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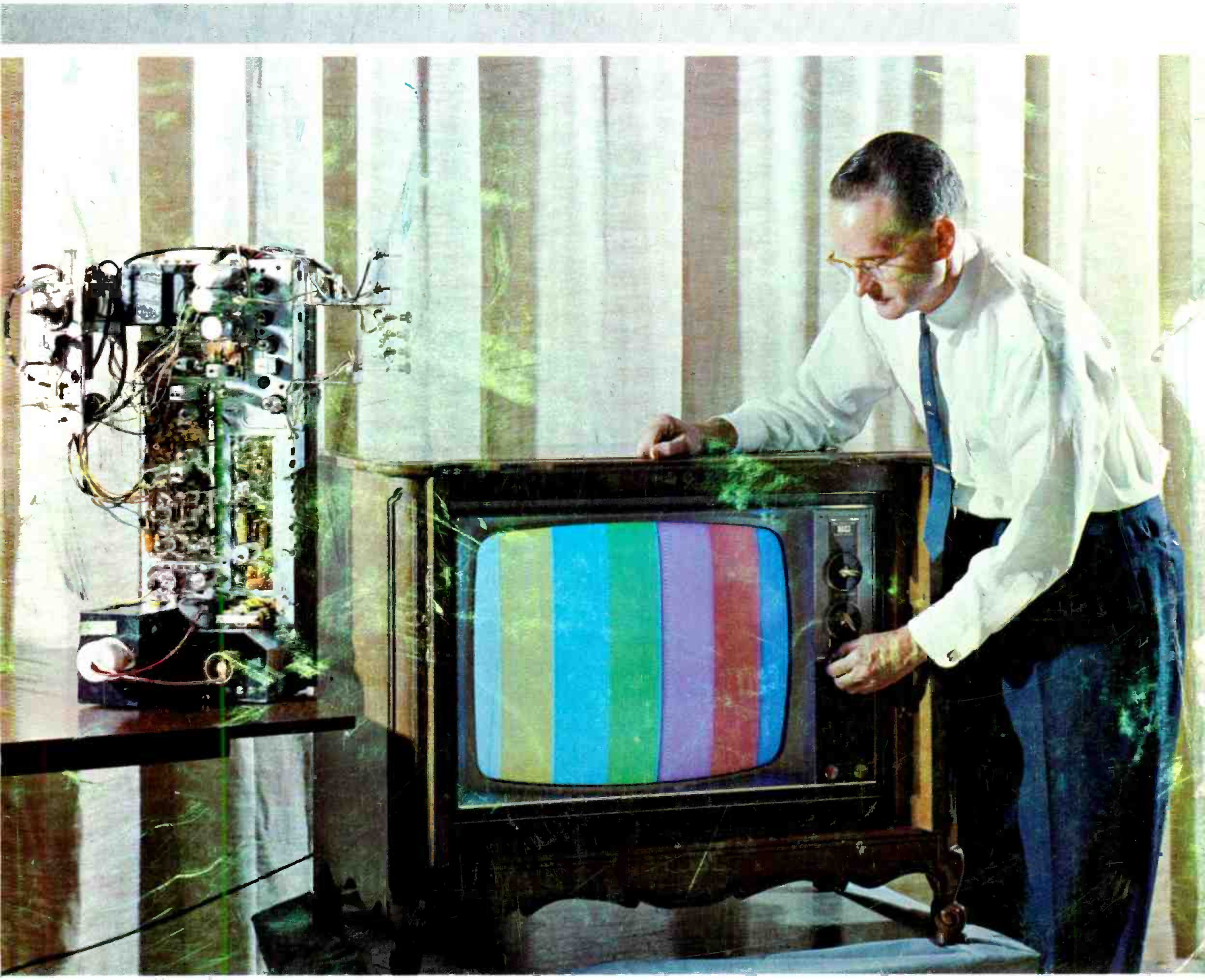

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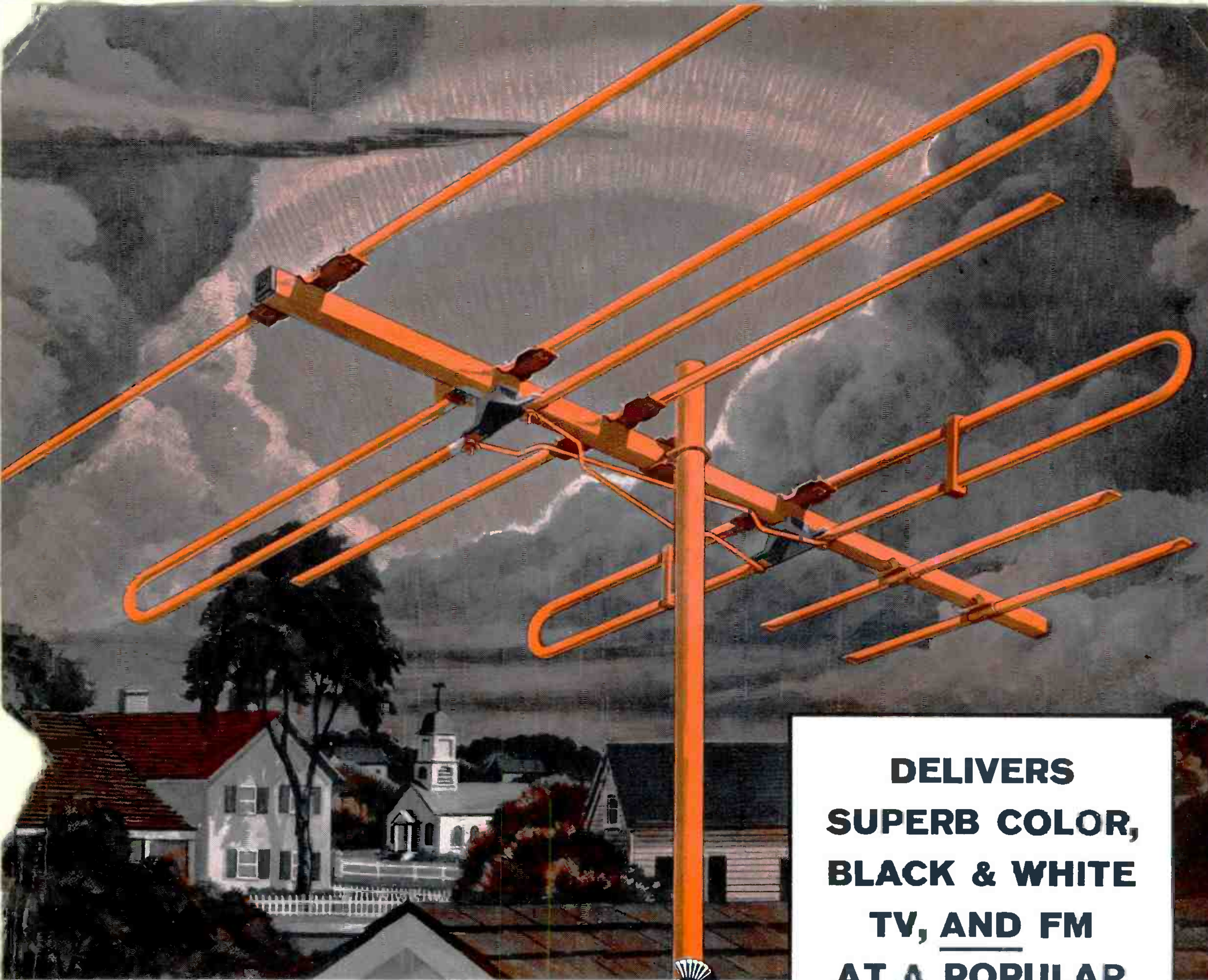

DELIVERS SUPERB COLOR, BLACK & WHITE TV, AND FM AT A POPULAR PRICE

COLOR GUARD

. . . the new all-channel VHF antenna for metropolitan to suburban areas

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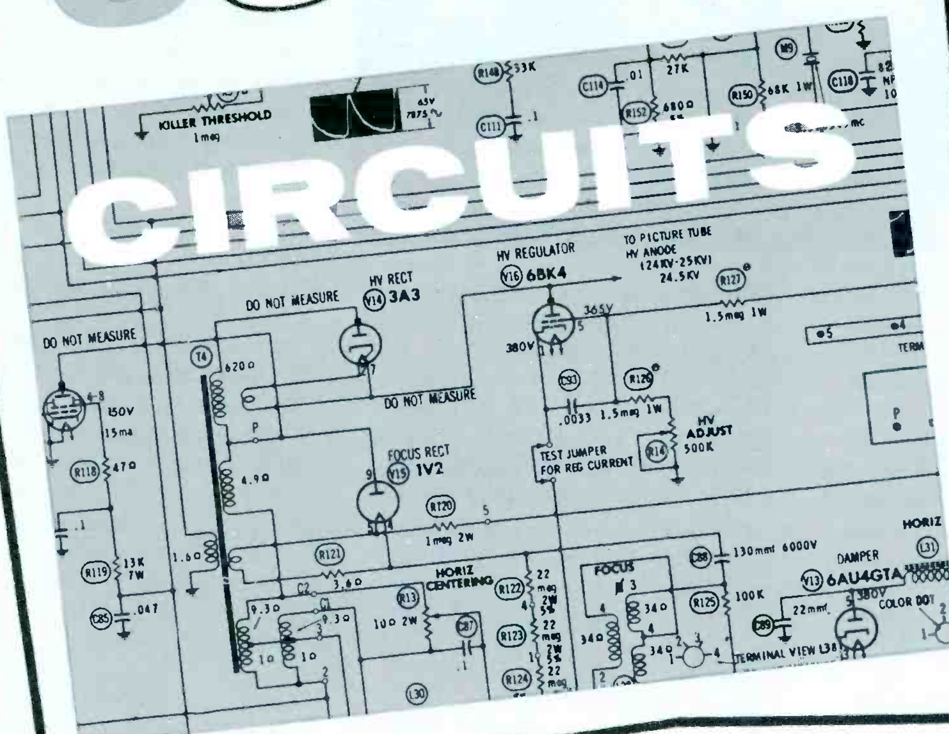
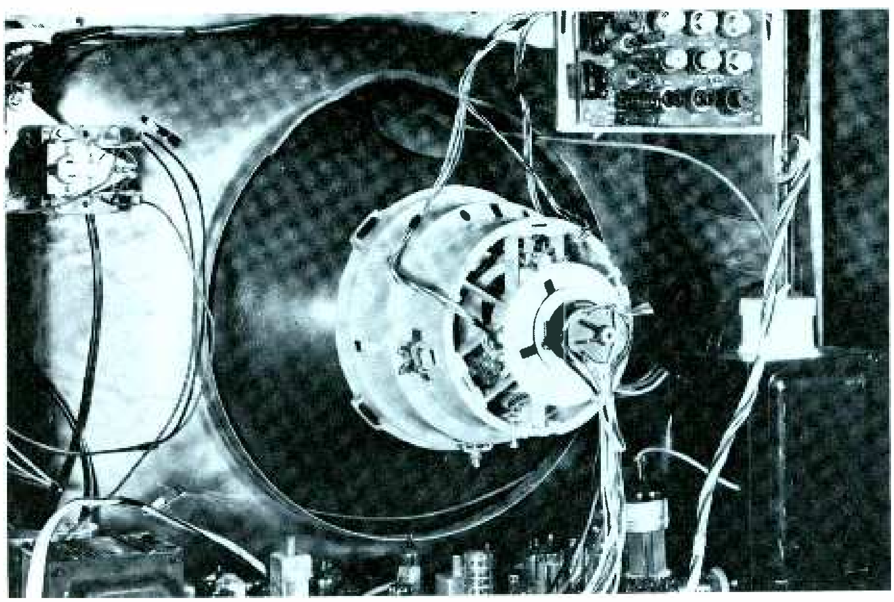


. . . 8-Page Book Section, with analysis and highlights of circuits and features used in the new color TV receivers.



The outlook for color-TV in 1965 is encouraging—for both sales and service. Most American television manufacturers are producing their own receivers, many using newly designed or modified circuits. Several completely new concepts in color receivers have been introduced and others are being planned. Both RCA and Zenith are presently producing receivers using 25″, 90° rectangular picture tubes. The 25″ RCA uses a CTC17 chassis; it's basically a CTC16 with modified sweep circuits for 90° deflection.

The photo on this page shows a view inside a cabinet using the CTC17 chassis, showing the encased deflection yoke-convergence assembly and metal shield surrounding the CRT.

Sears' 16″ color receiver, imported from Japan, is now on the American market. Some of the circuits and features of this small-screen receiver appear throughout this article.

Yaou Electric (of Japan) has introduced their 9″ transistorized color receiver (Model GTC-9). Features of this set include 47 transistors, 25 diodes, 6 thermistors, and 3 high-voltage rectifier tubes. A single-gun color tube, called a "colornetron," features a color-changing grid and an additional focus grid (operation of the tube is somewhat similar to Paramount's *Chromatron*).

Sylvania's '65 color receiver will be using their new 21FKP22 picture tube. This tube has new phosphors—the red one containing europium. According to Sylvania, the new tube has 40% more brightness

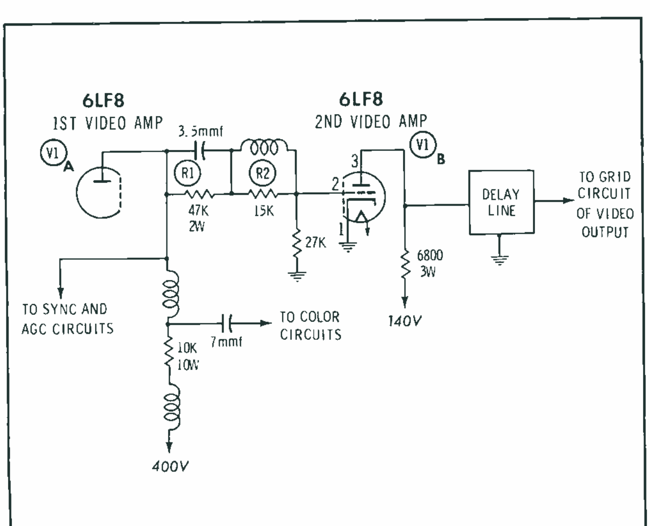


Fig. 1. Two-stage amplifier in RCA's CTC16 color chassis.

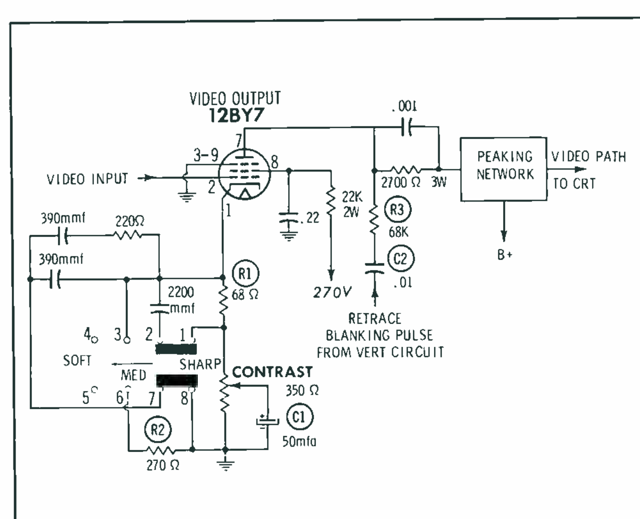


Fig. 2. Three-position peaking switch in cathode of 12BY7.

