywhere.*

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Net, $329.95

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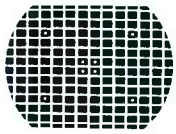

Enables you to troubleshoot and signal trace color circuits in color TV sets, or facilitate installation.

Generates white dot, crosshatch and color bar patterns on the TV screen for color TV convergence adjustments.

Generates full color rainbow display and color bar pattern to test color sync circuits, check range of hue control, align color demodulators. Demonstrates to customers correct color values.

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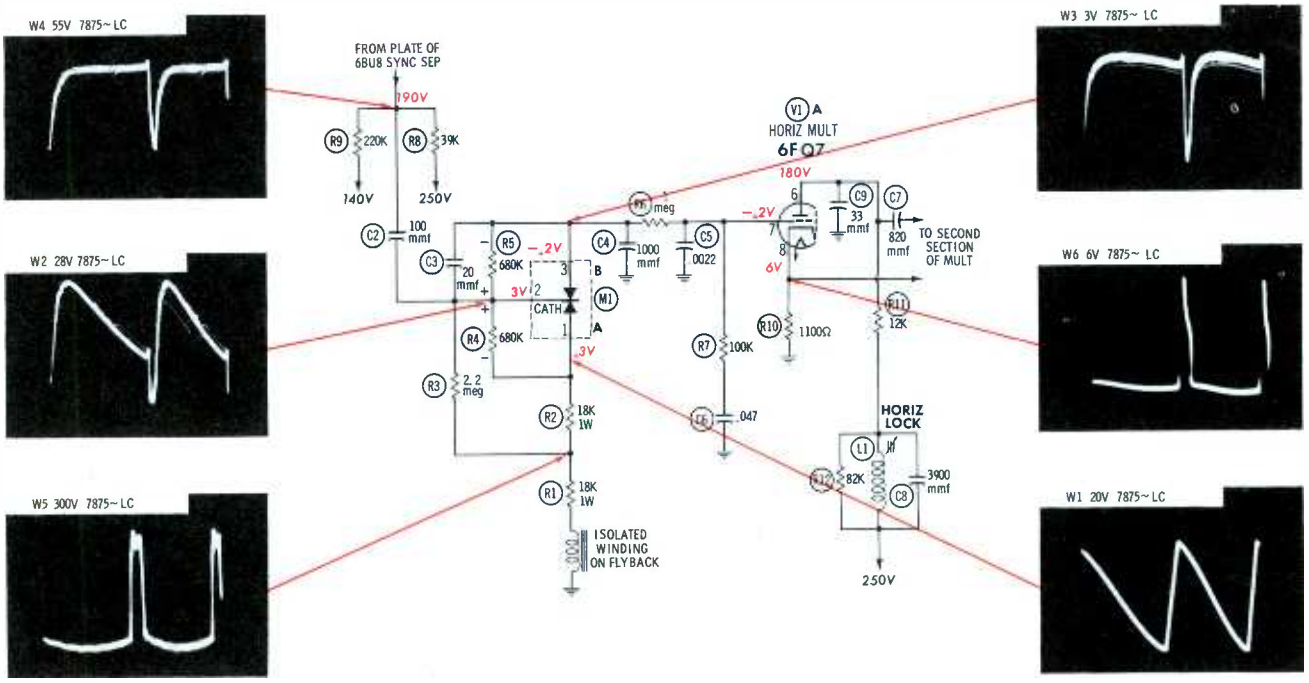
Circle 12 on literature card

PF REPORTER Symfact™

Horizontal AFC

Common-Cathode Type



DC VOLTAGES taken with VTVM, on inactive channel; L1 adjusted for zero volts on grid of V1A.

WAVEFORMS taken with wideband scope; low-cap probe (LC) used to obtain all waveforms shown.

Normal Operation

Through action of AFC stage, incoming sync pulses control frequncy and phase of horizontal sweep waveform developed by cathode-coupled multivibrator. Sync signal and sample of sweep signal are both fed to dual diode M1; if sweep retrace fails to coincide exactly with sync pulse, AFC circuit develops DC correction voltage that adjusts bias on input grid of multivibrator. Common-cathode circuit is now most widely used type of diode AFC. In version shown here (from Admiral Chassis 21G4), sample of sweep signal consists of flyback pulse W5, shaped by R2-C1 into sawtooth W1 for application to lead 1 of M1. Signal W3 at diode lead 3 is incidental to circuit operation. Some common-cathode AFC's have lead 1 grounded, and sawtooth of polarity opposite to W1 applied to lead 3. In either case, portion of sawtooth is coupled to lead 2 via M1 and external circuit. This common cathode terminal also receives negative sync pulses, whose tips always extend below negative peaks of sawtooth in W2; these tips drive both diodes into conduction. M1A current finds return path through R4, and M1B current through R5 —developing voltages across resistors in polarities shown. Resultant voltage across both resistors in series is used as output. Diodes conduct equally when multivibrator is correctly timed, and output is zero. (Some common-cathode circuits develop small negative output at point of equilibrium.) Correction of drift is explained under "Operating Variations." Ripple in AFC output is removed by filters R6-C5 and R7-C6.

Operating Variations

VOLTAGES On active channel, voltage at pin 7 of V1A can be varied from +3 to −2 volts (by means of L1) without loss of sync. Operation is most stable with voltage at zero or very slightly negative. Lead 3 of M1 is at same potential as multivibrator grid. Signal conditions have practically no effect on voltage at lead 1. DC reading at common cathode (lead 2) rises when sync is applied; nominal value is 12 volts, hold-in range 11 to 13.5 volts.

WAVEFORMS When L1 is adjusted, or multivibrator attempts to drift, phase of W1 shifts slightly. Sawtooth portion of W2 is also seen to shift slightly with respect to sync pulses. On the other hand, W3 shows practically no change. If multivibrator tends to lag, W1 is nearer its negative peak at sync-pulse time; in W2, sync tip extends unusually far below negative peak of sawtooth. Since both waveform changes are in negative direction, forward bias on M1A is little affected. However, because change occurs in W2 and not in W3, forward bias on M1B is increased. Consequently, M1B conducts more heavily than M1A, and resultant negative output from AFC makes multivibrator run faster. If opposite error occurs, signal voltages on leads 1 and 2 of M1 at sync-pulse time are shifted in positive direction, while voltage on lead 3 stays nearly constant. As a result, M1A conducts harder than M1B, and positive output from AFC "puts brakes" on multivibrator.

SYMPTOM 1

Tuning to Station Kills Raster

Normal Horizontal Sweep on Vacant Channels

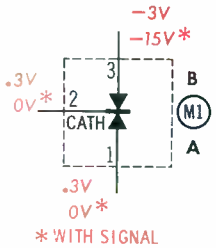
M1A Open

Picture appears momentarily, then falls out of sync and fades away. Sync signal seems to be pulling multivibrator so far off frequency it cannot develop normal drive waveform. Unbalanced AFC is likely. L1 has no effect—won't even produce squeal from flyback.

Waveform Analysis

On stations, W6 disappears, proving multivibrator is dead. Loss of sweep also knocks out W1 and W5. Overall amplitude of W2 is normal, but sawtooth component is small and doesn't change position relative to sync when L1 is adjusted. This sawtooth is simply due to discharge of C2 in intervals between bursts of diode conduction. Only fault in W3 is increased sawtooth slope.

Voltage and Component Analysis



Grid voltage of V1A averages −3 volts on vacant channels. Strong station signal forces voltage down to −15 volts, sufficient to cut off V1A. Same reading is found on lead 3 of M1. Leads 1 and 2 both have .3 volt (sync absent) or zero volts (sync present). Large voltage drop across M1B is sign of heavy conduction; identical voltages on both sides of M1A mean this diode is either shorted or nonconducting. Check of forward and reverse resistances in M1 reveals open "A" section. If M1B had opened, high positive voltage on grid of V1A would have lowered multivibrator frequency, also causing loss of raster.

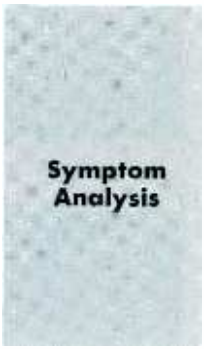
Best Bet: DC voltage analysis, assisted by scope.

SYMPTOM 2

Faint, Ragged Raster; Loud Squeal

Trouble Occurs Only On-Station

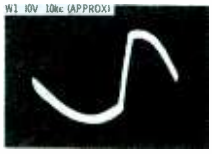
C4 Open

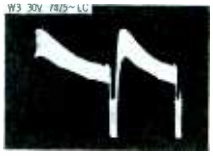


Squealing flyback indicates horizontal sweep frequency much too low. If HV circuit and CRT are not in tip-top shape, raster may disappear. Removing M1 restores solid (though critical) horizontal hold; this in itself is definitely abnormal.

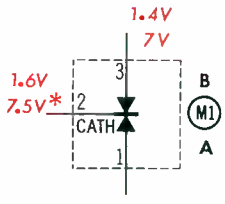
Waveform Analysis

W1 is severely distorted, with both frequency and amplitude only about half of normal; however, defects in this waveform are just a consequence of faulty drive signal to flyback. Much more important clue is amplitude of W3 (10 times normal). No hash or ripple is seen at grid of V1A, so attention is drawn to possible fault in C4. W2 looks like W3, but measures 35 volts.





Voltage and Component Analysis



With no sync pulses applied, DC voltage is only slightly low (1.6 volts) on lead 2 of M1, and a bit high (1.4 volts) on lead 3. More obvious error is noted on active channel: +6 to +9 volts on lead 3, and only .5 volt higher on lead 2. These readings help localize trouble in AFC stage, but are less efficient than scope for pinpointing defect. Actual root of problem is C4's failure to provide partial bypassing of signal to ground from anode of M1B. Excessive W3 causes degeneration that reduces conduction of M1B, and not enough negative voltage is developed across R5 to balance out positive voltage across R4.

Best Bet: Analyze results of waveform tests.

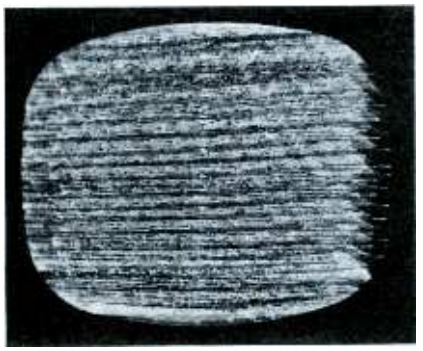
Erratic Sync

SYMPTOM 3

No Raster on Vacant Channels

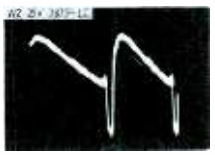
C2 Leaky

Symptom Analysis



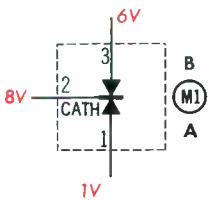
Sync signal seems to "key" horizontal sweep into operation. Usually, raster first appears as random lines, with loud squall from flyback. Stable picture can often be obtained by carefully adjusting L1, but sync is lost in switching off channel and back.

Waveform Analysis



Off channel, weak and distorted W1 is present; this proves sweep system is still functioning, though crippled. W1 becomes normal when station is tuned in and picture is stabilized. W2 and W3 are somewhat weak, and waveshapes are not exactly like those of normal signals; but neither waveform contains enough distortion to give positive clues to location of trouble.

Voltage and Component Analysis



When ground lead is clipped to pin 7 of V1A, normal raster appears on all channels; this test isolates fault to AFC. With ground lead removed, all "no-signal" voltages on M1 are too positive: 6 volts at lead 3, 8 volts at lead 2, and 1 volt at lead 1. If M1 is removed from circuit, voltage at junction R4-R5 remains at 8 volts, and V1A grid voltage rises to same level. DC leakage from B+ into AFC stage through C2 is possible suspect. C2 is best checked by *dynamic leakage test*, with lead unsoldered at AFC end, and receiver operating. VTVM reading between free end of C2 and ground, which should be zero, is 110 volts.

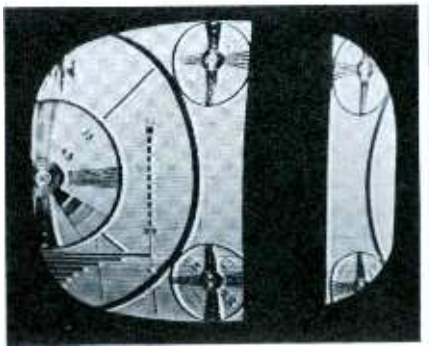
Best Bet: Voltage analysis followed by component tests.

Loss of Horizontal Sync

SYMPTOM 4

Tendency to Lock Out of Phase

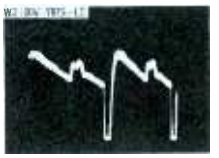
C1 Shorted

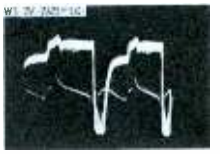


Symptom Analysis

Picture is usually broken up into slanting lines. It can almost be pulled into sync at one critical setting of L1, but horizontal blanking bar persistently slides out toward middle of screen. It shifts uneasily back and forth, rather than locking in solidly at any point.

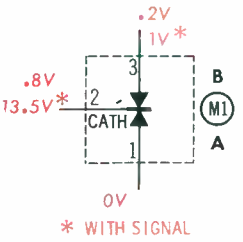
Waveform Analysis





W5 is normal and stable, but W1 is missing; this clearly pinpoints fault at lead 1 of M1. W2 is only 20 volts in amplitude, and contains spurious pulse that slides back and forth on sawtooth slope, keeping pace with blanking bar. This pulse is evidently a portion of W5 coupled through R3. Small stub of this stray pulse is also seen in W3, which has lower amplitude than usual.

Voltage and Component Analysis



This condition is difficult to troubleshoot by checking DC voltages, since all readings might be considered "within tolerance." With no station signal applied, lead 1 of M1 measures zero volts; lead 2 has .8 volt (slightly low); lead 3 has .2 volt. On active channel, voltages on leads 2 and 3 change to 13.5 volts and 1 volt, respectively; these values can be varied only a few tenths of a volt by adjusting L1 over its limited hold-in range. Resistance to ground from lead 1—only 1 ohm—draws suspicion to C1. Making resistance test at this point immediately after scoping lead 1 provides quick solution to this service problem.

Best Bet: Use scope, then ohmmeter, to pinpoint fault.

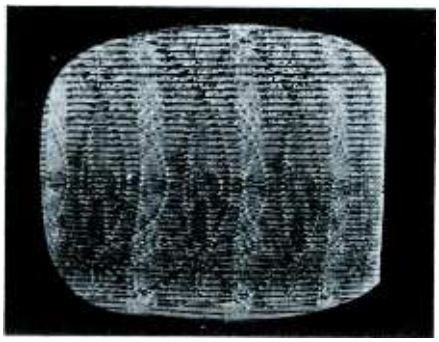
SYMPTOM 5

Horizontal Frequency Error

Intermittent Squegging on All Channels

M1B Shorted

Symptom Analysis

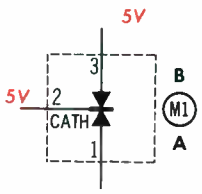


Overlapping images can be locked into sync, proving stable operation of multivibrator is possible at ¾ to ⅘ of normal frequency. When L1 is adjusted to make multivibrator run faster, circuit breaks into random oscillations before 15,750 cps can be reached.

Waveform Analysis

Principal waveform clue is increase in W3 amplitude to three times normal. W2 has only slightly larger amplitude than W3. Jumbled-looking trace between sync pulses is produced by mixture of sync and sweep-sample signals at different frequencies. Normal-looking W1 can be obtained by retuning scope sweep somewhat below usual frequency of 7875 cps. No significant ripple is seen at grid of V1A, so suspicion centers around area of M1B.

Voltage and Component Analysis



Under all signal conditions, voltage readings at leads 2 and 3 of M1 are identical—always a fraction of a volt more positive than grid of V1A. When dual diode is removed from circuit and checked with ohmmeter, forward and reverse resistances of B section are almost equal (2000 and 2500 ohms, as measured on 1K scale of VTVM having 1.5-volt battery.) Same test on normal diodes indicates 10K forward resistance, and infinite reverse resistance. Short in M1A would have grounded sync pulse via C1, causing critical hold.

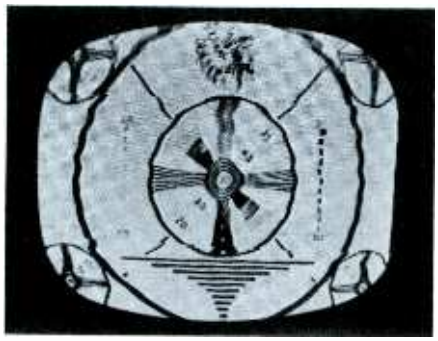
Best Bet: Isolate with either scope or VTVM.

SYMPTOM 6

Horizontal Jitter

Tendency to Piecrust Effect

C5 Open

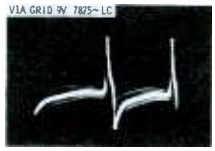


Symptom Analysis

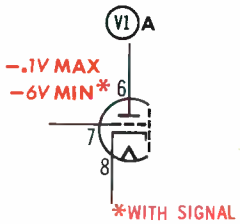
Setting of L1 can be found where picture is more stable than shown, but slight jitter persists. Piecrust appears when L1 is adjusted to raise frequency of oscillator; rotation in other direction causes conventional loss of sync (lines slanting down to left).

Waveform Analysis

Waveforms on M1 all look nearly normal, but unwelcome 9-volt pulses are found on grid of V1A, even on vacant channels. Waveshape looks like charge-discharge curve of RC network, suggesting AFC filter is functioning like grid-leak bias circuit. Closer look at W2 and W3 uncovers slight oddities; for instance, at "slow" end of hold-in range, unusually high trailing edge of sync pulse in W2 forms pip that rises above positive peak of sawtooth.



Voltage and Component Analysis



Routine voltage readings, without station signal, turn up no deviations from normal. Switching to active channel provides one clue: highest reading obtainable at grid of V1A by adjustment of L1 is −.1 volt, and grid voltage can be pulled down to −6 volts without loss of sync. Spurious positive-spike waveform at grid extends hold-in range of AFC system in negative direction (correcting slow multivibrator), but causes instability when AFC attempts to develop positive output voltage. AFC filter is obviously ineffective.

Best Bet: Scoping, followed by component checks.

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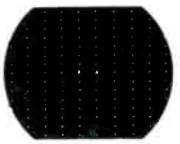
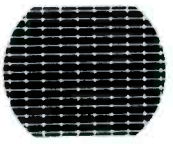
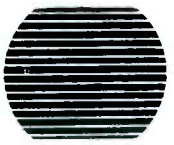


Dot Pattern



Crosshatch

Vertical Lines



Horizontal Lines

Color Pattern

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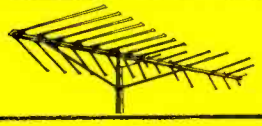

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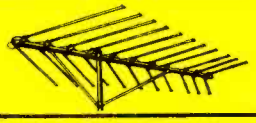

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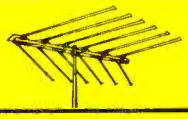

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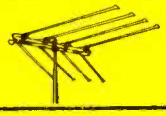

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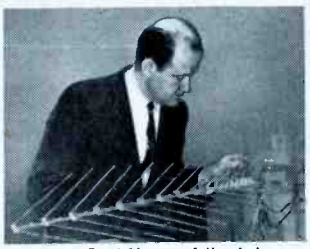

Professor Paul Mayes of the Antenna Research Laboratories of the University of Illinois, originator of the log-periodic V-dipole antenna concept.

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COLOR TV TEST GENERATORS

A signal - by - signal comparison of available instruments . . . by *Patrick M. Craney*

As color receivers become more popular, more and more technicians are turning to color service as a profitable segment of their business. Thus, among the instruments found on modern TV test benches are an increasing number of signal generators for servicing color sets. The technician needs to understand what the various types of color generators are capable of doing, if he is to use them most advantageously.

Four Color Signals

Basically, there are four types of color test signals used for service work. One is similar to the signal developed by color cameras; chroma information is provided in predetermined saturation levels and phase angles, formed into bars for easy viewing on the receiver screen. This pattern is called the NTSC signal, since it actually simulates the standards originally set by the National Television Standards Committee for compatible color television broadcasting.

The second test signal is considered an NTSC-type signal, in that fixed-phase color information is generated; on the receiver, however, only one wide bar of color is presented at a time. By manually switching the phase of the color information (which also simultaneously sets the correct saturation level) the operator can choose any one of several regular NTSC colors.

A third type of signal is produced by the displaced-subcarrier or rainbow generator. This signal presents a pattern of continuous color that changes hue from left to right across the CRT screen. It is accomplished by generating a 3.563-795 mc signal—usually referred to as a 3.56 mc signal that is displaced from the color-reference signal (3.579545 mc — nearly 3.58 mc) by exactly 15,750 cps. The result is a complete color spectrum across the screen, representing all the colors of a rainbow—hence the name.

The fourth system of color test signals is a variation of the rainbow presentation—the keyed rainbow signal. The colors appear the same as in the rainbow signal, except that they are interrupted at 30° intervals by a blank space—a bar containing no color. This spacing allows the service technician to check the exact placement of the colors, which appear as color bars.

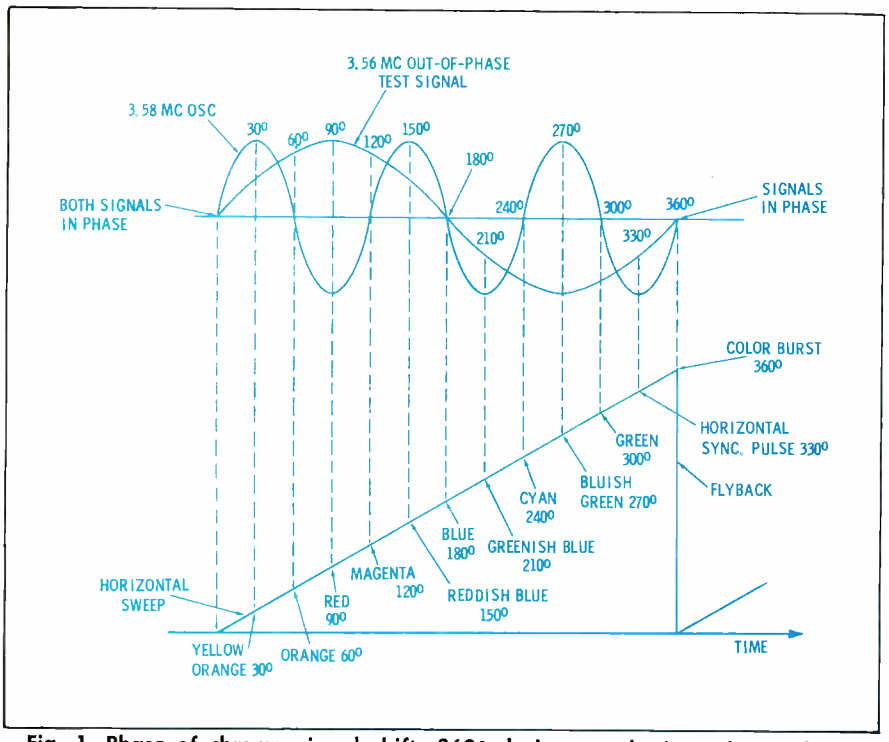

Fig. 1. Phase of chroma signal shifts 360° during one horizontal scan line.

The Rainbow Signal

Although the NTSC signal more nearly resembles televised color, the rainbow signal is much simpler. Therefore, let's examine it first, and see how such a signal is developed. Then we can learn how the NTSC signal is formed.

Consider just one horizontal line of the raster on a color CRT. Think of this line as being swept from left to right in a definite period of time —actually 1/15,750th of one second, or just over 63 microseconds. Fig. 1 shows the phase relationship between the chroma reference signal (3.58 mc) and the 3.56 mc test signal during the 63 microseconds required for one horizontal line to traverse the CRT screen. During one horizontal scanning line, the phase of the test signal shifts (with respect to the reference signal) by exactly 360°. When the resultant of these two signals is developed by the color demodulators in the color receiver, the color guns will be fed signals of constantly varying intensities during the horizontal scan time. Consequently, the line will change color as the beam sweeps from left to right, producing the full color spectrum.

As the next line is swept across

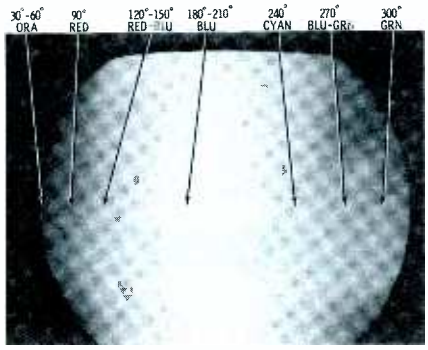

Fig. 2. Rainbow display, with the 30° points marked, has smooth transition.

the CRT screen, the process repeats itself. The test signal shifts through another 360° cycle, mixing with the chroma reference signal in the set. Result: another line of the same color spectrum. The next line does the same, and when all lines are swept, the raster contains all the hues of the rainbow—see Fig. 2.

Keying the Rainbow

Phase intervals of 30° have been chosen as points of reference for discussing this type of color pattern. As you can see from Figs. 1 and 2, certain points on the phase scale produce certain colors; likewise, each horizontal line shows a specific color at a particular point. When all the horizontal lines have been "painted" on the screen to form a rainbow raster, these 30° phase intervals can be marked off on the screen to indicate where each color should fall.

In some generators, these intervals are marked electronically. This is done by switching off the chroma circuit in the generator at the specified 30° intervals. The waveform photo of Fig. 3 shows how the signal looks when this is done. Remember that each bar contains a burst of 3.56 mc information. When this burst is mixed with the set's reference-oscillator signal, the color demodulators determine exactly what color will appear during that particular portion of the horizontal scanning line. Thus, on each line

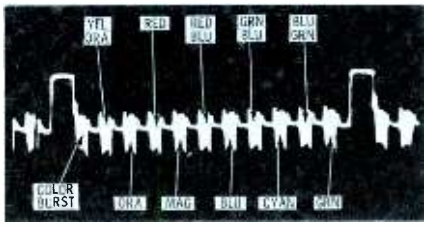

Fig. 3. Actual waveform of keyed-type rainbow display, with colors marked.

there appears a section of color followed by a section of no color—a blank space. If these blank spaces are separated by 30° intervals, they serve nicely to mark the point at which each color should appear.

This keying on and off of the rainbow pattern during each line gives rise to the term "keyed rainbow." Since the exact position of the different colors is a definite indication of the phase of the signal reaching the color demodulators, this signal can be used to check operation of the chroma and demodulator circuits in a color receiver.

You'll also notice an extra burst of signal in Fig. 3, perched on the shoulder of the horizontal sync pulse. This is the 3.58 mc reference burst that controls the chroma circuits in the color set. The burst is needed to synchronize the reference oscillator in the receiver with the zero-phase point in the generator. Since the burst occurs while the signal is still in the blanking portion of the horizontal pulse, this color reference signal cannot be seen on the screen of a normal receiver. It is necessary, however, to normal operation of the set, and should always be visible in the test signal being fed into a color receiver.

NTSC Generators

The more easily understood of the two types of NTSC generators is the single-bar unit. Since there is only one color to consider at a time, it is not difficult to understand how this color is generated.

Take a look at the color wheel in Fig. 4. This is just another way of showing, in vector form, the phase relationship between the various color signals. In the NTSC generator, all the color signals are basically 3.58 mc signals; only the phase is changed to determine the color. For example, if the signal is generated with a time delay that corresponds to a phase shift of 76.5°, it will produce red on the screen of the CRT. You will notice the color wheel for NTSC signals shows phase relationships differing slightly from those shown for the rainbow signal.

How does this signal produce constant color instead of the rainbow hue? Simply because the phase is held constant. Remember that the signal from a rainbow generator changes phase through the entire

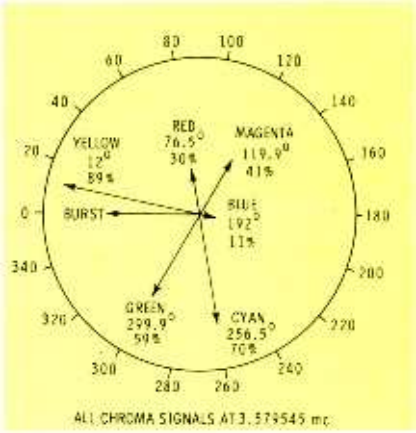

Fig. 4. Chroma-phase color wheel is for NTSC-type signal generators only.

time duration of each horizontal line, because it is a 3.56 mc signal. The NTSC signal is 3.58 mc, with its phase controlled by a timing device, usually a delay line.

Consider what happens when this fixed-phase signal mixes with that of the reference oscillator in the receiver. Both signals are fed to the chroma demodulators, and the CRT guns receive just the right proportions of signal to produce a particular color. Change the phase of the test signal, and the demodulators cause a different color on the CRT screen.

The simplified diagram of Fig. 5 shows how the delay line is used to set the color generated by the single-bar NTSC unit. The delay line has successive taps that represent various degrees of time lag. The 3.58 mc signal is applied to the delay line and to a burst-gate stage. A switch allows the operator to select a tap on the delay line that corresponds to the time lag (phase shift) required to develop a particular color in the receiver. A timing multivibrator works with the burst gate to keep the mixer inoperative for the

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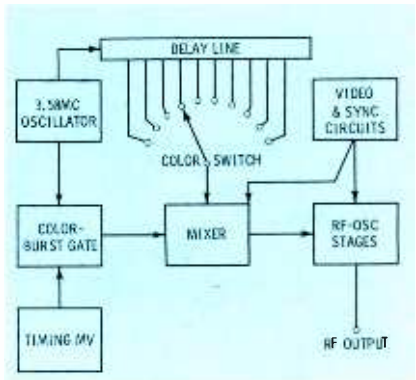

Fig. 5. Single-bar NTSC generator has manual switch to pick delay-line tap.

QUICKER SERVICING
by Larry Allen

Let's ANALYZE TROUBLESHOOTING

That's a strange-sounding title, wouldn't you say? Troubleshooting *is* analyzing, so how are you going to analyze analyzing? Well, the answer is: We're going to analyze just what it takes to troubleshoot a piece of electronic gear—I mean what kind of *thinking* it takes. Sound unusual? Maybe so, but when you realize that troubleshooting is 80% thinking and 20% manual labor, perhaps it is time we did a little talking about the mental efforts of troubleshooting.

Now, don't get me wrong. I'm not going into a long, drawn-out discourse on philosophy; what I'm going to describe to you is a practical way to think your way through a tough dog, quickly and easily. Believe me, you need to do it more often than you might imagine. So, let's talk about troubleshooting; you may be surprised how much easier troubleshooting can be when your thought processes are functioning in as good order as your VTVM and scope.

What is "Troubleshooting"?

The other day, one of my regular customers brought a set into the shop and hoisted it onto the counter. He explained briefly that it had quit suddenly, that he was in a hurry, and that he would stop by for it in a couple of days; then he hustled out. And there I stood, open-mouthed, without the slightest idea of his complaint. It was obvious I was going to have to start from scratch; that is, to fix this set, I'd have to begin at the very beginning.

Where's that, you say? Well, it so happens I have a definite ceremony I go through before I even take the back off a set. I've listed the steps in the chart of Table 1 so you can find them easily when you want to refer to them again.

Troubleshooting Steps

(1) Learn the symptoms, preferably by asking the owner.

(2) Verify the symptoms yourself.

(3) By careful analysis of the primary symptoms, make a quick diagnosis of which section is at fault.

(4) Note any secondary symptoms and diagnose their probable cause.

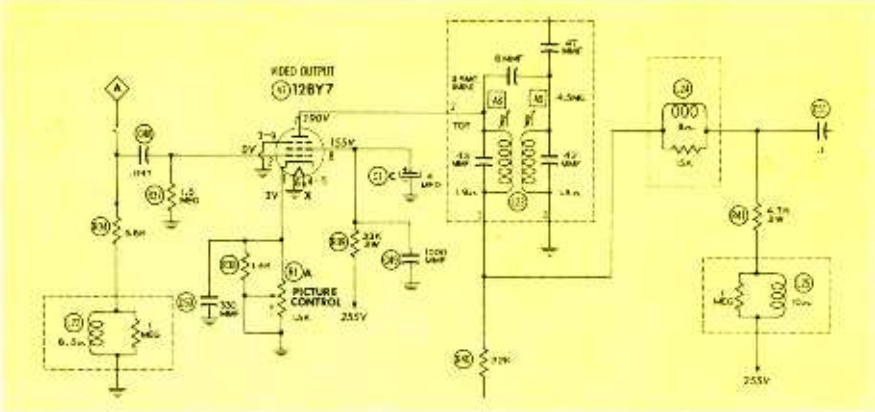

Fig. 1. Reasoning isolated video stage; further analysis pinpointed the fault.