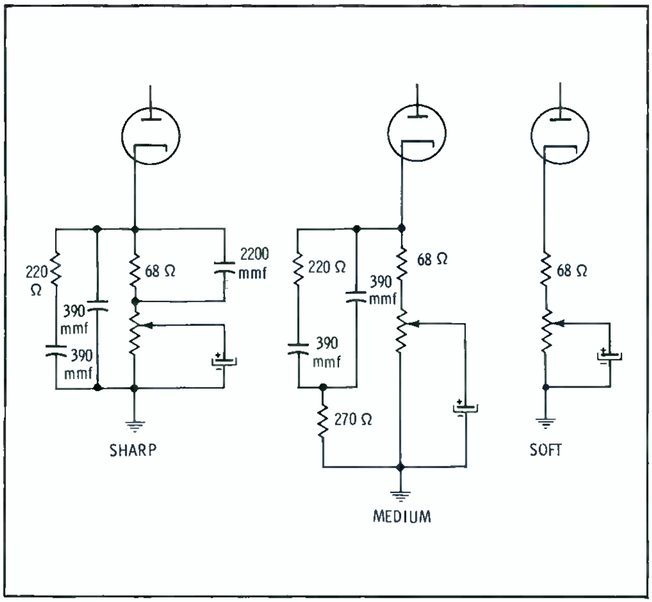


Fig. 3. Schematic shows networks by switch position.

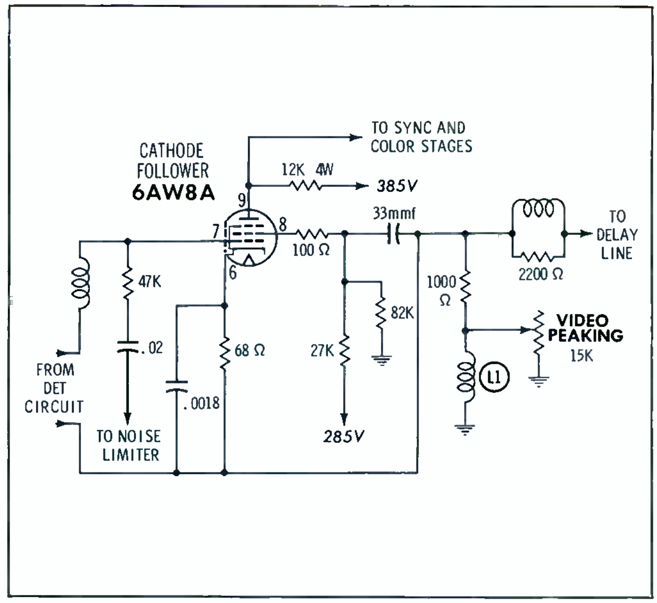


Fig. 4. WTS-907 has a variable control for video peaking.

than the earlier sulphide tubes, and is capable of producing a more vivid red.

Sylvania also announced a new line of receiving tubes for color circuits that operate in the 270-volt B+ range. Could be we'll see the present 400-volt B+ supply lowered in the near future. The company plans to introduce a 25″ receiver soon, too.

Now that we've gotten an overall view of color receivers, let's proceed to the major circuit changes and new circuits in the '65 color chassis.

Luminance Channels

The majority of the new color receivers for '65 have similar front-end stages. Usually, you'll find a turret-type VHF tuner, a transistorized UHF tuner, and three IF stages featured. The detector circuits usually contain a diode; the biggest differences appear after the detector stage. For this reason, we'll discuss only the circuits located beyond that point.

The two-stage video amplifier stage shown in Fig. 1 is basically the same circuit that was used in RCA's CTC15 chassis. The familiar 6AW8A however, has been displaced by a new tube type—a 6LF8; it's similar to a 6AW8, but improved construction permits more efficient operation as a positive-grid amplifier. (The basing of the tube is identical with the 6AW8, but they shouldn't be directly interchanged.)

Signals to the sync, AGC, and color circuits are still taken from the plate of the pentode section. The triode section operates with a positive grid as before; its main purpose is to match the impedance of the delay line. DC coupling is used from the plate of V1A to the grid of V1B (via R1-R2).

Also in RCA's CTC16 for '65, you'll find a familiar 12BY7 video output stage, shown in Fig. 2. The peaking switch first used in the last year's chassis has been retained, with a few modifications: The 350-ohm contrast potentiometer, with a 50-mfd electrolytic at the slider, is still used; however the control isn't tapped, as in previous chassis. Two additional fixed resistors are used—a 68-ohm and a 270-ohm. Circuit configurations in various positions of the video peaking switch are shown in the simplified schematics of Fig. 3. As you'll notice, the 68-ohm resistor is always in series with the cathode-type contrast control regardless of the switch position. As in previous chassis, vertical blanking is via R2-C3, mixing with the plate signal, which is DC coupled to the cathodes of the picture tube.

Motorola is marketing two color receivers again this year. Their 23″ rectangular receivers will use the TS-908 chassis introduced in '64; most of the circuits (including the luminance channel) remain unchanged. Motorola's 21″ TS-912 chassis, with series-wired tube filaments, has been replaced by a completely new chassis—the WTS-907. Physically, the chassis follows the

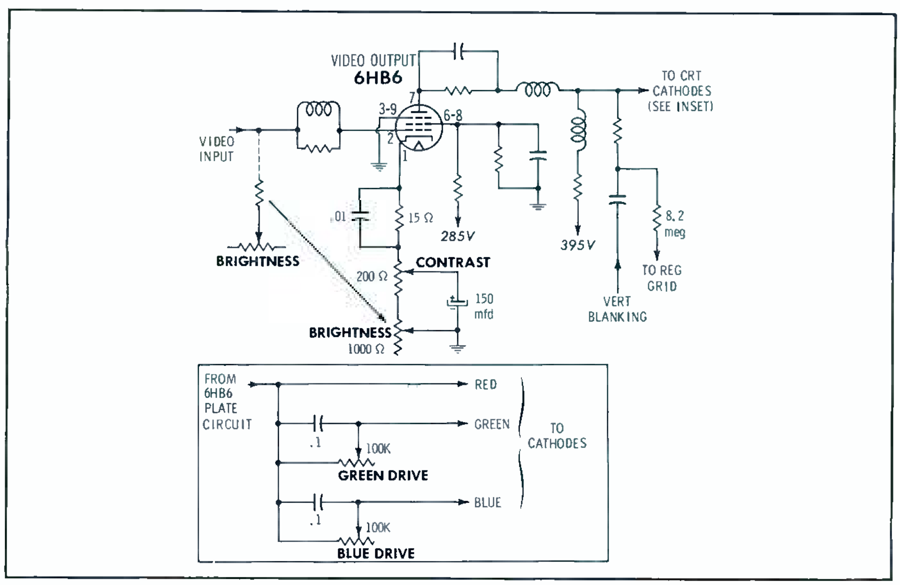


Fig. 5. Both brightness and contrast controls are located in cathode circuit.

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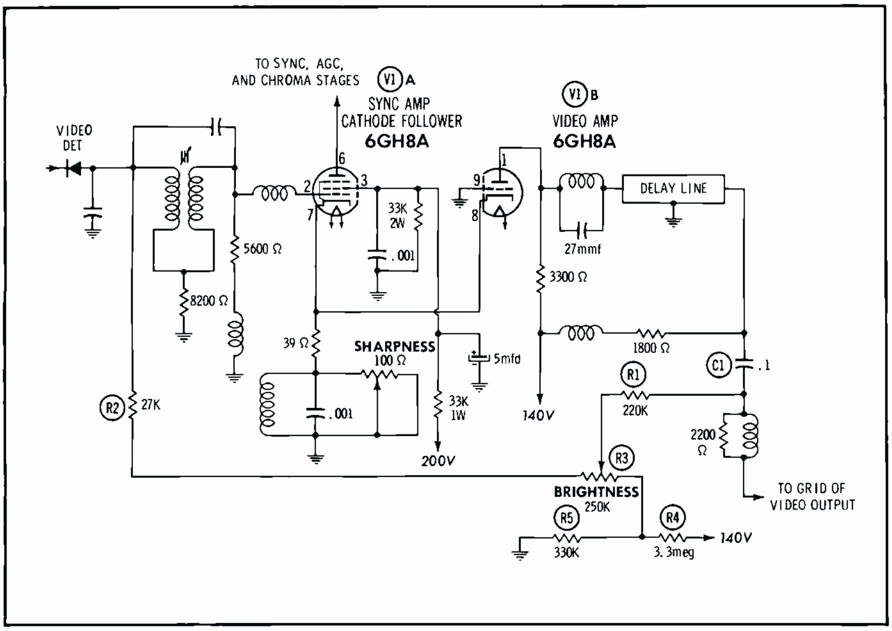

Fig. 6. Magnavox 45 series features a sharpness control for video response.

23″ version; many of the circuits are also very similar—including the "bootstrap" video circuit in Fig. 4. Changes in this circuit (from last year's) include the addition of a 15K-ohm peaking control. At one extreme setting of the control, peaking coil L1 is shorted out; at other settings, a parallel resistance controls the frequency response of the network—and thus affects the video.

The video output stage used in the WTS-907 is shown in Fig. 5. Comparing this circuit to Chassis TS-908 (23″), we find a number of changes. The brightness control, previously located in the output-tube grid circuit, is now in the cathode circuit—in series with the contrast control. The contrast of the picture is controlled by the amount of cathode-signal degeneration (that's familiar); the brightness control, however, varies the DC bias of the 6HB6, the plate voltage of the tube, and thus the brightness of the raster. Remember, any change in plate voltage affects the CRT cathode voltage.

The inset in Fig. 5 shows the circuit at the picture-tube cathodes. The method of drive control is a bit unusual, too. As always, the red cathode receives the highest drive signal. However, notice in this circuit that the drive signals for the blue and green guns are series-coupled via a resistor-capacitor network. Generally, the signal is tapped off from a control that also affects the CRT bias to a large degree. Here, DC voltage isn't changed substantially, so interaction between the screen and drive controls is held to a minimum (making for easier tracking adjustments).

Magnavox's new 45 chassis series contains a completely changed video stage (Fig. 6). The detected signal is DC coupled to the pentode section of a 6GH8A. This section has dual functions: (1) amplified sync, AGC, and chroma signals are developed at the plate, and (2) the video signal is obtained from the cathode circuit and DC coupled to the cathode of the triode video amplifier via a cathode resistor that is common to both stages. The triode section functions as a grounded-grid amplifier, whose output impedance matches that of the delay line. A "sharpness" control in the cathode circuit can be used to adjust the overall frequency response of the stage.

At first glance, it appears that AC coupling is used; notice the output of the delay line is coupled via C1 to the grid of the video output stage. However, the DC reference level of the video signal is maintained from the detector, through the video stages, and to the CRT cathodes. A voltage divider network (R4-R5) across the 140-volt B+ source applies a constant positive voltage to one side of the brightness control. The negative DC voltage established at the detector (by the video signal) is applied through R2 to the other side. The brightness control setting (via R1) determines the average DC bias on the output tube and sets the plate voltage of the stage. Now, as the plate is DC coupled to the picture tube, any change in conduction of the output tube would cause a change in brightness; the negative voltage developed at the detector adds to or subtracts from the grid bias, and thus maintains an even brightness level.

Another feature in Magnavox's new chassis is the service switch—now familiar to most technicians.

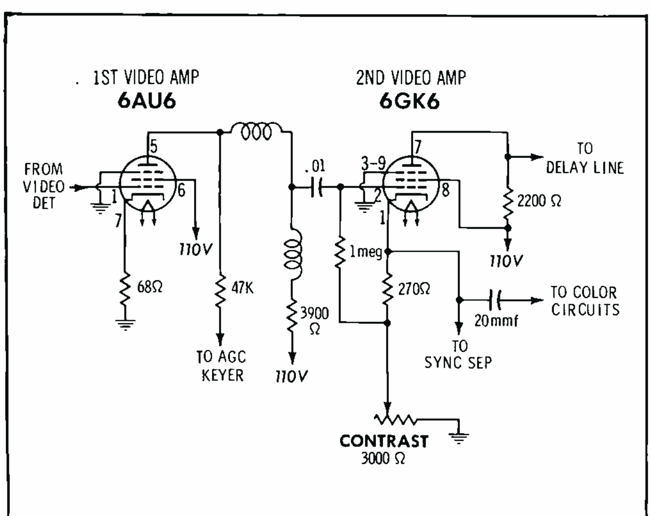

Fig. 7. Signals for color and sync are taken from cathode.

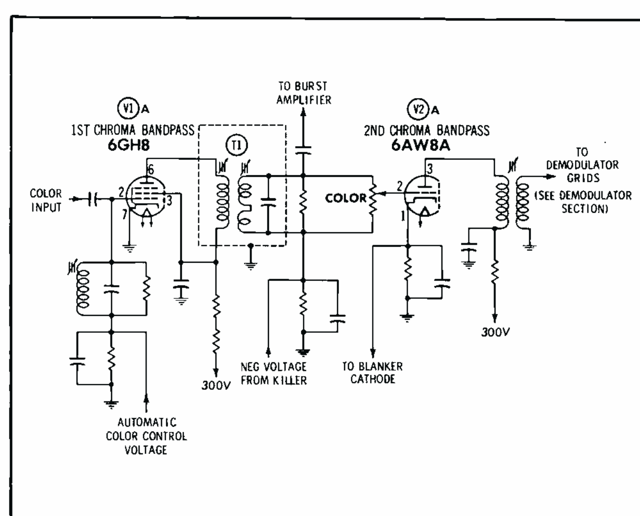

Fig. 8. Sears' 16″ color set has two-stage chroma circuit.

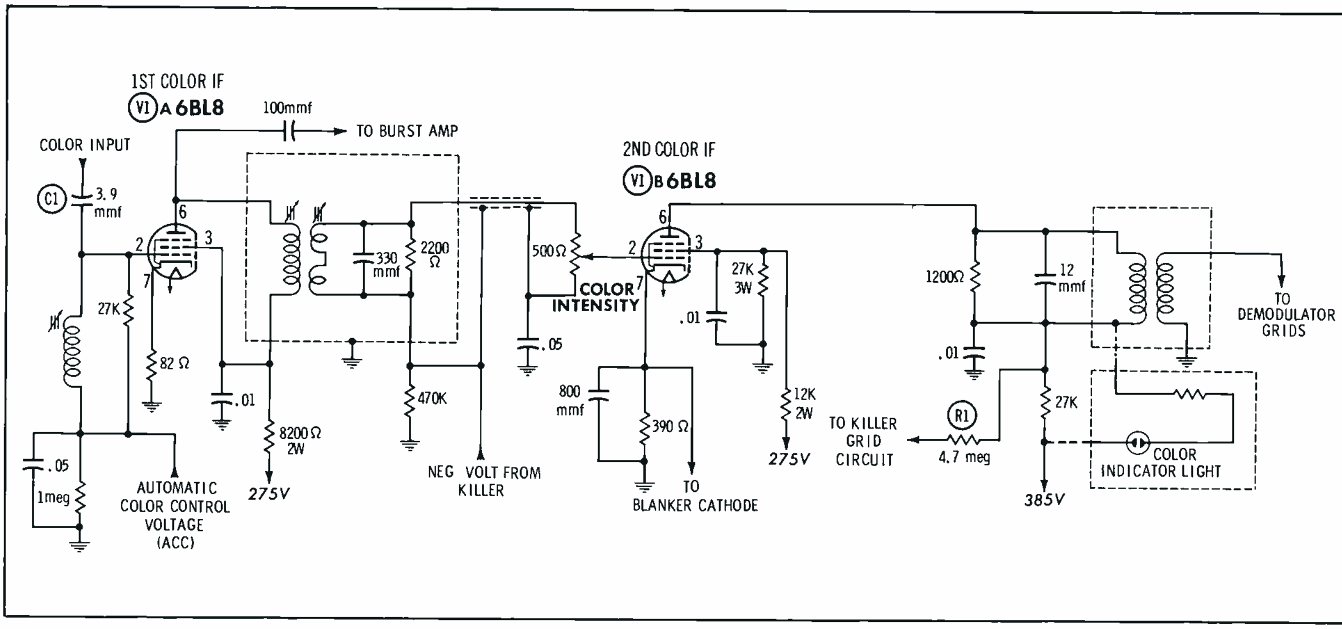

Fig. 9. Color indicator light is gone; resistor returns to color killer stage.

In most sets, the switch has only two positions; in the 45 series, a three-position switch is used—*normal, service,* and *purity.* The *service* position has the usual arrangement for collapsing the vertical sweep during screen adjustments; in addition, plate voltage to the first and second IF's is removed, preventing noise and snow from interfering with adjustments. In the *purity* position, the vertical sweep doesn't collapse; only the IF's are disabled.

Incidentally, you'll find that the CRT-bias switch used last year in the blanker circuit has been displaced by a variable control. The level of blanking pulse fed to the color difference amplifiers is adjusted by this control.

You'll find luminance channels similar to those just discussed in Westinghouse's '65 color chassis—the V-2476.

A two-stage video amplifier is used in the Setchell-Carlson U800 chassis (Fig. 7). A 6AU6 serves as the first amplifier in a straightforward pentode circuit. The composite video signal is R-C coupled to the second amplifier—a 6GK6.

This circuit isn't too different from those used in some black-and-white receivers; a contrast control in the cathode varies both the grid and cathode voltages, and video is developed at the plate. However, it's not too common for the cathode to supply the signals to the sync and color stages—a feature to remember in Setchell-Carlson color chassis. The luminance signal is fed from the delay line to the video output tube—another 6GK6.

Other New Luminance Circuits

Although the size of the picture tube is 16″, the luminance channels (and the front-end stages) used in Sears' small-screen color receiver (Chassis 562.10100) aren't unfamiliar. Here's a brief rundown: A three-stage IF strip, using two 6BZ6's and a 6DK6; a 6AW8 video amplifier, in the familiar "bootstrap" circuit—luminance information from cathode circuit to delay line; signals for chroma, sync, and AGC taken from the plate circuit; a 6JY8 video output, with brightness control in the grid circuit, contrast in the cathode. The cathodes of the CRT are DC coupled to the output plate circuit; fixed-resistor dividers set the amplitude of drive signals fed to red, green, and blue guns. Overall, the video circuits look similar to those used in RCA's CTC7 and CTC9 chassis.

Zenith's luminance channel, in their new 25MC30 chassis follows

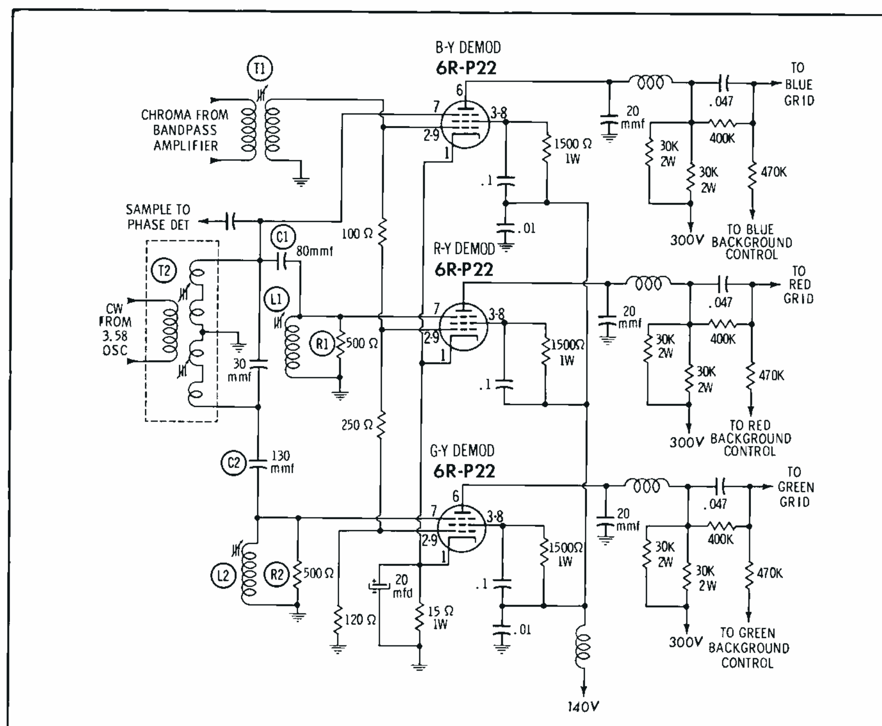

Fig. 10. New imported receiver demodulates on three axes: B-Y, R-Y, and G-Y.

closely that used in last year's 25-LC30. The cathode-follower stage now uses a 6KT8, rather than a 6HL8. The 12GN7 video output is still present in a circuit identical to last year's.

Editor's note: The television manufacturers listed in Table 1 are using warmed-over (or identical) versions of the CTC15 chassis of last year. We discussed that chassis series in this section of the November 1963 PF REPORTER.

Chroma Bandpass Stages

In Sears 16″ imported color receiver, you'll find the two-stage chroma bandpass circuit shown in Fig. 8. You're still servicing color receivers having an almost identical circuit; looking back to 1959 and the era of RCA's CTC7, you'll also find a two-stage bandpass. Substitute a 6GH8 for the 6U8 used in that older first amplifier stage, make the second transformer adjustable, juggle component values slightly, and you have this circuit.

There are a few important points to remember when servicing bandpass circuits of this type: (1) Automatic color control (ACC) voltage is applied to the first stage; if it becomes *too* negative, it can cut the tube off. (2) The burst signal *must* pass V1 and reach the secondary of T1, before it can reach the burst amplifier. (3) The second bandpass stage is controlled by negative voltage from the color killer.

The basic two-stage *color IF* (another name for chroma bandpass) shown in Fig. 9 first appeared in Motorola's 23″ TS-908 chassis. This year, it's also used in the 21″ WTS-907—with only a slight modifica-

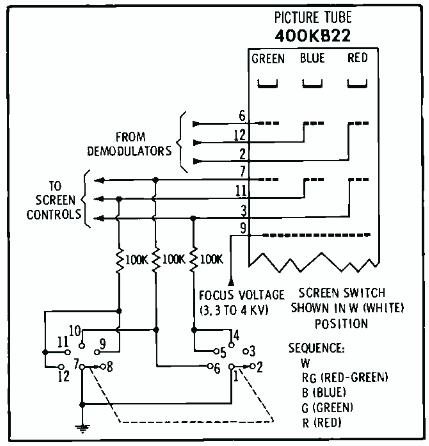

Fig. 11. Built-in screen switch is useful during purity-convergence steps.

tion: The color indicator light is omitted, and a 4.7-meg resistor is added from the plate-supply network to the grid of the killer stage—to better control the killer (at cutoff) during color programs.

Table 1

Airline	Olympic
DuMont	Philco
Emerson	Sparton
Electrohome	Sylvania
General Electric	Travler
Gamble-Skogmo	Wells-Gardner

Actually, the operation of these color-IF stages follows those bandpass circuits just discussed. ACC voltage controls the first stage, the burst must pass through V1A, and the second stage is controlled by the color killer. A more detailed operation of these stages appeared in the November 1963 issue.

Other Bandpass Amplifiers

RCA is continuing to use their one-stage bandpass circuit as in the CTC12 and CTC15 chassis. The pentode section of a 6GH8A is used; the triode section of the same tube is the color killer.

The bandpass amplifiers in the Magnavox 45 series, and in the Setchell-Carlson U800 chassis, are similar to those in the RCA chassis. Zenith's Chassis 25MC30 has the familiar two-stage bandpass section used in the majority of their previous receivers.

Color Sync Stages

You won't find much changed in these stages of the '65 receivers. Most manufacturers are staying with their proven circuits of previous years. Let's briefly review a few of the main features and mention a couple of minor changes in certain chassis.

In the 45 series Magnavox, you'll find a 6EW6 burst amplifier; 6JU8 killer phase detector-color phase detector; and 6GH8A chroma reference oscillator and control tube. The same tube complement is used in RCA's CTC16 chassis and Sears/Silvertone's 21″ color receiver.

Setchell-Carlson's U800 has two 6AL5's, rather than the quadruple diode 6JU8; the basic circuits are very familiar.

One notable change in Zenith's color sync stages for '65 is a 6KT8 replacing a 6GH8 used last year. The tube functions as the 3.58-mc oscillator and reactance control.

In Sears' 16″ chassis, the tube complement of the color-sync section includes a 6EW6 burst amplifier; 6BN8 phase detector-killer detector; and 6GH8 oscillator-control tube. These stages, too, operate like those in the 1959 RCA receivers.

Both of Motorola's new chassis (21″ and 23″) use circuits similar

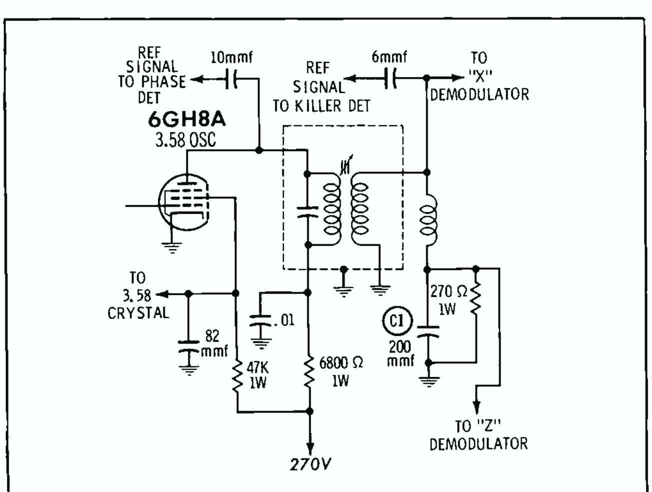

Fig. 12. CTC16 change in demodulator, for improved color.

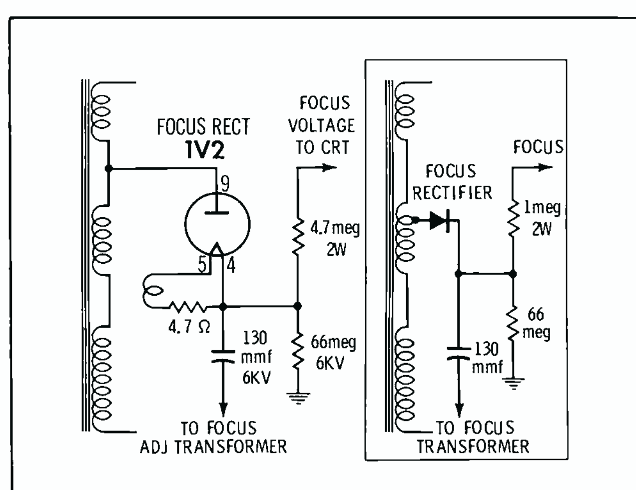

Fig. 13. 1V2 replaces diode rectifier in last year's color set.

to those in the 23″ TS-908 we described in the November 1963 issue.

Demodulators

The biggest news in demodulators this year is the circuit shown in Fig. 10. It's used in the Sears' 16″ receiver.

First, notice there are three independent demodulators in this circuit: B-Y, R-Y, and G-Y are all demodulated separately. The 6R-P22 tube type used in each stage is unfamiliar, and we have no specifications at this time. This tube appears to have been especially designed for this application.

The only connections common to all three stages are the grid and the cathode resistors. You'll notice the cathode is bypassed by a large electrolytic, so no usable signal is developed at this point. All three grids receive virtually the same chroma signal from the bandpass stage via transformer T1. T1 delivers approximately 5 volts of signal, when a keyed-rainbow generator is connected to the set.

T2 couples the CW signal from the local 3.58-mc oscillator to the suppressor grids (possibly trigger plates). Available from the secondary of T2 are three signals of different phase: one fed directly to the B-Y demodulator (also to the phase detector stage as a sample pulse), another via phasing network C1-L1-R1 to the grid of the R-Y demodulator, and a third via a similar network (C2-L2-R2) to the G-Y demodulator. The network coils (L1 and L2) are tunable, to obtain the proper phase for demodulation on each axis.

The plate circuits of each tube are identical, and are DC coupled to their individual control grids in the tricolor picture tube (no amplifiers following the demodulators). The waveforms fed to the CRT grids are as follows (with 5 volts of color signal at the secondary of T1): 33 volts to the blue grid, 30 volts to the red grid, and 10 volts to the green grid, all peak-to-peak measurements. In most 21″ receivers, these signal voltages approach or exceed the 100-volt level.

As in earlier color receivers, you'll find background controls for each gun. Therefore, gray-scale tracking must be undertaken with both screen and background controls. No service switch here! However, this chassis does feature a built-in screen killer switch (Fig. 11).

A five-position switch, located on the rear of the chassis, can be used during purity and convergence adjustments. Three 100K resistors are connected to the screen grids of the 400KB22 picture tube; as the switch is rotated, these resistors are alternately (or jointly) connected to ground—in the sequence shown in Fig. 11.

RCA's new CTC16 chassis has a slight change in the demodulator circuit from that used in the CTC-15. The CTC16 circuit is shown in Fig. 12. Capacitor C1 (part of the phase-shift network) is changed from 150 mmf to 200 mmf, giving a larger displacement of the "X" and "Z" axis. Better color rendition on the new sulphide tube prompted the change.

Zenith, Magnavox, Setchell-Carlson, Packard-Bell, and Motorola are using demodulator circuits similar to those in their 1964 chassis.