Since the customer had gone, I skipped the first step and proceeded to the second. The symptom turned out to be a case of "sound, no video." Now this is a relatively easy fault to track down, and it is an excellent one to demonstrate the thinking processes that make for effective troubleshooting. The chassis was an older model, and an examination of the schematic revealed the video section shown in Fig. 1. My thinking processes went something like this (remember, thinking these things takes much less time than telling about them):

. . . The raster is okay; so that eliminates the probability of trouble in the horizontal, high voltage, or vertical stages. The sound comes through plainly, so I can assume the tuner and IF stages are working, and the sound stages are all functioning. All that's left is the sync, AGC, and video. (I start removing the back, at this juncture.)

The sync section I can't check until I restore video, so I'll ignore it for the time being. Either the video stages are bad, or the AGC is overloading and blanking the video—not an uncommon trouble in sets like this one.

(Reaching into the chassis, I pull the video tube and reinsert it.) Not the slightest flash on the screen, so I assume the video circuit is bad between this point and the screen. So, instead of looking into the AGC circuit—or any other of the stages eliminated earlier—I'll turn immediately to the video stage and hunt the trouble. . . .

Digging into the underside of the chassis, I quickly find an open peaking coil, and the mental part of my job is done. Elementary? Nothing to

it, you say? That's right, but without the thinking process first, it wouldn't have been so easy—would it? And that is the exact point. A logical approach will make any service job easier. In just a moment, I'll tell you of a different set—a more bothsome one—that step-by-step troubleshooting helped repair. But first I'd like to spell out some of the rules for troubleshooting effectively.

Three Easy Steps

That's all there are—just three! And they are the keys to efficient troubleshooting. Learn to apply them, and you'll soon be taking the "tough" sets right in stride; in fact, you'll probably be taking on sets from technicians who are less experienced and knowledgeable, and haven't learned how to use logical procedures yet.

Inspection

Inspection can encompass several facets—a look at the screen, a glance at the tubes on the chassis, a visual inspection of the components under the chassis, tracing a burnt odor with your nose, or listening carefully for a characteristic noise from the speaker or from some component. This careful inspection is first on the list of servicing steps for every top-notch technician.

The efficient serviceman learns to do this automatically. He probably is still busy removing the screws from the back when he starts inspecting tubes to see if they're lit. He may be cleaning the face of the CRT while he's observing the screen to see what the picture symptoms will tell him. He may lay the chassis on its side the instant he puts it on the bench, to have a view of both top and bottom while it warms up. These timesaving procedures are the sign of a good serviceman; he makes very movement count toward finishing the job.

The complete inspection will usually take less than five minutes of his time, but it will tell him many things; it will even lead him straight to the trouble in almost half the sets he encounters. You can put the routine inspection to work for yourself. Get the habit; it will make you money.

Isolation

To be able to locate a defective part, you must have some idea where to look.

Frequently, a faulty component looks deceptively okay. This is where the technique of isolating the defective stage comes into play. Once the faulty stage is located, other techniques can pin down the bad part; therefore, if an inspection fails to turn up a specific defect, use stage isolation as your second big step.

As you've no doubt surmised by this time, in the example I gave earlier I isolated the stage closely in my preliminary inspection. I had only two stages left to check by the time I completed my inspection.

Pinpointing

The final step is to pinpoint the faulty part. This is the aim of every troubleshooting step—a fact that should be remembered. No matter how many or how few steps you take, finding the defective component is the ultimate goal. The fewer steps, and the quicker you accomplish them, the sooner the job is done and the greater the profit in your pocket.

Consequently, you can now summarize these three steps, keeping the common goal in mind. (1) *Inspect* the set thoroughly as you disassemble it; perhaps you can see, smell, or hear the faulty component; (2) *Isolate* the faulty stage, by reasoning or by instruments, and perhaps a closer inspection of that specific area will reveal the fault; and (3) *Pinpoint* the defect by proper use of instruments within the faulty stage.

Using Logic

You can consider every stage in any piece of electronic gear as acting on some other stage, or being acted upon by some other stage. Fig. 2 shows an action diagram of a typical television receiver; a similar diagram can be drawn of every electronic device. Don't mistake this for an ordinary block diagram, for it isn't. It contains arrows to show how each stage acts on another, and the arrows are coded to indicate the type of action.

Two types of stage interaction are possible: signal action and DC (or controlling) action. The former is indicated by solid lines in the diagram; DC control is indicated by dashed lines. Notice how easy it is to understand the workings of a complex piece of equipment through such a diagram. You may want to learn how to lay out such a diagram for just one section of a receiver. It's easy; listen to the explanation of circuit action later, and you'll see.

The arrows show the direction of action. For example, the antenna acts upon the tuner, by feeding signal voltages into the input. (The tuner could be further broken down into its stages—RF, mixer, and oscillator—if that would help in troubleshooting.) The tuner sends signals through the video IF stages to the video detector. Here, at the detector, the diagram shows graphically the division of the signal into three segments: video for the CRT, sound IF, and video for the sync and AGC stages. The sync and

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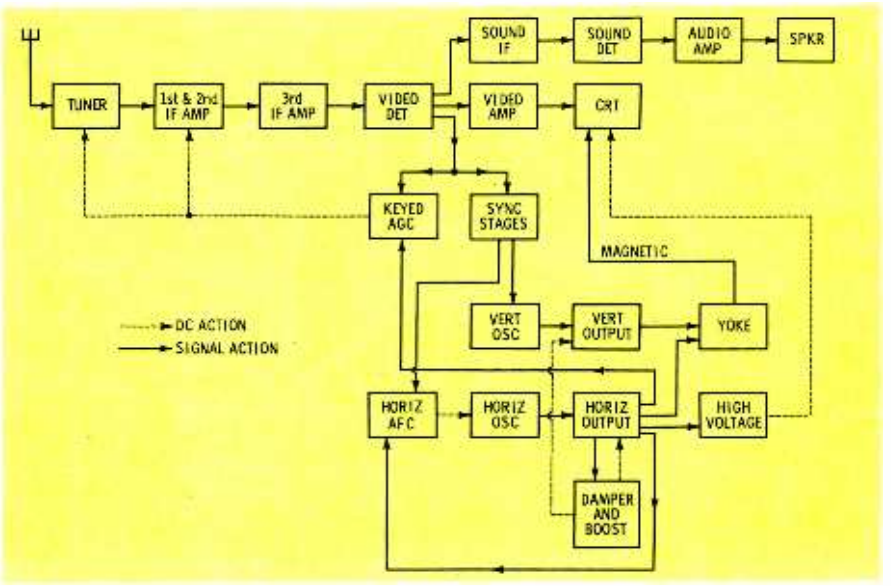


Fig. 2. Action diagram is excellent way to trace interaction of various stages.

Servicing Industrial Electronics by Len Buckwalter

In the closed-circuit TV business, utility is the rule; the equipment has only to deliver visual images that bear just enough video information for the task at hand. Color may not be important. This principle is summed up by one active CCTV equipment maker: "When we install CCTV to monitor a hazardous operation, such as the charging of a nuclear reactor, we don't care about the color of a person's clothing; we're just interested in whether he's exposed to danger." This and many other CCTV applications are handled easily by monochrome equipment.

Medical Uses

Yet the use of color in CCTV is burgeoning in those highly selective areas where the need justifies the added cost and complexity. Three fields emerge as most active in their use of color CCTV: medicine, military, and merchandising. The prime field is medicine, and for good reason. In the past half-dozen years, CCTV has instituted a minor revolution in doctors' training. With a camera peering over the surgeon-teacher's shoulder, the area of observation is no longer restricted to a mere handful of students. Any number may watch the proceedings very closely on monitors, and literally multiply their training by many times.

But one advantage is still missing if the CCTV image is black and white. Body tissues and various organs present a monochrome image of dull-gray contrast and confusion. Only through color does medical CCTV achieve its utmost usefulness to the student.

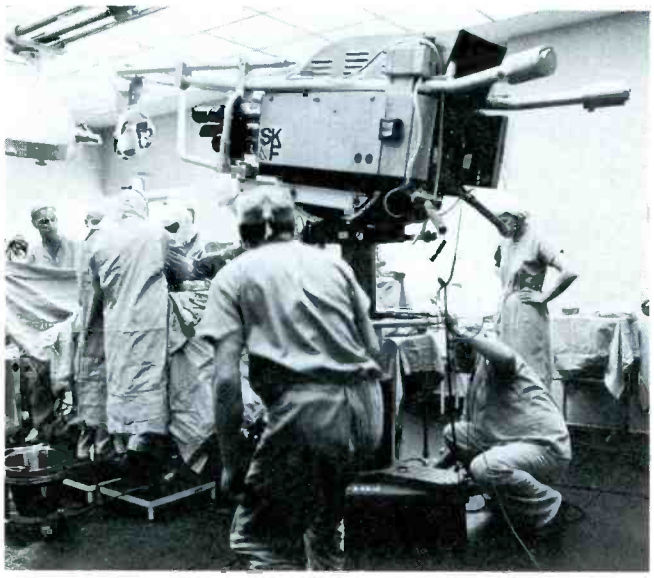
For example: Walter Reed Hospital, with its extensive system, can expose a patient to "remote" specialists via an elaborate color-TV installation that links the hospital's major diagnosis centers. With leased microwave facilities that provide three-channel distribution, color images may be displayed on as many as 100 monitors simultaneously.

The value of color CCTV was early recognized by large pharmaceutical firms. Smith, Kline, and French—now a frequent user of color TV for medical purposes—dramatized the medium's potential in September, 1962. Linking the Telstar satellite with a closed-circuit network, doctors in England presented seven patients before the color cameras. The receiving end was some 2500 miles away at the Shoreham Hotel in Washington, D.C. The impact was unmistakable. More than 1,000 physicians who witnessed the demonstration rose to their feet and applauded when color images (and the patients' symptoms) materialized on the screen.

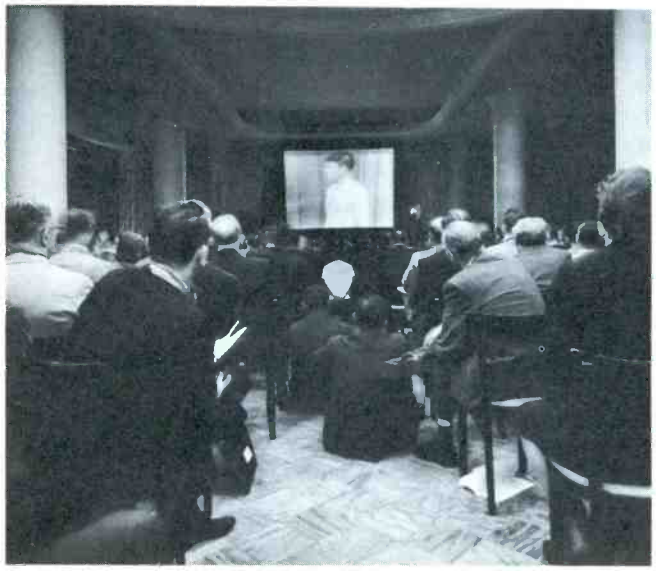
Another drug firm, Ciba, is currently sponsoring for doctors a long-term series of CCTV colorcasts on topics that range from hypnosis to medical electronics.

The Military

CCTV in color is making significant progress in military circles. Again, color is not used for its own sake. Monitoring a missile launch, or training pilots in realistic flight



Televising surgical procedures in color is most popular use for equipment.



Physicians witness color CCTV telecast via *Telstar* communications satellite.

simulators, are just two applications. One of the more provocative military uses of color CCTV—since it holds distinct possibilities for civilian industry — is what the Air Force terms a "management communications tool." The concept is summed up by Lieut. Col. Maynard Y. Binge, Chief of the Command Management Center: "In an age of aerospace technology and weapons systems, where men must absorb and remember an ever-increasing amount of information, we need the most effective management tools available, and color TV is certainly among them." The Colonel went on to say that the Air Force chose color over monochrome because evidence indicates that briefings presented in color make at least three times the impression of those in monochrome.

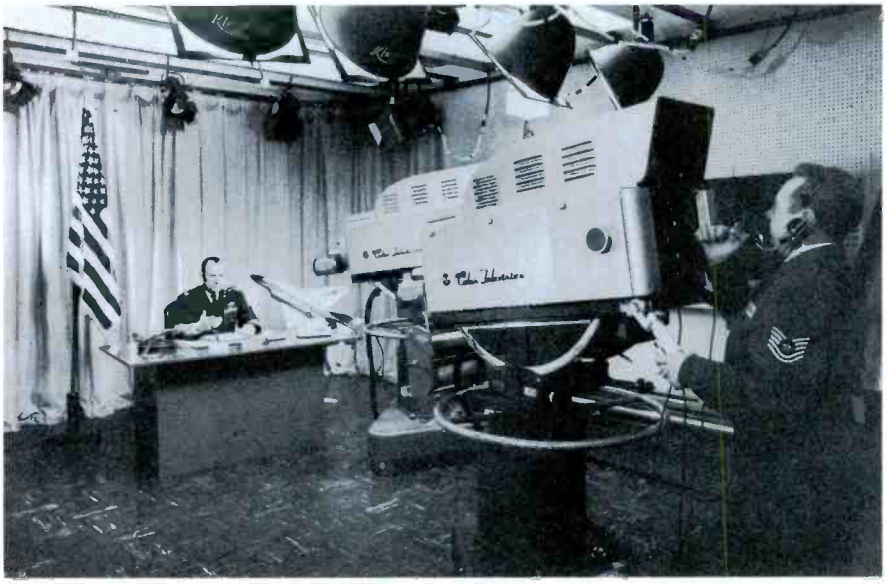
Nor has color's viewer impact escaped civilian industry. What better medium could Celanese Corp. have chosen to introduce its new polyester fiber *Fortrel?* Tying 34 cities into a CCTV network, the company displayed clothes created from Fortrel to 10,000 department-store executives over the country. The effect of these designs and fabrics would have been lost in front of a black-and-white camera.

Some Do, Some Don't

Thus, color CCTV is variously a practical necessity in medical use, a tool of management, and a merchandising medium. Why, then, has color made only a negligible dent in industrial markets? The most widespread use for CCTV in industry is in data display. And, as mentioned earlier, monochrome can get laudable results.

In discussing the situation with various equipment producers, we found a range of opinion about industry's need for color CCTV. RCA is optimistic. A spokesman for that company told us: "In industry, the color of a flame or an ingot or a chemical can be a highly important (or even critical) factor in process control, quality assurance, and other areas."

The North American Philips Co. (better known as Norelco) expressed reservations as to the immediate future of industrial color TV: "It is difficult to conceive of color in industry until reproducibility of exact color graduations becomes completely accurate. The success of color TV in industry will depend on its ability to portray precisely the colors in industrial processes of one type or another."



Military management considers color CCTV as a vital communications tool.

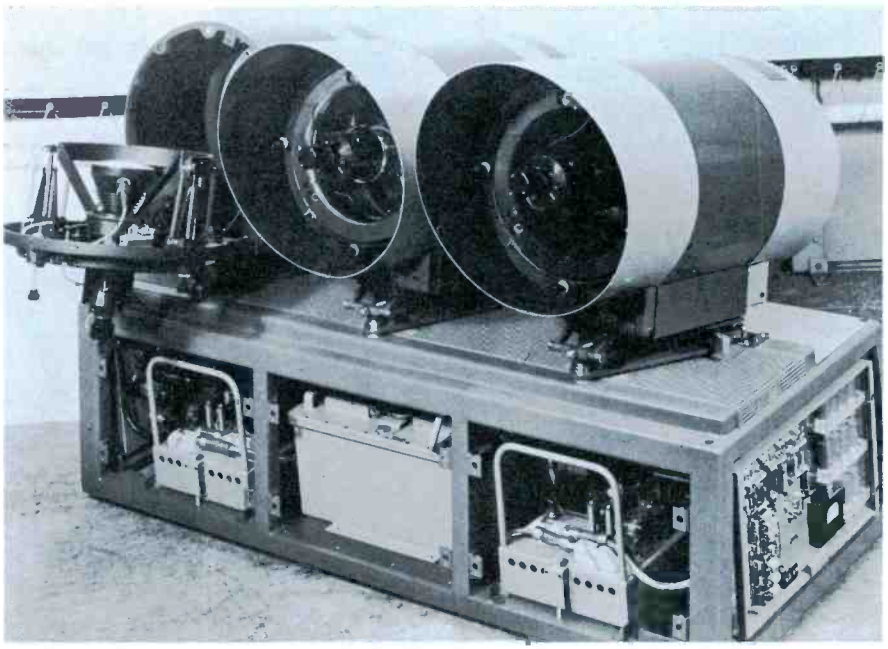
Other opinions stress certain drawbacks which retard more rapid acceptance of color in industry—primarily the considerable cost. A basic installation for medical use might sell for about $85,000 or run as high as $125,000, depending on the number of accessories. One color camera, used commonly in CCTV work, falls into the $50,000 range. High-quality color monitors are tagged at about $3,500 each. By comparison, a black-and-white system can be had today for less than $1,000. And lighting, production, and technical problems are fewer than with color.

A novel approach to color is being pursued by General Precision Labs, a company active in the manufacture and installation of monochrome CCTV. GPL engineers are presently working on a system that would adapt much of the standard monochrome equipment for color operation. Details have not been released, but this new technique may help lower the cost barrier that keeps the medium from potential users such as schools.

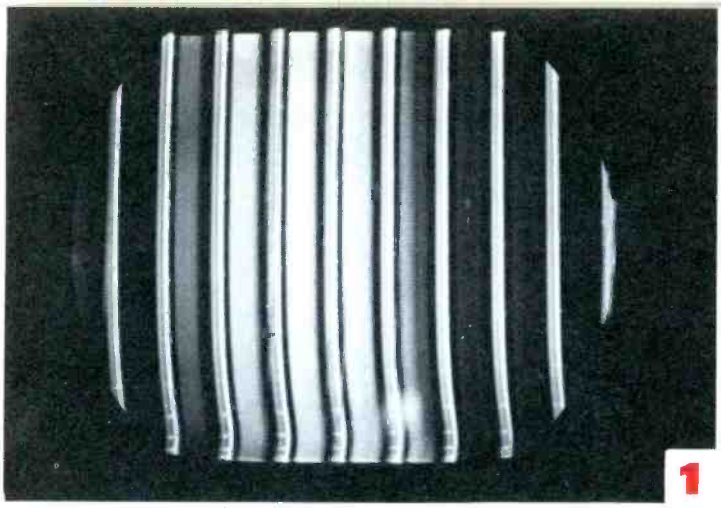
Systems

In any case, color CCTV is def-

• *Please turn to page 102*



Projection system removes the limiting factor of a small-size viewing screen.



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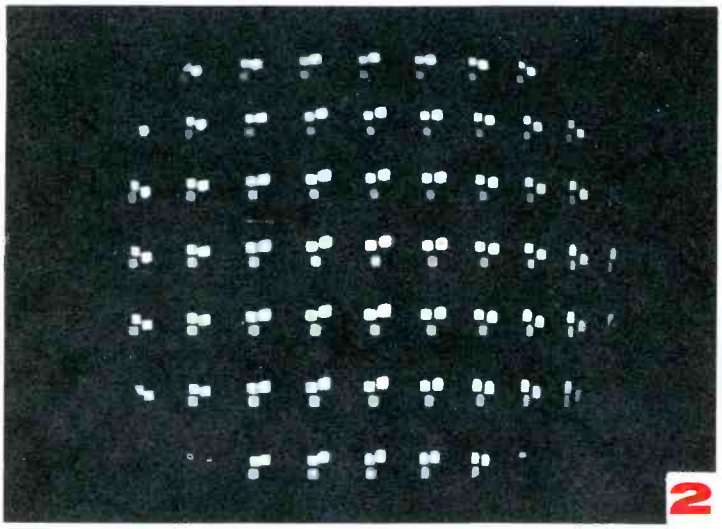

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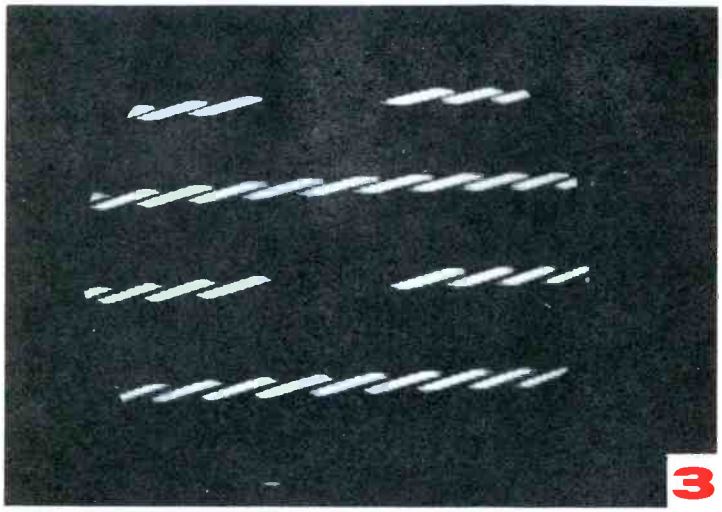
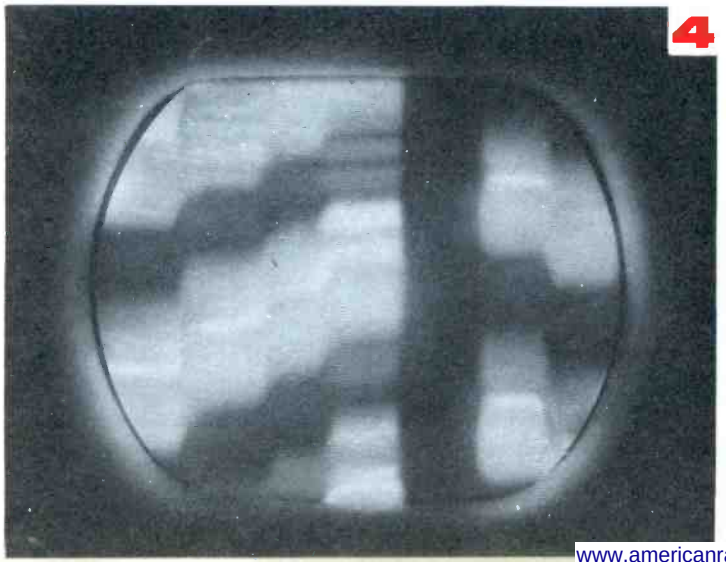


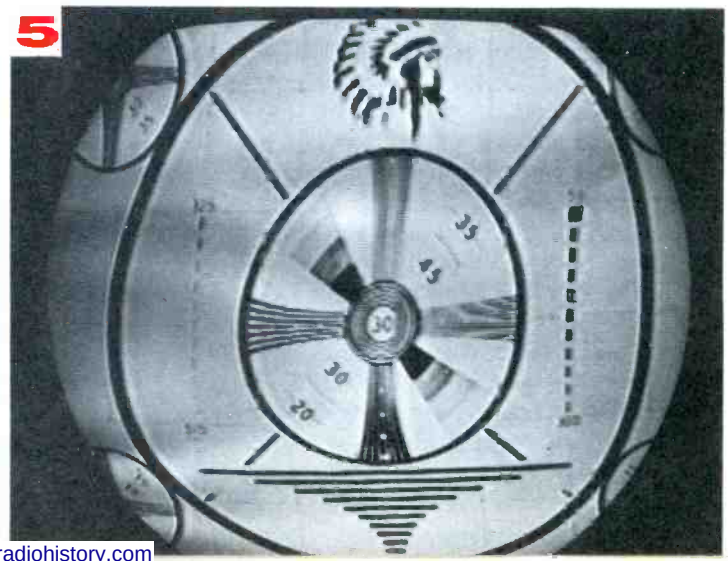
3

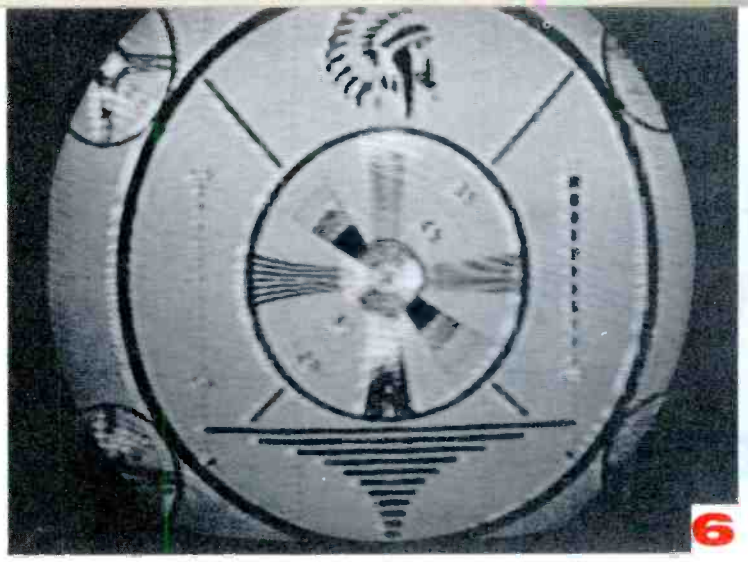
COLOR SYMPTOM CLUES

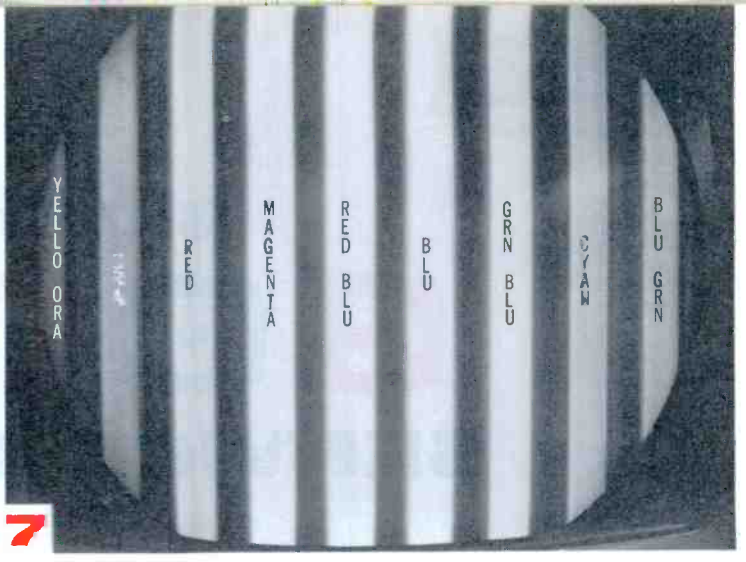
Whether on a color or monochrome set, visual symptoms are usually the first clue to be analyzed by the TV technician. This is a quick method of trouble-shooting, since it is generally the picture the customer complains about. The picture symptoms shown here are indicative of a few common troubles found in color TV receivers, and reveal much if properly interpreted. When analyzing symptoms such as these, do not rule out the probability of color-control misadjustments or poor alignment in the color circuits.

4 5









6 7

1

Poor color fit, due primarily to luminance-signal delay, characterized by color bars overlapping the blanking spaces.

2

Badly misconverged pattern denotes convergence misalignment, convergence-circuit troubles, or bad convergence yoke.

3

A horizontally torn dot pattern such as this indicates poor horizontal sync between the test generator and TV receiver.

4

Out-of-sync color bar pattern denotes defective 3.58 mc oscillator circuitry or misalignment of color bandpass stages.

5

Impurity showing up as shading in portion of test pattern is frequently caused by the CRT face becoming magnetized.

6

Color snow in a monochrome picture is due to misadjustment of color threshold control or fault in the bandpass amplifier.

7

This photo shows the proper sequence of colors displayed on the screen of a color receiver with keyed rainbow pattern.

8

The labels shown here denote colors obtained on the screen using a keyed rainbow when red demodulator stage is dead

9

With the blue demodulator stage inoperative, the colors obtained with a keyed rainbow display are as noted here.

8 9

DOLLAR & SENSE Servicing

by Forest H. Belt

starting a COLOR SERVICE BUSINESS

There has to be a beginning. For some technicians, the beginning would be hard to pin down. They can't remember just when they actually started thinking of themselves as color-TV technicians; they just sort of drifted into it. A customer got a set, and called them to service it. Pretty soon the word got around, and suddenly they were servicing color regularly. And liking it. And making money at it.

With the boom that is taking place in the field of color TV, a new breed of color specialists has sprung up. In many cities, you'll find shops that service color almost exclusively. Their monochrome activities are confined to second sets in homes where the first set is color.

Sometimes these specialists have an entire shop devoted to color servicing; some include sales quarters. Others—and these are even more numerous—have set up within established shops. The result is the same: a service technician who is making his sole living servicing color receivers.

These facts are signs of the times. Readers ask us more and more frequently "Can you tell me how to get into the color servicing business?" "What instruments will I need?" "What parts should I stock?" "How much investment should I plan?"

Answering these questions has been the subject of several articles in this issue—our annual Color TV Special Issue—and in several other issues through the past year. Even last year's Color TV Special was filled with articles on the subject. Most of these have been written about the technical aspect of color servicing; we'll try to answer some of your other questions in this article, those pertaining to exactly how to go about starting a color servicing business from scratch.

Know Your Stuff

Our first admonition to the would-be color specialist is almost academic, but we're going to say it anyway: *Be sure your technical knowledge and experience are of "specialist" quality*. There is no substitute for these; you must have them if you are to be a success in color servicing.

If your understanding of color is a little hazy, review! Attend the service clinics held regularly by color TV manufacturers; most of them are free. Go through some of the fine color-servicing textbooks now available (a few are listed in Table 1). Work for awhile in a shop that services color sets; gain that valuable experience. When you decide to become a specialist, be sure you have the stuff specialists are made of.

Table 1

available from Howard W. Sams & Co., Inc.

COL-1	Color TV Trouble Clues	PFR Staff
TVC-1	Color TV Training Manual	C. P. Oliphant and Verne Ray
CSL-1	Color TV Servicing Made Easy	by Wayne Lemons and Carl Babcoke

Is a Color Business Different?

Not really. That is, you will need the same things to start a color-servicing business that you'd need to start any other kind. You'll need operating capital to tide you over until the profits start accumulating. Don't start without reasonably solid financial backing, whether it's your own or someone else's.

You'll need a location. Will you sell sets? If so, you'll need a spot where prospective customers can find you easily; in fact, a dense-traffic location will be best. But perhaps your financing won't permit a high-rent area. Settle for the best you can find where you won't be tucked away from the world. If you're not going to sell sets, maybe you prefer privacy. Customers are not likely to carry their color sets in for service; so if you're a service-only shop, location isn't of great importance. Just make it nice enough you'll not be ashamed for your customers to drop by.

You'll need certain test equipment. Space doesn't permit covering this facet in great detail, but other recent PF REPORTER articles do treat this subject. Suffice it to say here that you'll need a wideband scope, a color-bar generator, a VTVM, a degaussing coil, extension cables, and a set of ordinary servicing and alignment tools. If you're going to be a "tough-dog" expert, you'll also want a good sweep alignment generator, a marker generator, and probably a marker adder. A VOM will come in handy for a lot of jobs and is handy to have around to back up the VTVM. There are other timesaving devices you'll pick up as you go along; but those named are rather basic.