Horizontal Sweep and High Voltage

Most technicians will probably say "welcome back" to the 1V2 as the focus rectifier in RCA's CTC16 chassis. Long familiar in this function, the 1V2 was displaced for a year by a special diode rectifier (see Fig. 13 for the new circuit, and the inset for last year's). The focus transformer circuit is slightly changed to give faster action (more positive change during adjustment) and better range (4 to 5.3kv).

The damper circuit (Fig. 14) has also been revamped to give more efficiency and better linearity. The capacitors associated with the horizontal efficiency coil have been changed, and one .056-mfd unit now shunts the coil. C1 is now a dual .15-mfd unit (previously, section A was .068-mfd and section B was .082-mfd). According to RCA engineers, the changes permit better operation and longer life expectancy for the horizontal output tube. Adjustment procedures for the efficiency coil are the same as in last year's CTC15 chassis.

Fig. 15 is a schematic of the horizontal output stage used in the CTC-16. This is basically the same circuit used last year, but one important point we failed to comment on is the connection via R1 from the grid of the blanker tube to the grid of the 6JE6. If the shunt regulator fails, the high voltage will climb to approximately 30kv — unless it's

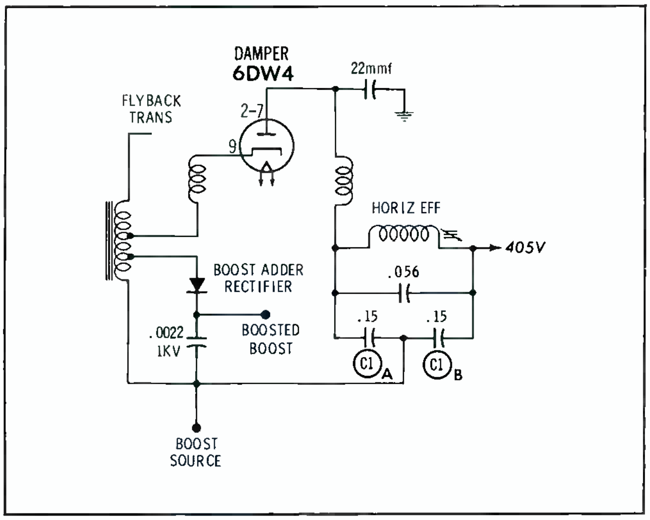

Fig. 14. Revised damper circuit in new CTC16 color chassis.

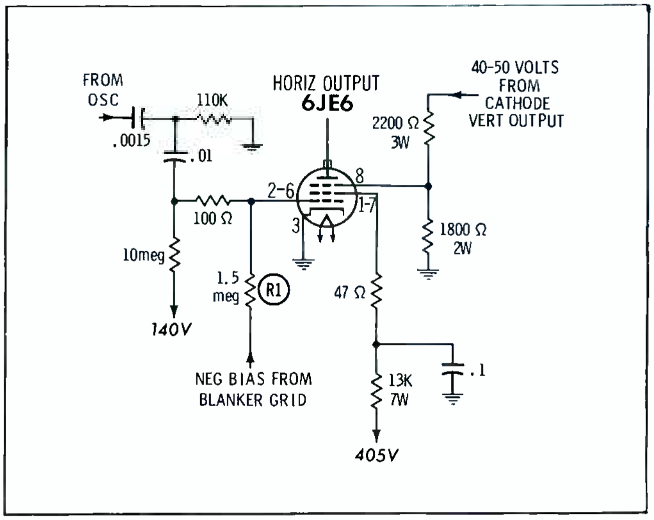

Fig. 15. Protective circuit prevents high-voltage runaway.

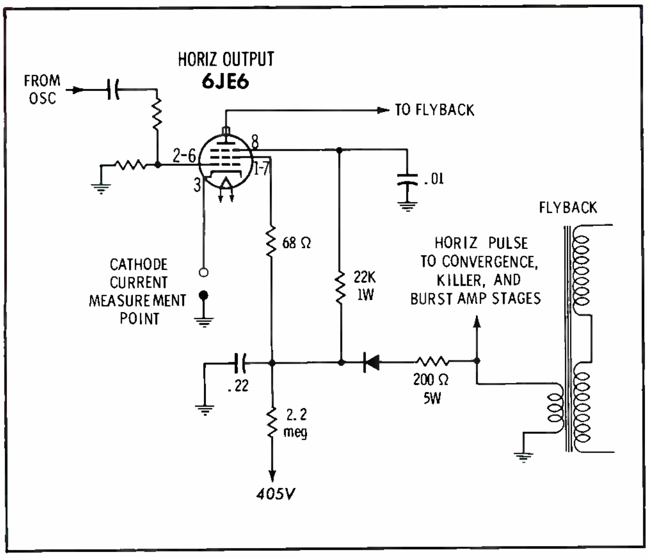

Fig. 16. Automatic control of sweep by screen-circuit diode.

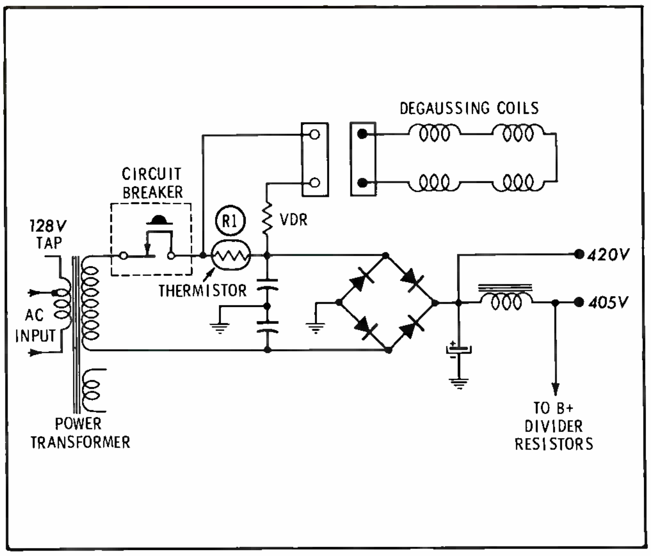

Fig. 17. Color chassis has bridge rectifier circuit and ADG.

checked. If the regulator does fail, more negative voltage will be developed at the blanker grid (an increased horizontal pulse fed to the blanker stage develops a higher voltage); but more negative bias is then applied to the grid of the 6JE6 (via R1), decreasing the high voltage. Incidentally, a new, higher-dissipation regulator (6BK4A version) is used in the CTC16 chassis.

Setchell-Carlson's U800 chassis has an automatic sweep control in its output stage (Fig. 16). A horizontal pulse obtained from a winding on the flyback is rectified and fed to the screen grid of the 6JE6. Any change in output sweep is reflected back to the screen circuit via this arrangement, maintaining a constant sweep. The same winding supplies keying pulses to the convergence, color-killer, and burst-amplifier stages.

Other Horizontal Circuits

With the exception of a change in horizontal output tube type (6HF5 in place of last year's 6JS6), the horizontal stages in Zenith's new chassis are unchanged.

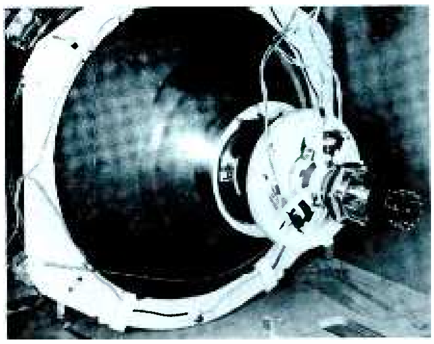

Fig. 18. Physical location of degaussing coils is around CRT flange.

In Motorola's new receivers (21″ and 23″) two 6JM6's, wired in parallel, have replaced the 6DQ6B's in the output sockets. Magnavox's 45 chassis uses the new 6BK4A regulator; other tubes rounding out the horizontal complement include 6JE6, 3A3, and 6DW4. As it was last year, a diode-type focus rectifier is still used.

Tubes used in Sears' 16″ are familiar color-receiver types—3A3, 6DQ5, 6BK4, and 6DW4—with the exception of the focus rectifier, which is a 5642.

Power Supplies

All of the '65 color receivers (released to date) are transformer powered, and use silicon rectifiers. The usual B+ circuit is a full-wave doubler, using two silicons. An exception this year is RCA's CTC16 chassis, which has four silicon rectifiers in a full-wave bridge circuit (Fig. 17). Also new is the physical location of the rectifiers—they're mounted on a printed circuit board.

Automatic degaussing (ADG) is also new in most models having wood cabinets. The circuit is shown in the schematic of Fig. 17; the degaussing coils themselves are pictured in Fig. 18, located on the metal flange surrounding the CRT. Three extra components—thermistor R1, a voltage-dependent resistor (VDR), and a set of coils—are connected in the secondary circuit of the power transformer (before the B+ rectifiers). ADG occurs each time the set is turned on (if its been off awhile).

Operation of the circuit is fairly simple: The cold value of thermistor R1 is 120 ohms, while the VDR starts with a low resistance. When power is applied, most of the AC current in the secondary winding flows through the low-resistance coils and VDR; the magnetic field around the coils provides the degaussing action (the metal flange serves as a core). As R1 heats up, its resistance drops; a lower voltage is thus present across the VDR, causing its resistance to rise. The combined action of both resistors (one increasing, the other decreasing) causes a smooth, gradual decrease in current through the degaussing coils to zero. This smooth action prevents the picture tube from becoming remagnetized. The entire cycle is completed before a raster appears on the screen.

Several other manufacturers are offering a form of ADG in their color receivers, too. Packard Bell's 98C8 chassis has a bit different circuit. It's not automatic but, a spring loaded, push-button switch to start the degaussing action is located on the rear of the cabinet. The circuit is shown in Fig. 19. ▲

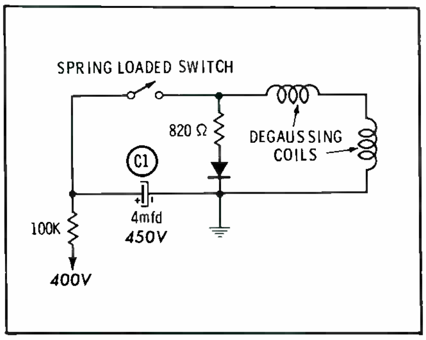

Fig. 19. Packard Bell's new color set is available with this ADG circuit.

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PF REPORTER

including Electronic Servicing

VOLUME 14, No. 11 NOVEMBER, 1964

CONTENTS

ABOUT THE COVER

This, our Annual Color Issue, is the largest and most colorful PF REPORTER ever prepared for our readers. This milestone for us is paralleled this month by another industry achievement—the introduction of giant-screen color TV by at least two manufacturers. Our cover shows the new 25" RCA color set in operation, and a chassis—the CTC17—that is used in these new sets. Details of servicing this and other color receivers begins on page 1 and continues through the entire issue.

Letters to the Editor

Dear Editor:

I ran across the July 1964 PF REPORTER. On page 42, you stated that approx. (sic) all ex prison inmates are dishonest. Prison stiticians (sic) prove that approximately 2% or more turn honest and need a chance. They *paid* for a chance. As a (sic) ex law officer, I know. I came back to TV work (with honesty). What about some TV-radio men using *used* parts? This to my belief is dishonest. I am not an ex inmate, but meet many talented ones who are. A debt paid is a debt paid, but people does (sic) not accept this. An employer should put an ex inmate on a trial bases (sic) and use honesty on both sides. Here servicemen are underselling service and forcing honest ones out of business.

A (SIC) EX LAW OFFICER
Phoenix, Ariz.

'Nuff said.—Ed.

Dear Editor:

I've been a subscriber to PF REPORTER for more than two years. I've wanted many times to write and tell you what I think of the magazine, but kept putting it off. In your June 1964 issue, I read The Troubleshooter's answer to Mr. Novak concerning a B+ short in an AM-FM radio. Your solution was precise and to the point. I—as well as many other technicians I know—appreciate the trouble your staff goes through to help us with problems like this.

ROBERT G. ADAMS
Adams Radio Repair
East Hartford, Conn.

Thanks, Bob, for taking the trouble to let us know. Answering the many hundreds of Troubleshooter letters that arrive here each year is indeed a mountainous project for our staff. But it will never be a chore as long as we knew we are truly helping—as evidenced by letters such as yours.—Ed.

Dear Editor:

We enjoyed reading the July 1964 article "Transistorized Mikes for Mobiles" by Mr. Tanner and Mr. Soll, but would like to point out that there is also a transistorized *ceramic* communications mike available. The Euphonics Model C-47TR is constructed with a lead zirconate titanate element and contains a two-stage transistor preamp. The result, as you pointed out in your article, is carbon-mike level without carbon problems.

GEORGE GROVER
Vice President, Engineering
Euphonics Corp.
Guaynabo, P. R.

Our readers will be interested to know about the ceramic unit, George. We appreciate your bringing it to their attention. —Ed. ▲

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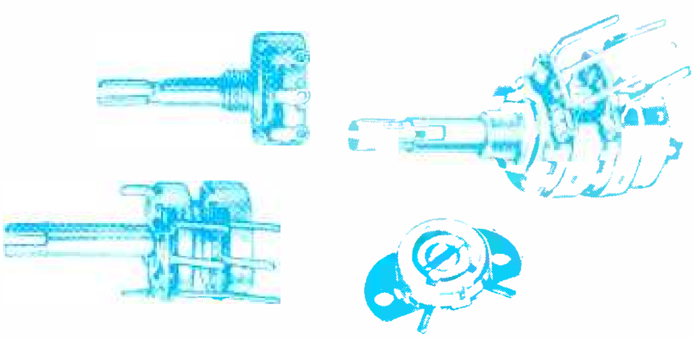
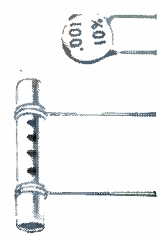
COVERAGE IN DEPTH



WHEN YOU NEED A CONTROL for a color tv set, you can be sure that Centralab will provide an *exact replacement.* Rely on Centralab's total coverage: buzz controls, dual concentrics, twins, and of course, all your single control requirements. Centralab coverage goes hand-in-hand with Centralab *quality:* These units can't loosen, shafts can't pull out. In fact, it's hard to tell the difference from the original manufacturer's control; but you can rely on Centralab quality and guarantee your replacement.



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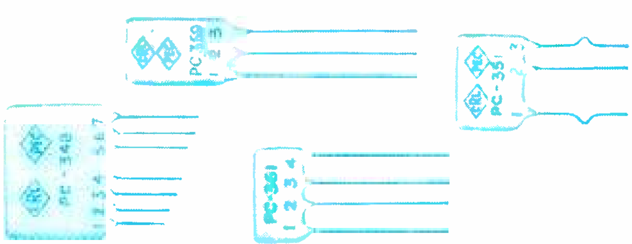

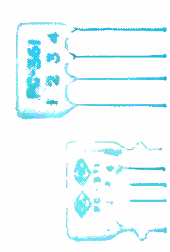

WHEN YOU NEED A PACKAGED CIRCUIT for a color tv set, the chances are it's a snowy day in August. Centralab invented them, makes most of them—but we can't sell many replacements because they so rarely go bad. (That's quality!) Just in case, though—we can provide the exact replacement. (That's coverage!)

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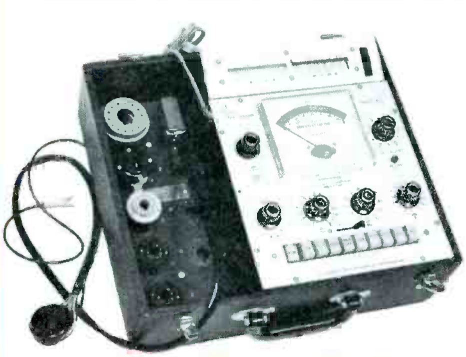

Now a picture tube tester - booster with features wanted most by the TV servicemen. Color keyed - push button operated for ease and speed. Designed to make more accurate tests than any other tester now in existance. Completely versatile for all black and white or color picture tubes. Oh yes! we keep you up to date.

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See These Testers At Your Franchised Distributor and Ask Him About a Trade-In Deal

"Service Engineered Electronic Test Equipment"

Jackson

The Jackson Electrical Instrument Company Dayton, Ohio

Circle 7 on literature card

The Electronic Scanner

news of the servicing industry

Plant Addition Planned

RCA has announced it will construct two buildings at its Lancaster, Pa., plant as the first step in a program for expansion of color TV picture tube facilities. Expected to be completed in summer and fall of 1965, the buildings will add 90,000 square feet of color tube manufacturing space and 45,000 square feet of room for engineering operations. A sizable portion of the manufacturing space will be used for production of the company's new 25″, 90° rectangular color tube. Part of the engineering building will be devoted to development work on a new 19″, 90° rectangular color tube, which is expected to be introduced during 1965.

New Name

Capehart Corp. has changed its name to **Clavier Corp.** The name-change announced recently by Roy J. Benecchi, president, is said to reflect a management decision to modify the company's approach to the consumer product segment of its business. "We will continue as an important supplier of military and government products," Mr. Benechhi added.

Stereo Auto Adapter

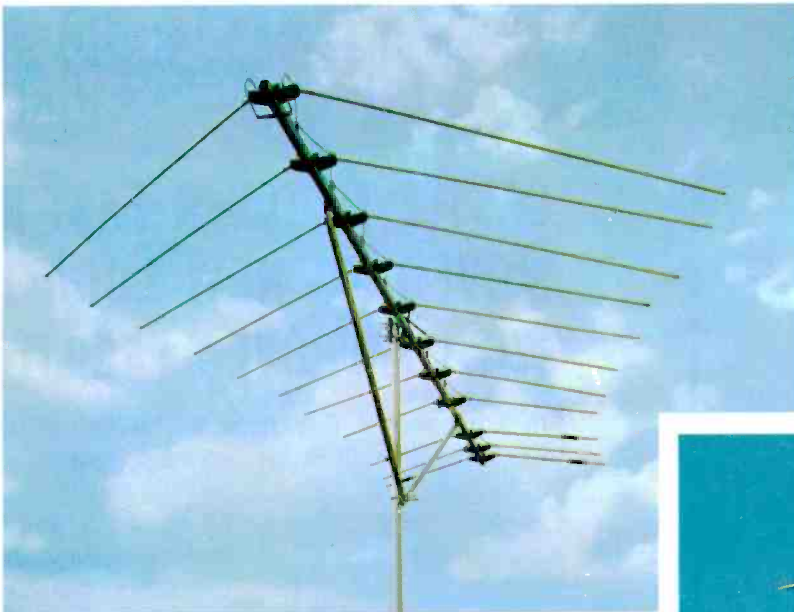
A transistorized adapter developed by **Delco Radio Div.** allows stereo reception in 1965 Chevrolets equipped with the original equipment AM-FM radios. The stereo adapter, result of a three-year design program, is a separate unit. The device can be plugged into the 1965 receivers with no modification required; the installation can be made as a factory option or later by a dealer. For stereo reception, two front speakers are located under the instrument panel in the cowl kickpads and two rear-seat speakers are mounted at the outboard ends of the package shelf just behind the back seat.

25″ Color Receiver

Zenith Sales Corp. has introduced their family of 25″ color television receivers featuring a rectangular color tube developed by the company's tube and research facility, The Rauland Corp. The handwired line was first shown at a recent meeting of distributor executives; limited shipment of the sets began last month. Considerably higher in price than the 21″ models, the new receivers are equipped with a three-gun, shadow-mask type color tube with a projected viewing area of 300 square inches, a 90° deflection angle, and a slimmer profile than the deeper round tubes. One of the new rectangular tubes is shown on a test jig in the accompanying photo.

Transistor Warranty

A warranty which is to be valid five years from the date of purchase, has been announced by the **Sony Corp. of America** for transistors made by the company and used in the manufacture of its radios, television sets, and CB transceivers. In announcing the warranty, Mr. S. Inagaki commented "The reliability of Sony transistors for television and radio sets has been proved over the years; we have complete confidence in our transistors, and thus are pleased to announce their five-year warranty." ▲



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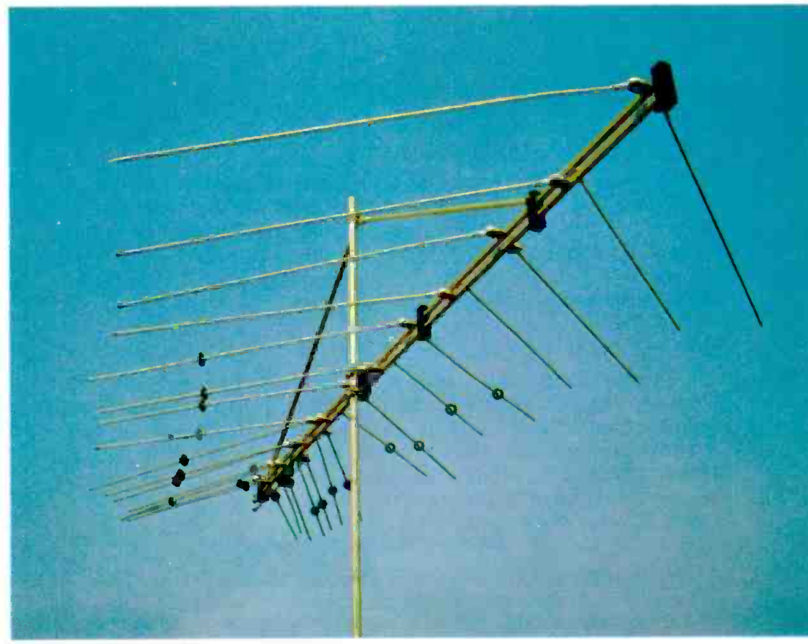

Model LPV-14

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You Can Rely on JFD Log-Periodic* TV

COLOR and

NEW—from the famous JFD R&D Laboratories in Champaign, Illinois — the authentic Log-Periodics with the engineering advances that outperform all others in COLOR, black and white—on VHF, UHF, VHF/UHF/FM!

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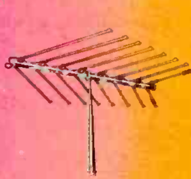
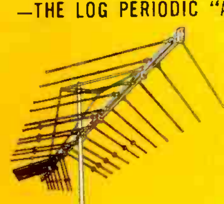


model	description	list
LPV17	18 Cells Directors	$59.95
LPV14	15 Cells Directors	49.95
LPV11	11 Cells Directors	39.95
LPV8	8 Cells Directors	29.95
LPV6	6 Cells	21.95
LPV4	4 Cells	14.95

NEW! THE FIRST COMBINATION VHF/UHF/FM/STEREO —THE LOG PERIODIC "ALL-VU"—WITH SINGLE LEAD-IN



model	description	list
LPV-VU18	18 Cells	$69.95
LPV-VU15	15 Cells	$59.95
LPV-VU12	12 Cells	$49.95
LPV-VU9	9 Cells	$39.95
LPV-VU6	6 Cells	$27.50

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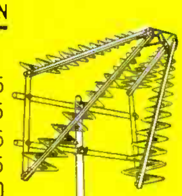
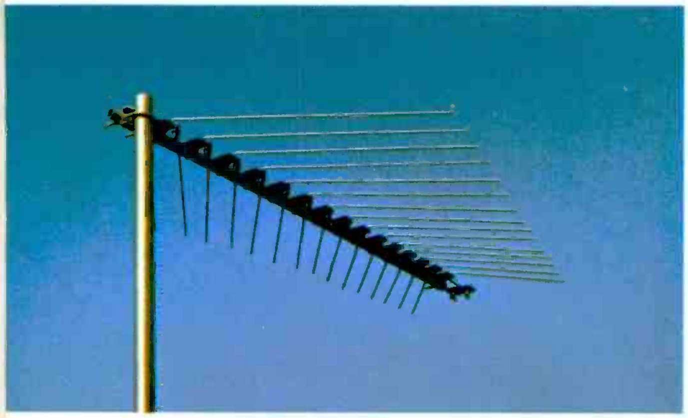


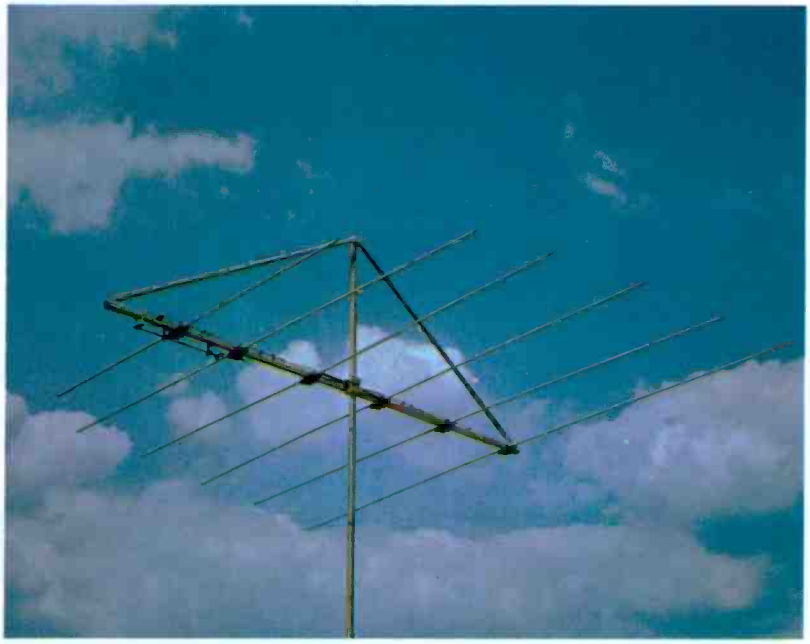
model	description	list
LPV-ZU20	E-Plane Stacked	$37.50
LPV-ZU10	1-Bay	$17.95



Model LPV-U15

Model LPV-ZU20 ZIG-A-LOG

Model LPL-FM6 FM/STEREO



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BANDWIDTH: Frequency-independent log periodic design delivers broad band performance never before possible. Does not discriminate against any channel—or frequency.

RESPONSE: Consistently flat (± ½ db) across **both** low and high bands for the finest color reception.

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Whether it's VHF, UHF, VHF/UHF/FM, or FM/STEREO, JFD HAS THE LOG PERIODIC TO HELP YOU MAKE THE SALE OTHERS CAN'T!

SEE WHY AT THE MOMENT OF TRUTH, THE PICTURE IS THE PROOF—THE JFD LPV LOG-PERIODIC WORKS BEST!

*Don't gamble on Log-Periodic "look-alikes" and imitations! Insist on the genuine LPV by JFD—exclusive producers of the pace-setting Log-Periodic antenna developed from research performed by the Antenna Research Laboratories of the University of Illinois.

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NEW! LOG PERIODIC LPV FOR UHF CHANNELS 14 TO 83 & VHF 7 TO 13

model	description	list
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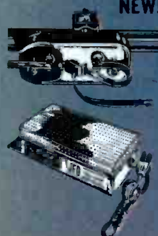
LPV-U15	15 Cells	$18.95
LPV-U9	9 Cells	$12.50
LPV-U5	5 Cells	$ 6.95

NEW! LOG PERIODIC LPL-FM STEREO

model	description	list
LPL-FM10	10 Cells	$49.95
LPL-FM8	8 Cells	$39.95
LPL-FM6	6 Cells	$29.95
LPL-FM4	4 Cells	$19.95

NEW! TELE-AMP ANTENNA AMPLIFIERS FOR VHF, UHF & FM



model	description	list
VUT-3	3-Transistor VHF/UHF/FM Amplifier	$49.95
VN-2	2-Nuvistor VHF Amplifier	$39.95
VT-2	2-Transistor VHF Amplifier	$39.95
VT-1	1-Transistor VHF/FM Amplifier	$34.95
UHT-1	1-Transistor UHF Amplifier	$39.95
FT-1	1-Transistor FM Amplifier	$34.95

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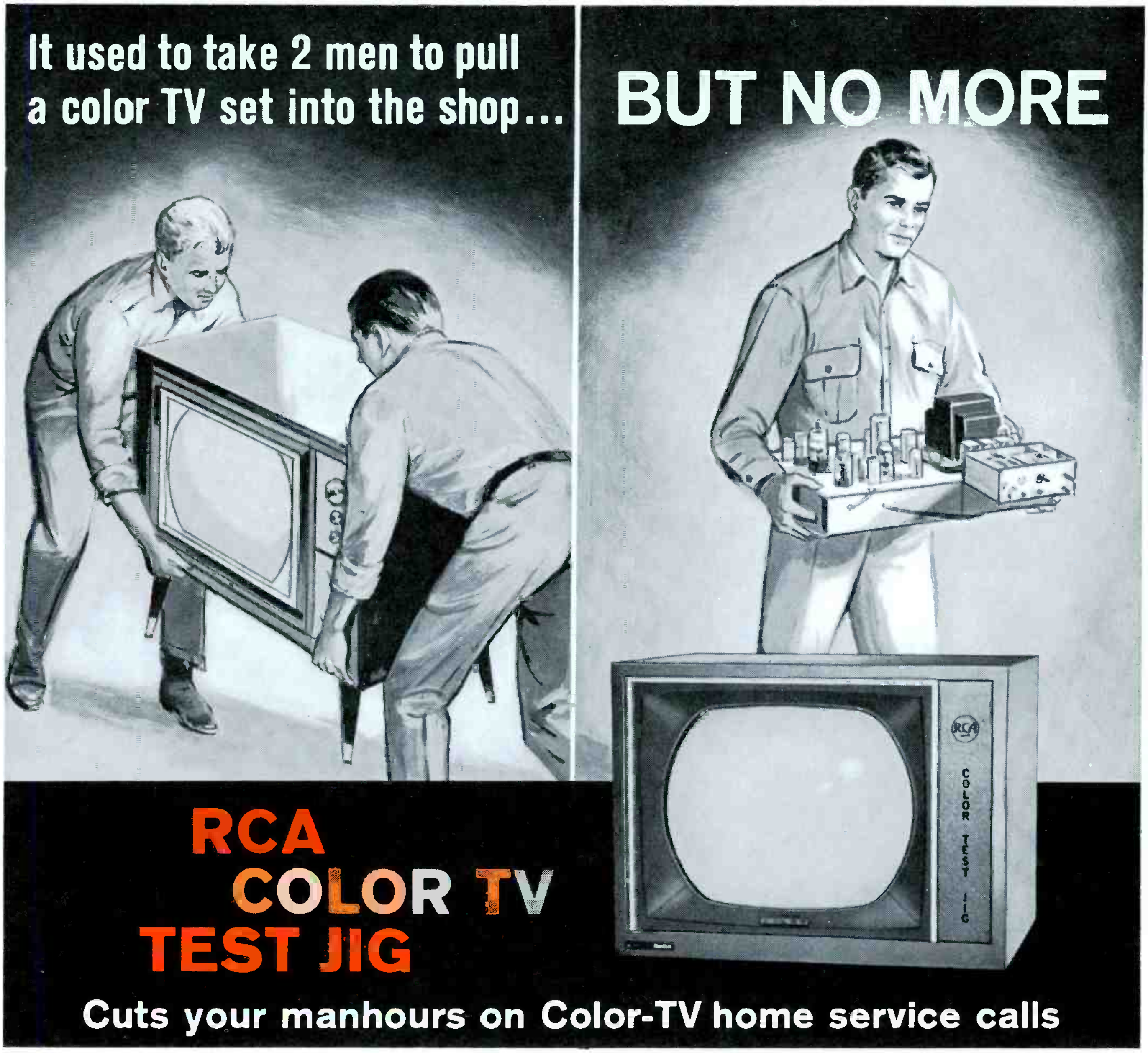

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No longer must you send two men to a customer's home to pull in his entire color set. Now, one man can simply remove the chassis and bring it back to your shop for testing, troubleshooting and alignment in your RCA Color TV Test Jig.