You'll need a workbench. It should be sturdy, for color chassis aren't exactly the lightweights of the service business. It will have to be large enough to handle the biggest chassis you expect to encounter. You may

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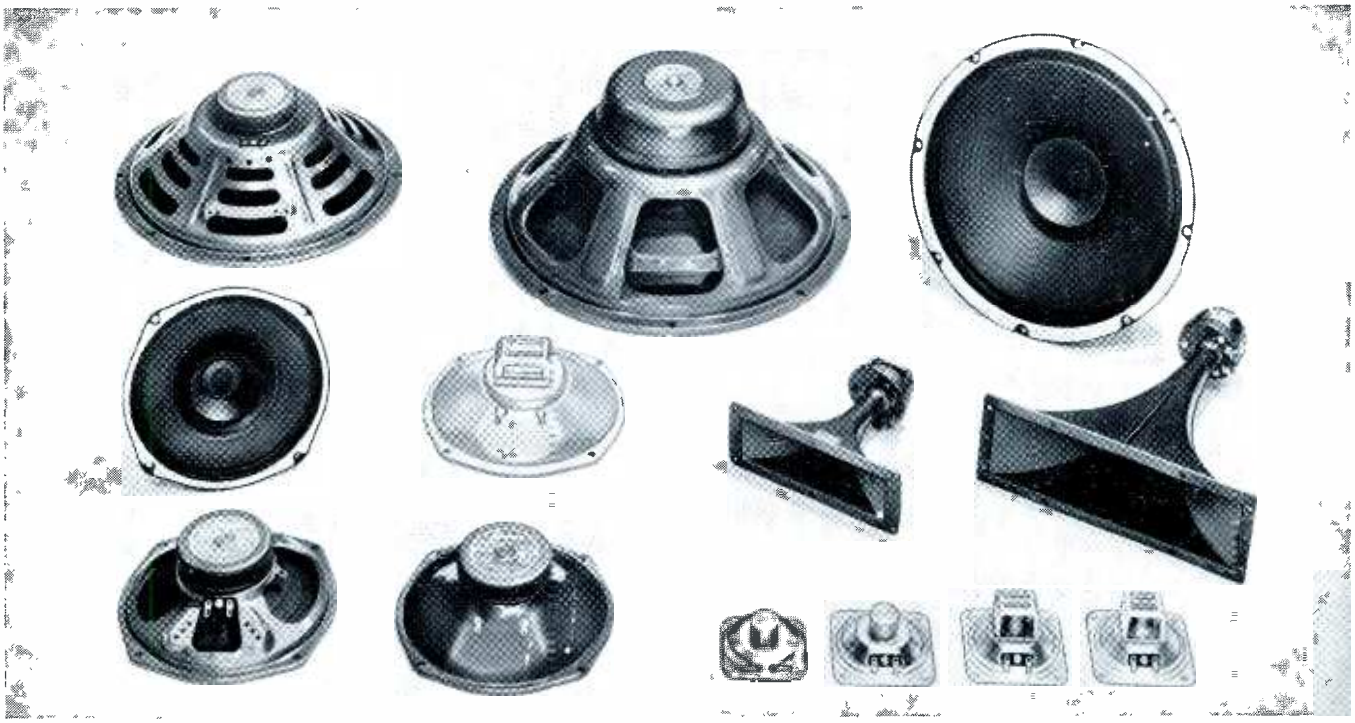

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D-8R8	Full Range, Dual Cone	8"	50–14,000	8	12	$14.65
D-12R8	Full Range, Dual Cone	12"	40–13,000	8	14	18.25
W-8R8	Woofer	8"	45–2,000	8	20	13.65
W-12R8	Woofer	12"	35–2,000	8	25	17.75
W-15N8	Woofer	15"	30–2,000	8	30	56.25
M-8U8	Midrange, Closed-Back	8"	600–4,000	8	25	7.65
M-8R8	Midrange, Closed-Back	8"	600–4,000	8	30	14.00
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T-35W8	Direct Radiator Tweeter	3½"	2,000–15,000	8	15	5.50
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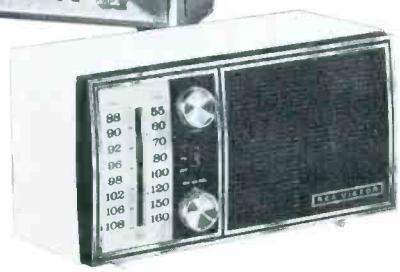

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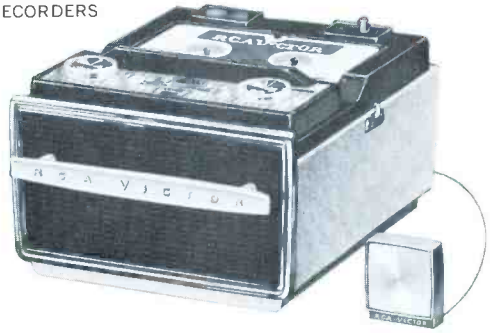

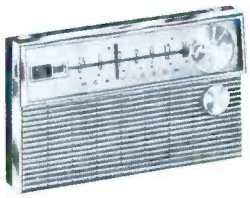

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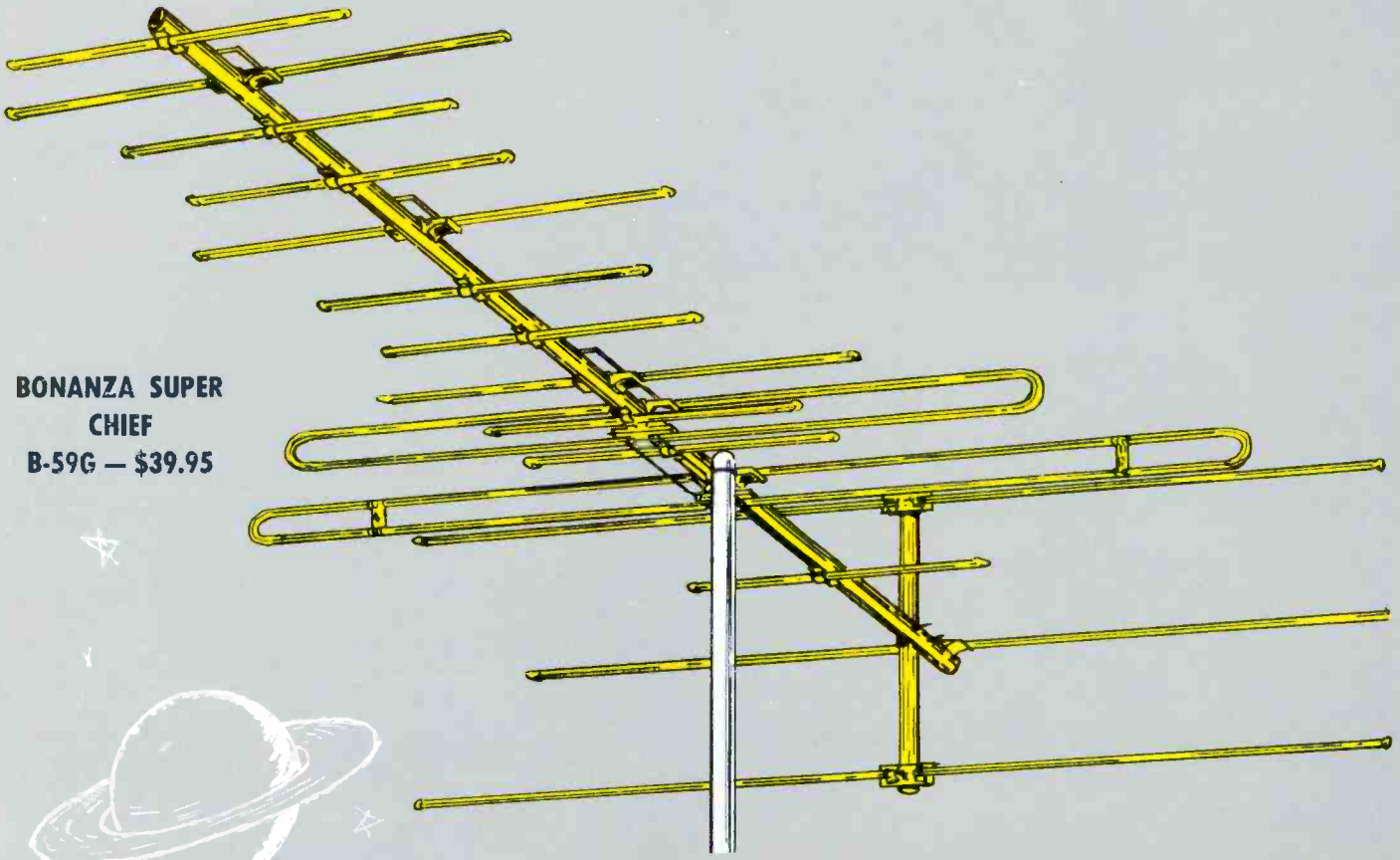

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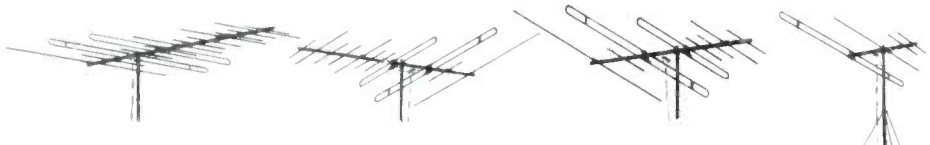

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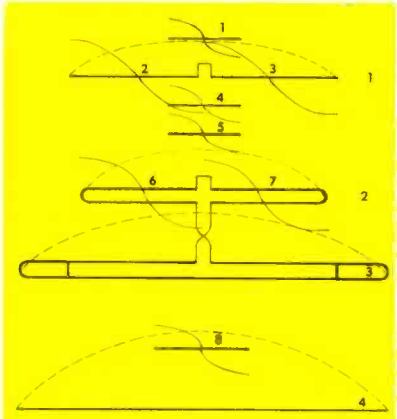

Diagram illustrates the high and low band system.
High band—solid lines
Low band—broken lines

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even want room for two or three, in case you have to let an intermittent (heaven forbid!) cook while you work on another set. And don't forget to leave room, on the bench top or on a shelf, for your test equipment. While you won't need every piece of equipment at hand all the time, you'll find as you become proficient at color servicing that the scope and VTVM are almost indispensable. The color-bar generator will run them a close second.

Don't forget a tube caddy (an excellent stock for one is included in this issue). Unless you're set up within a larger service shop, a good proportion of your business will come through service calls. When you become a top-notch color bench technician, perhaps other service technicians will make the calls, and bring the difficult bench work to you. Meanwhile, you'll probably be making a lot of service calls. Be prepared.

That brings up the question of help. Who's going to mind the store while you're out making calls? Most one-man shops solve that problem by setting aside a portion of the day for calls and the rest for bench work. Some prefer to make their calls in the morning. One advantage in waiting till afternoon is that you can offer "same-day" service to those who call during the morning. Who takes phone calls while you're out? You could just let them go, but there are also several ways you can get them. If the distance isn't too great, you can put an extension at home so your wife can answer while you're out. If that isn't practical, the phone company offers message-taking devices at reasonable cost. Alternatively, there are secretarial answering services who will answer your phone in your absence. This latter method entails extra phone-company charges on top of the rates charged by the answering service, but often the cost is paid many times over in added service income. Get costs, evaluate the percentages, and decide for yourself.

You'll need a vehicle, although many service businesses have been started by using the family car. If that happens to be a station wagon, you've got it made! When your business gets larger, you'll want to consider a neatly lettered pickup and delivery truck; meantime, start with what you can afford, and work your way up.

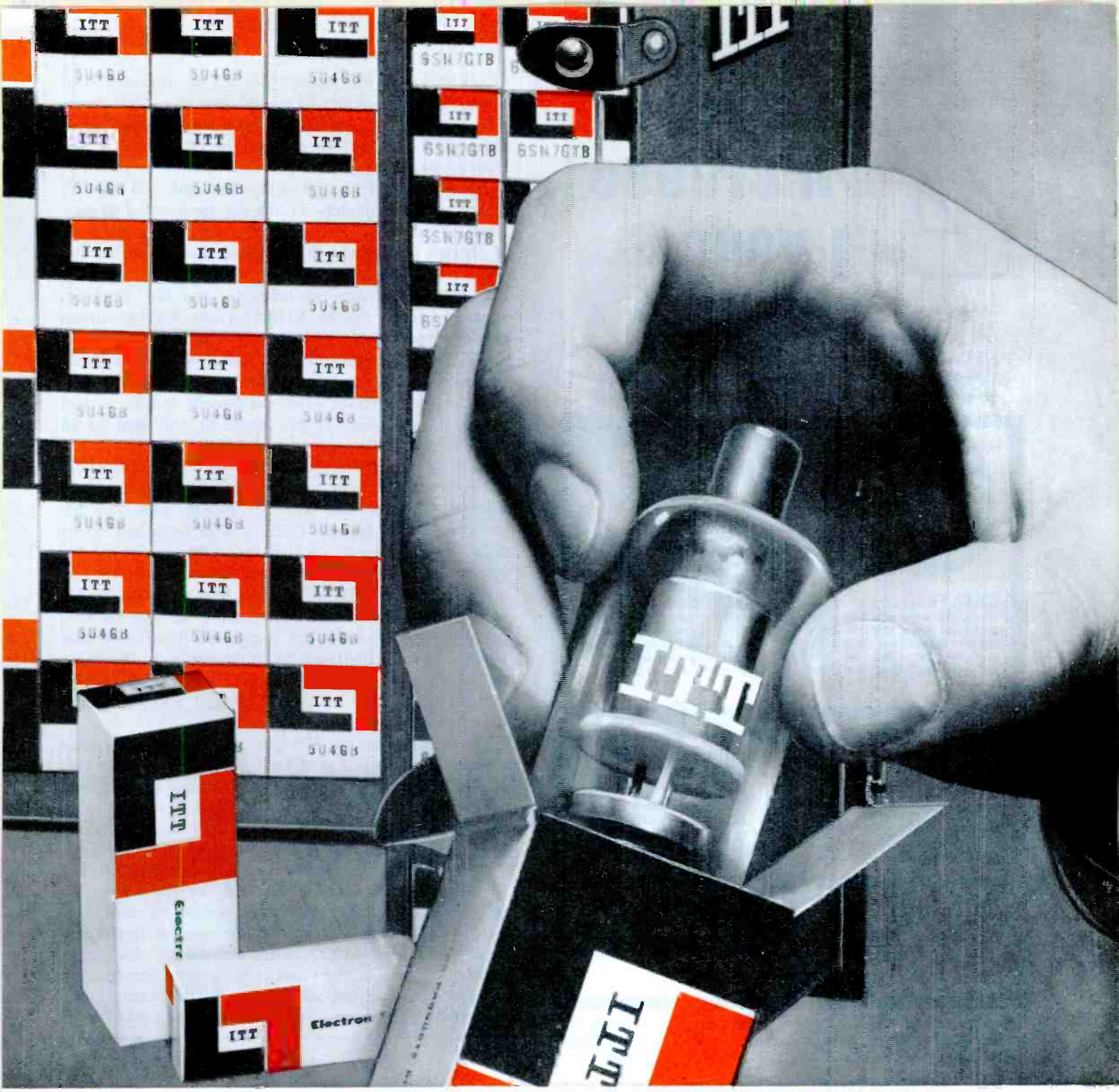
If you're fortunate enough to live close to a distributor, your parts problem will be minimized. In any case, you'll have only to stock a set of tubes for the sets you're going to service, some fuses, resistors, and capacitors, and very little else. You can get most parts you'll need rather easily. If you find certain parts moving rapidly, stock one or two. But wait and let the inventory build up later. You'll need your capital now for operating and promoting your new color business.

Finding the Money

Just how much money is it going to take to get this business going? We know a chap who actually did start a color servicing shop just over a year ago, so we'll use his operation as an example.

He started with a thorough knowledge of color sets and their servicing. He had a few hundred dollars saved, and decided it was time he started his own business.

He began by evaluating his needs. He was fortunate



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in one respect: He worked out an arrangement with a large furniture dealer to set up shop in a back room. The rent was low; in fact, he paid only a small minimum, with the rent to increase in proportion as his business picked up.

He established his test equipment and tool requirements at approximately $1200, for he decided to purchase all new gear. He designed a workbench and a set of shelves that would fit his space, and estimated the cost at $150 for materials; he would build them himself. His tube caddy, its contents, and his initial inventory figured out to $1500. Thus, his investment capital requirements had already reached $2850.

Then he sat down and calculated how much it would cost him to run the business for six months if he had absolutely no income. (He was playing it safe, just in case.) His rent was $20 per month to start, and for an extra $5 the dealer agreed to let him put a phone extension in the dealer's office, so the office girl could answer it. So he figured a flat $25 minimum for rent. The phone itself cost $15 per month, plus $50 for installation and deposit. Utilities were furnished, so he didn't need to worry on that score. He calculated his vehicle expense at a minimum of $25 per month, knowing it would rise as business began pickup up. He figured that, if worst came to worst, he and his wife could get by on $350 per month, so he allotted that amount as his withdrawal from the business. Realizing that a new business would require quite a bit of promotion, he laid his plans and allotted $30 per month for advertising, printing, and postage.

Allowing an extra $20 per month for unforeseen expenses, he arrived at a total monthly operating cost of $465. For six months, with the phone expense and a $10 business license added, the total came to $2850. This represented the amount of operating capital he felt he needed to safely kick his business off.

Now he had a calculated need for about $5700. His $1600 savings wouldn't cover that, by any means. So he set about planning how to finance the venture.

He first arranged a loan to purchase the test equipment, borrowing $1000 to be secured by the equipment itself. He worked out a long-term consignment arrangement with two distributors for his entire initial inventory, under an agreement to pay monthly for all

"Snap out of it, Jason! You know better than to get personally involved in a case!"

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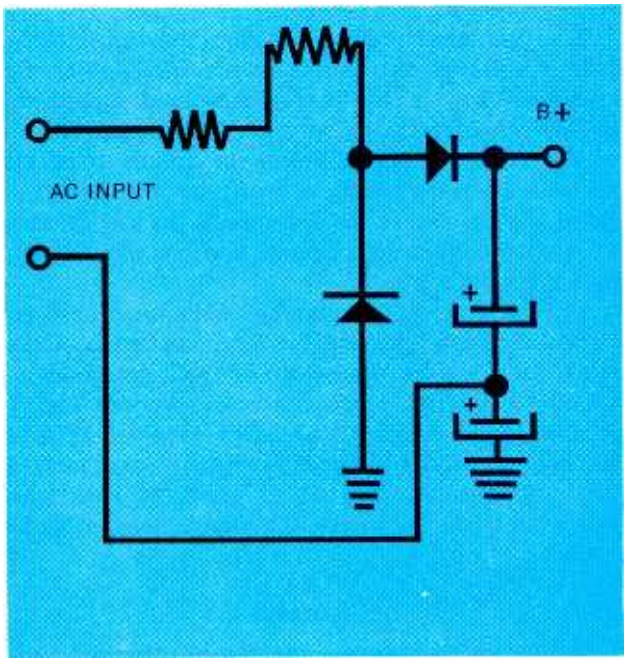
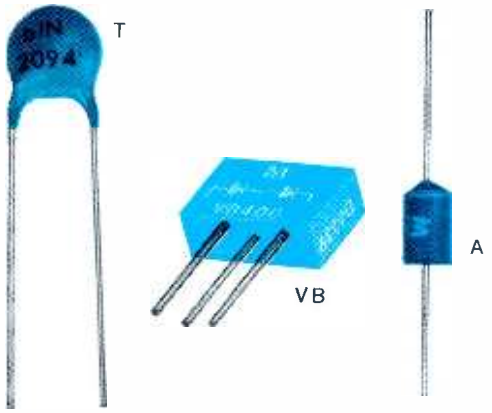
Replacing selenium with silicon rectifiers





Ever wonder about replacing those old selenium rectifiers with modern silicon rectifiers? Stop wondering. It's being done every day and you can do it too! Take a typical TV voltage doubler circuit for example.

1. You know the seleniums are bad or you wouldn't have started . . . right? Right.

2. Forget about the terrific size difference between the new silicons and those old seleniums. Silicons are smaller because they're *much* more efficient.

3. Remove the old seleniums and toss 'em in the trash can. Install the new silicon rectifiers FOLLOWING POLARITY VERY VERY CAREFULLY. The slick way is to use a Mallory VB500 (you'll have one less solder connection to make and the circuit is right on the rectifier). Or you could use a pair of 1N2095's or A500's. Either way those Mallory rectifiers will give you the *best* service you'll ever get.

4. Output voltage (B+) will *usually* be higher because silicon rectifiers are more efficient. So, you'll probably need a dropping resistor in series with the one already there. Turn the set on and check with a voltmeter. Suppose B+ reads 20 volts higher than the schematic calls for. Divide this increase by load current (perhaps 500 ma) to get the value of the resistor you'll need. (40 ohms in this case.) Now multiply the voltage increase by current to get wattage rating (10 watts in this case).

5. But suppose B+ voltage *isn't* higher. This is a clue that something's wrong with the filter capacitors. Check them out with a capacitance bridge or try this very simple deal. Parallel a good TC62 (10 mfd @ 350 WVDC) across each filter in turn. If you get a marked B+ increase you need some replacement electrolytics. We'd suggest a Mallory FP, WP, W, or TC of the proper rating.

6. If you'd like a lot more detail on this replacement arrangement, drop us a line and we'll send a folder by return mail. Meanwhile see your Franchised Mallory Distributor for all Precision Mallory Components . . . batteries, capacitors, controls, switches, resistors, semiconductors and vibrators.

Circle 21 on literature card

items sold during that month, plus an extra 20% which went toward converting the inventory to his own. (In this case, both distributors knew the technician well, and he had a reputation for both integrity and capability.) Eventually he would own his inventory, and for now the arrangement took care of another $1500 of his original capital needs.

At this point, he'd obtained about all the secured financing he could on the shop's assets, so he had to set about locating another $1600 to go with the $1600 he had saved. At the bank, he barely managed to raise the additional $1600 by mortgaging his car and furniture.

Now he was just about in business. His $1600, the bank's $1600, $1000 secured by the test equipment, and $1500 advanced by the distributors in the form of inventory made the $5700 he had planned. He was in shape for opening, and open he did.

Developing New Customers

Now our hero really got things moving. He made visits to all the distributors in his area, letting them know he was in business—ready and equipped to handle color service for anyone. He dropped by some of the larger dealers, offering to handle their color service. Then he went to work on the department stores. By the end of the first month, he had developed two department-store accounts, and one dealer sent all his color work.

That was the real beginning. With some cash coming in, he began pushing for retail customers. Once a week, he took an afternoon off and personally distributed handbills, specifying color service only. The idea of calling a color "specialist" appealed to several set owners, who subsequently became customers and boosters. Business became so good, he even started taking an ad in the weekly TV supplement of his local paper.

Success

Within the first six months, the distributors' faith in him was justified; he not only paid for all the advance inventory, but purchased about $300 worth of additional parts for his working inventory. The color test equipment is now paid for, the loan on his car and furniture will soon be, and he never did have to dig into his $1600 savings. He managed the rest on earnings from his growing business.

He is definitely a successful color specialist. He had all the ingredients: a knowledge of the field, the ability to plan his operation, and the determination to carry it out. Oh, yes, he works pretty hard; he even puts in a few evenings trying to keep up when the store accounts (he has four now) and the dealers (he handles color servicing for five dealers) are having busy weeks.

But he's getting what he wanted—his own business. He'll probably be moving into his own shop one of these days, and maybe getting some help, but you can bet he'll have it all planned out before he makes the move—and that'll be a success, too.

It's a good business—color servicing. It needs hard-thinking, hard-working fellows. If you're one, you can be a specialist, too. ▲

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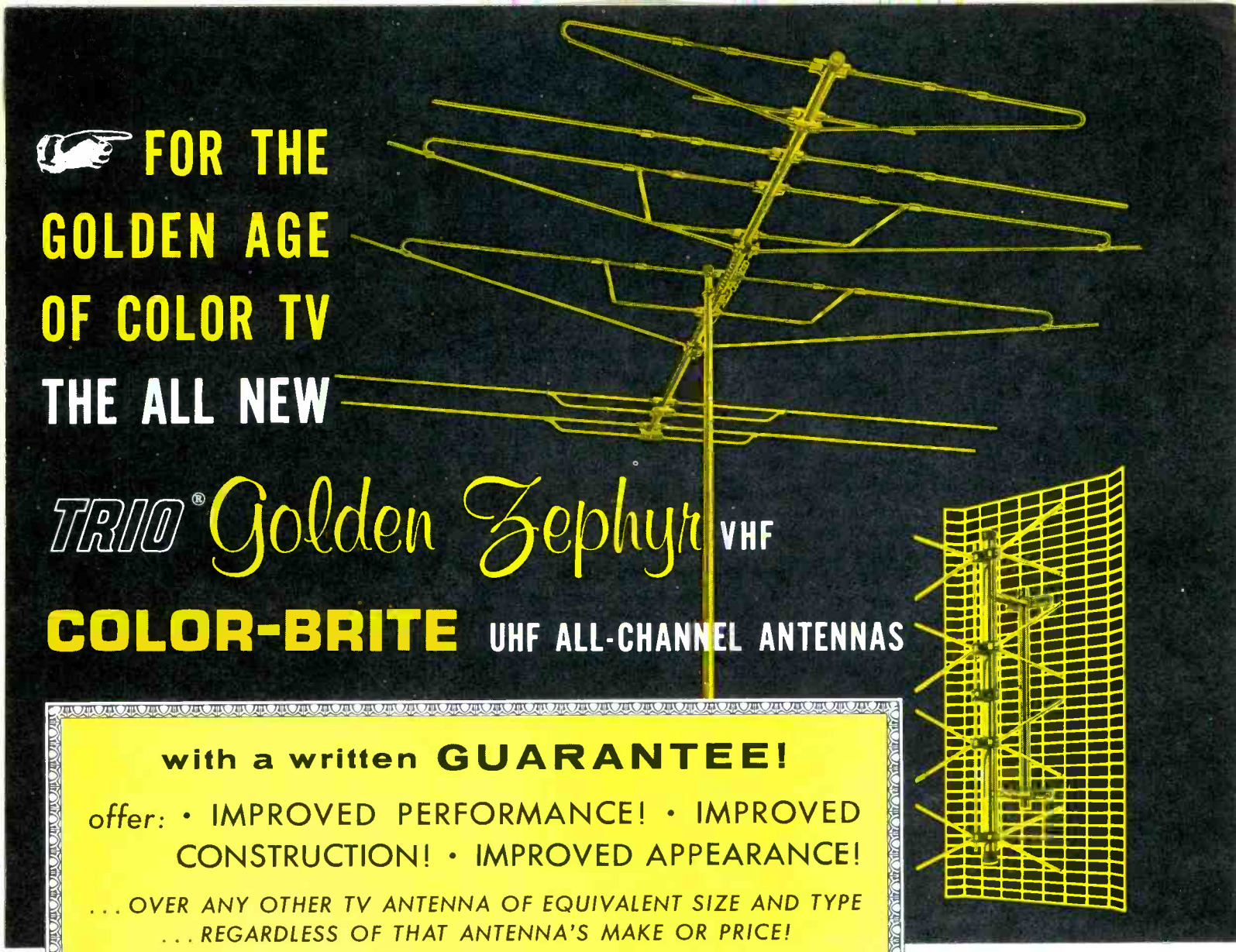

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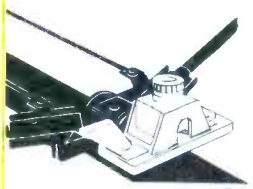

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Circle 23 on literature card

VERTICAL PROBLEMS VS CONVERGENCE

Should you touch up the convergence adjustments after every vertical-sweep repair? —by Carl H. Babcoke

There is a common "old-wives' tale" that says it is always necessary to reconverge a color set after performing repairs in the vertical circuit. This may have been true in some of the earlier models, but in modern receivers it is hardly true. Yes, a vertical trouble may cause some slight upset in convergence; but repair the vertical fault, and you'll usually cure the convergence.

Nevertheless, it is well to understand how such a tale might get started. As with most rumors, there is some basis in fact; it is important to sort the true facts from the "dressing up" such stories usually accumulate along the line. Let's go back a few years and examine just how vertical troubles can affect convergence in older sets—quite a few of which are still around.

Days of Yore

To begin with, vertical troubles have always been the same for color sets as for black and white: no sweep, insufficient height, poor linearity, no sync, wrong frequency (rolling), loss of interlace, and poor retrace blanking. Of all these, only the second or third could affect convergence to any degree—and this is true of older models as well as modern sets.

A Real Oldie

How many of you were servicing color sets back in '57, when the latest thing was the CTC5? Fig. 1 shows how that chassis develops convergence signals within the vertical and horizontal output circuits.

There are three sources for the voltages necessary to converge the three electron beams at all points on the screen of the color CRT.

For converging the center section of the screen, the DC voltage across the cathode resistor of the horizontal output stage is applied directly to three parallel 100-ohm controls, which in turn select the value of DC voltage applied to end A of the vertical convergence coils (via the tilt windings of the vertical output transformer). Another DC voltage of lesser amplitude is applied to the other end of the vertical convergence coils; this voltage is taken from the cathode circuit of the vertical output tube, and reaches the convergence coils via the amplitude controls. The result is an adjustable slight DC bias current in the convergence coils. This bias controls the beams in the center of the screen.

In addition to the DC voltage already mentioned, a 60-cps sawtooth is developed in the cathode circuit of the vertical output stage. This waveform appears across the vertical amplitude controls, which are returned to ground through the taps on the DC controls. This sawtooth signal is applied to one end of each convergence-yoke coil, with an amplitude controlled by the vertical amplitude potentiometers.

The third vertical convergence signal is a 60-cps spike generated in special windings on the vertical output transformer—the tilt windings, one for each gun. End A of each convergence coil is connected to a control that bridges the tilt winding.

Summing up the actions of these three signals, and their respective controls: The DC pots determine the amount of DC in the vertical convergence coils, and affect the beams mostly in the center of the screen. The vertical amplitude controls are fed by a sawtooth, and exert their greatest effect near the top and bottom of the screen, "bowing"

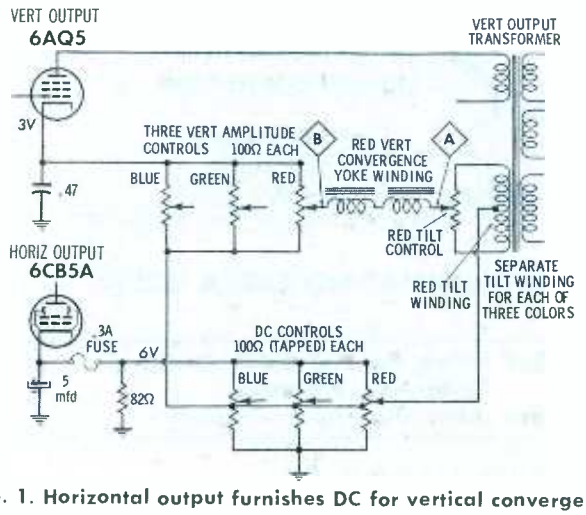

Fig. 1. Horizontal output furnishes DC for vertical convergence.

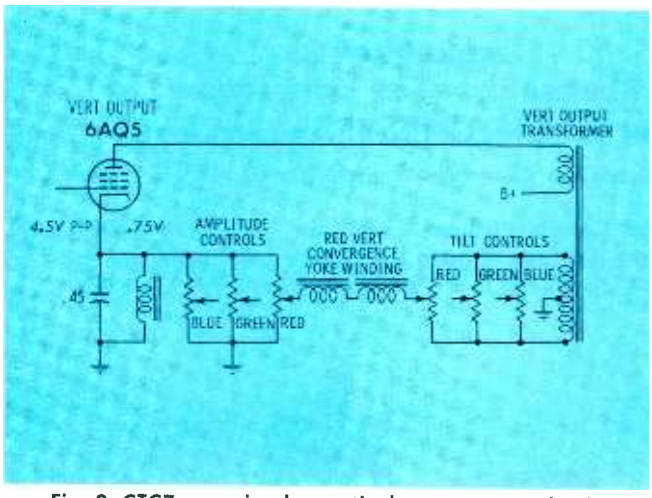

Fig. 2. CTC7 uses simpler vertical convergence circuit.

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Motor	Low Voltage, light duty	Light duty, thinnest gears	Heavy duty
Stall Torque*	115 in. lbs.	75-112 in. lbs.	525 in. lbs.
Brake Torque*	Exceeds stall torque	Exceeds stall torque	435 in. lbs.
Rotation Time* (360°)	60 sec.	60 sec.	45 sec.
Housing	Cast zinc	Thin die-cast alum.	Heavy re-inforced die-cast alum.
Weather Sealing	Flexible neoprene boot	Flexible neoprene boot	Weather-proof bell casting
Thrust Bearing	Small, dead weight collars	Light-weight shaft support	Heavy duty 6½" dia. ball-bearing
Extra-Cost Thrust Bearing Access.	Available	Available	Not required
Gear Arrangement	Alum. worm	Light spur & pinion	Heavy spur & pinion
Mounting Design	Offset	Offset	In-Line, symmetrical
Mast or Tower Mounting	Yes (with Tower adaptor)	Yes (with Tower adaptor)	Yes (no adaptor req.)
Compensating Rheostat on Meter Models	Yes	No	Yes
Positive Synch on Auto Model	Yes. 10° steps	No (dependent on motors)	Yes. 6° steps
Auto. Model Out-of-Synch Indicator	Yes	No	Yes
Compass Indicating-Light Model	Not available	Not available	Available
Thermal Protector	Yes (secondary circuit)	No	Yes (primary circuit)

*Based on CDE engineering laboratory tests of purchased samples.

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Circle 24 on literature card

the vertical lines. The tilt controls combine the sawtooth and the spike waveforms; their primary effect is moving the top and bottom of the convergence lines in opposite directions.