Look at some of the extra advantages built into this money-saving unit:

- **Minimizes costly damage claims.** Pulling chassis eliminates possibility of scratching or damaging a customer's cabinet when transporting it to and from his home.
- **Saves time.** Eliminates need to reconverge a customer's set when chassis is returned. Convergence control panel on Test Jig provides static and dynamic convergence.
- **Versatile.** Can be used with all RCA color chassis.
- **Safe.** Supplied with factory-installed safety glass and kine mask.
- **Complete components kit,** supplied with unit, provides all necessary service components and instructions for installing RCA Color Picture Tube.
- **Professional appearance.** Finish matches that of your other RCA test instruments.

The RCA Color TV Test Jig is available through your Authorized RCA Parts and Accessories Distributor. See him this week to find out how this versatile instrument can help you capitalize on the growing Color TV servicing market.

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Channel Master is so far ahead in indoor antenna design, it isn't even funny.

There's something new in the air! A truly exciting and complete line of heads-up indoor antennas for TV and FM—**fourteen** in all. Designs that are strikingly different. Beautiful Compact. Space-saving. With exclusive cork-cushioned legs and corrosion-resistant brass elements. Every one of them looks beyond today toward tomorrow. And their looks are matched by advance-engineered performance that gives incomparable, **true** new gain. (Up to 4 DB).

Channel Master 6-in-1 all-channel antennas. The first indoor units to use **outdoor type** elements such as yagis and stacked bow-ties. Assures absolutely matchless pull-in power and interference control for color and black-and-white (in both VHF and UHF). FM Stereo and FM. These are honest all-channel models. Because they have **two** separate transmission lines . . . one for UHF and the other for VHF. And each 6-in-1 antenna has a 4-in-1 counterpart for VHF/FM only, which is equally outstanding.

The prices (fair-traded) start $4.98. But here's the big-profit news: For only a dollar more than the VHF model, you can offer your customer the 82-channel version. You'll go pretty far with a step-up line like Channel Master.

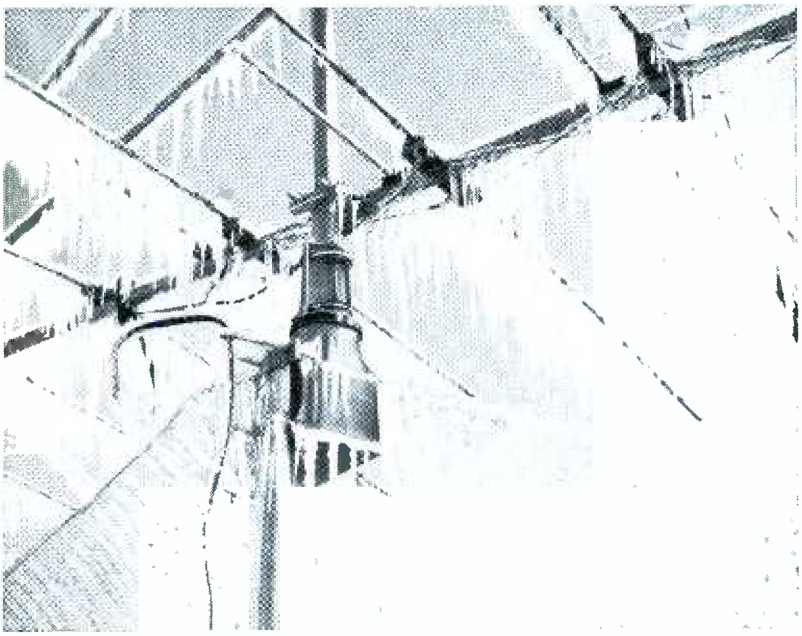
From left to right: 4-in-1 Alpha for VHF/FM with "Automagic" Clarifier Switch. $7.95. 6-in-1 Canaveral-82 . . . all-channel and FM with unique "Butterfly Dipole". Gives more gain than stacked dipole. $10.95. 4-in-1 Gamma for VHF/FM. $5.95.

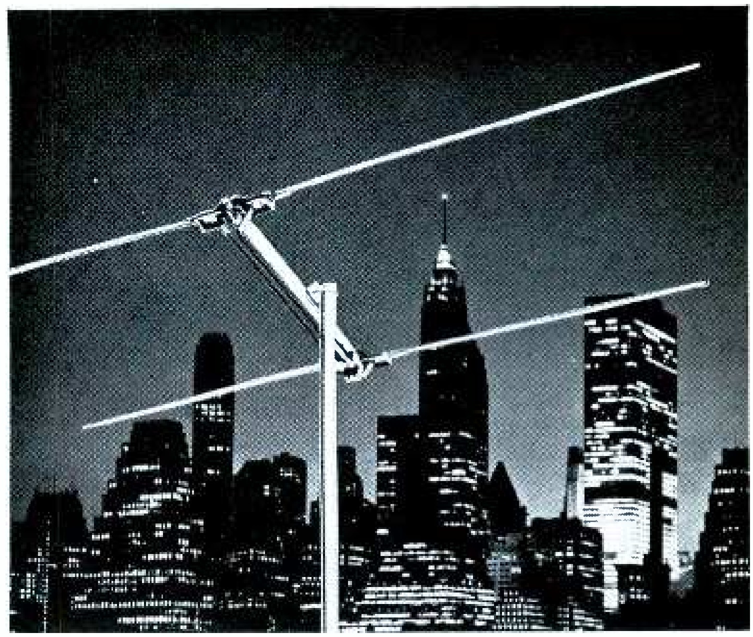
IF PRODUCT OR PERFORMANCE DEFECTIVE ★ Good Housekeeping GUARANTEES REPLACEMENT OR REFUND TO CONSUMER

CHANNEL MASTER

NEW DIRECTIONS IN SPACE

by CHANNEL MASTER





*A rotator so powerful it can turn a 329 lb. ice-loaded installation**

Other rotator makers may get the shakes at the thought. But ice or no, with the Tenn-a-liner, even the heaviest antenna array will turn. Easily.

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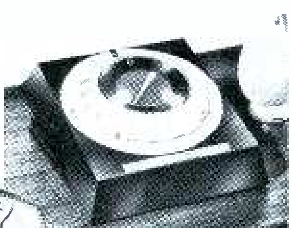

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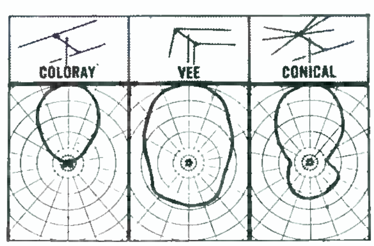
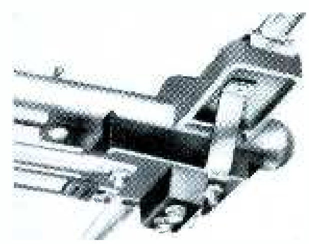


The Coloray actually has a higher front-to-back ratio than a 10-element single-channel yagi. Just compare the polar pattern of the Coloray with those of most commonly used city antennas.



The secret? A unique transposed phasing harness with an impedance balancing power equalizer circuit.

Circle 10 on literature card

The Troubleshooter

answers your servicing problems

Lost Audio, Video, and Brightness

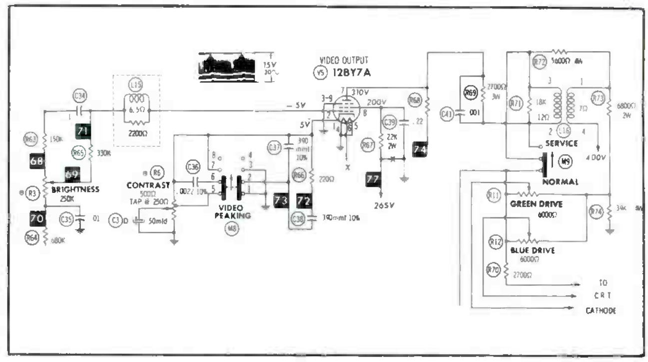
I have been servicing color television for five years, but I have recently encountered the following problems in several RCA CTC15 color receivers. When the set is turned on, there is no brightness, audio, or video, but simply turning the channel selector to the right or left and back again results in a normal picture. Operation remains normal until the set is turned off for awhile and then back on again. I suspect tuner trouble but how can the tuner kill the brightness?

HAROLD T. BOALICH

Clearfield, Pa.

RCA CTC15 chassis is covered in PHOTOFACT *Folder 673-2. The symptoms you describe seem to indicate an incorrect AGC setting; this is not uncommon in these sets. You can correct the situation by following this procedure: Tune in a strong TV station and advance the AGC control until instability appears in the picture; reduce the control setting until the unstable condition just disappears; check all available stations for proper AGC action.*

Loss of brightness is probably an indirect result of DC coupling between the plate of the video output tube and the CRT; with the screen conrtols set a little low, or the brightness control slightly below normal, absence of video will often



result in a loss of brightness. Defects in the tuner, IF, video, or AGC stages could cause a loss of video, and therefore a loss of brightness.

Dots Won't Converge

I have an RCA CTC15 color receiver, which the customer wants converged. The first thing I observed was that the magnet that moves the red dot was all the way out and the blue magnet was touching the neck of the tube. I tried a static convergence, but even when the blue magnet was pushed all the way in against the neck of the picture tube the red and blue dots still wouldn't overlap. Could you give me some assistance on this matter, or do you think the red gun is imperfect?

BORIS G. KNESVIC

Cranford, N. J.

It sounds as though your problem may be caused by improper adjustment of the static convergence magnets. Try removing the individual slugs from their magnet forms and rotating them 90° before reinserting them into the forms. This should give the proper range of dot movement. That is, the

No Raster at Maximum Brightness

Wishing to get into color service work, I figured a good way to start was to buy an old set and fix it up. Mine is an RCA CTC4A chassis. Many hours and lots of small parts later, I have been able to get this set in good shape except for one trouble which has me beat. When the brightness control is advanced to near maximum, an area at the top of the picture about three inches wide becomes shaded and completely out of focus. This condition can also be caused by advancing the contrast control. When the brightness and contrast controls are both set to maximum, the raster slowly disappears. This happens on both color and black-and-white programs.

I have tried a CRT booster, installed a new focus control, changed the high-voltage regulator and focus rectifier, along with numerous resistors and capacitors through the set. Could you please help me on this one?

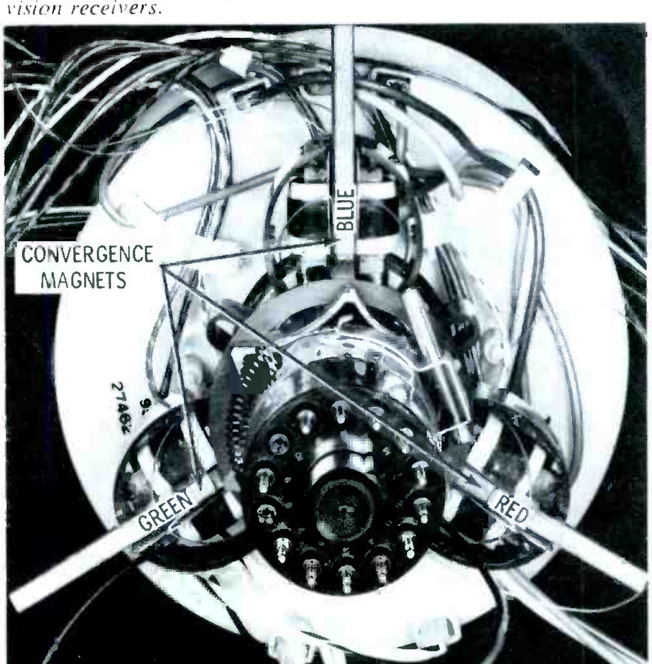
LEO R. CORNELL

Richmond, Calif.

Your description of the symptoms in your CTC4 color chassis (covered in PHOTOFACT *Folder 314-9) seems to indicate a trouble that is common with these chassis. We have serviced these receivers quite extensively, and find this to be a common fault that can be eliminated only by an overall reduction in drive levels to the CRT. What happens is this: When the brightness and contrast controls are rotated toward maximum, an excessive load is placed on the high-voltage circuits. The HV supply just can't supply the resultant current demands. Reducing the settings of the screen and background controls slightly usually eliminates the problem, although it reduces maximum brightness. However, there is no reason to ever operate the receiver at so high a brightness level. Adjust the contrast and brightness controls alternately for a normal picture. In a receiver this old, don't worry about tracking throughout the brightness range; simply adjust the screen and background controls for a white background at a normal brightness.* ▲

dots can be made to cross over one another. If this procedure fails, recheck the purity adjustments. If purity is too far off, a static adjustment cannot be performed satisfactorily.

The article "Objective: Pure White" in the November 1962 issue goes quite deeply into convergence adjustments—including exactly what each control does. Also, the article "ABC's of Convergence" in the September 1964 issue has a diagram showing correct convergence procedure. The information in these two articles will help you understand convergence in color television receivers.