Troubles

We had a few cases of really "different" troubles in those sets. For example, I remember one in which the raster became slightly egg-shaped. Within a week, the convergence went haywire; the vertical convergence lines formed an "S", each bending in a different direction. I'd seen this symptom caused by heater-cathode shorts, so I tried a new vertical output tube, without success. Following the same line of thinking, I reasoned that the cathode capacitor might be the culprit. It was, and a new one cured the trouble. However, it was necessary to reconverge, for this capacitor seems to have a considerable effect on the waveshape fed to the convergence coils.

Another case comes to mind in which the customer's complaint was intermittent vertical roll. We brought the set into the shop, and

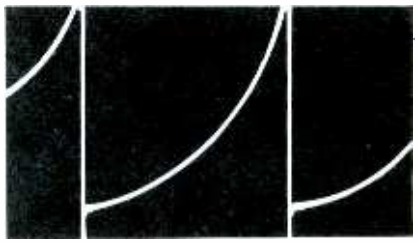

Fig. 3. Waveform applied to vertical amplitude controls in CTC7 chassis.

tried every trick we knew to cure the vertical rolling problem. Sync was solid, so we temporarily ruled out sync problems; the trouble seemed to be in the vertical multivibrator itself. Watching it on the bench for a few days, I noticed the convergence changing, too. Following this lead brought me eventually to the cathode of the horizontal output tube. Replacing the 6CB5 cured both the shifting convergence and the intermittent roll. Leakage between heater and cathode was placing an undesirable 60-cps sine wave in the convergence circuits, and the waveform was feeding back to the vertical output stage. Since the output stage is part of the vertical multivibrator, the feedback was shifting the frequency slightly and causing occasional roll.

We also discovered that other troubles in the horizontal output circuit had a way of affecting vertical sweep and convergence, since both stages share a few resistances (like the tapped portion of the DC controls). A faulty 6CB5 has more than once drawn excess current through the DC controls and caused them to develop "spots" and erratic operation. We finally made it a rule to check their operation every time we changed a 6CB5 or a 6AQ5.

And Then There Was . . .

Interaction between the horizontal and vertical output circuits was minimized in a later chassis, the CTC7. Fig. 2 shows the new arrangement. The DC bias in the convergence coils was almost eliminated, and permanent magnets were reinstated as the center-convergence device; a slight DC voltage from the vertical output cathode still appeared across the convergence winding, but its effect was negligible.

The vertical amplitude waveform (see Fig. 3) is taken from the cathode of the vertical output tube, as in the CTC5. In the CTC7, how-

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Simplifies Demodulator Alignment—The type of color display produced by this instrument provides the ultimate in simplicity for precise demodulator alignment.

Provides Automatic Deconvergence—Eliminates the necessity for continual static convergence adjustments. The instrument automatically deconverges a white into a color dot trio without digging into the color set to misadjust the convergence magnets. It also deconverges a white horizontal or vertical line into red, green and blue parallel lines. This greatly simplifies dynamic convergence adjustments.

Provides Exclusive Color Gun Killer—Front-panel switch control makes it easy to disable any combination of the three color guns. Eliminates continuous adjustment of the background or screen controls, or connection of a shorting clip inside the receiver. The switch also selects the individual grids of the color tube and connects to a front-panel jack to simplify demodulator alignment.

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Circle 26 on literature card

ever, the tilt voltage for all three controls is taken from one winding on the transformer.

We found the choke from the 6AQ5 cathode to ground to be quite critical in its effect on the vertical convergence. If it opened, it flattened the waveform considerably, and caused a shift such as when the tilt control is misadjusted —only more so.

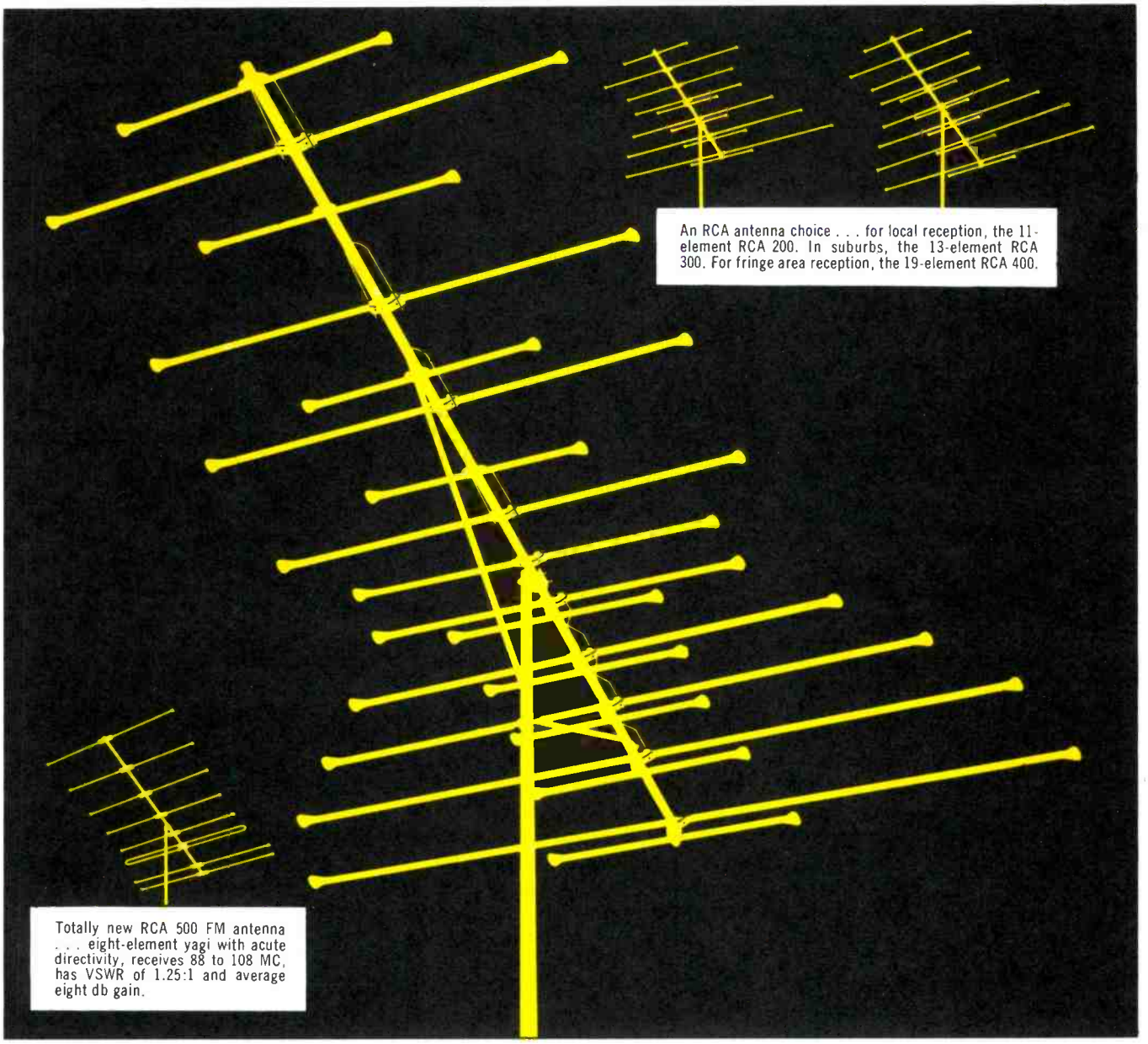
Here are some general effects we've noticed in servicing these chassis: A shorted cathode capacitor causes an increase in height, accompanied by a bowing of the vertical convergence lines. A cathode-heater short makes the lines shift in one direction at the top, and in the other at the bottom; the result is a sort of curved "X" formed by the green and red vertical lines. Oddly enough, blue convergence is affected very little by vertical faults. An open cathode choke, on the other hand, usually causes the height to shrink and the center convergence to shift.

Make Way For the New

Modern receivers have solved many of the problems that were seemingly inherent in the older sets. New control arrangements give the service technician more control over the exact shape of the convergence lines than he would have ever dreamed possible. Designs have improved to the point that few interaction problems occur in recent chassis. When a vertical trouble pops up, it can be repaired and the convergence will return to normal without serious after-effects.

However, this is not to say that vertical troubles cannot be mistaken for convergence troubles—or vice versa. This problem still exists to some small degree, but even this is minimized by modern design. Generally, however, a fault in the vertical circuit will display a change in height or linearity long before it will appear as a convergence error. And, conversely, faults in the convergence circuits rarely reflect themselves into the vertical circuits.

Consequently, there is little reason to pursue the phantom any further. You've been able to gain a little insight into the reason for the popular myth, and perhaps at the same time learned some new tricks about servicing these old color chassis. ▲



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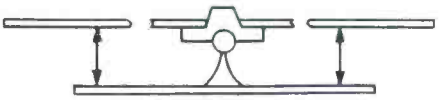

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Circle 28 on literature card

COLOR . . . it's easy if you keep calm

Most troubles are just as simple as those in other types of equipment . . . *by Wayne Lemons*

Human nature, being what it is, makes us reluctant to enter an unknown field. When we are forced into it by circumstances, we too often look for overly complicated problems and just as often bypass the obvious.

Take, as an example, one of my first encounters with a color TV receiver. This was a sort of "shotgun" affair where, despite all my efforts, I couldn't talk the customer out of my working on his set. I ventured warily into the customer's home to be met by an almost new color set with a bluish-green screen. (As I found out later, this hue was a pure "cyan"—just as described in the textbooks.) I pulled the back of the set and, while checking tubes, made small talk about phase angles, vectors, color wheels, chroma channels, and so forth. My spiel had the hoped-for effect of impressing the customer, but was absolutely meaningless to me as far as the actual repair was concerned. The tubes checked okay, but to be safe I replaced three or four of the tubes in the color circuits—still making no progress whatsoever in finding the real cause of the cyan screen.

As with all neophytes, it seems, I decided to make a few well chosen adjustments. (To tell the truth, I tried all of them, including convergence!) There were changes, no doubt about that, but my original trouble was still with me. Somewhere I had read that the screen color usually changes when the 3.58-mc oscillator quits working. Immediately my mind latched onto this illusory possibility, and a chassis pull seemed in order. I informed the customer of this decision and got his blessing.

I still shudder to think what I might have done to that color chassis if, at this crucial moment, I hadn't accidentally taken note of the CRT heaters. I was stopped short, with a nut driver in my hand, by the revelation that there was a heater glow in two of the guns and none in the other. It didn't take more than thirty minutes to figure that this unlighted gun could very well be my trouble. (I could tell you my problems in changing that first color CRT—but that's another story.)

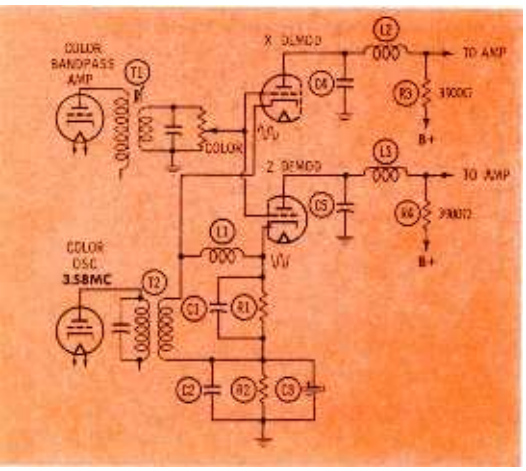

Fig. 1. Color demodulators detect both phase and amplitude of color signal.

Phases Aren't So Bad

What quirk of the mind had made me overlook the obvious and imagine all sorts of dire troubles lying deeply buried inside the color chassis? What kept me from checking the obvious first? Perhaps it had been my prior reading about color—written from the point of view of an engineer, who is always working with *good* components. Somewhere in my eagerness to learn all about color, I must have become so entangled in a web of pedantic theory of how a color set works that I overlooked how it would act if it *didn't* work. It's easy to forget that a color set is made up of tubes, resistors, capacitors, transformers, etc., and has no more phase angles or vectors per capita than a black and white set.

Phase is simply a method of comparing the arrival time of one signal to that of another. Vectors are a pictorial method developed by mathematicians and engineers to present this time comparison in picture form. If you find it easy to *think* in vector terms, they are ideal in displaying instantaneous circuit action, but if you think the way a lot of us do, you may be unduly and unnecessarily concerned with the problem of understanding them.

We can make more headway by forgetting about the niceties of engineering theory and, instead, relating color circuits (phases and all) to something more familiar to us as service technicians. As an example, let's take a typical color demodulator (Fig. 1). This circuit uses twin triodes, with two signals fed to each triode. One of these inputs (the cathode signal) simply drives the tube into conduction at specified times; in this sense, the demodulator can be broadly compared to a keyed AGC circuit. The other input, fed to the grids, is the color signal which is to be demodulated. It varies in *amplitude* (size) according to the *strength* of the color being transmitted, and also varies in *phase* (timing of each cycle) to indicate *which* color is being transmitted at any instant.

The cathode signal is a 3.58-mc sine wave generated by the color oscillator in the receiver. It has a fixed amplitude, to set the conduction point of the tube; besides this, its phase is locked in with that of a transmitted reference signal (burst). The phase of the cathode

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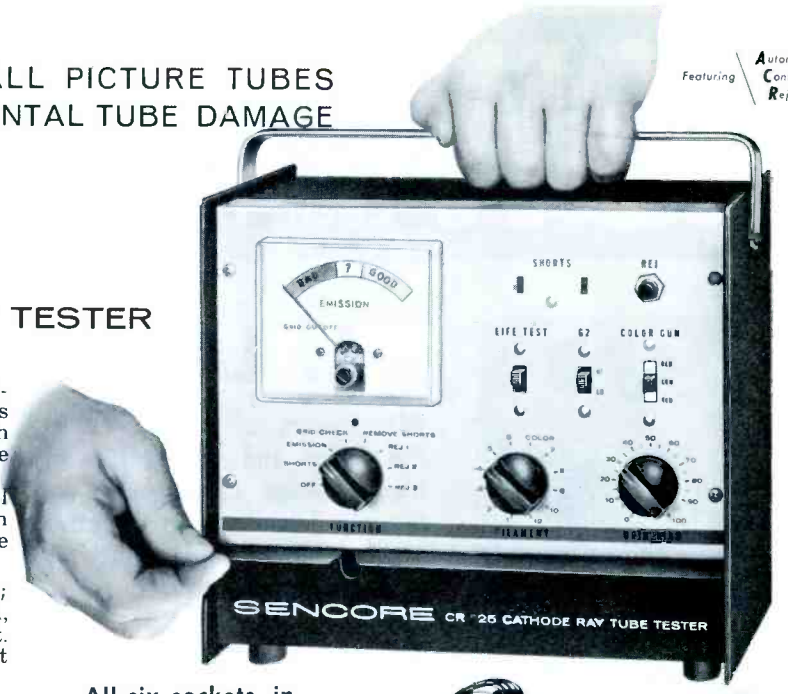

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Uses DC on all tests. Unlike other CRT testers that use straight AC, the CR125 uses well filtered DC on all tests. This enables Sencore to use standard recommended checks and to provide a more accurate check on control grid capabilities. This is very important in color.

No adaptor sockets. One neat test cable with all six sockets for testing any CRT. No messy adaptors, reference charts or up-dating is required. The Sencore CR125 is the only tester with both color sockets. (Some have no color sockets, others have only the older type color socket.)

All six sockets, including latest color socket, on one neat cable.

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Model CR125 ..... **$69.95**

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PS127 DELUXE WIDE BAND OSCILLOSCOPE AT A SURPRISINGLY LOW PRICE

This all new 5 inch oscilloscope offers the finest in performance, portability and appearance. Vertical amplifier frequency response, flat within 1 DB from 10 CPS to 4.5 mc and only 3 DB down at 5.2 mc insures true waveform reproduction. Vertical amplifier sensitivity of .017 volts RMS for one inch deflection on wide band (without band switching) is found only on scopes costing hundreds of dollars more. High input impedance of 2.7 megohms shunted by 99 mmfd (or 27 megohms with 9 mmfd with built-in low capacity probe), insures minimum circuit loading. For the first time, waveforms can be viewed in TV horizontal and vertical output circuits with the low capacity probe that will withstand up to 5000 volts peak to peak. To top that, the vertical amplifier attenuator controls are calibrated directly in peak to peak volts for fast direct reading of all peak to peak voltages.

Horizontal amplifier extended sweep range from 5 to 500 kc in five overlapping steps and frequency response from 10 CPS to 1 mc within 3 DB insures linear sweep and positive sync. External inputs for horizontal sweep and sync, intensity modulation, and smart two-toned case and "designer" styled controls brands the PS127 a truly professional oscilloscope.

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Circle 29 on literature card

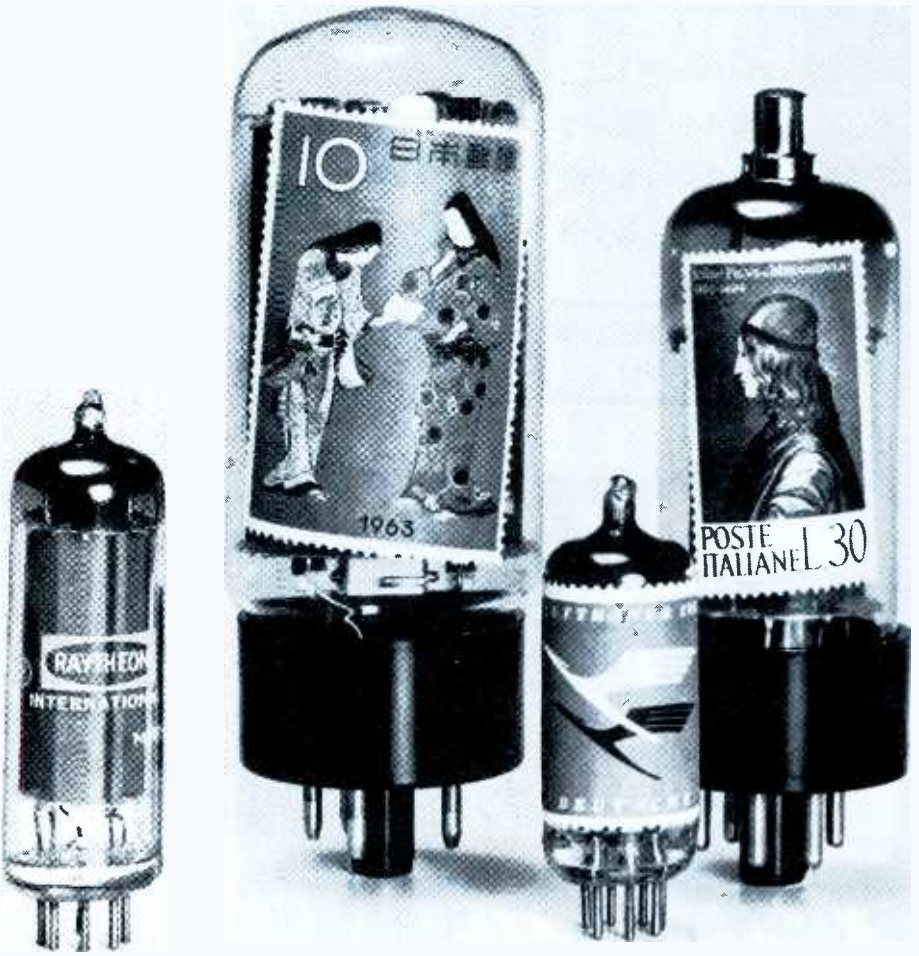
signal for the Z demodulator is different from that for the X demodulator, because a specific time lag (slightly less than a quarter of a cycle) is produced by L1, R1, and C1. The action of both demodulators is otherwise identical.

The demodulators are keyed into conduction only during the negative peaks of the cathode signal. The amount of conduction is proportional to the grid voltage that exists at the moment of keying; here, too, the action is somewhat the same as in an AGC keying tube. If the grid signal is on its positive excursion when the demodulator conducts, the plate current will be heavier than average, and there will be a relatively great voltage drop across the plate-load resistor. On the other hand, a negative alternation of the grid signal will result in a smaller voltage drop across the plate load. Naturally, the greater the swing between positive and negative peaks of the grid voltage, the more variation will be present in the output of the demodulator. That takes care of the amplitude modulation on the color signal.

The phase modulation is also recovered by applying exactly the same principle. Let's say that a positive peak in the color signal arrives at a time slightly later than the negative peak in the signal from the color oscillator — this would mean that the plate current will be somewhat less than if the peaks had arrived at the same time. Since the "yield" of plate current decreases proportionally as the phases of the two signals become farther apart, phase changes can be demodulated.

Obviously, variations in timing as well as fluctuations in amplitude of the incoming color signal will affect the average plate current of the demodulator and produce a voltage change that can be used to modulate the electron guns in the CRT.

Are you still wondering how the receiver is able to tell amplitude modulation apart from phase modulation, since they are both demodulated by the same method? Easy —that's why *two* demodulators are used. The paired circuits see the color signal from two different viewpoints, so to speak. Their outputs (after amplification) are applied to two different CRT guns,



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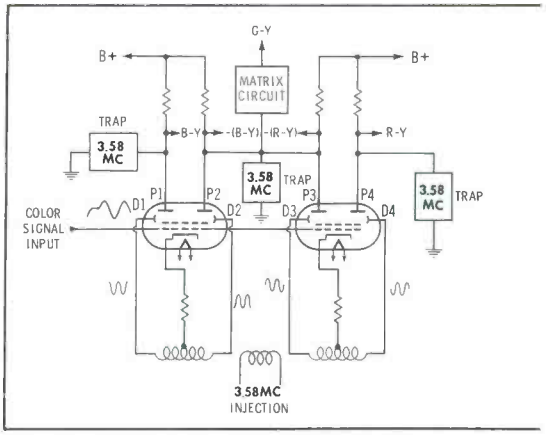

Fig. 2. Switch-type demodulators develop both plus and minus R-Y, B-Y.

and samples of both demodulated signals are mixed to obtain a signal for the third gun. Changes in the relative proportions of the signal voltages fed to the three guns are automatically translated into a full range of colors.

Perhaps color demodulation can be better understood by taking a look at a "switch" demodulator (Fig. 2). Switch-type tubes have twin plates and pairs of "deflectors" (D1, D2, D3, D4) that are tied directly to the secondary windings of the color reference-oscillator transformer. When D1, for example, has a positive voltage on it, the electron beam inside the tube is deflected to the P1 side, and only this side of the tube works. On the next half cycle D2 becomes positive, and only the P2 side conducts. Deflector plate D3 receives its positive signal peak one-quarter of a cycle later than D1, and maximum output at P3 will occur at this point. The P4 output leads P3 by one-half cycle; thus, it leads P1 by one-quarter of a cycle.

This "switching" action makes it fairly easy to see that a color demodulator is really a "keying" circuit, with each section operating only during a selected portion of each cycle from the 3.58-mc color reference oscillator.

In both types of demodulators just described, an unwanted 3.58-mc component remains in the plate signal. It is removed by traps in the plate circuit of each demodulator to prevent interference on the CRT screen. The remaining outputs are simply changes in demodulator plate voltage, and these are used (either directly or after amplification) to vary the bias on the picture-tube guns in direct proportion

Can you afford to guess

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for Color and Black and White

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MODEL SS117

How many times do you ask, "Why do I take so long finding that sweep trouble?" How often have you wondered whether weak horizontal sync was caused by defective sync circuit, horizontal oscillator, or sync discriminator? Can you quickly isolate inadequate width or low 2nd anode voltage to the oscillator, output, flyback transformer, or yoke? How many times have you changed a good yoke by mistake?

The SS117 will pinpoint troubles like these in minutes with tried and proven signal injection, plus yoke substitution for dynamic in-circuit tests. Error proof push button testing enables you to make all tests from the top of the chassis without removal from cabinet for maximum speed and profit on every job.

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- Horizontal Deflection Yoke: Checked by direct substitution with adjustable universal yoke on SS117.
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- Vertical Output Transformer: By simple signal injection for full height on picture tube.
- Vertical Deflection Yoke: By signal substitution for full height on picture tube.
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- New features include: Large 0 to 300 microamp meter for minimum circuit loading; all-steel carrying case with full mirror in adjustable cover; two 115 volt AC outlets in cable compartment.

Size: 10¼" x 9¼" x 3½". Wt. 10 lbs.

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to the various colors and shades that were originally transmitted.

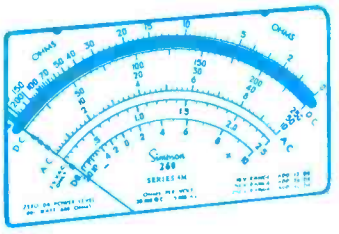
The above explanation, you will note, used not one single vector. We hope it may give many of you a better insight into the not-so-complicated process of color detection.

Convergence—You Can Do It!

Today's color sets are so simple to converge that learning this process is largely a matter of getting your hands on a set and getting the "feel" of it. Convergence adjustments on all sets made since about 1958 or '59 have positive and quick-acting adjustments — turn a control and something happens!

When all the convergence adjustments need readjustment (or appear to), go through all the adjustments quickly; that is, "rough in" all the controls and then go over them all again to make finer adjustments. This method is recommended because all the controls interact somewhat, and making fine adjustments at the beginning of the setup procedure is a waste of time.

What does a particular convergence control do? If you have some doubt about this, move the control and see. Move it far enough so that you can see the action and where it has the most effect. Pay especially close attention to the screen areas indicated in Fig. 3. If a particular control moves a green vertical bar across a red vertical bar and back, then halfway between these two extremes is the correct setting. Finding the best spot is like adjusting an IF transformer on an AM set. There, you have to move the screw far enough to see if you have reached a peak—you do this by going past the peak and then re-



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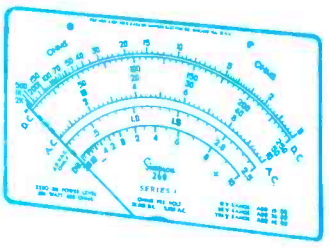

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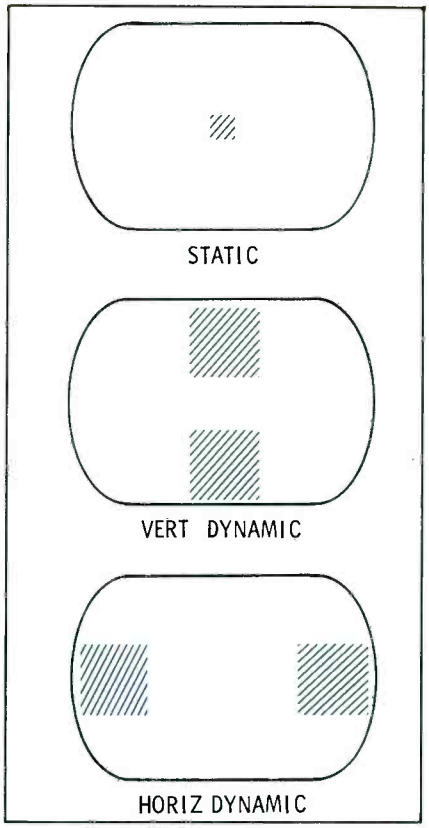

Fig. 3. Keep an eye on the shaded areas while adjusting convergence.

turning to it. Do the same with convergence adjustments, both static and dynamic — move them far enough so you can tell where the "peak" or converged point is. For example, on static convergence, move the blue dot down to and past the yellow dot (red and green converged), and then move it back in the other direction—split the difference and you have convergence!

Looking Ahead

Color TV, at long last, is on the move. New ideas, new competition, and new circuits will steadily reduce the selling price of new sets. Color servicing may well be your prime source of income in just a very few years. New developments no doubt will simplify the circuitry, but even now the average color set has only a half-dozen more tubes than a black-and-white set. Get into color service as soon as possible—turn down *no* opportunity to increase your knowledge about color. There is no magic formula whereby knowledge can be poured into the brain by the tubfull, but getting proficient in color servicing can and will be interesting, invigorating, *and* rewarding if you keep your head—and your sense of humor. ▲

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A standard color bar, white dot, crosshatch generator especially made for field service on color TV . . . and at a great savings to you.

Check these outstanding features and you will see why this generator belongs on the top of your list for color TV servicing.

All patterns crystal controlled offering "rock like" stability. You'll think the patterns are painted on the TV screen.

Simplified operation speeds up every servicing job. Just dial the standard keyed bars, white dots, crosshatch, vertical bars or horizontal bars and watch them "pop" on the screen. That's all there is to it.

Exclusive adjustable dot size. The white dots can be adjusted to the size that satisfies your needs by a screwdriver adjustment on the rear. No need to argue about dot size anymore. Just select the size that you like to work with best.

Pretuned RF output to Channel 4. Other low channels can be selected if Channel 4 is being used in your area by simple slug adjustment. Patterns are injected directly into antenna terminals, simplifying operation and saving servicing time.

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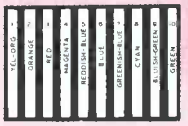

Ten standard keyed color bars (RCA type) that automatically provide all colors at specified NTSC phases . . . but without need of interpretation when servicing.

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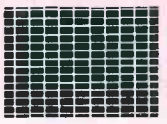
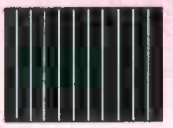
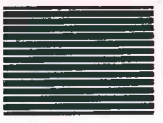


Stabilized crosshatch pattern for simplifying convergence adjustments.



10 thin white vertical lines for horizontal dynamic convergence adjustments . . . often missing on other generators.



14 thin horizontal lines for vertical dynamic convergence. Also missing on many high priced generators.

March into your local parts distributor and demand the CG126 Sencore color generator that sells at ½ the price of others. Don't let him switch you.

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TRANSISTOR CIRCUITS in industry

. . . by Barron Kemp

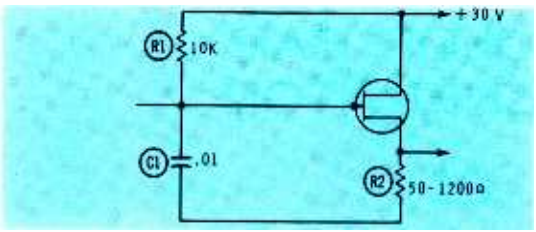

Fig. 1. Silicon unijunction transistor can be used as temperature transducer.

In the relatively few years since the invention of transistors—just after World War II—the development and application of transistor circuits in industry has been an epic story. Remarkable advances have been made, especially in automation equipment, electronic computers, measurement devices for the atomic-energy industry, and medical electronic apparatus.

Instrumentation

Various types of electronic measuring instruments are used throughout the industrial world for measuring and controlling humidity, flow, pressure, motion, and many other parameters. The application of transistor circuits to industrial process control has played an important role in improving quality and productivity.

Temperature and Pressure

Circuit designers have long been plagued by temperature problems involved in the use of transistors in unusually hot or cold environments. However, the temperature sensitivity of transistors can be turned into an advantage by using them as direct temperature-sensing elements.

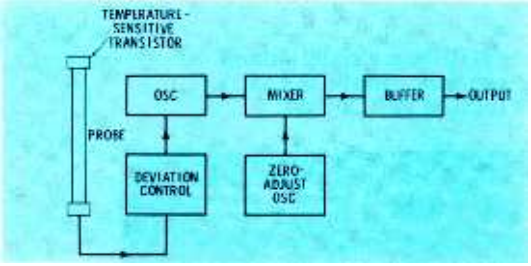

Fig. 2. In digital thermometer, transistor is separated from other circuits.

The design approach for this application consists of using a silicon unijunction transistor in an oscillator circuit (Fig. 1), whose output frequency changes as the temperature of the transistor changes. The transistor is generally isolated from the circuit by mounting it in a probe, as diagrammed in Fig. 2, and placing the probe in the environment where temperature is being measured.

Silicon unijunction transistors are also pressure-sensitive, since both P- and N-type silicon are piezoresistive materials whose resistance changes with variations in tensions applied to them. If the unijunction transistor is connected in the relaxation-oscillator circuit of Fig. 3A, and the temperature is held constant, the oscillator frequency will vary according to pressure as indicated in Fig. 3B.

Power Measurement

There has always been a need for accurate, fast instruments for measuring RF power. The use of transistors in a bridge circuit makes it possible to obtain direct power measurements with speed and accuracy under a wide variety of conditions. Such an instrument is inexpensive, compact, and of such light weight that it can easily be held in the hand. Since it is battery-operated, its use is not restricted to areas served by power lines. As a result, it is very useful for field measurements of RF power from radio, television, radar, or other transmitters.