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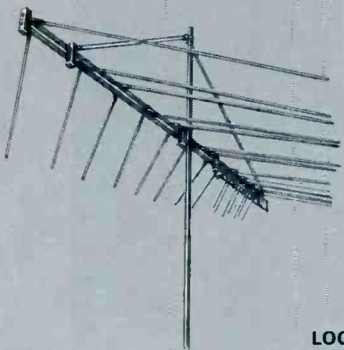

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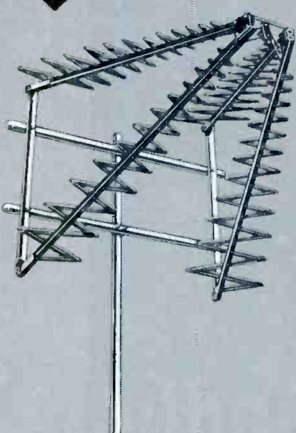

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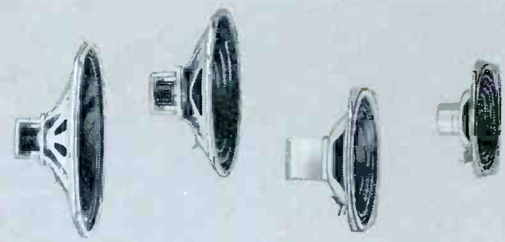

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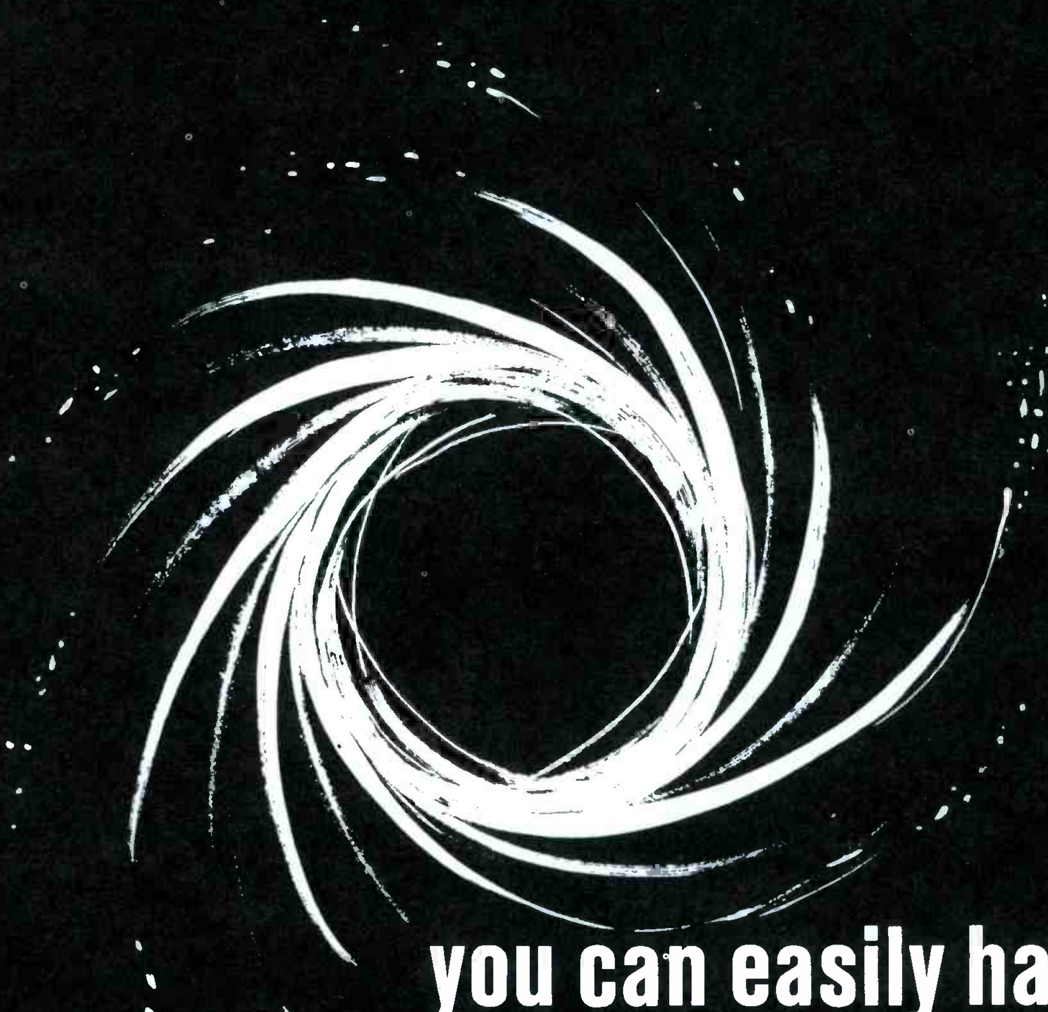

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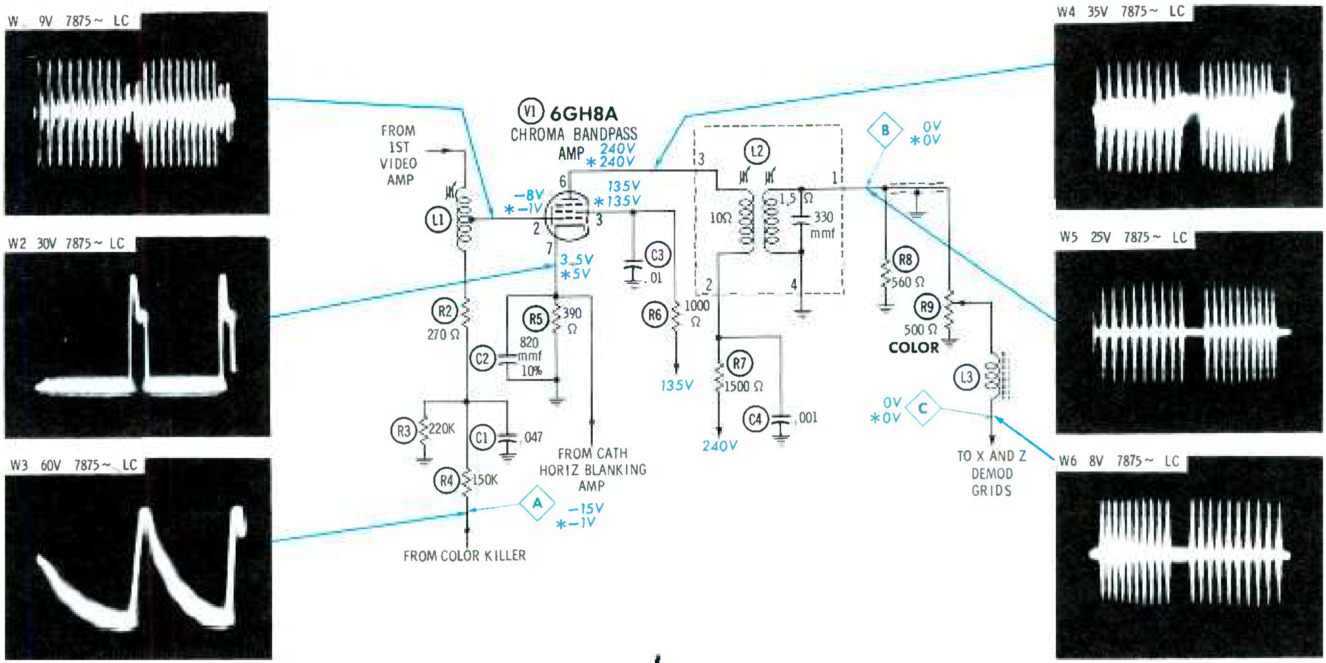


DC VOLTAGES taken with VTVM, on inactive channel; antenna terminals shorted. *Indicates voltages taken with signal present—see "Operating Variations."

WAVEFORMS taken with wideband scope; TV controls set to produce normal color-bar pattern on screen. Low-cap probe (LC) used to obtain all waveforms.

Normal Operation

Both single- and dual-stage amplification is found in chroma bandpass amplifier of color receivers. Single-tube circuit shown here (from Bradford Model WGEC-89946A) is found in several modern color receivers. Whether one or two stages are used, purpose is same—to amplify signal. Chroma signal for single tube is taken from first video amplifier plate, whereas dual stages are fed directly from video detector. Signal for two-stage circuit is thus considerably smaller in amplitude and is opposite in polarity. Bandpass stage is biased off during monochrome reception by color-killer circuit, with C1, R3, and R4 as filter and voltage divider network. When color is received, negative bias from killer is removed, allowing bandpass stage to operate. L1 couples composite color (chroma signal plus burst) to V1 grid, and is tuned to pass only frequencies between 3 and 4 mc. L2 tunes plate circuit for passing same range of frequencies to demodulator control grids. Color control R9 limits amplitude of signal applied to demodulator grids, thus controlling amount of signal fed to CRT grids. R6 and R7 supply plate and screen voltages, with C3 and C4 as bypass capacitors. Decoupling action of C4 and R7 also affect passband characteristic of L2. Positive horizontal blanking pulse at cathode (pin 7) cuts bandpass amplifier off during burst interval (horizontal retrace time), leaving only chroma information in output signal of bandpass stage. In some receivers using two color amplifier stages, pulse to remove burst is fed to demodulator circuit.

Operating Variations

A Negative voltage varies from zero to 22 volts depending on setting of color-killer. Control setting is correct when color snow just disappears with receiver on vacant channel.

Pin 2 DC voltage, with or without signal, changes from zero to −12 volts with adjustment of killer control; color is lost completely when grid has more than −7 volts applied. Contrast control is located in cathode of third video amplifier and has no effect on voltage readings in this stage.

Pin 3, 6 Plate and screen are both connected to B+ through relatively low-value resistors, voltage decreases only slightly with signal present; change here is barely noticeable.

Pin 7 Without signal, voltage swings from 3.5 to 5 volts depending on setting of color-killer control. Normal is 3.5 volts.

WAVE-FORMS Amplitude of W1 changes as receiver fine tuning is adjusted or as signal strength at antenna terminals varies. W4 follows same pattern as signal at grid. Small amount of horizontal pulse may appear in W1 and W4 due to stray pickup. Amplitude of W6 varies from zero to 15 volts peak to peak depending on setting of color control.

SYMPTOM 1

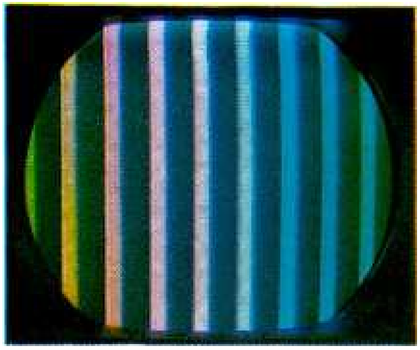
Color Weak

Monochrome Picture Normal

R6 Increased In Value

(Screen Supply Resistor—1000 ohms)

Symptom Analysis

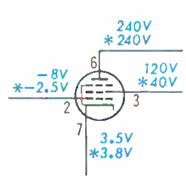


Color is weak even at maximum setting of color control. Black and white reception is normal, so trouble probably isn't in tuner or IF. Colors are represented correctly, tint control has sufficient range, proving oscillator and control circuits okay.

Waveform Analysis

Normal W1 confirms suspicion that previous stages are normal. Reduced amplitude of W6 proves trouble is in bandpass amplifier stage. W4 only 3 volts p-p indicates tube conduction greatly reduced—normal is 35 volts p-p. All color bars have equal amplitude, throwing suspicion somewhere other than plate circuit. Trouble in plate circuit would change response of L2 causing unequal saturation or improper phase of bars.

Voltage and Component Analysis



Voltages without signal are all normal, offering no clue to defective component. Bandpass stage is normally cut off with no signal present, therefore voltage measurements without signal have little meaning. With signal, a significant clue is gained from the reduced voltage on screen (pin 3)—only 40 volts. Plate voltage is normal—tube isn't drawing excessive current. B+ side of R6 measures 135 volts, strongly indicating R6 has increased in value. Very leaky C3 might cause similar effect, but R6 would then overheat.

Best Bet: Scope finds stage, VTVM locates component.

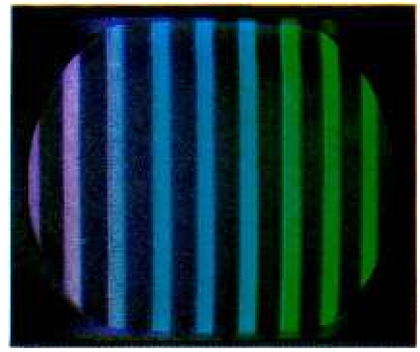
SYMPTOM 2

Color Incorrect

Tint Control has Full Range

R2 Increased in Value

(Grid Resistor—270 ohms)

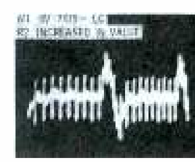


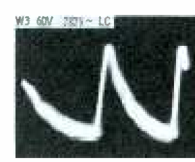
Symptom Analysis

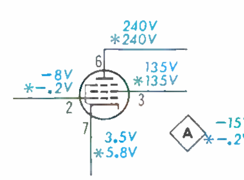
Flesh tones appear reddish blue; tint control changes faces from magenta to blue rather than from magenta to green—indicating improper 90° phase shift. Colors all have equal brightness, and color sync is okay. Symptom doesn't point conclusively to any specific stage.

Waveform Analysis

Bandpass amplifier stage is usually suspected only when color is weak or missing. However, incorrect color phase can be caused by this stage if the response of either L1 or L2 is drastically changed. Abnormal W1 (compare to normal) definitely points to trouble in grid circuit. W3 is okay—means R2, R3, R4, or C1 is troublemaker. R2 is most likely as other components would have less effect on response of L1. Open L1 would kill color.







Voltage and Component Analysis

Scope indications suggest voltage checks in bandpass amplifier stage. All voltages are normal without signal; however, with signal, both grid and cathode give incorrect readings. Lowered negative voltage on grid leads to suspicion of trouble in grid circuit. Decreased negative voltage at A gives no definite indication to specific component, as grid network is also common to color-killer plate. Neither waveforms or voltages are conclusive enough to pinpoint component. Only resistance reading will spot increased value of R2.

Best Bet: Scope, then voltage and resistance checks.

SYMPTOM 3

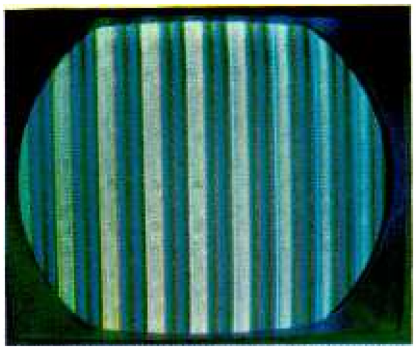
Color Abnormal

Colored Vertical Lines in Picture

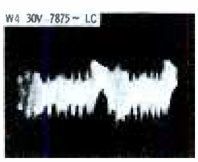
L2 Open, Terminal 4

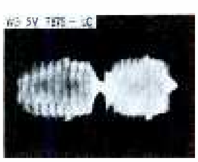
(Bandpass Transformer)

Symptom Analysis



Numerous colors are present on screen but are seen only as colored vertical bars in picture. Operation of color and tint controls appears normal. 3.58-mc oscillator must be operating—otherwise no color would be obtained. Color quite weak, indicating bandpass trouble.