The usual measuring circuit consists primarily of an audio oscillator and bridge connected in a closed-loop circuit. The amplitude of the audio signal is variable and is controlled by the condition of balance of the bridge. The balance is, in turn, dependent upon the total power in a thermistor, which the closed loop seeks to maintain at a constant value. When the instrument is placed in an area where RF power is present, the resistance of the thermistor changes; as a result, the bridge becomes unbalanced. The unbalance voltage is applied across the input of the audio oscillator, and causes the audio power to be decreased until the cumulative power in the thermistor is again restored to its initial value. At this point, the bridge is again balanced; so no further change occurs in the audio signal. The output of the audio oscillator, which is proportional to the RF power applied to the thermistor, is displayed on a meter cal-

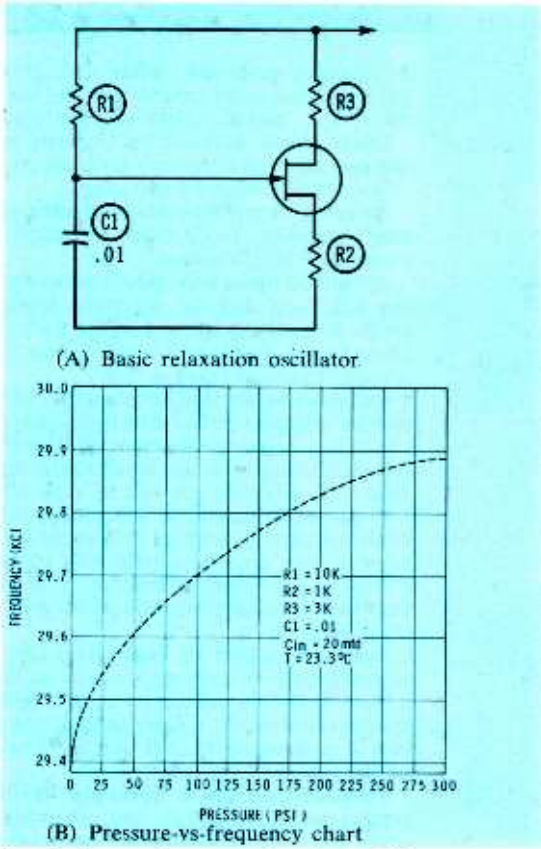

Fig. 3. Unijunction transistor in a different circuit can measure pressure.

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TV lead-in cable should be replaced at least once every two years. Hot summers, cold winters, and salty air do the dirty work . . and the picture suffers.

This means that you have a made-to-order replacement market. Automotive garages make extra profits by selling replacement spark plugs and fan belts. You can make extra profits simply by telling your customer how his old deteriorated cable keeps him from getting the best possible picture.

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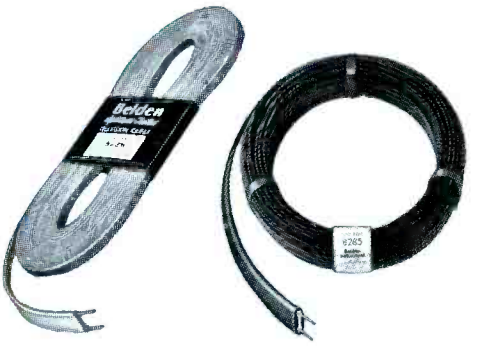

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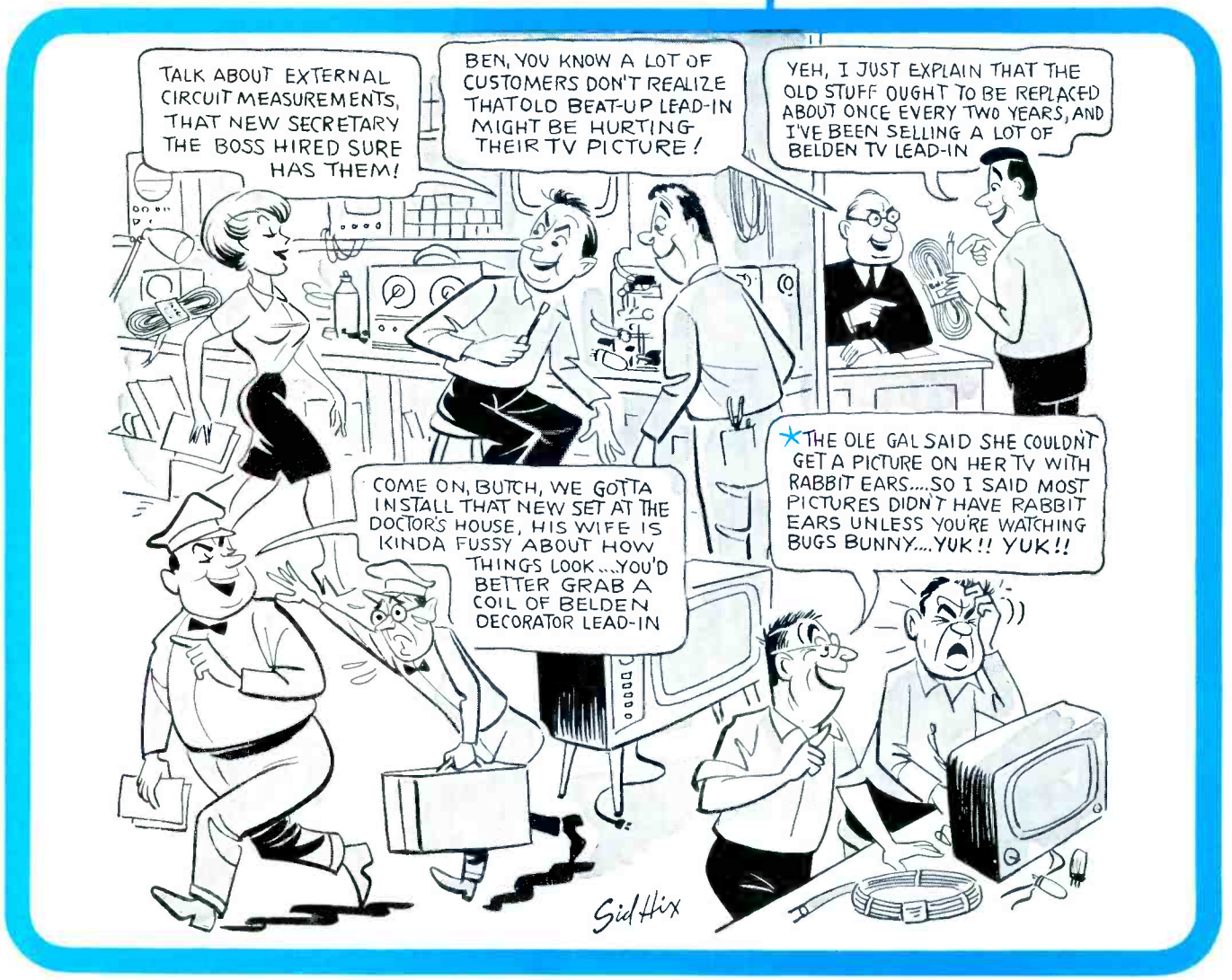

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ibrated in milliwatts and dbm.

Radiation Measurements

Transistor circuits are very important in measuring apparatus used with industrial applications of atomic energy. Geiger counters, proportional counters, beta counters, electrolytic cells, various types of scintillators, and photomultiplier circuits are only a few of the instruments which employ transistor techniques. Circuits using transistors are also useful in isotope-utilization equipment, accelerators, and nucleus fusion - reaction equipment, and will be more extensively utilized in future instrumentation.

Count-Rate Meter

One typical application, the count-rate meter circuit in Fig. 4, comprises two 2N45 junction transistors connected in a bistable circuit. The second transistor X2 conducts as long as no pulses are being fed from the Geiger tube (or other radiation-detecting element) to input transistor X1. The conduction of X2 is sufficient to bias the base of X1 to cutoff. An incoming pulse from the geiger tube to the emitter of X1 (which presents a high impedance when not conducting) triggers conduction of this transistor, and its collector becomes less negative. This voltage change is applied to the base of X2 and causes it to stop conducting. The range capacitor (C1, C2, or C3) charges through the base resistor of X2 and, when the base voltage nears zero, the regenerative action reverses and X2 again conducts. The resulting output pulse causes X1 to stop conducting, and the circuit is then ready to accept the next pulse from the Geiger tube.

When used with metal-walled Geiger tubes employing a positive high voltage (and consequently producing negative pulses), the count-rate meter circuit uses NPN 2N168 transistors. The circuit is the same as shown in Fig. 4 except the battery and diode are reversed, and the signal is applied to the base of the second transistor. In either circuit, the available ranges are 1000, 10,000, and 100,000 counts per minute for a full-scale indication. The time constants for these ranges are approximately 4, 3, and 2 seconds respectively. The DC drain from the 2.5-volt battery is about 1.5 ma, giving a useful battery life of more than 800 hours.

Instead of being driven directly by the Geiger tube, the count-rate meter may be preceded by a five-stage transistor amplifier which provides for adequate alpha, beta, and gamma contamination detection. A 5-ma input pulse to the amplifier produces output pulses of constant 5-volt amplitude. The total DC input power required is only 30 milliwatts, and a power supply consisting of six series-connected 1.25-volt mercury cells gives a usable battery life of 400 hours or more.

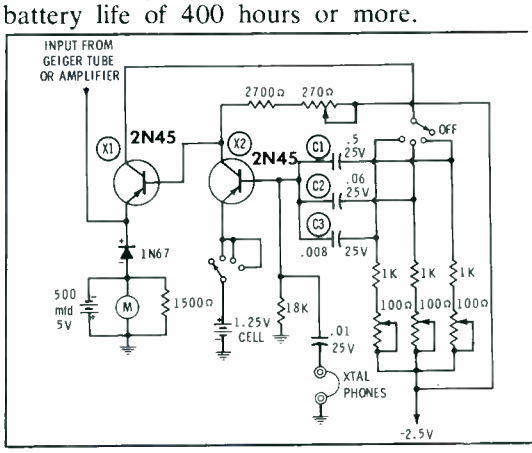

Fig. 4. Count-rate meter circuit is a portion of atomic-radiation detector.

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Honest tests on today's tubes demand 14-position selector switches. Compactrons, novars, 5- and 7-pin nuvistors, 10-pin headers, transistors and diodes, along with the older type tubes, can all be checked out—completely and correctly—including high sensitivity leakage and gas tests, with the truly modern Hickok Model 800A. This quality tube tester includes these other recognized Hickok-quality features: ***Hickok-developed G_m test on all tubes • Sensitive, instantaneous inter-element leakage and shorts test • Filament continuity test—and the original HICKOK roll chart subscription service keeps it up-to-date!***

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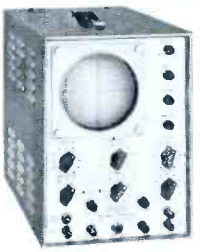
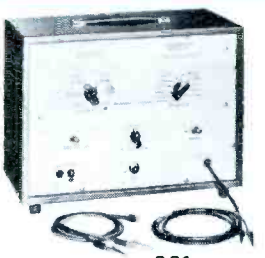


677
Wide Band Oscilloscope

470A
Uni-scale VTVM



661
Color Bar Generator

THE HICKOK ELECTRICAL INSTRUMENT CO. • 10566 Dupont Avenue • Cleveland, Ohio 44108

Circle 39 on literature card

The high-voltage supply for the Geiger tube uses a single 2N43 junction transistor in a blocking-oscillator circuit, which may be used to produce either positive or negative 900 to 1200 volts by properly connecting the transformer secondary, rectifier, and voltage divider.

Digital Computers

Transistor circuits have multiple advantages for use in electronic computers. They permit a large number of circuit elements to be packed into a comparatively small space, while minimizing heat-dissipation problems; furthermore, special switching transistors have the extremely fast rise-time characteristics necessary for high-speed computer operation.

There has been a strong tendency in industry to specialize digital computers according to their purpose; that is, for business, scientific, or control use. A further step in this direction is the development of *single*-purpose computers for industrial use. These systems are used for purposes such as controlling manufacturing processes, numerical control of machine tools (in accordance with a predetermined cutting order and magnitude), and regulating chemical processes.

Many of the circuits of industrial digital computers are based on the operation of a basic pulse amplifier such as that shown in Fig. 5. The width of the pulse produced by this circuit is controlled principally by the peak emitter current and the magnetizing inductance of the transformer. The pulse amplitude is fixed by saturating the transistor. The pulse shape is affected to a lesser extent by the time constant of the collectors supply circuit and the distributed capacitance of the transformer.

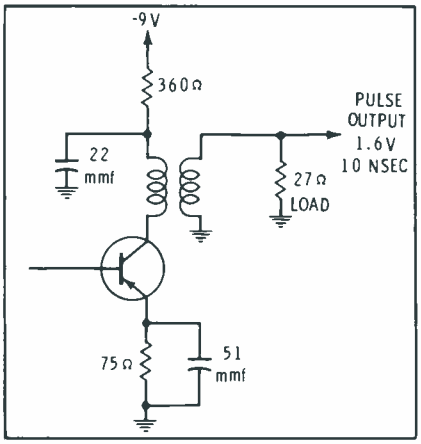


Fig. 5. This pulse-amplifier circuit is a basic element of digital computer.

This basic pulse circuit can be turned into a *gated pulse amplifier* by adding a "level" transistor (X2 in Fig. 6) to the basic pulse amplifier. In addition, a pulse-mixing circuit can be set up by adding a

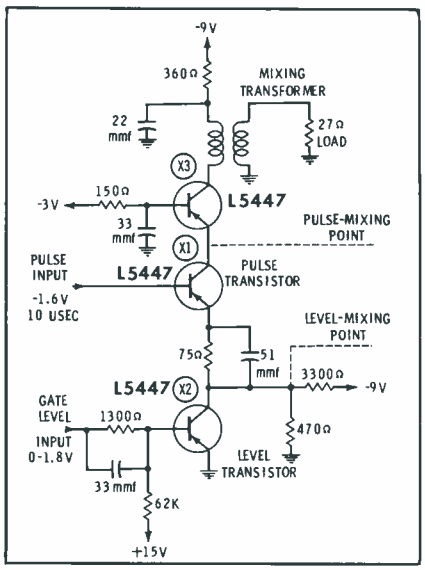


Fig. 6. Pulse circuit with gating and provisions for mixing pulse outputs.

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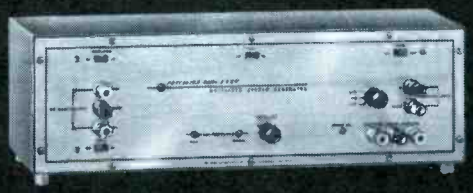

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Circle 42 on literature card

grounded-base stage (X3, Fig. 6) in the collector circuit of the pulse transistor to create a low-impedance mixing point where the outputs of pulse transistors may be paralleled.

A *register driver* (Fig. 7), to feed the pulse outputs to *register* circuits for temporary storage, results from adding a high-power 2N706 output stage to the pulse-mixing circuit. It can drive up to eight output cables.

Fig. 8 shows another pulse-amplifier variation, in the form of a high-amplitude pulse generator used to drive the compact, folded microstrip delay lines that control the timing functions of the computers.

Digital-to-Analog Converters

When the output of a digital computer is used to control industrial processes or drive monitoring instruments, it is often desirable to change the information from digital to analog form, since many of the process controls and instruments are analog devices.

Digital-to-analog converters make wide use of transistor techniques. One circuit of this type (Fig. 9) uses a stepping motor driven by suitable transistor circuits. Operation of the stepping motor is similar to that of a polarized relay. There are two permanent-magnet detent positions which alternate with each 18° of shaft rotation. DC coil power of proper polarity overcomes the magnetic detent and produces torque to advance the rotor from one of these detent positions to the next.

The circuit of Fig. 9 is a 12-volt DC supply which provides a 1-ampere pulse (2-millisecond peak) operating at 300 steps per second. The output transistors must be capable of withstanding the 70-volt transient back voltage from the stepping motor. If necessary, voltage transients can be limited by use of capacitors or resistors connected

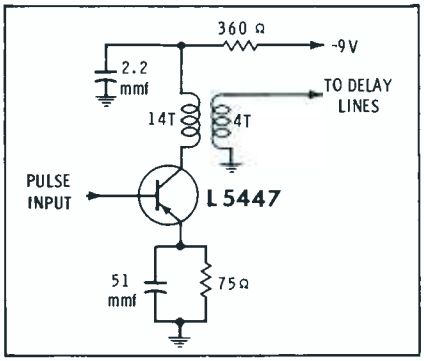


Fig. 8. Pulse generator for driving delay lines that control computer timing.

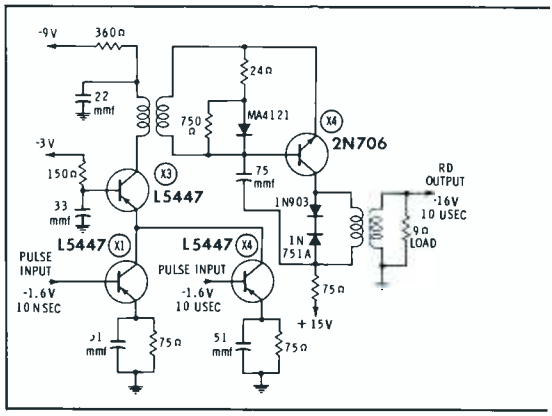


Fig. 7. Register driver is a pulse amplifier with high-power stage added.

across the stepping motor or output transistors, although this may also limit the top speed of the motor.

Industrial TV

The application of industrial TV shows a tendency toward using it in combination with radiocommunications equipment. ITV apparatus is composed of transmitting and receiving sections which operate over radio links, as well as over closed-circuit wire systems where the two sections are connected by a camera cable or coaxial cable. The necessary operations for producing and transmitting the image can often be handled entirely from the receiving end of the link. In equipment using this control arrangement, development of transistor techniques has made possible considerable miniaturization and increase in reliability of the equipment.

Conclusion

Hundreds of other examples of transistorized industrial circuits could be cited, but the varied applications just described will suffice to illustrate the versatility of transistors for electronic measurement and control functions throughout industry. ▲

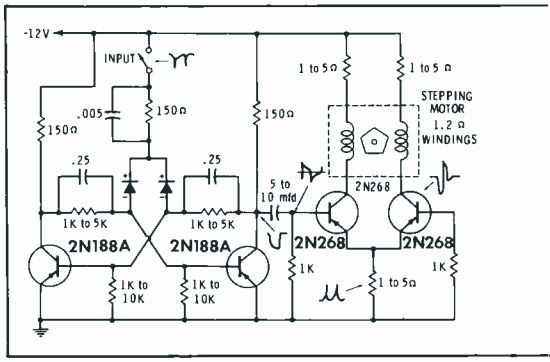
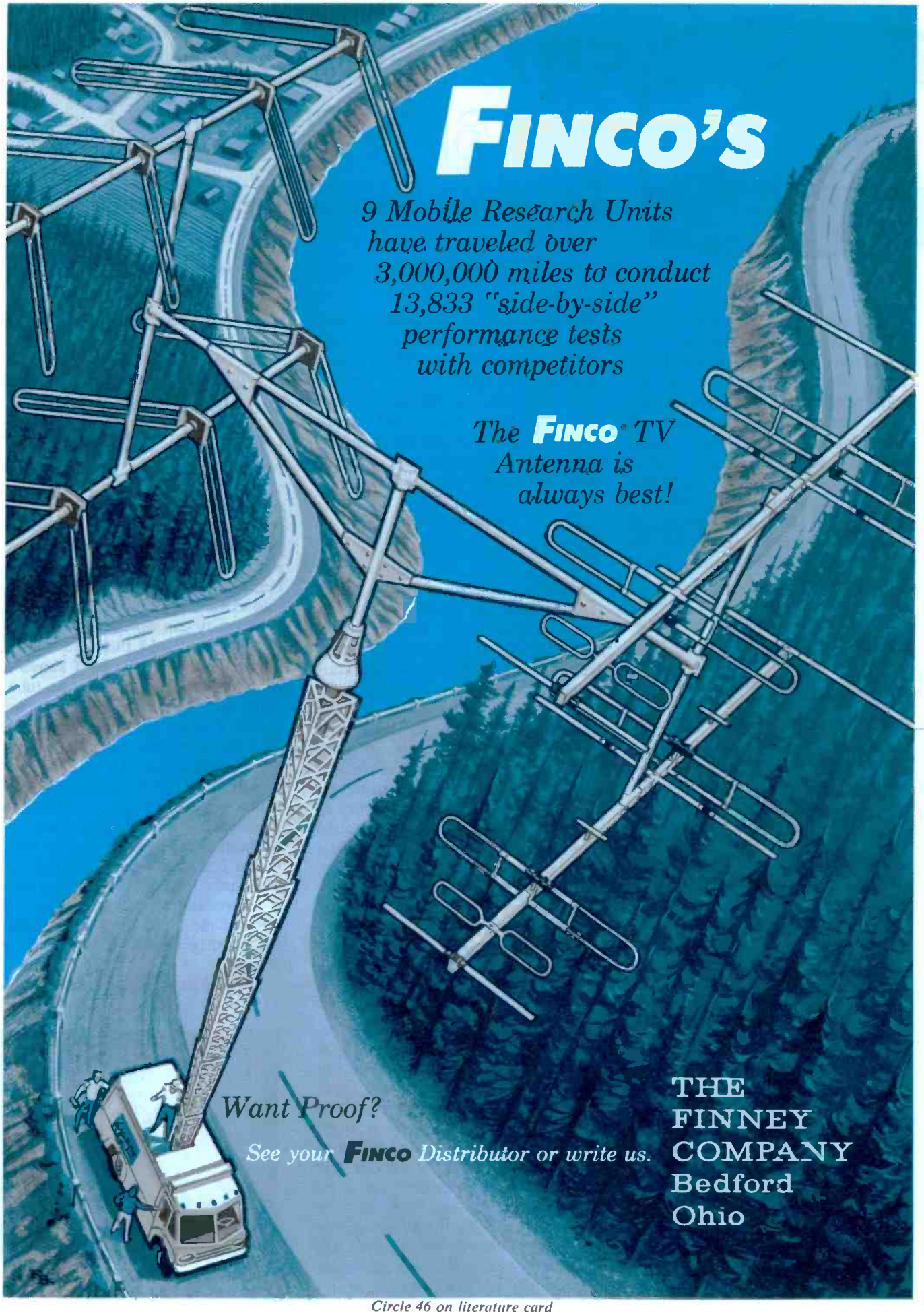
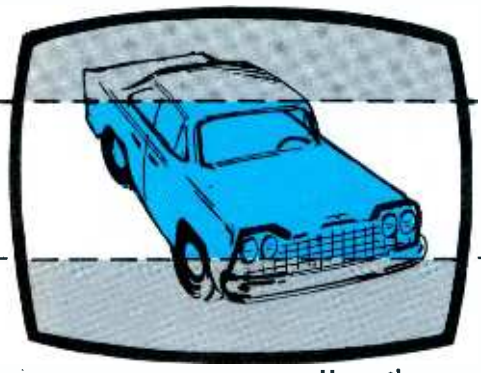


Fig. 9. Stepping-motor drive circuit used in a digital-to-analog converter.



Circle 46 on literature card



CRT BRIGHTENERS

FOR COLOR AND MONOCHROME

How they extend the life of aging picture tubes . . . by Forest H. Belt

The most expensive single part inside most monochrome and color TV cabinets is the picture tube. Tell a customer he needs a new one, and you're probably in for a lengthy discussion of the pros and cons of even owing a TV set. The tactful and wise serviceman can forestall many verbal exchanges of this nature by recognizing the symptoms of a faulty CRT early and alterting his customer to the dim future of his TV picture, well in advance of its actual happening.

When the viewer finally realizes that the picture is getting too faded-out to watch comfortably, his most likely question will be, "Can't anything be done about it?" What he really means is, "Can't we do anything less expensive than replacing the picture tube?" or "Isn't there some way we can make it last until we can afford a new tube or a new set?"

The answer is that there *are* a couple of ways to postpone the final demise of a dimming picture tube, but you should explain to your customer the advantages and disadvantages of trying to extend the life of the CRT. The two ways are *reactivation,* (or *rejuvenation*) and installing a *brightener*. Either method will usually—but not always—produce a brighter raster for some indefinite period of time. But it is important that your customer realize how indefinite that period may be. It might last for weeks, even months, but eventually the tube will dim out completely, and another tube will be the only answer.

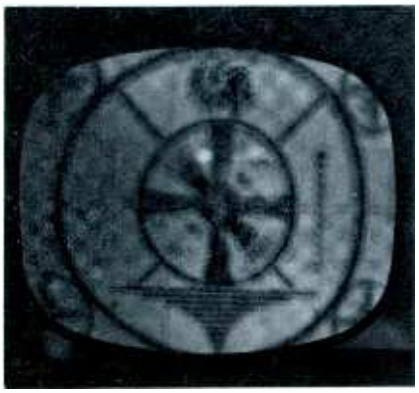


Fig. 1. Picture is beyond reclaiming.

Rejuvenation

Reactivation of a weak CRT consists of reviving the ability of the cathode to release electrons easily and in sufficient quantity to form a solid electron beam. This is usually done by one or two methods—or a combination of both. The first consists simply of overheating the cathode sufficiently to "shake up" the molecules rather thoroughly; this excess heat causes molecules of more active material to migrate to the surface of the cathode structure, thus providing a greater quantity of free surface electrons. The second method consists of "flashing" the cathode and grid, by applying a high voltage between them and thus causing the grid to "yank" a brief surge of high-velocity electrons from the cathode. The result is reactivation of the surface layer on the cathode, allowing electrons to be released more freely.

Both these methods are effective, but there are considerations you should know about before you undertake to rejuvenate a tube. There is always the possibility that the heater is already so weak it won't take the extra heating, and will burn open. Furthermore, the cathode may not be able to withstand the extra heat or the flashing, and may be damaged. Lastly, the tube may be so far gone that neither method will produce results; if that's the case, you might as well prepare to replace it or junk the set.

Brighteners

If you can get to the weak CRT early, there is plenty of chance you can revitalize it. In fact, it may not be necessary to take the risk of rejuvenation; perhaps you can install a brightener. A brightener merely raises the heater voltage—and thus the heat applied to the cathode—by a small percentage; if there are still plenty of active electrons just below the surface of the cathode, this extra heat will bring them out where they can do some good.

Notice we said that you should get to the set early. Fig. 1 shows a set with a badly faded picture tube. This one had been dimming for nearly a year; the serviceman had told the customer for months that it was getting bad, but the customer preferred to pull the shades and watch it in the dark. Adding a brightener was of no help at all; rejuvenation did help for a short time, but in just over a week the set was dim again. Finally, another shot with a rejuvenator and a brightener afterward did make the set watchable for another month or so, but that was all.

If the customer had consented to

• *Please turn to page 89*

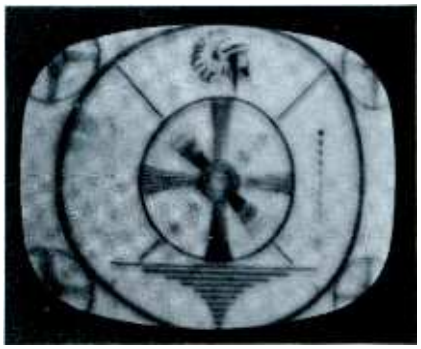


Fig. 2. This one might be salvageable if reached at an early enough period.

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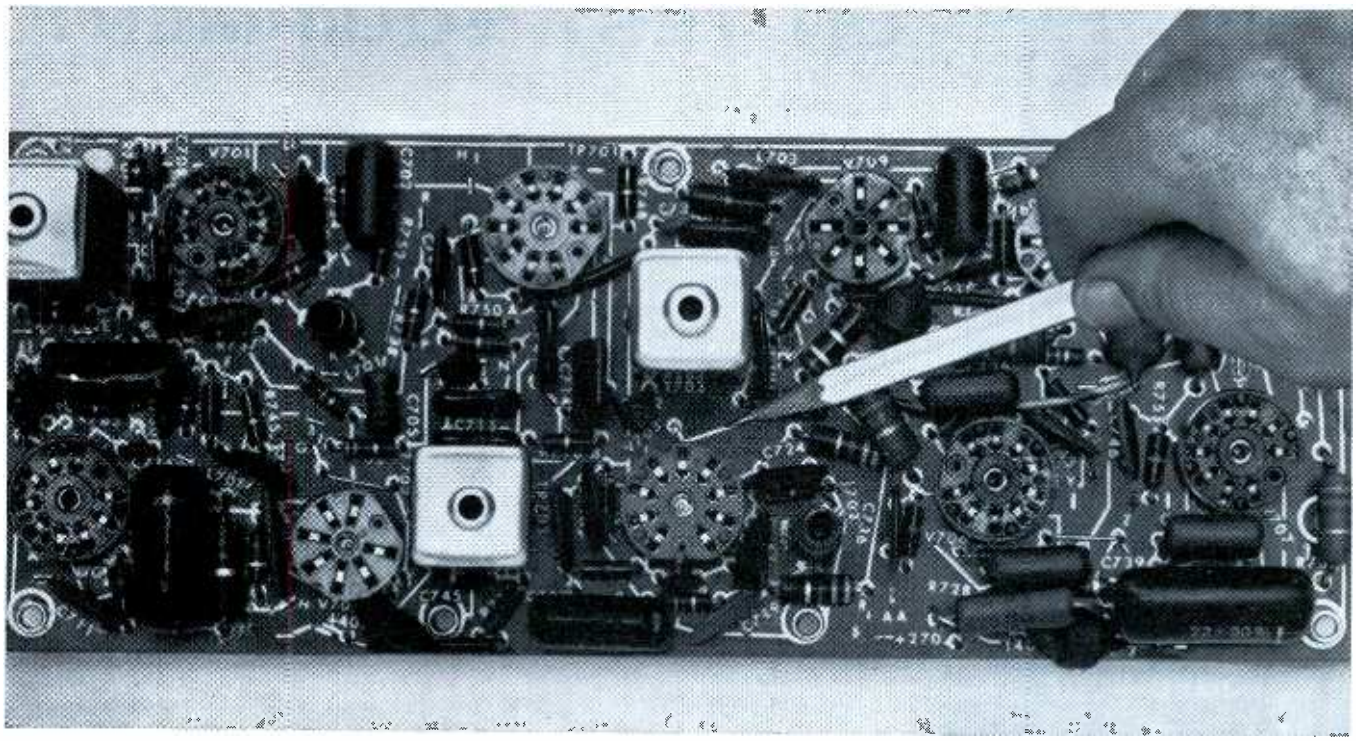

RCA Victor Color TV Chroma Circuitry

You can see at a glance how new streamlined "road-mapping" makes servicing faster, easier, surer than ever before

Pictured above is the "new look" in RCA Space Age Sealed Circuitry . . . the new precision-crafted boards that you'll see in *all* 1964 New Vista Color and in most RCA Victor black-and-white television sets for 1964.

This new schematic diagram "road-mapping" consists of *straight white lines* that run *directly* from *point-to-point.* No confusion, no difficult paths. And the extra space gained has been used to make the label markings larger. You can see and trace the circuits at a glance.

Here again RCA Victor has made a vitally important contribution to easier, faster and more accurate servicing. It is part of our continuing research program to offer the utmost in reliability with Space Age Sealed Circuitry.

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by DICK PAVEK

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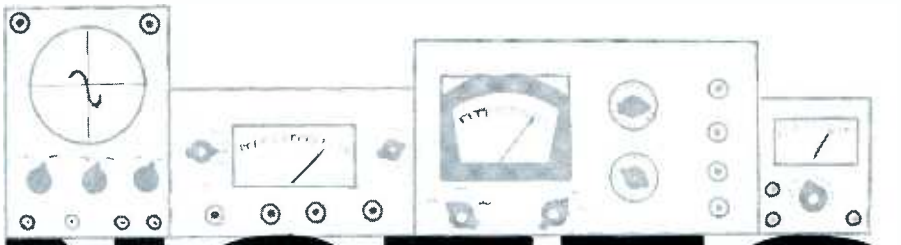

NOTES ON TEST EQUIPMENT

by Forest H. Belt

Aligner for Stereo FM

With more than 200 FM stations broadcasting stereo programs at least part time, receivers and multiplex adapters are becoming more popular each month. To service these sets, RCA has developed their Model WR-51A Stereo FM Signal Simulator—pictured in Fig. 1.

Specifications are:

1. *Power Required—110-130 volts; 60 cps; 40 watts.*
2. *RF Output—Center frequency 100 mc; variable 800 kc above or below center; approximately 100 mv rms with 60 db of attenuation, in 20 db steps; crystal-controlled marker outputs at separate jack, 10.7, 90.95, 96.30, 101.65, and 107 mc; impedance 300 ohms with cable pad.*
3. *Composite Stereo Output — From 0 to 3 volts peak to peak, variable; output impedance depends on setting of level control; consists of regular monophonic signals (L + R), either stereo channel, 19 kc pilot signal only, 38 kc signal only, 67 kc SCA signal only, all dependent on setting of* FUNCTION *and* FREQUENCY *switches; any combination of these can be frequency modulated on the RF carrier, at a modulation deviation determined by the* RF DEVIATION *control setting; distortion less than 2%.*
4. *Internal Signals—400 cps, 1 kc, and 5 kc audio signals available either directly at audio output jack or frequency modulated on RF carrier; also internally generated 19 kc, 28 kc, 38 kc, 48 kc, and 67 kc signals available directly or modulated; accuracy of 19-kc signal ±2 cps.*
5. *External Signals—None required.*
6. *Sweep Output—Center frequency 100 mc; sweep rate 60 cps; sweep width variable from 0 to 750 kc; crystal controlled markers must be added externally.*
7. *Panel Meter—Face size 2½"; sensitivity 200 ua; zero-center scale, marked plus and minus 10; used with built-in rectifiers to measure balance at speakers of amplifier being tested.*
8. *Controls and Terminals — Rotary* FUNCTION *and* FREQUENCY *switches;* CENTER RF FREQ ADJ., *19* KC SUBCARRIER LEVEL, *and combination* RF DEVIATION/SWEEP WIDTH/AUDIO LEVEL/COMP SIG LEVEL *controls;* POWER OFF *switch incorporated with* SUBCARRIER LEVEL *control; three* RF ATTENUATOR *slide switches; three coaxial* COMP SIG/AUDIO, RF OUT, *and* IF MARKER *output jacks; red jeweled pilot lamp.*
9. *Size, Weight, Price—10" x 13½" x 8"; 14 lbs; $249.50.*

Fig. 1. Stereo FM signal generator can be used for sweep alignment of RF, IF.

The stereo signal section of the Simulator is not unusually different from other instruments we've examined in our lab and reported in this column. Fig. 2 shows a functional block diagram.

A 19 kc crystal oscillator initiates and controls most of the actions. A frequency doubler forms the 38 kc signal for the balanced modulator, while an audio oscillator generates the left or right channel signals. The balanced modulator forms the L-R sideband signals which are fed via a delay line to the function switch.

Meanwhile, the 19 kc pilot signal is mixed with the L+R signal and fed also to the function selector. The setting of the selector determines the mode of operation and its output is fed to a buffer amplifier that isolates the output load from the delay and mixing sections. The audio-composite signal (buffer) amplifier is coupled through a potentiometer that controls the amount of signal fed to the composite-audio output jack; the same control sets the level of stereo or audio signal coupled to the reactance modulator.

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This 7″ x 9″ x 1″ beauty goes anywhere, standing on its own easel or hung on the wall like a picture. Matches any set you sell or service *electronically* with its patented two-antennas-in-one design. Ask your Distributor or write for details now.

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GALLO ELECTRONICS CORP., 12 Potter Avenue, New Rochelle, N.Y.

Circle 50 on literature card

A 100 mc oscillator develops the FM center frequency, and includes a control which can shift the center frequency from 99.2 mc to 100.8 mc. The reactance modulator varies the frequency at a rate equivalent to whatever audio or stereo composite signal is applied through the deviation control. The resultant FM output is coupled through a series of 20 db attenuators that can be switched separately into or out of the line; with all three attenuators active, the output signal (approximately 100,000 microvolts) is attenuated by 60 db (leaving about 100 uv at the RF output jack). A terminated cable matches the 75 ohm output to 300 ohm receiver terminals.

The WR-51A differs from other stereo generators in its built-in sweep alignment generator for stereo receiver front ends. The dashed lines in Fig. 2 show which sections of the instrument function when the selector is set to the "SWEEP & MARKER" position. A 60-cps signal is taken from the filament heater source and fed through the selector switch and deviation control to the reactance modulator. The 100 mc signal is thus swept at a 60 cps rate, at a sweep width determined by the setting of the deviation control. This signal can be fed directly into the tuner of an FM receiver, and fed to a scope through a demodulator probe.

The Model WR-51A can thus be used to sweep-align the RF and IF sections of any FM receiver. Tracking of the FM oscillator can even be checked, using the unmodulated signal from the crystal-controlled marker generator. This internal oscillator is held at 5.35 mc, and high-order harmonics are generated. Therefore, the 17th, 18th, 19th, and 20th harmonics fall within the FM band—at 90.95, 96.3, 101.65, and 107 mc. The lowest and highest can be used in regular RF tracking adjustments—spacing the oscillator coil windings at the low end of the band and adjusting the trimmer capacitor at the high end. Intermediate tracking can be checked with the other two spot frequencies.

The discriminator (or the ratio detector) can be checked by disconnecting the smoothing capacitor and connecting the scope for the usual S-curve display. The marker output of the WR-51A can be coupled loosely to one of the IF or limiter stages of the receiver; the 2nd harmonic of the 5.35 mc oscillator will mark exactly the 10.7 mc point on the S-curve. If the marker falls at any other point than halfway between the two peaks, you'll have to adjust the demodulator transformer of the set—the secondary for moving the crossover point, and the primary to produce a maximum-amplitude, symmetrical S-curve.

Once the RF, IF, oscillator, and stereo multiplex sections of the receiver are working normally, the WR-51A provides means for checking the entire audio system. Balance of the overall system can be determined, and channel separation measured, by using the balance meter and its connecting cables.

The connections are simple to make; just clip them on the speaker voice coil terminals. The panel meter will indi-

RCA—PIONEER OF COLOR TV—BRINGS YOU

ALL YOU NEED FOR COLOR-TV SERVICING

RCA Color-Bar/Dot/ Crosshatch Generator

Low-cost, lightweight, portable instrument that provides all essential Color-TV test patterns. Simple to operate: only 3 controls. RF output leads connect directly to antenna terminals of receiver; no external sync leads required. Crystal-controlled signals assure rock-steady patterns, free from "jitter" and "crawl." Extra-wide-range chroma control. Generates:

- **Color-bar pattern:** ten bars of color, including R-Y, B-Y, G-Y, I and Q signals spaced at 30° phase intervals for checking phase and matrixing, and for automatic frequency and phase alignment. Permits accurate alignment of the "X" and "Z" demodulators which are used extensively in RCA Victor and many other makes of color TV receivers
- **Crosshatch pattern:** a grid-like pattern of thin sharp lines for adjusting vertical and horizontal linearity, raster size, and overscan
- **Dot pattern:** a pattern of small sized dots facilitating accurate color convergence adjustments

$189.50* with output cables.

RCA 5-Inch Oscilloscope for Color-TV

A wideband scope excellent for checking colorburst signals and general troubleshooting of wideband color circuits and other electronic equipment. Muilt-scale calibrated graph screen makes measurement of peak-to-peak voltage as easy as with a VTVM.

- New 2-stage sync separator assures stable horizontal sweep lock-in on composite TV signals
- Dual bandwidth: 4.5 Mc at 0.053 volt rms/in. sensitivity. 1.5 Mc at 0.018 volt rms/in. sensitivity
- Continuously adjustable sweep frequency range: 10 cps to 100 Kc
- 3-to-1 voltage-calibrated, frequency-compensated step attentuator for "V" amplifier
- Simplified, semi-automatic voltage calibration for simultaneous voltage measurement and wave-shape display
- Vertical-polarity reversal switch for "upright" or "inverted" trace display

$249.50*, including direct/low capacitance probe and cable, ground cable, and insulated clip.

RCA Television FM Sweep Generator

Specifically designed for visual alignment and troubleshooting of color and black-and-white TV receivers, and FM receivers. The RCA WR-69A has pre-set switch positions for all VHF TV channels, FM broadcast band, and TV video, chrominance, and IF frequencies. The WR-69A has these important features:

- IF/Video output frequency continuously tunable from 50 Kc to 50 Mc
- Sweep-frequency bandwidth continuously adjustable from 50 Kc to 20 Mc on IF/Video and FM; 12 Mc on TV channels
- Output level—0.1 volt or more
- Attenuation range: TV channels, 60 db IF/Video, 70 db FM, 60 db
- Return-trace blanking
- Two adjustable bias voltages on front panel

$295.00* including all necessary cables.

RCA RF/VF/IF Marker Adder

Designed for use with a marker generator (such as RCA's WR-99A) and a sweep generator (such as RCA's WR-69A), this instrument is used for RF, IF, and VF sweep alignment in both color and black-and-white TV receivers. In visual alignment techniques, it eliminates distortion of sweep response pattern. Important features:

- Choice of four different marker shapes provided by front panel switch for different types of sweep-response curves and for positive and negative sweep traces
- Provides very high-Q markers of high-amplitude and narrow bandwidth
- Complete front panel control of marker shape, marker amplitude, marker polarity, sweep amplitude, and sweep-trace polarity

$74.50* complete with cables.

RCA Crystal-Calibrated Marker Generator

Supplies a fundamental frequency RF carrier of crystal accuracy for aligning and troubleshooting color and B&W TV receivers, FM receivers and other electronic equipment in the 19-260 Mc range. Combines functions of multiple-marker generator, rebroadcast transmitter, and heterodyne frequency meter.

- Highly stable output
- May be calibrated at 240 separate crystal check points—accurate calibration provided at 1-Mc and 10-Mc intervals
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- Sound and picture carrier markers available simultaneously

$242.50* complete with output cable and phone tip.

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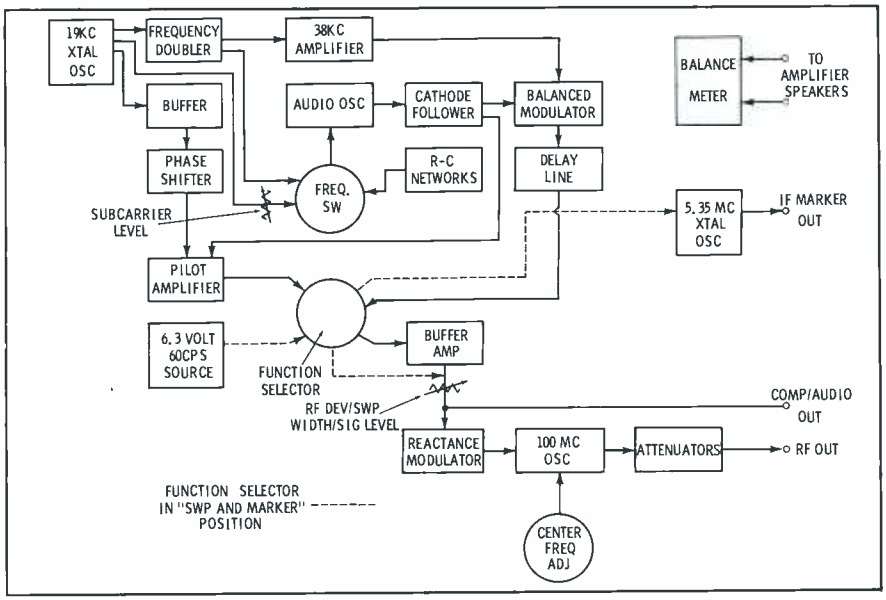

Fig. 2. Functional block diagram shows interaction among stages and controls.

cate the balance between the amounts of signal reaching each speaker. Here's how it worked on a set we used in the lab:

We first fed a signal simultaneously into the inputs of both audio amplifier channels, using the 400 cps output. This was accomplished by paralleling the amplifier input connectors with a jumper. Noting a slight reading in the direction of the right channel, we adjusted the amplifier balance control to equalize both channels; the result was a reading at exact center—zero on the meter. Next, the same test was performed with the 1000 cps and 5000 cps signals; both still read zero, so we were assured that the amplifier channels were precisely balanced.

Then we connected the stereo signal to the input of the stereo (multiplex) adapter. Switching between the left and right stereo channels on the panel of the WR-51A resulted in corresponding readings to the left and right on the balance meter. Noting a slight difference between these readings, we adjusted the balance control in the adapter to equalize the readings; the left reading was then about the same as the right.

Then, to check separation between the two channels, we temporarily disconnected the right-channel meter lead from the speaker terminals. Switching the generator to produce right-channel stereo, we found almost no signal reaching the left channel of the audio system; any appreciable indication would have meant that right-channel stereo was entering the left channel. Repeating this test for the other channel proved that no left-channel stereo (from the generator) was entering the right channel of the audio amplifier; of course, the left channel meter lead was disconnected during this test. Had either test revealed poor separation, we might have had to reset the separation control on the multiplex unit, or even realign the entire adapter.

As a final check, we fed a stereo signal into the RF antenna terminals of the FM set. Repeating all the stereo-channel tests merely proved that the RF and IF stages, and the FM demodulator, were not causing any phase shift or selective attenuation of sidebands that might create unbalances in the later stages of the unit. Thus, we used the WR-51A to check (and align, when necessary) an entire stereo FM receiver, from antenna to speakers. ▲

For further information, Circle 90 on literature card.

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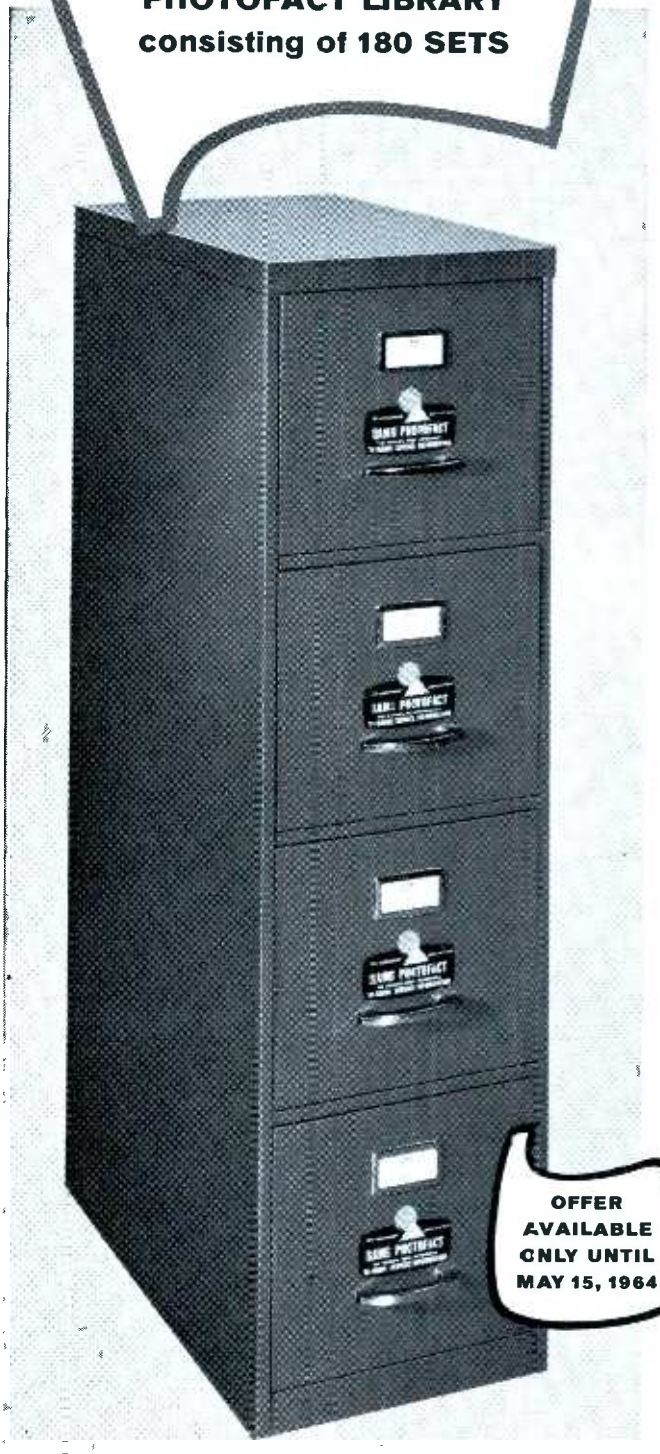

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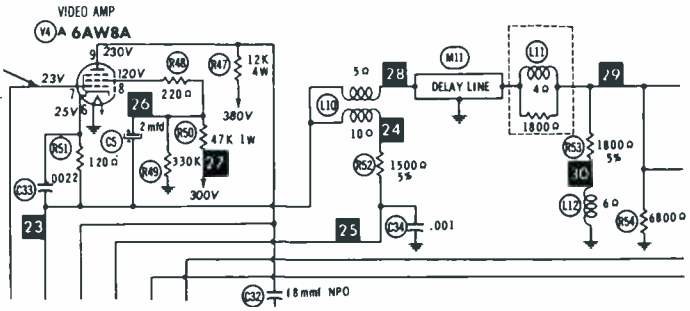
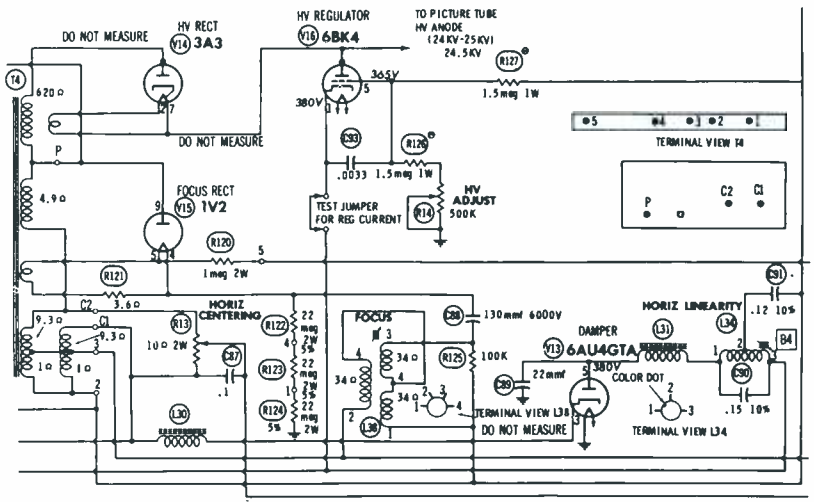
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience



Chassis: Admiral 25E6
Symptoms: Multiple ghosts.
Tip: The picture on the CRT screen will display multiple ghosts on both the left and right sides of the images, giving the appearance of excessive video ringing. This trouble is usually due to a defective delay line (M11) in the luminance channel. A change in its impedance causes video signals to bounce back and forth between the input and output. A quick test is to short the delay line with a clip lead. If the "ghosts" disappear—especially those on the right side of the images—replace M11. When procuring a replacement, make sure you get one that matches the particular receiver you're servicing.



Chassis: Admiral 25E6
Symptoms: Loss of focus with severe blooming on the CRT.
Tip: Several causes of this defect were covered in the December, 1962 issue —and here is another. C93, the .0033 mfd capacitor connected from the cathode to the grid of the 6BK4 regulator tube, develops high-resistance leakage, upsetting the regulator circuit. When this occurs, the high voltage is reduced, producing a blooming raster with a loss of focus. Don't forget to make this component one of your prime suspects when these symptoms are present.

In some receivers, you may find the leads of C93 are carefully spaced by a piece of fish paper. Don't discard the paper when replacing the capacitor. Redress the leads of the new component in the same manner as the original; the leads serve as a spark gap for the regulator circuit.

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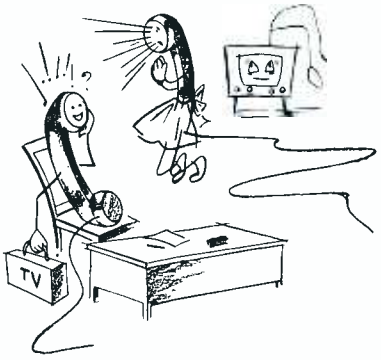
Telephone Etiquette



The telephone is frequently the first contact a service shop has with a prospective customer. Here are some ideas to make that contact pleasant and fruitful.

The next time your telephone rings, don't let it jingle four or five times; answer it immediately. Identify yourself by using either your phone number or the name of your shop.

One of the first things to ask is the caller's name; then use it later in the conversation. This helps build the customer's confidence.

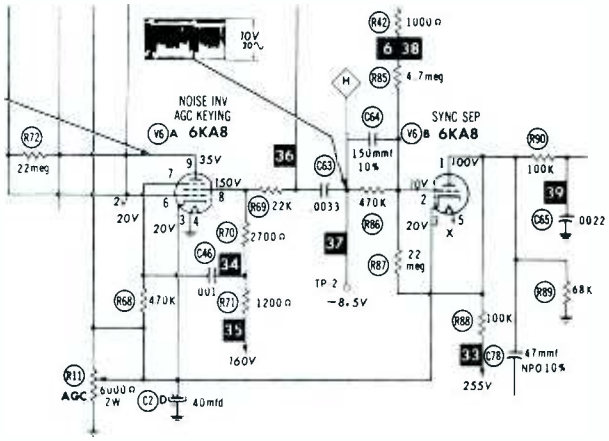
Be sympathetic; express your sincere desire to help. After all, perhaps the weekend is coming, or a favorite show is due soon, and a TV set that doesn't work may be upsetting the customer's plans considerably.

Don't interrupt the speaker even though you don't agree with what he or she is saying. Let the caller finish and then, in a polite tone ask for more information in an attempt to understand.

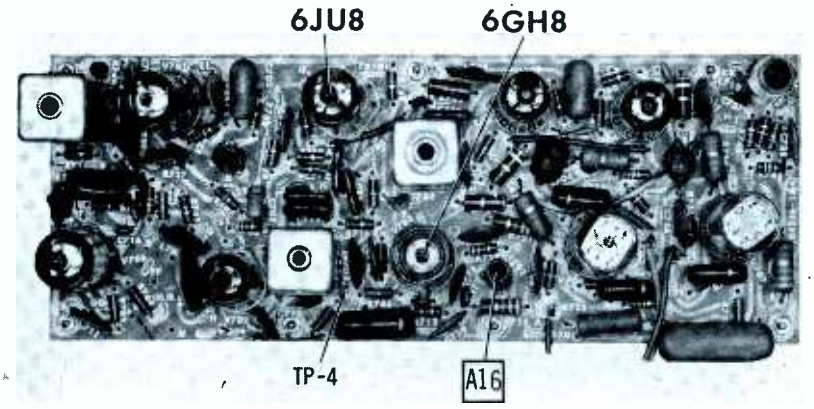
Don't use technical terms the average customer doesn't comprehend. They may feel you're trying to undermine their intelligence or make them look inferior.

If you must leave the phone for any length of time, either ask the caller to hold the line or ask if you can call back as soon as you have the information.

By following these simple rules of telephone etiquette, you may find your customer relations greatly improved.

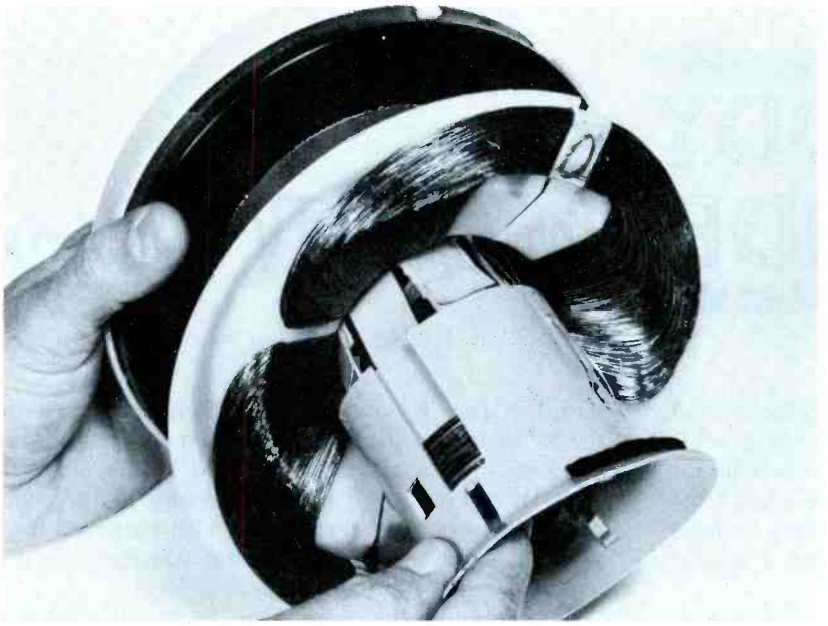


Chassis: RCA CTC12
Symptoms: Negative or severely overloaded picture.
Tip: This defect will normally give the impression of AGC trouble. After replacing the AGC keying tube, and readjusting the AGC control, you'll probably have a normal picture again. However, before you pronounce it cured, make the following test: Turn off the receiver, wait for a few moments, and then turn it on again. Wait three to four minutes to see if the trouble reappears. If the picture overloads again, you'll probably find AGC control R11 open.

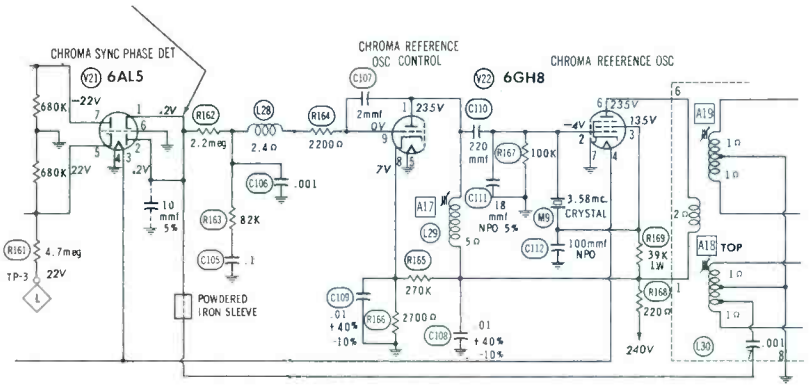


Chassis: RCA CTC12
Symptoms: Loss of color sync, indicated by three blobs of color running across screen; predominant color will usually be red.
Tip: This defect normally occurs about six months after a receiver has been installed. First, try replacing the 6GH8 chroma oscillator and control tube, and the 6JU8 chroma sync phase detector-killer detector. Check to see if operation returns to normal, using a color signal from a station if possible. (The signal from your color-bar generator may be strong enough to force the colors into sync.) If you must use a generator, don't connect the output leads directly to the set, but merely lay them close to the receiver's antenna. If the out-of-sync condition remains after the tubes have been replaced, you'll need to retune the chroma reference oscillator coil in the following manner: ground TP-4 on the chroma printed-circuit board (to remove AFC voltage), and adjust A16 for a zero beat of the color-bar pattern (color bars stopped, or floating slowly across the screen). As a final step, check operation of the tint control for its normal range—flesh tones varying from green to magenta.

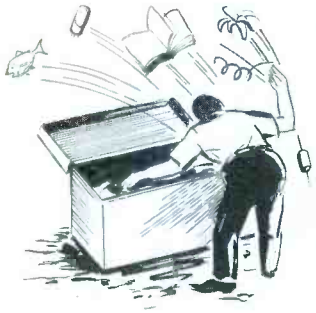
Chassis: Zenith 29JC, 27KC, 26KC, 25LC
Symptoms: Unable to center raster.
Tip: The centering of the raster on Zenith's color receivers is accomplished by pulling two sets of gut strings extending from the rear of the deflection yoke. If they have no effect on the raster, the centering mechanism is probably defective. The only cure is to replace the entire centering device. This unit, shown in the photo, is not an integral part of the yoke; it's a separate unit, containing circular magnets, that fits inside the hole in the yoke. The magnets some-



times become unglued from their mountings, making the unit inoperative. As shown, the unit is fairly simple to replace—just snap out the old, and snap in the new.



Chassis: Zenith 29JC20
Symptoms: Loss of color
Tip: Several other symptoms may accompany this defect: The loss of color may be intermittent; the fine tuning may be critical when receiving a color program; the horizontal hold control may also be touchy, causing changes in color hue. When symptoms of this nature appear, try replacing C107, the 2 mmf capacitor connected between the grid and plate of the 3.58 mc control tube. This capacitor has opened in a number of these chassis, causing the symptoms mentioned above. After replacing C107, it's a good idea to check and, if necessary, realign the color sync stages. ▲



CADDY GUIDE for Color TV Servicing

Glance at the size of the caddy(s) you presently use for regular TV service calls. Add a color-bar generator, degaussing coil, and the other extras needed for servicing a color receiver, and then try to "tote" the combined total to your truck without making at least two trips. You'll quickly see the need for a special caddy—just for color.

The tube guide we've shown here is for that purpose, and will enable you to service all the major color receivers introduced since 1955. If you aren't presently doing enough color work to warrant a special caddy, keep this list handy for future reference.

You'll notice the chart is in two parts. The bottom list specifies only tubes used in color receivers produced in late '63 and early '64; whether you'll carry the tubes in this list will depend on the sets you'll be servicing. Tubes and fuses marked in the main chart with an asterisk (*) are used mostly in early-model color receivers; to carry these is also optional. If your area has UHF stations, make sure you carry the tubes marked with the ‡ symbol.

In addition to the components listed, it's a good idea to carry a couple of 3.58 mc crystals—one metal-encased type and one with a glass envelope. You may wish to include a small stock of detector diodes, such as the 1N60, 1N64, and 1N295. The chart also lists tubes you'll encounter from time to time in remote control units for color receivers.

TUBE TYPE	CADDY STOCK	TUBE TYPE	CADDY STOCK	TUBE TYPE	CADDY STOCK	TUBE TYPE	CADDY STOCK	TUBE TYPE	CADDY STOCK	TUBE TYPE	CADDY STOCK
1V2	2	6AU6A	2	6BZ6	2	6DV4	1‡	6GM6	2	6KA8	1
1X2B	1*	6AU8A	1	6CB5	1*	6DW4	2	6GU7	1	6KT8	1
3A3	3	6AW8A	3	6CB6	2*	6EA8	2	6GX6	1	6SN7	1*
3AT2	1	6AZ8	1*	6CG7	2	6EH7	2	6GY6	1	6T8	1*
3DG4	1	6BA11	1	6CL6	1*	6EJ7	2	6HB6	1	6U8	2
5U4GB	1*	6BC8	1	6CN7	1	6EM7	2	6HE5	1	6X8	1*
6AF4A	1‡	6BK4	2	6CQ8	1	6EW6	2	6HF5	1	12AT7	1*
6AG7	1*	6BN6	1	6CW4	1	6EV7	1	6HL8	1	12AX7	1
6AL5	2	6BN8	1	6DE6	2*	6FH5	1	6HS8	1	12AZ7	1
6AN8	1*	6BQ5	1	6DQ5	3	6FQ7	2	6HZ6	1	12BH7	2
6AQ5A	3	6BQ7A	1*	6DS4	1	6GH8	2	6JH8	2	12BY7	2
6AU4GTA	2	6BY6	1*	6DT6A	1	6GK5	1	6JU8	1	12GN7	1

TUBES USED IN LATEST COLOR RECEIVERS (NOT LISTED ABOVE)

TUBE TYPE	SUGGESTED STOCK	TUBE TYPE	SUGGESTED STOCK
1AU2	1	6JE6	1
3DT6	1	6JC6	1
4BL8	2	6JH6	1
4HA5	1	6U10	1
6BL8	2	7GU7	1
6BM8	1	12GC6	1
6DQ6	1	15CW5	1
6EZ5	1	15DQ8	1
6FG7	1	15LE8	1
6GF7	1	15HB6	1
6GL7	1	16A8	1
6HA5	1	19AU4	1

FUSES (2 OF EACH)

RATING	TYPE
3/10A	N S/B
3/10A*	C
.45A*	3AG
½A	N S/B
¾A*	C
¾A	3AG
2A	3AG
3.5A	C
4.5A*	3AG
10A	3AG S/B

*Used in Early Color Receivers (CTC4, CTC5)
‡In UHF Areas

CRT Brighteners

(Continued from page 76)

an early remedy, the serviceman could probably have added a few extra months of life to the tube. That's what happened with the set in Fig. 2. The serviceman noticed this one dimming about four months after it started to weaken. He convinced his customer that a brightener *might* extend the life considerably. He installed one, and the customer was pleased to observe the picture improvement shown in Fig. 3. Compare the two; it's easy to see that the customer would have been sold on a brightener simply on the basis of the immediate improvement. If the overall life of the tube was extended, then the customer merely got a bonus.

Servicemen who successfully use and sell brighteners make a strong point of the immediate improvement; it's a good selling point. But they are also very careful to point out the temporary nature of the results. There is nothing but a callback to be gained from a customer who expects a dim three-year-old picture tube to last another three years after a brightener is installed. In the set shown in Figs. 2 and 3, the picture tube was dim again in about six months; but, as the customer himself pointed out, the brightener made those months of viewing more enjoyable.

The Inside Story

A brightener is a very simple device, actually—thus, its low cost. It consists of a small transformer with a stepup voltage ratio of about 1:1.2. In the diagrams of Fig. 4, two types of brighteners are shown—the isolated type and the autotransformer.

There are four primary classifications into which picture tubes fall

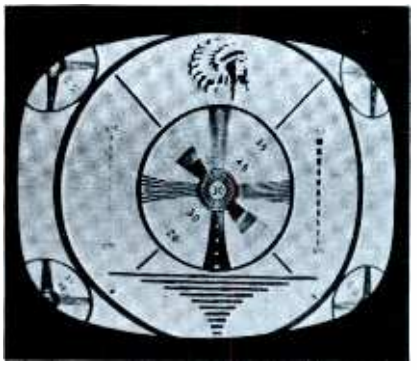


Fig. 3. Still not tops, but enough better to please the customer immensely.

when you're trying to choose a brightener to fit them—duodecal (most older sets), button-base 8-pin (used on 110° tubes), shell-base 8-pin (also for 110°), and the large neodiheptal socket used on color CRT's. All brighteners are designed to be plugged directly onto the base of the CRT; the CRT cable from the chassis can be plugged onto the other end of the brightener cable. The units shown in Fig. 4 are for a standard duodecal socket.

In older brighteners, it was necessary to consider whether the unit would be used in a set with series or parallel filaments. There are modern designs that can be used with either type. In fact, it is possible in some lines to stock only four types and take care of most monochrome and color CRT requirements; only the sockets are different. The switch shown in the autoformer circuit of Fig. 4 permits choosing whichever mode of operation suits the filament circuit of the set in which the unit will be used.

There are also designs which perform auxiliary functions in addition to brightening the picture. A CRT with a heater-cathode short can, in many cases, be used with no problem whatsoever, merely by inserting a brightener of the isolated type. Fig. 5 shows an example of how this is possible. In the upper diagram, the heater-cathode short can ground the filament string at the CRT, causing possible burnouts of other tubes in the string. In the lower circuit, the windings of the brightener isolate the short, and this

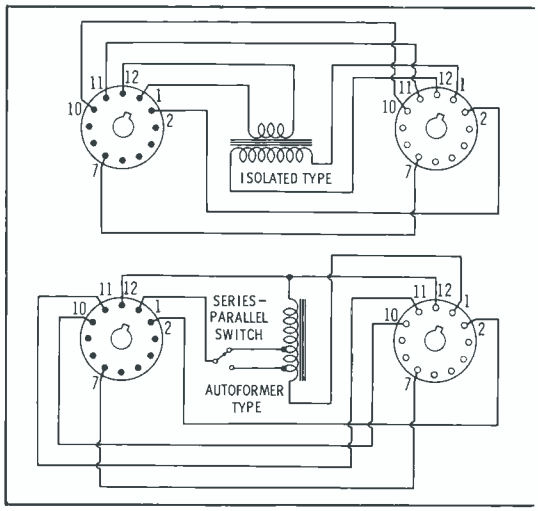


Fig. 4. Two of the most common types of CRT brighteners—for duodecal tubes.

prevents overloading the first few filaments in the string.

For Color

The primary difference between monochrome brighteners and those for color CRT's is the socket. However, since there is only one filament voltage in present use for color picture tubes — 6.3 volts — one type of brightener can fill all needs. Color brighteners are usually of the autoformer type.

It might seem that a brightener would affect all the guns equally in a color CRT, because the heater voltage is increased on all of them when a brightener is installed. In general, this is true; in a number of cases, however, the effects of the brightener have been most pronounced on the guns that are weakest. In one set, the red gun had become so weak that the red screen control was wide open and it was

Table I—CRT Voltages and Currents

BASE	DUODECAL	BUTTON 110°	SHELL 110°	NEODIHEPTAL (COLOR)
8.4 VOLT	450 ma	450 ma	no	no
6.3 VOLT	300 ma	300 ma	no	1.8 amp
	450 ma	450 ma	450 ma	
	600 ma	600 ma	600 ma	
4.7 VOLT	300 ma	no	no	no
2.68 VOLT	no	450 ma	no	no
2.34 VOLT	no	600 ma	no	no

still difficult to get enough brightness with proper gray-scale tracking. With a brightener installed, the weakened red cathode was "stirred" into action, and more electrons became available to be sent through the red gun. The other cathodes, which already had plenty of free electrons, were heated too; but the color screen controls had to be adjusted only slightly to cut the beam current back to normal. Thus, in effect, the red gun was the only one that was affected to any great degree by the brightener.

What To Buy

Now you know when to use a brightener, and what for. How do you go about choosing the exact model to install? You must know three things: what type of base the CRT has, what voltage and current the CRT requires, and what type of filament circuit the set uses.

Table I indicates the different voltages and currents that are used with most presently available CRT's. If you can tell your supplier what category the CRT belongs in, he can usually tell you what brightener to use with it. Some manufacturers provide charts that set forth this information.

You can carry a small stock of brighteners that will fit most purposes, at a rather low investment. Then, when your customer asks for the alternative to buying a new picture tube, explain that there may be a way out. Try a brightener. You have nothing to lose, and the customer has a few months of better viewing to gain—at low cost. You'll be doing both him and yourself a favor. ▲

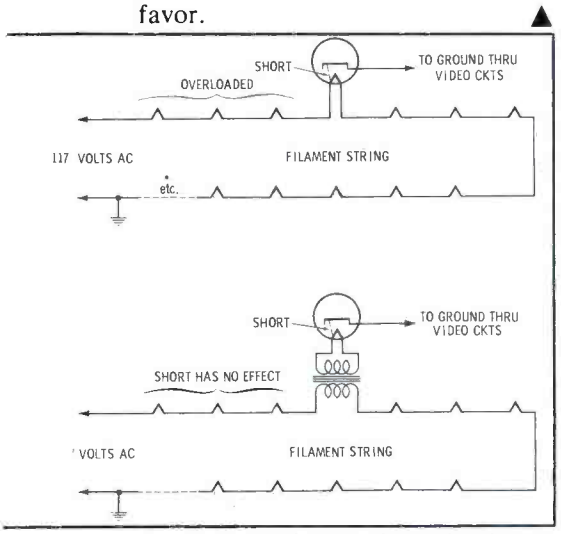


Fig. 5. Isolated type of CRT brightener makes shorted picture tube usable.

Troubleshooter

(Continued from page 19)

channel and back again also gives a temporary cure.

R. FARRINGTON

St. Thomas, Virgin Is.

The nuvistor tuners used with this chassis have occasionally run into difficulty with oscillation of the RF stage. Sometimes you can check for this condition simply by disconnecting the antenna, or running your hand along the lead-in, and watching to see if the herringbone pattern changes. The oscillations can sometimes be stopped by squeezing the ground tabs on the metal shell of the nuvistor, to establish better contact with the socket. Another measure that may be helpful is a slight touch-up of the neutralizing trimmer in the RF stage. If the herringbone pattern persists, you'll save time by discussing the problem with your nearest RCA Victor distributor.

Color CRT Swaps

Do you have any information about installing one of the newer and more efficient types of tricolor picture tubes in an RCA Chassis CTC7?

RAY R. COOPER

Lompoc, Calif.

From several sources, we've heard of troubles that have been encountered in replacing the 21CYP22 with the newer sulfide-phosphor tubes (21FJ22). The new types have the HV anode connector in a different location, and are designed to use new-style mounting brackets. As a result, installations of these tubes in CTC7's have often been plagued by arcing between the anode and the mounting hardware—hard to stop, once it gets started! Another hazard has been damage to the filament of the new CRT as a result of a high-voltage flashover within the gun structure.

This isn't all. In the new tubes, the efficiency of the red phosphor has been almost equalized with that of the blue and green phosphors, thus making it no longer necessary to provide extra drive to the red gun. Accordingly, the red color-difference and CRT drive circuitry of an older set must be carefully modified to be compatible with the new tube.

To sum up, color-CRT conversion does not appear to give enough improvement in picture quality to justify the difficulties entailed.

Retrace Lines in Color

An RCA Chassis CTC10 works fine except for vertical retrace lines that appear after a warmup period of 30 minutes. All waveform and voltage measurements seem okay in the video, sync, and vertical circuits. An explanation of the vertical blanking in this receiver would be appreciated.

W. M. THORNTON

Round Lake Beach, Ill.

The blanking circuit consists merely of two resistors (a 100K and a 68K) wired in series from the plate of the vertical output tube to the plate of the video output tube. Many other color chassis use a capacitor in series with a resistor. Either way, the extremely high-amplitude vertical output pulses are reduced to approximately 100 volts peak to peak, by the voltage-dividing action of the blanking network and the video plate-load circuit.

Your description of the trouble suggests that one of the blanking resistors is opening when hot, thus removing the vertical pulses from the video input to the CRT. You can verify this supposition by observing the plate waveform of the video output tube while the retrace lines are just beginning to appear. In a normal signal, the blanking pulses can be seen plainly as sharp positive spikes rising above the "back porch" of the vertical sync pulses. These spikes normally remain even when the tuner is switched off channel, but will disappear if the retrace coupling circuit becomes open.

Ghost Riders?

An RCA Chassis CTC7A has some sort of ghost problem. For instance, in one scene that showed a black horse running across a field into the distance, a *white* horse appeared to be keeping pace with him, staying about 50′ to his right. I can reduce this secondary image by reorienting the antenna, but it is still strong enough to detract from viewing. When I tried a yagi antenna, it only made the ghost stronger—although it

did eliminate the phase reversal of the ghost signal.

R. VAN CAMP

Long Beach, Calif.

The receiving site may have an unusually severe problem with RF signal reflections; if so, any set connected to the existing antenna should show the same characteristic ghost pattern. You might save a lot of trouble by taking along a portable TV on the next call and thoroughly checking the quality of reception.

If the source of the ghost proves to be inside the color receiver, one of the first things to check is the delay line in the video circuit. This component sometimes develops a defect that changes its impedance, causing it to be improperly terminated. When this happens, signals will be reflected back through the delay line and returned with an additional time lag. Temporarily clip a jumper across the input and output terminals; if the ghost disappears, try replacing the delay line.

Other ghost-producing troubles in color sets are similar to those encountered in black-and-white TV; a couple of examples are regeneration or misalignment in the IF strip. The first step in tackling such problems is simply to check and make sure all shields are properly installed and grounded.

Concealed Culprit

Please advise Mr. Richard S. Howison (September *Troubleshooter*) that his intermittent sound trouble in Zenith Chassis 16E21Q is caused by C37, the 470 mmf capacitor across the secondary of the sound IF transformer. This unit is easily overlooked, since it's mounted inside the transformer can. I'm a Zenith dealer, and happen to have had the same trouble with two similar sets. The capacitor is so touchy that the set may act up on one day and be all right for the next two days or more. A capacitor checker won't spot the fault. As an extra precaution, it's a good idea to resolder all the leads on the transformer.

CECIL R. HYMEL

Innis, La.

I know just what Mr. Howison is going through. I've encountered four cases of this trouble in the past six months, and nearly pulled my hair out on the first one. If he will replace C37, the 470 mmf capacitor in coil L12, I am sure his problem will be ended.

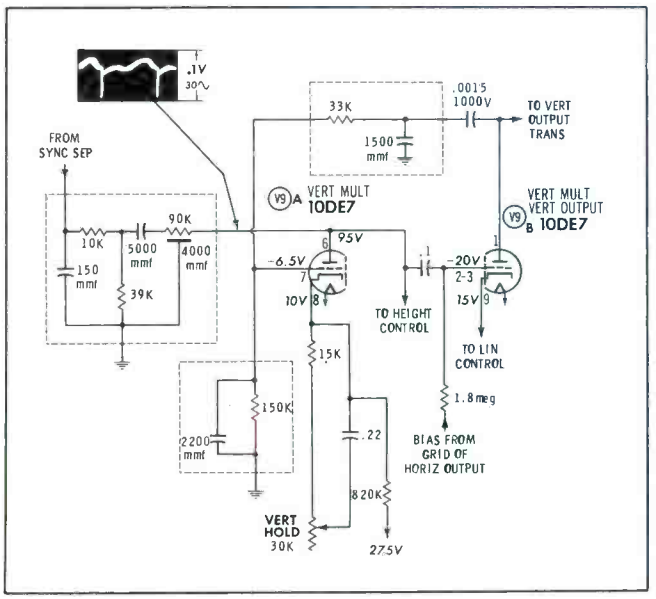
EDWARD H. LASTEIN

Laurence Harbor, N. J.

You might know it—we recommended checking every other capacitor in the sound IF circuit, and skipped this one! Thanks very much, fellows, for helping us correct this oversight.

Sync Too Weak?

When a Philco Chassis 9L35 (PHOTOFACT Folder 425-2) is turned on, the picture is always rolling as it comes into sight. The rolls can be stopped with the vertical hold control, but the



action of the control is very critical. Once the sync is stabilized, the picture stays locked in for awhile; then it begins to roll slowly. I've checked voltages and resistances, and substituted parts in the sync and vertical circuits; I don't know what I've overlooked.

J. ELWYN ARNOLD

Fieldale, Va.

Fairly critical vertical hold can be expected in this set, since the sync pulse obtained from the integrator (W6 in the schematic) normally has an extremely low amplitude. This weak pulse is adequate to lock in the picture under ordinary conditions, since it is amplified by the vertical output tube before being fed back to the grid of V9A to trigger its conduction. However, various troubles in the sync or picture circuits can cause virtual disappearance of W6, with consequent loss of vertical sync; furthermore, even a normal pulse may be too small to overcome slight frequency drifting due to marginal faults in the vertical multivibrator.

Component substitution, such as you've been doing, is a good way to eliminate drift troubles. But before proceeding with this method of servicing, try monitoring W6 to see if the sync pulse intermittently loses amplitude or disappears entirely. If it does, use the same monitoring technique to trace back through the sync-separator and noise-inverter stages—and, if necessary, work back through the video circuits. The plate of the sync separator should display clean vertical sync pulses with an amplitude of 25 to 35 volts, and preceding points in the signal path should have normal composite video waveforms.

An alternate type of integrator unit, Philco part number 30-6030-9, has been used in some of these sets in place of the 30-6030-6 shown on the schematic. Changing to the alternate type might possibly improve vertical sync.

Half-Dead B+

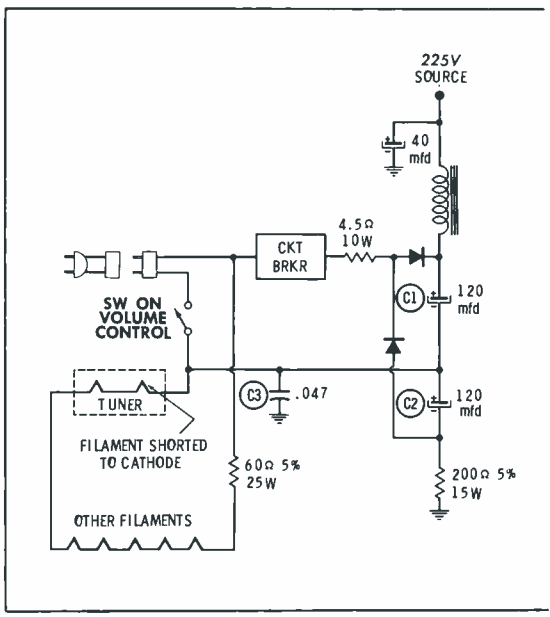
I have on my shop bench a Silvertone Chassis 528.50180 (PHOTOFACT Folder 411-2) that has fairly normal sound, but lacks high voltage. The output of the B+ supply measures only 140 volts instead of the normal 230 volts. Changing the filter capacitors and selenium rectifiers has proved fruitless, and no short has been found in the B+ load circuits.

EMIL SAVINO

(address not given)

This trouble, a fairly common one in several different Silvertone chassis of this vintage, is usually traced to a filament-to-cathode short in one of the tuner tubes. As shown in the schematic, the series filament string and AC input circuit in these sets are isolated from the chassis, with one side connected to the junction of the B+ voltage-doubler capacitors C1 and C2. When this point is grounded to chassis by the short in the tube, the filament circuit can still function normally, but one-half of the B+ voltage doubler is disabled; therefore, the voltage delivered to the B+ load is only half of normal. Notice that a short in C3 would produce the same symptoms.

Sometimes the short causes the affected tube to burn out, as described in "Unusual Faults in Filament Circuits" on page 35 of the January, 1963 PF REPORTER. *However, there is a fair probability the tube will continue to operate, resulting in the symptoms you have reported.* ▲



Analyze Troubleshooting

(Continued from page 35)

AGC signal is divided into two equivalent portions, to perform their action in both the sync and the AGC sections.

One interesting aspect of such a diagram is its ability to show the source of action for a stage, and the next action in sequence. For example, take the AGC. Even if it were not labeled as a keyed type, the signal path from the horizontal output stage would be a giveaway. And the action of the stage? According to the arrows, the output is a DC voltage fed back to the first two IF stages and the tuner.

A similar action-reaction chain is demonstrated in the horizontal AFC circuit. The action diagram indicates that signals are received both from the sync stages and from the horizontal output stage. The two signals are compared, and develop a controlling DC voltage for the horizontal oscillator, to hold it on frequency. Sure is easy to see when it's drawn out like this, isn't it?

Analyzing Stages

Now comes the part that really gets you into the real thing—troubleshooting within the stage, and finding the actual defective part. There are two ways you can look at a stage from a troubleshooting standpoint, and it is very important that you remember these two classifications; your success as a conqueror of tough dogs could very well rest on learning to apply the facts in this discussion.

Signal Handling

Almost every stage of any electronic device processes signals in some way or another. Even if its output is DC (like a rectifier stage), it handles some form of signal. The signal may be 60-cps line voltage, or it may be UHF television frequencies; the point is: in some way or another, nearly every stage handles signals.

We can expand on this somewhat. *The manner of handling is invariably determined by the components*—their type and value. For example, look at the two simple amplifier stages in Fig. 3. They are very similar, except for parts values. The signal in A must be a fairly low frequency, because of the large

coupling capacitor and the large values of the bypass capacitors; also, the output load is an iron-core unit generally associated with low-frequency signals. The stage at B, on the other hand, would not handle low-frequency signals. The small-value coupling capacitor will pass only higher frequencies; the bypass values are such that low-frequency signals entering the stage encounter serious degeneration. Lastly, the output coupling device is an air-core transformer, suitable mostly for higher frequencies. Thus, a quick look at the components values by an experienced technician would tell him instantly whether the stage would pass or attenuate audio signals.

Now, let's examine the various portions of a stage, and see how signals are handled within the stage. If we know how to follow the progress of a signal within a stage, we can tell when this path of progress is broken; this is the secret to isolating the defective stage. Fig. 4 shows how a signal progresses through a normally functioning stage.

First, consider the input circuit of

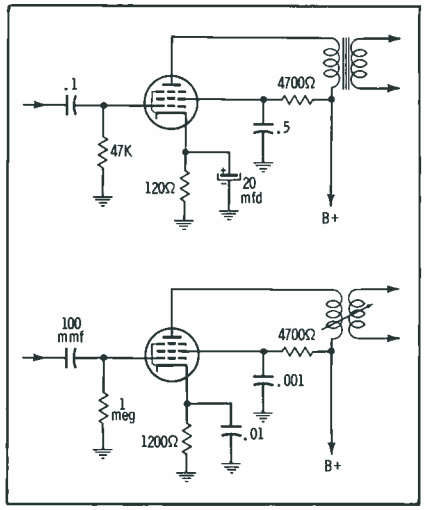


Fig. 3. Component values and types are key to exactly how stage works.

the stage as the load for the previous stage. The input could be a coil or transformer, or an RC network as shown. The important thing is that the input circuit receives some form of signal from from the preceding stage. When troubleshooting, be sure the signal is being delivered properly to the input portion of the stage.

Next, the input circuit can be considered as a generator of signals for the stage. Ignoring the prior stage, you can now treat the input circuit as the source of signals which are being applied to the grid of the tube.

The tube is a signal-passing device (a transistor would serve the same purpose in a transistor set). It may amplify the signal, it may mix several signals, it may eliminate certain signals, (as a sync separator eliminates video), it may change the signal to DC, or it may simply pass the signal along without amplification (like a cathode follower). In any case, it acts as a load for the input circuit; it must receive and process the signals being fed to the input. In processing the signals, it then becomes the "generator" of signals for its output load circuit. In troubleshooting, therefore, you must be sure the tube first receives the correct signals, and then passes the correct signals on to the output load.

The third drawing in Fig. 4 shows the output circuit and the two ways of considering it. It acts as a load for the tube, on the one hand. On the other, it can be considered as the "generator" of signals for the input circuit of the next stage.

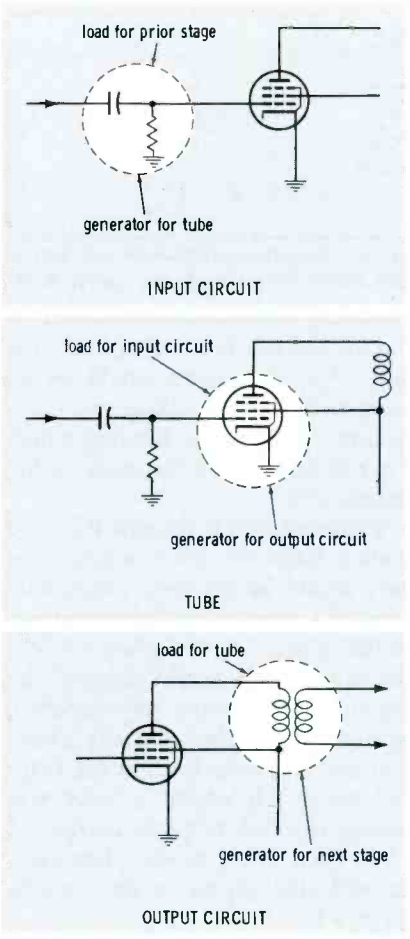


Fig. 4. Each portion of stage can be considered separately for analysis.

The simplified schematic in Fig. 5 — of a noise-cancelling keyed AGC system — shows how several forces can act upon the same stage. But you'll notice you can still apply the reasoning outlined above: The tube is the load for the input circuits, but is the generator for any signals (or, in this case, the DC voltage) passed on to the output circuit or to the next stage. The tube in Fig. 5 is a load for three different signals: negative-going video (and sync) at the grid, positive-going video at the suppressor grid, and the horizontal-frequency keying pulse at the plate.

You'll notice that both an input and an output are connected to the plate. Here is an example of how components can affect the way a signal (or voltage) is handled: The high-value resistor keeps signal voltages from entering the DC output path, while the capacitor keeps DC out of the keying-signal input path.

Thus, no matter how complicated the stage, it can be broken down into individual signal-handling circuits. And this method of considering every portion of the stage as

either a signal load or a signal generator can help trace the action in any stage. Even an oscillator is simply an amplifier that provides its own input signal. Sketch an action diagram of an oscillator; it should look something like Fig. 6.

DC Handling

While every stage can be considered as a signal-handling device, it can also be analyzed from the viewpoint of how it handles DC supply voltages. While tracing the signal is the quickest way to localize the stage in which a fault lies, and may occasionally help pinpoint a faulty component, the remainder of faults will be tracked down by applying a knowledge of how power-supply voltages affect the tube, and how the stage affects the voltages.

Take a look at Fig. 7A. The various voltages are shown as they are applied to an ordinary pentode tube. The tube is also represented as a group of variable resistances in series. The voltage effects on plate current are as follows: The B+ applied to the plate makes the resistance of the tube lower (increases plate current), as does B+ applied to the screen. The grid bias is negative, and thus increases the resistance (lowers the plate current) as it becomes more negative. The suppressor voltage can increase or decrease plate current, depending on whether it is (respectively) positive or negative; at ground potential it merely suppresses secondary emission.

In Fig. 7B is an actual circuit, with the signal-handling components omitted; only those parts are shown that affect DC voltage distribution within the stage. The tube is represented as one resistance that is variable depending on the values of screen voltage and grid voltage. These two voltages are the only ones considered, because they have the most effect on current within the circuit; *plate* and *cathode* voltages depend mostly on plate current, and not vice versa. In fact, plate and cathode voltages can shift considerably without great effect, *provided* the grid and screen voltages are held constant. Remember this fact; it will be used many times in your troubleshooting.

Thus, if the plate voltage of V1 is low, look for some fault that has increased the current through the tube

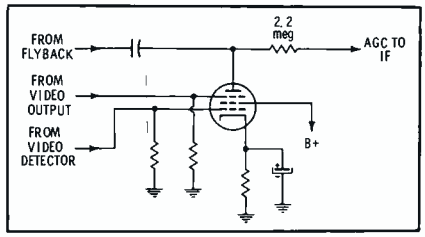


Fig. 5. Simplified schematic of keyed AGC stage shows multiple signal path.

—causing the constant resistance of R1 to reduce the voltage at the plate. Possible causes would be an increase in screen voltage or a reduction in grid bias. Finding which it is will put you on the track of the defective part.

Suppose cathode resistor R2 were to open. Since no current could flow, there would be no drop whatsoever across R1, and the full plate voltage would appear at the plate of V1. The same result would occur if the grid suddenly became very negative, cutting off the plate current within the tube. A quick check at the cathode would tell which actually was causing the lack of plate current; if R2 is open, most of the plate voltage will also appear at the cathode pin of V1.

It is easy to see that many possible faults could affect the DC distribution within any stage. It is necessary only to know what normal voltages exist, and the abnormal ones can be traced to a cause. If bias is dependent upon signal, lack of it may indicate that signal is not being provided by an earlier stage. On the other hand, it may indicate that a leaky coupling capacitor is reducing the bias. In either case, the lowered plate voltage points to reduced bias, which in turn leads toward the cause.

Practical Troubleshooting

Now let's see how you can apply this way of thinking about troubleshooting, and turn it into cash in your pocket. You can do so by using this form of thinking to help you troubleshoot every electronic device you're asked to service—the simple radio, a tough-dog TV, or

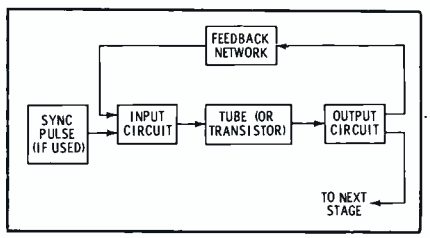


Fig. 6. Action diagram of oscillator.

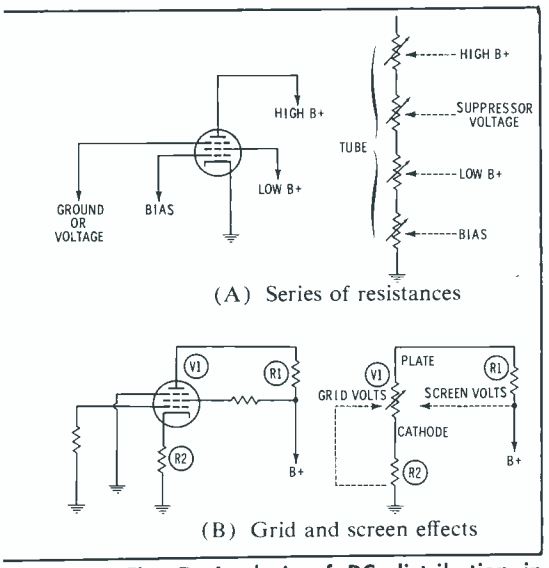


Fig. 7. Analysis of DC distribution in stage, with effects of voltage changes.

the complicated radar system on an ocean liner. The rules are the same for all: (1) Make a brief thorough *inspection*. (2) *Isolate* the inoperative section by analyzing the sequence of actions from input to output of each stage, and from stage to stage. (3) *Pinpoint* the defective part, either by tracing signals or by analyzing the DC distribution within the stage.

Once you've mastered this technique, you'll rapidly become known as an expert—the guy who can service anything. And you'll be handling most of your troubleshooting with your brain (which almost always can work more quickly and profitably than your hands).

Special Generator

Something unusual is the Model 407 Remote Aligner by Simpson. This instrument furnishes crystal-accurate signals for alignment of television remote control receivers. Although the instrument comes factory equipped with up to four channels, specified by the purchaser, an extra crystal socket on the panel accepts crystals for any remote control system that operates between 35 and 45 kc. A special lock-in control optimizes operation of the instrument with any specific crystal in that frequency range. If a number of different systems will be encountered, it is a simple matter to stock a crystal for each supersonic frequency involved, enabling the user to check and align almost any type.

With the unit producing the proper waveform, the signal level can be adjusted by an output control on the panel. For low-output operation, a 100,000:1 attenuator probe is included with the instrument, and the test cables accomodate a variety of input connections. Transmitter units can be checked for frequency by beating their output with that of the Model 407, and checking for a zero beat.

A lot of servicemen, who need more than one transmitter unit for testing and adjusting the several types of remote-control systems now being used, will find this unit the answer to their problem. ▲

For further information, Circle 92 on literature card.

Test Generators

(Continued from page 33)

first several microseconds of the horizontal sweep. Then the mixer is turned on, and the 3.58 mc signal —at whatever phase has been selected by the switch—reaches the modulator stages and is fed to the receiver. Near the right end of the horizontal line, several microseconds before the beam flies back to start another line, the burst gate again cuts off the mixer. The result is a horizontal scanning line that is first black (no color), then contains a section of color, and then goes black again. When the raster is completely swept, the color appears as one wide vertical bar in the screen; thus the term "single bar."

Full-Display NTSC

The full NTSC color generator is by far the most elaborate type presently available. Fig. 6 shows the signal that is generated by one unit of this type. The waveforms show what takes place during two horizontal scanning lines. You'll notice the bars

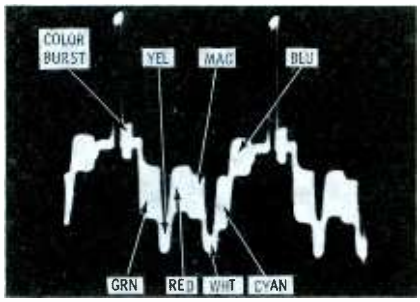


Fig. 6. Output of full-NTSC instrument uses varying amplitude levels as well.

are not exactly in the order indicated on the color wheel of Fig. 4, but are in an order chosen by the manufacturer.

Again, a delay line is used to establish the phase of the 3.58 mc signal for each color. The big difference is that a very complex and elaborate electronic switching system selects the different taps at predetermined intervals along the horizontal scanning line. Thus, when the entire raster is swept, the different-colored sections of the horizontal lines appear as vertical bars of selected color across the CRT screen.

Table I—Color TV Test Generators

	Full NTSC	Single-Bar NTSC	Keyed Rainbow	Rainbow	Dots	Crosshatch	Vertical Lines	Horizontal Lines	RF Carrier	Sound Carrier (4.5 mc)
Accurate Inst. Model 156					X	X	X	X	X	X
B & K Model 850		X			X	X	X	X	X	X
B & K Model 1074				X	X	X	X	X	X	X
B & K Model 1076				X	X	X	X	X	X	X
EMC Model 800					X	X	X	X	X	
GC Electronics Model 36-6101					X		X	X		
Heathkit Model IG-62			X		X	X	X	X	X	X
Hickok Model 656XC	X				X	X	X	X	X	X
Hickok Model 660				X	X	X	X	X	X	
Hickok Model 661		X			X	X	X	X	X	
Jackson Model 800		X			X	X	X	X	X	X
Precision Model 450			X		X	X	X	X	X	
RCA Model WR-64A			X		X	X			X	X
SENCORE Model CA122			X		X	X	X	X	X	X
SENCORE Model CG126			X		X	X	X	X	X	
Simpson Model 430	X								X	X
Win-Tronix Model 150				X					X	
Win-Tronix Model 250					X	X	X	X	X	

The block diagram of Fig. 7 shows an extremely simplified version of how this system functions. Two oscillators initiate the main actions. The 15,750 cps oscillator feeds a timing delay line whose chief function is to switch on (gate) the adder stages at the beginning and end of each bar, thus setting the duration of each bar. The 3.58 mc oscillator furnishes a burst signal for synchronizing the set's reference oscillator with the generator, and a 3.58 mc signal for the color-phase delay line. This delay line determines the phase of the 3.58 mc signal fed to the adders. The outputs of the color adders are mixed with the synchronizing burst in a composite adder, and fed on to the output or modulator of the instrument. There are many shaping and timing networks that are not shown in Fig. 7, but the general function is apparent.

If you are familiar with all the various signals used, you will have little trouble putting to use any type of generator you may purchase. Some servicemen have expressed a preference for one type, some for another. With the understanding you have gained of the various types, you should be in a position to decide for yourself which unit you can use to best advantage with your particular method of servicing color sets. Waveform information for both NTSC and keyed-rainbow signals will soon appear on most service information for modern color sets. When you're servicing those old chassis for which waveforms haven't been provided, it is absolutely necessary that you know the characteristics of the test signal provided by your test generator, as we've described them.

The chart in Table I shows several of the more recent signal generators for color servicing. None of these are sweep generators of the type used for alignment; they are strictly intended for analyzing, testing, troubleshooting, and adjusting color circuits. Some are for convergence only; others can be used for chroma testing as well. The various auxiliary features that might apply are included in the chart, such as whether the unit has an RF output or must be connected to the video section of the receiver. Not indicated is the fact that some of these units include other TV test functions that do not necessarily apply only to color sets.

Evaluate your own service procedures. Check into those presented in this and other issues of PF REPORTER. Decide which generator can best serve your needs, and then learn all you can about the signal it generates. Your trouble will be amply rewarded by the increased speed and ease with which you can handle the toughest color TV repairs. ▲

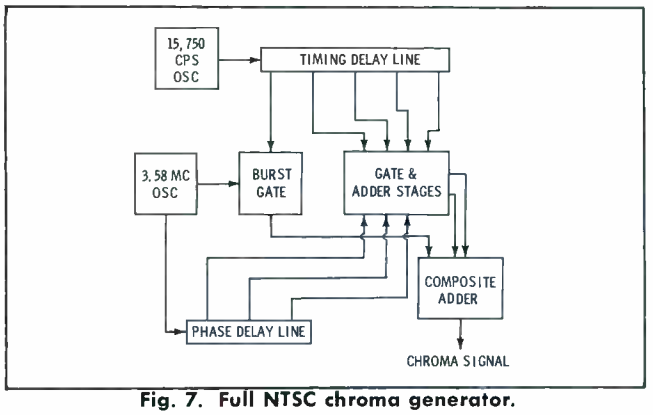


Fig. 7. Full NTSC chroma generator.

CCTV in Color

(Continued from page 37)

initely here and is being implemented in those applications where it is already paying its own way. Much of today's color equipment for CCTV is drawn from the broadcast field and is virtually interchangeable between the two applications. Some typical pieces of equipment are shown in the accompanying illustrations.

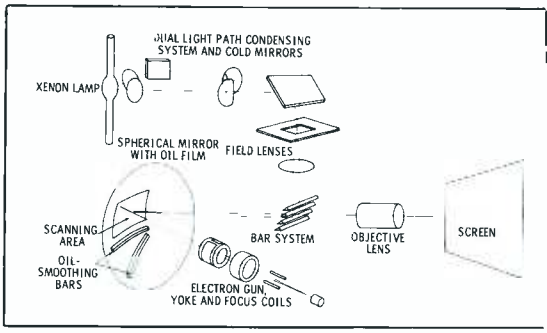
Let's consider some basic elements that go into a modest sized color system, as might be found in a modern hospital. Since it is important that no technical personnel be in the operating room, the camera is controlled remotely. This may be accomplished from a nearby control room. Equipment racks contain a video monitor that may be switched to each of the three color channels (red, blue, or green), a waveform monitor, and a lens control for remote focusing, zooming, and adjusting the lens diaphragm. Also in racks are sync generators for the whole system, scanning generators, and correction signals for the camera tubes. Test signals for alignment are also provided. Another rack contains audio equipment —limiters, amplifiers, and necessary intercom circuits. In effect, the color CCTV system is a TV studio in miniature, with signals confined to a video cable. Where long-distance operation is contemplated, coaxial and microwave facilities of the telephone company are available, or a private microwave link may be installed.

One major technological advance giving some impetus to color is the projection system. Viewing is not confined to the 21″ screen, since color images may be enlarged up to 12′ by 16′. A Swiss-made unit, the *Eidophor,* exploits a high-intensity light source in an electro-optical arrangement. Electrons from the CRT gun "engrave" picture information on a layer of oil. Light from a xenon-arc lamp is then modulated as it passes through "wrinkles" in the oil, and the result is projected on a screen.

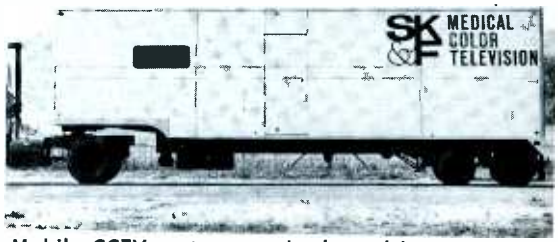
The Future

Can the high basic investment in equipment, which seemingly rules out color for the occasional user, be overcome? The answer is "yes," as already discovered by several firms who need a color CCTV setup perhaps once or twice a year. Companies have been formed that specialize in providing color CCTV facilities on a short-term basis. One large organization owns the equipment, and furnishes all technical and production resources needed to cover an event. Judging from its success, this lease arrangement has been the most satisfactory solution to date for color on an interim basis. Clients for this service include representatives of business, industry, education, and government.

The varied opinions on color CCTV's future—ranging from "no demand" to "it's developing fast" —appear to confirm that the medium is having growing pains. But one useful indicator is the history of black and white. Only after considerable production and success in the entertainment field did monochrome diversify into closed-circuit application to an appreciable degree. There are signs that color CCTV may enter through a similar route. The complexity of color entertainment equipment is creeping downward, as are the prices, and production rates are rising. These factors should ultimately transfer the particular benefits of color to CCTV on an even greater scale. ▲



Xenon-arc lamp, optic condensers, cold mirrors, and oil-covered spherical mirror are all part of special high-intensity projection device in one system.



Mobile CCTV system can be leased by a company for any period of time.

PRODUCT report

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

80-Watt Stereo Amplifier (161)

The latest version of the 299-series stereo amplifiers by **H. H. Scott, Inc.** is the Model 299D. This low-distortion amplifier features a switched, front-panel headphone output for private listening, a powered center-channel output for driving an independent nonamplified speaker system, a harmonic distortion less than 0.8%, and a hum level of –80 db. The power rating is 40 watts per channel within a frequency range of ±1 db from 19 to 25,000 cps. Additional features are: nonmagnetic aluminum chassis, exclusive Scott level-balancing system, large output transformers, individual tone controls for each channel, a separate power switch, a subsonic cutoff filter, and a price of $229.95.

Indoor TV Preamp (162)

A new TV preamplifier designed for indoor use has been developed by **Jerrold Electronics Corp.** Designated the Model TA-66, the unit uses two transistors to provide a gain to four sets of 7.5 db on channels 2 through 6. On channels 7 to 13, the gain is 5.6 db. Housed in a low-silhouette plastic case, the $34.95 "Indoor Super Powermate" includes a fully-isolated 117 volt AC power supply.

Tape Talk (163)

Seven new reel-to-reel tape recorders, ranging from a low-cost four-speed monaural unit to a studio-styled model for the advanced music lover, are now available from the **Revere-Wollensak Div.** of the 3M Company. Also available are four models of stereo tape-cartridge recorders, each of which is capable of providing up to 15 hours of continuous listening. The monophonic reel-to-reel Model 524, which is priced at $125.00, can play uninterrupted music for 24 hours from a 7" reel containing 3,600' of tape, operating at its slowest speed of 15/16 ips. Other models, ranging slightly higher in price, feature various functions such as two- or four-track stereo, automatic shutoff, VU meters, reel locks, outputs for external amplifiers and speakers, recording level indicators, and balanced tone controls.

On the cartridge-type recorders, several prerecorded tape cartridges can be stored in a well on the machine. Then, when the "play" button is depressed, a cartridge drops into place and is automatically threaded. After playing, the tape will automatically rewind, reject, and another cartridge will fall into place and be played. This process is repeated for up to 20 cartridges, for 15 hours of playing.

24-Channel CB Transceiver (164)

A crystal-controlled CB transceiver using 9 tubes, 5 nuvistors, and 7 diodes, has been introduced by **Polytronics Laboratories, Inc.** Designated the "Poly-Com Pro," the radio operates on all 23 CB channels, plus an additional channel for Civil Air Patrol, Government, County, etc. The receiver offers an all-nuvistor front end—including cascode RF amplifier, nuvistor 1st mixer, tunable oscillator, and second-conversion oscillator (which is crystal controlled). Featuring a 6:1 vernier tuning dial, 6 mc first IF, 455-kc second IF, and separate null and peak controls, the recevier has a "primary" AGC for improved desensitization to crossmodulation. The sensitivity rating is .1 mv for 6 db S+N:N ratio.

The transmitter contains an adjustable pi network with separate tuning and loading controls for maximum power output (a minimum of 3.5 watts on all channels). "Transmit" and "Receive" neon indicator lights are located on the front panel, along with an illuminated meter to indicate signal strength, modulation, and RF power output. The unit can also be used as a public-address amplifier. Priced at $29.95, the transceiver comes complete with microphone and mounting bracket.

Desoldering Gun (165)

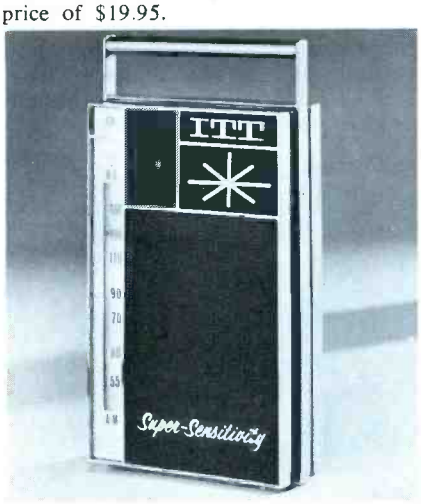
A new desoldering device, using a twin-valve vacuum system to draw molten solder from circuit boards and wiring, has been developed by **Oneida Electronic Mfg. Co.** The unit consists of a tip (which replaces the regular gun tip), a stainless-steel holding tube for melted solder, and a suction bulb equipped with twin air valves. The "Solder-Vac" fits all popular soldering guns and carries a suggested dealer net price of $7.95.

Stereo Headphones (166)

A new set of high-fidelity stereo headphones sporting a separate woofer and tweeter element for each ear is being marketed by the **Superex Electronics Corp.** The Model ST-M, incorporating miniaturized crossover networks within each phone are controlled by knob located at the rear of each phone. Other features of the 8-16 ohm headphones include a fully adjustable headband, strain-relieved cord, plastic phone cushions, and a net price of $29.95.

All-Weather Speaker (167)

Designed to equal systems many times its size, **Minneapolis Speaker's** new "Music-Mini" is an 8" speaker within a weather-resistant 20-guage steel enclosure. The speaker itself, designed to withstand high humidity and a wide range of temperatures, can deliver 8 watts of audio with a frequency response from 70 to 13,000 cps. Housed in an 8¾" x 8¾" x 4¼" cabinet, the 8-ohm unit is designated the Model MM-8-F, and carries a list price of $19.95.



Transistor Radios (168)

A new line of portable transistor radios (the 6400 series) has been introduced by **International Telephone and Telegraph Corp.** The $14.95 Model 6406 uses six transistors, has a 2" dynamic speaker, and is no larger than a pack of king-sized cigarettes. The eight-transistor Model 6408 is priced at $21.95 and uses a 2¾" dynamic speaker, while the 6409-A is a high-sensitivity, nine-transistor unit costing $34.95. Another model, the 6409-F, is a $39.95 AM/FM portable radio using 9 transistors, 5 diodes, and 1 thermistor. (Both 6409 models use 2¾" speakers.) The fifth model of the series is the AC/battery-powered 6421-FX — a portable AM/stereo/FM radio in a walnut finished cabinet with swingout speakers. It features 5 speakers, a stereo indicator, balance meter, and a price of $169.95.

Adjustable Height Desk Mike (169)

The advantage of adjustable height has been built into a new desk-top microphone designed by **Shure Brothers, Inc.** Called the Model 450 "Dispatcher," the unit features a push-to-talk switch-bar in its base, with an optional locking feature. An additional switch under the base provides instant selection of high or low impedance. Using a controlled-magnetic cartridge, the Model 450 has a frequency response of 100 to 9,000 cps. Working into a low impedance, the mike has an output of –51 db; into a high impedance, its output is –52.5 db. (0 db = 1 volt per microbar). The Model 450 comes equipped with a 7' four conductor (two conductors shielded) cable, measures 10 5/16" high (adjustable), 4" wide, and 5 11/16" deep. Its color is neutral gray, and its price is $49.95.

STATEMENT REQUIREO BY THE ACT OF OCTOBER 23, 1962; SECTION 4369, TITLE 39, UNITED STATES CODE SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF PF REPORTER published monthly at Indianapolis, Indiana for October 1, 1963.

1. The names and addresses of the publisher, editor, and business manager are:

Publisher: Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, Ind. 46206; Editor: Forest H. Belt, 4300 W. 62nd St., Indianapolis, Ind. 46206; Business Manager: Mal Parks, Jr., 4300 W. 62nd St., Indianapolis, Ind. 46206.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

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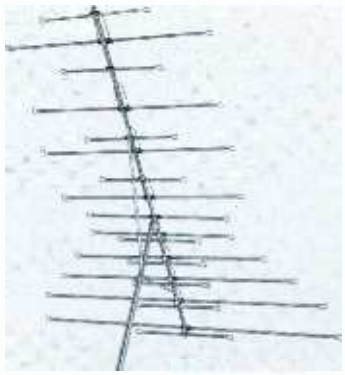
4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 80,631.

(Signed) MAL PARKS, JR., Bus. Mgr.

Sworn to and subscribed before me
this 8th day of Octoher. 1963
(Seal) Phyllis L. Shaffer, Notary Public



TV and FM Antennas (170)

A new line of TV and FM antennas by **RCA** combine the most desirable features of all-channel yagis and end-fire arrays. The three new TV antennas —each suited for both color and monochrome reception—utilize a cross-fed, stagger-tuned driven element assembly which gives high gain, flat frequency response, and high front-to-back ratio. Gold anodizing protects the antenna from corrosion, and maintains a high-gloss finish.

The wrap-around mast clamp has four pairs of jaws that prevent the clamp from crushing the antenna boom and automatically align the boom on the supporting mast; "lock-tight" elements add extra rigidity and afford easy assembly.

The Model 500 FM antenna is an 8-element broadband yagi with a VSWR of 1.25:1 and a flat 8-db gain across the entire FM band.

Industrial Two-Way Radio (171)

The "Hallmark 3000," a new 25-50 mc two-way radio with a plate input power of 30 watts, is capable of operation over normal terrain of up to 50 miles. Manufactured by **Hallmark Instruments,** the unit is designed for the business or industrial services. It includes a noise limiter, a squelch circuit, and a speech clipper to prevent overmodulation. Available for either 115 volts AC or 12 volts DC, the unit also features transistorized Class-B modulator for low power drain and, in the 12-volt model, a transistorized power supply. The Hallmark 3000 measures 4" x 11" x 8" and is priced at $269.50.

Miniature Capacitors (172)

A smaller, low-cost electrolytic capacitor called the "Trans-Lytic" is available in a wide range of capacitance values, and in voltage ratings from 3 to 25 volts DC. Manufactured by **Sprague,** this plastic-encased capacitor utilizes special low-leakage construction to meet the special requirements of transistor circuitry. In addition, it has a plastic case with thermo-setting resin end-seals to resist moisture and humidity.

Microminiature Tool Kit (173)

A microminiature tool kit designed for working on tiny, hard-to-handle parts is a new product of the **Beauchaine Sales Corp.** Tool handles of the SH-400 kit

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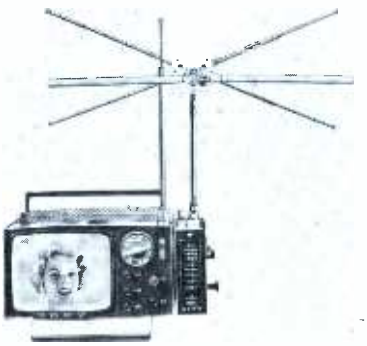
are precision balanced aluminum alloy with chrome-plated brass chucks. The ten worktips are tool steel, swaged to .030" diameter to compact the grain structure of the steel. They are precision ground and honed to such shapes as graver, chisel, needle point, spade, root knife, 180° hook, and bifurcated manipulator. Tips are 24-karat gold plated to resist contamination. Also supplied is a very fine India sharpening stone. The kit is packed in a fitted instrument case, and the individual tools are contained in plastic vials.

101 Tele-Clues (174)

A booklet titled "101 Tele-Clues" containing that many visual symptoms of TV troubles has been published by **General Electric.** Included are schematics of three GE receivers which were used to produce the symptom photos appearing throughout the booklet; the faulty components are indicated. "101 Tele-Clues" carries a part number of ETR-3700 and is priced at $1.00.



Compact Converter (175)

An all-transistor UHF converter has been designed by **Sony** to provide all-channel reception for their Model 5-303W Micro TV or their 8" Model 8-301W. The converter, Model VUC-4W, weighs only 13 oz, and is available with both a carrying case and detachable antenna. Easily installed with a minimum of connections, the unit uses an Esaki (tunnel) diode and mesa-type transistors, and derives its operating power from the TV set. Priced at $49.95, the VUC-4W is provided with an external antenna jack. ▲

CATALOG AND LITERATURE SERVICE

ANTENNAS & ACCESSORIES

93. *ANTENNACRAFT* — Catalog sheets, illustrated in color, with complete performance and pricing information on new *Gold Bonanza (VHF)* and *Gold UHF* antennas—single, stacked, or in kits.
94. *ANTENNA SPECIALISTS* — Complete set of catalog pages listing outstanding features of both amateur and Citizens-band beam antennas.
95. *BLONDER-TONGUE* — 8-page booklet "UHF is Coming to Your Town"; explains potential of new all-channel UHF market opening to service technicians.
96. *CHANNEL MASTER* — Brochure describing *Super-Crossfire* high-gain antenna, designed for both stereo-FM and TV reception.*
97. *CHARLES ENGINEERING* — Descriptive engineering brochure on *Wizard* 300 set coupler.*
98. *FINNEY CO.*—Brochure describing *Finco* 3000 Series set couplers, traps, filters, and transformers for antenna installations.*
99. *GALLO*—Descriptive brochure on FMS-101, an FM antenna system with transistorized preamplifier, entirely contained within decorative 6½" x 3¾" x 1-3/16" case.*
100. *JERROLD ELECTRONICS* — New 4-page brochure describing *Powermate* line of TV-FM preamplifiers; includes specifications and illustrations.*
101. *JFD*—Specifications and operating information on *Transis-tenna* and newly designed, long-range LPV log-periodic TV antennas. Illustrated brochure showing entire line of indoor antennas and accessories for TV and FM. Data sheets on UHF antennas.*
102. *MOSLEY ELECTRONICS*—Illustrated catalog giving specifications and features on large line of antennas for Citizens band and amateur applications.
103. *ZENITH*—Informative bulletin on new line of log-periodic vee-type antennas for FM, and monochrome and color TV.

AUDIO & HI-FI

104. *ATLAS SOUND, Div. of American Trading and Production Corp.*—New illustrated catalog 563, containing specifications of microphone stands and loudspeakers for use in public address, commercial, or industrial installations.*
105. *BRITISH INDUSTRIES* — Four comparator guide booklets containing information on *Garrard* automatic changers, *Wharfedale* speaker systems, *Gold Lion* vacuum tubes, and *Multicore* solder.
106. *ELECTRO-VOICE* — High-Fidelity catalog No. 159, a buyer's guide to component loudspeakers, accessories, and kits.*
107. *EUPHONICS* — Four informative brochures illustrating ceramic phono cartridges and microphones; cartridge cross-reference index is included.
108. *MINNEAPOLIS SPEAKER* — Descriptive catalog with illustrations of new weatherproof Music *Mini-Speaker* for indoor or outdoor hi-fi reproduction; also includes information on new 8" speaker.
109. *OAKTRON*—"The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.
110. *QUALITONE* — Wall charts, with needles pictured, for cross-reference of all popular needle replacement needs.
111. *QUAM-NICHOLS*—General catalog listing loudspeakers for commercial, hi-fi, auto, and other applications; data on new ceramic magnet speaker is also included.*
112. *SONOTONE*—4-page brochure containing information on *Velocitone Mark IV* stereo cartridge.*
113. *SWITCHCRAFT*—Product bulletin No. 134, describing stereo *Littel-Jax* 14B, for cutting out speakers when using stereo headphones, or for use in three-wire input circuits.
114. *TALK-A-PHONE*—Three catalogs of intercoms for office, industry, home, and apartment house applications.
115. *UTAH*—Catalog listing complete line of speakers and accessories for high-fidelity and public-address equipment. Also contains speaker replacement data.

COMMUNICATIONS

116. *CADRE* — Operating and instruction manual on Model 522, transistorized Power/Signal meter for 5-watt transceivers.
117. *RAYTHEON* — Descriptive sheet on *Ray-Tel* CB communications system, using solid-state frequency synthesizer.*

COMPONENTS

118. *BUSSMANN*—Bulletin SBCU on Buss Fustat Box Cover Units offers simple, low-cost way to protect workbench tools, soldering irons, drills, and the like against damage and burnout. Units fit standard outlet or switch boxes; have fuseholder, plus a plug-in receptacle, switch, and pilot light.*
119. *COLUMBIA WIRE* — Comprehensive catalog 110 describing many service-dealer wire needs plus an array of multicolor coax cables.
120. *CLAROSTAT*—Information on new *Uni-Tite* Service Center for selecting and assembling dual concentric controls.
121. *LITTELFUSE*—Catalog No. 15 showing specifications on complete line of fuses, fuse holders, and merchandising aids. Includes technical data pertaining to uses and construction of different type fuses.*
123. *MALLORY*—Condensed catalog of semiconductors (No. 9-334), listing silicon rectifiers, pre-packaged rectifier circuits, and zener diodes.*
124. *PERMA-POWER* — Descriptive literature on full line of CRT brighteners for color and monochrome receivers.
125. *SPRAGUE*—Latest catalog C-615 with complete listings of all stock parts for TV and radio replacement use, as well as *Transfarad* and *Tel-Ohmike* capacitor analyzers.*
126. *STANCOR ELECTRONICS* — Durable wallcard tabulating proper output transformer to use with each of 260 different audio output tubes; includes specifications for each transformer recommended.*
127. *TRIAD*—New catalog TV-63/64 lists many replacement items for radio, TV, and hi-fi.
128. *WALDOM*—New catalog PMR-3 gives complete list of packaged electronic and electrical products "for prototype, maintenance and repair." Includes such items as solderless terminals and connectors, hardware, tube sockets, and terminal strips. Comprehensive list of speakers for foreign-made transistor radios helps technician to select replacement types.

SERVICE AIDS

129. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflet, which also contains a comprehensive list of universal and original-equipment tuners. Shipping instructions, labels, and tags are also included.*
130. *COLMAN* — New 1963-64 catalog of radio-TV replacement components and service aids.*
131. *INJECTORALL* — New 1963 catalog showing complete line of chemicals used in electronics.*
132. *PRECISION TUNER*—Literature supplying information on complete, low-cost repair and alignment services for any TV tuner.*
133. *STANDARD KOLLSMAN* — Four-color postcard of new top-of-set UHF converter is promotional mailing piece available to dealers marketing UHF converter line.
134. *WORKMAN*—Brochure sheet No. 46C and 25C, describing new transistorized auto ignition system and transistorized power converter.
135. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight aluminum construction.*

SPECIAL EQUIPMENT

136. *ACME ELECTRIC* — Complete specifications and applications for control-type magnetic amplifiers with capacities from 5-1000 watts and voltage ranges from 24-160 volts.
137. *ATR*—Descriptive literature on selling new, all-transistor *Karadio*, Model 707, having retail price of $29.95. Other literature on complete line of DC-AC inverters for operating 117-volt PA systems and other electronics gear.*
138. *ARROW FASTENER* — Leaflets describing Model T-75 cable tacker, T-85 and T-18 low-voltage wire tackers, for speeding cable and wire installations. Illustrations showing methods used for various wire thicknesses are also included.
139. *GC ELECTRONICS*—Giant-sized catalog FR-65 contains 330 pages, forming the most complete listing yet published of new products and equipment offered by all company divisions.*
140. *GREYHOUND*—The complete story of the speed, convenience, and special service provided by the Greyhound Package Express method of shipping, with rates and routes.
141. *TERADO*—Sheet depicting wide line of 60-cps mobile power inverters and several types of battery chargers.*
142. *UNITED PARCEL SERVICE*—Special story booklet, written for the general public, gives an inside look at "Today's Radio-TV Repairman" and some aspects of his business.
143. *VOLKSWAGEN*—Large, 60-page illustrated booklet "The Owner's Viewpoint" describes how various VW trucks can be used to save time and money in business enterprises; includes complete specifications on line of trucks.

TECHNICAL PUBLICATIONS

144. *CLEVELAND INSTITUTE OF ELECTRONICS*—"Pocket Electronics Data Guides" with handy conversion factors, formulas, tables, and color codes. Additional folder, "Choose Your Career in Electronics," describes home-study electronics training programs, including preparation for FCC-license exam.
145. *HOWARD W. SAMS*—Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics; including special new 1963 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

146. *B & K*—Catalog AP-21R describing uses for and specifications of new Model 1074 Television Analyst, Model 1076 Television Analyst, Model 850 Color Generator, Model 960 Transistor Radio Analyst, new Model 445 CRT Tester-Rejuvenator, new Model 250 Substitution Master, Model 375 *Dynamatic* VTVM, Model 360 *V-O-Matic VOM*, Models 700 and 600 *Dyna-Quik* Tube Testers, and Model 1070 *Dyna-Sweep* Circuit Analyzer.*
147. *EICO*—1964 test equipment catalog and catalog sheets on new Model 430 small general-purpose oscilloscope with 3" screen, and on Model 902 IM-Harmonic Distortion Meter and AC VTVM.*
148. *HICKOK* — Complete descriptive and operating information on Model 661 *Chrom-Aligner* standard NTSC color-bar generator.*
149. *JACKSON*—Complete catalog describing all types of electronic test equipment for servicing and other applications.*
150. *MERCURY ELECTRONICS* — Catalog giving full information on Models 1000, 1100, and 1200 Tube Testers, Models 202 and 203 Self-Service Tube Testers, new Model 301 Combination Tester, new Model 501 Component Substitutor, and Model 800 CRT Tester-Reactivator.*
151. *SECO*—8-page bulletin describing company's complete line of modern tube testers.*
152. *SENCORE* — Special, newly released data on color test equipment, including the entirely new low-cost CG126 Color Generator, CA122 *Color Circuit Analyzer*, and PS120 *Wide-Band Scope*.*
153. *SIMPSON*—Latest series of VOM's are described in test-equipment bulletin; also information on line of automotive test equipment.*
154. *TRIPLETT*—Brand new test equipment catalog No. 45-T, listing complete line of testers and accessories.*

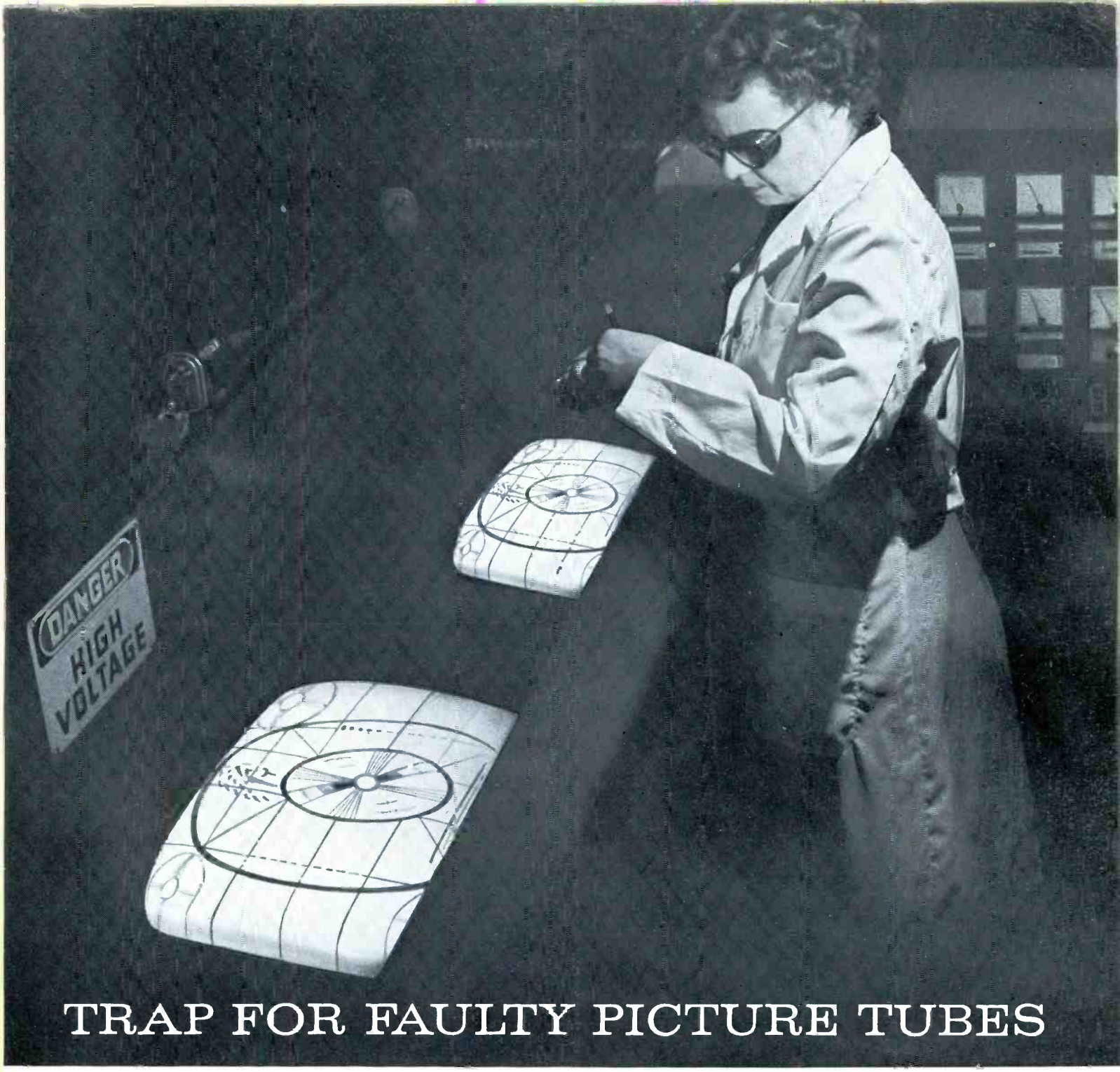
TOOLS

155. *BERNS*—Data on unique 3-in-1 picture-tube repair tools, on *Audio Pin-Plug Crimper* that enables technician to make solderless plug and ground connections, and on new-style *ION* adjustable "beam bender" for CRT's.*
156. *ENTERPRISE DEVELOPMENT* — Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.
157. *XCELITE* — Bulletin N763 describes Allen-hex screwdrivers with fixed handle (11 sizes) and with interchangeable blade (8 sizes).

TUBES & TRANSISTORS

158. *AMPEREX* — Catalog specifically devoted to extensive line of silicon planar epitaxial transistors. Describes applications for different types, with their basic specifications.
159. *SEMITRONICS* — New updated 16" x 20" wall chart CH7 lists replacements, with substitution data, for 2000 U.S. and foreign transistors.
160. *GRODEN INC.*—New, condensed semiconductor catalog listing complete line of components.

***Check "Index to Advertisers" for further information from this company.**



TRAP FOR FAULTY PICTURE TUBES

RCA Guards Against Callbacks 26 Ways

Under the watchful eyes of trained inspectors, RCA Silverama® Picture Tubes are carefully scrutinized for screen quality and focus.

All Silverama replacement picture tubes as well as those destined for original equipment undergo a battery of 26 automated tests. These include: warm-up, emission, gas, leakage, electron-gun performance, and other critical factors that can spell the difference between long-term performance or costly callback. Tubes failing a single test are automatically tagged and rejected. In addition to automatic testing, every tube lot leaving the RCA plant has been sampled by Quality Control.

Nothing is left to chance; part by part, inside and out, from base to faceplate the quality of each tube has been carefully controlled and assured prior to assembly. Even the Silverama envelope is carefully inspected prior to re-use, and is internally scrubbed, buffed, and restored to the peak of its optical capabilities. Result: a superior picture tube, an RCA Silverama. Make it your next installation choice.

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

The Most Trusted Name in Electronics

Circle 75 on literature card

CARRY EACH SILVERAMA FACTORY-FRESH INTO YOUR CUSTOMER'S HOME. New Foam-Lined RCA Picture Tube Tote Bag makes scratched, marked, or scuffed faceplates a thing of the past. Makes carrying both easier and safer. Two sizes: one for 16" to 19" tubes, one for 20" to 24" tubes.

SEE YOUR AUTHORIZED RCA PICTURE TUBE DISTRIBUTOR FOR DETAILS

BIG PACKAGING

SEE ~~BREAK~~THROUGH

Now you can see and check at a glance! Inventory Control is much easier with the Littelfuse "see-through" plastic cover fuse box– Another Littelfuse first.

LITTELFUSE DES PLAINES, ILLINOIS

Circle 76 on literature card