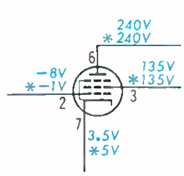




Waveform Analysis

Normal W1 proves trouble isn't in preceding stages or bandpass grid circuit. Distorted W4 helps isolate troubled stage. Amplitude of W4 is near normal, therefore bandpass stage is amplifying signal; plate and screen voltages are probably okay. Greatly reduced amplitude and improper signal in W5 holds significant clue to trouble in L2. Loss in amplitude should be only slight, as signal is coupled through L2. 30-volts loss is too great.

Voltage and Component Analysis



All voltage measurements (with or without signal) are normal, offering no clue to trouble stage. Gain in bandpass amplifier is approximately 3 under normal conditions, and improper functioning of this circuit can not always be detected by VTVM. Following clue obtained from scope (that defect is probably in plate circuit), resistance checks reveal open connection of L2. Point B should measure 1.5 ohms to ground, but with open at pin 4, meter shows 220 ohms from B to ground. Open connection on board has same effect.

Best Bet:* *Isolate stage with scope, then resistance checks.

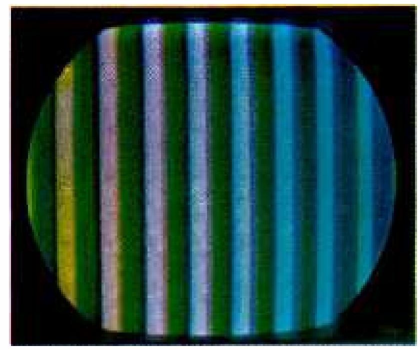
SYMPTOM 4

Color Weak

Also Smeared

R7 Increased in Value

(Plate Supply Resistor—1500 ohms)

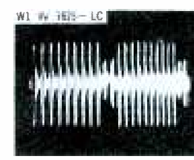


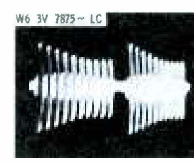
Symptom Analysis

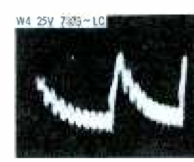
Color is weak and washed out, with a smearing or splashing-over of the colors. Smearing is more noticeable with color generator connected to antenna terminals than with station signal. Incorrect frequency response of bandpass amplifier is indicated.

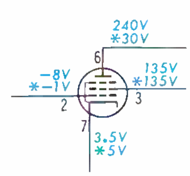
Waveform Analysis

Normal W1 indicates neither preceding stages nor response of L1 is responsible for trouble. Reduced and uneven amplitude of bars in W6 confirms suspicion of trouble in bandpass stage. All bars aren't same amplitude—definitely throws suspicion on plate circuit. Abnormal W4—signal is reduced extremely in amplitude, and oversized horizontal blanking pulse is present — definitely isolates trouble to bandpass amplifier plate circuit.









Voltage and Component Analysis

Information gained from scope analysis suggests voltage checks in bandpass amplifier should be most useful. Voltages without signal are normal, consequently giving little help. With signal, valuable clue is found by measuring plate voltage—only 30 volts, while normal reading is 240 volts. Source voltage is normal, therefore R7 must be defective. Tube isn't overconducting, thus lowering plate voltage, because indications on grid, screen, and cathode are normal. Increased value of R7 contributes to detuning L2, thus causing color to smear.

Best Bet:* *Scope, then VTVM.

SYMPTOM 5

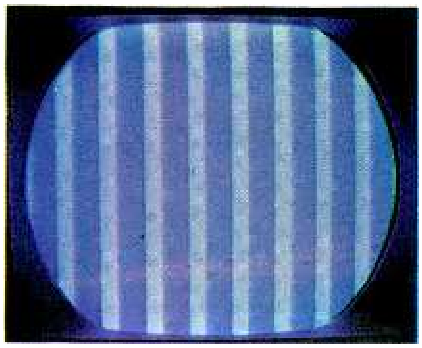
Color Lost

Monochrome Pix Normal

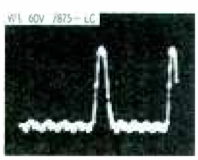
C1 Open

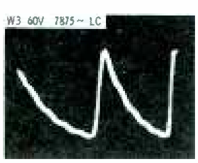
(Filter Capacitor—.047 mfd.)

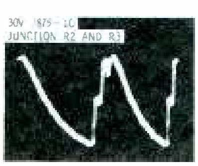
Symptom Analysis



No color can be obtained with a normal station signal. With color-bar generator connected to antenna terminals, fine tuning adjusted so receiver is overtuned, and color control at maximum, slight color can be seen. Indicates trouble is probably in bandpass amplifier.



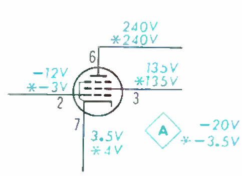




Waveform Analysis

Extreme abnormality of W1 points to trouble in grid of bandpass amplifier or in color killer. W1 shows chroma information is present but enlarged horizontal pulse in waveform offers definite key to trouble. Normal W3 indicates defect is in grid circuit, eliminating killer stage. Presence of horizontal pulse at junction of R2-R3-R4 pinpoints one of them or C1 as troublemaker. These components should filter horizontal pulse.

Voltage and Component Analysis



Increased negative voltage at grid explains loss of color—bandpass amplifier is practically cut off. Cathode voltage increases only slightly over reading without signal, verifies fact that tube is conducting only slightly. Negative voltage at A is also more negative than normal, with or without signal, but gives no conclusive evidence. Filter network is common to bandpass grid and killer plate. Voltage readings aren't conclusive. Resistance checks of R2, R3, and R4 show they're okay; C1 must be open.

Best Bet: Scope isolates, resistance checks pinpoint.

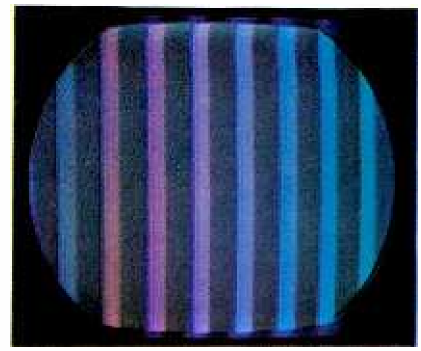
SYMPTOM 6

Color Weak

Color Missing on Left

R5 Increased in Value

(Cathode Resistor—390 ohms)

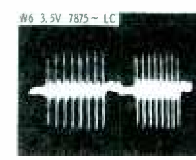


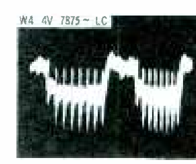
Symptom Analysis

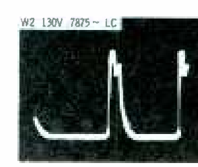
At normal setting of color control, with station signal, no color can be seen on screen. Adjusting color control produces weak color. However, left side of screen is still without color. Tint control will shift generator bars 30° in either direction; bandpass amp is suspect.

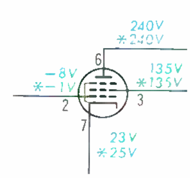
Waveform Analysis

Normal W1 (not shown) proves preceding stages are normal. In W6, reduced amplitude and first two bars missing isolates stage. W4 shows, along with reduced amplitude, horizontal pulse is blanking out first two bars. Most significant clue is provided by W2—130 volts p-p; normal is only 30 volts p-p. Increased value of cathode resistor develops very large blanking pulse, keeping tube cut off during first part of each horizontal line.









Voltage and Component Analysis

Cathode voltage, (with or without signal) is greatly increased, providing definite clue to trouble in bandpass stage. Increased cathode voltage could be caused by overconduction of tube—normal voltage readings at pins 3 and 6 rule out this possibility. Normal grid voltage leads definitely to suspicion that value of R5 is increased. Fact that color is missing from left side of screen isn't explained by voltage readings. However, analysis of cathode waveform answers question. Pulse should cut tube off only during burst interval.

Best Bet: Localize with scope; pinpoint with meter.

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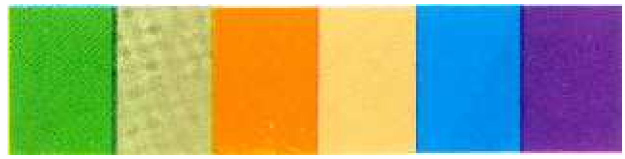
checking phase of

COLOR-BAR GENERATORS



Be sure your color test display is correct

. . . by Robert G. Middleton

Fig. 1. A typical multibar pattern.

Color-bar generators provide various chroma signals that can be used for the adjustment and troubleshooting of color-TV receivers. All of the chroma signals obtainable from any one generator have the same frequency; either 3.579545 mc or 3.563-795 mc (usually abbreviated to 3.58 mc and 3.56 mc). NTSC-type generators supply 3.58-mc chroma signals, and rainbow-type generators supply 3.56-mc signals. Since all chroma signals have the same frequency, where do the different color bars come from? Fig. 1 depicts a typical NTSC color-bar pattern. The different colors correspond to different phases of the 3.58-mc chroma signal.

What Phase Means

The *phase* of the signal simply means the *time* at which it starts. Fig. 2 shows a sine wave that has been progressively shifted in phase. Each waveform starts at the *same* time, but it starts at a different point in the cycle. For example, we know that current leads voltage in a capacitor by 90°, as depicted in Fig. 3A.

It is most convenient to represent a phase difference by means of vectors, as seen in Fig. 3B. This eliminates the necessity for drawing the sine waves; the vector lengths show the peak values of the sine waves.

Basic Chroma Phases

Basic chroma phases are shown in Fig. 4; these are burst, R-Y, B-Y, and G-Y. All chroma phases are referenced to the color burst. Color-bar generators, regardless of types, supply R-Y and B-Y signals; many also supply a G-Y signal, and some additionally provide a G-Y/90° chroma signal (see Fig. 5). Note, in Fig. 4, that R-Y and B-Y are separated by 90°; thus, R-Y and B-Y are said to be in quadrature. Likewise, Fig. 5 shows that G-Y and G-Y/90° are in quadrature. These quadratic relationships make it easy to check the basic chroma phases of a color-bar generator.

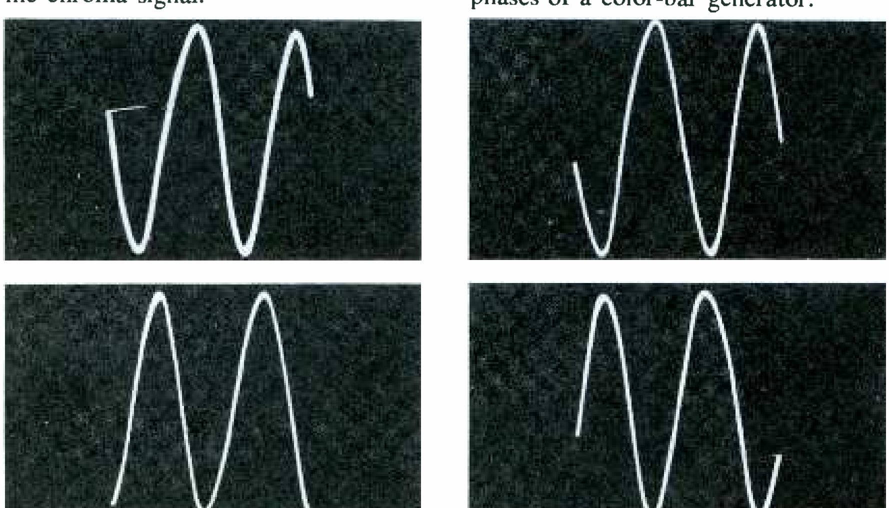


Fig. 2. Varied phase of the sine wave as seen on scope.

Let us see how the system works. The chroma demodulators in a color-TV receiver are phase detectors. Fig. 6 shows a block diagram of a typical chroma section. If you apply an R-Y signal to the R-Y demodulator, full output is obtained; a B-Y signal applied to the R-Y demodulator will give zero output. Again, if you apply a B-Y signal to the B-Y demodulator, full output results; an R-Y signal applied to the B-Y demodulator will give zero output. Finally, if you apply a G-Y signal to the R-Y and B-Y demodulators, full output is obtained from the G-Y matrix; a G-Y/90° signal fed to the R-Y and B-Y demodulators will provide zero output from the G-Y matrix.

Practical Procedure

Now, let's see how to check chroma phases in the type of color-bar generator that supplies a single bar at a time and displays a black bar that splits the color bar, as depicted in Fig. 7A. These principles apply to any form of single-bar display. You can use the screen of a color TV set as an indicator, although a scope gives a more accurate indication of phase. Proceed as follows:

1. Connect a scope and low-C probe to the output of the R-Y demodulator (Fig. 6).
2. Set the color-bar generator to R-Y output.
3. Apply the output from the generator to the input terminals of the color receiver.
4. Tune in the color-bar pattern (Fig. 7A).
5. Adjust the receiver's color-phas-

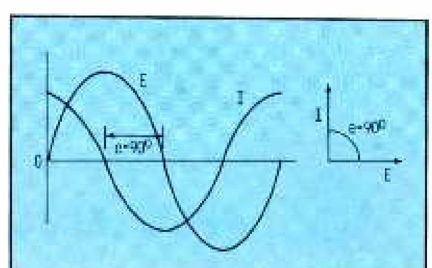


Fig. 3. In capacitor, I leads E by 90°.

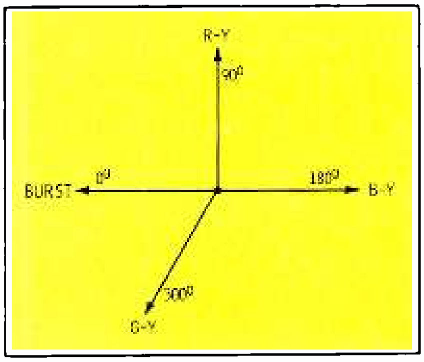


Fig. 4. Chroma phase relationships.

ing control for maximum height of the "color" segments in the scope pattern (Fig. 7A).

6. Switch the generator to B-Y output. The scope pattern (Fig. 7B) should now indicate a null (zero color output).

Note that this test does *not* require that the color-TV receiver be in accurate adjustment, because the scope is connected only to the R-Y demodulator output. The test is accurate, even if the B-Y demodulator or G-Y matrix is out of adjustment.

If these test results are satisfactory, you know that the generator is supplying R-Y and B-Y signals exactly in quadrature, as required. On the other hand, if the test results are not satisfactory, it is advisable to repeat the test; be sure you start by adjusting the color-phasing control carefully for maximum R-Y output. Then switch the generator again to B-Y output to see if a null is obtained. If you do not obtain the null on the second trial, you can conclude that the generator is not supplying R-Y and B-Y signals in quadrature to each other.

Troubleshooting the Delay Line

Chroma phases are generated by delay lines similar to the one depicted in Fig. 8. Any defective component will cause the chroma phase to be incorrect. In the present example (R-Y and B-Y phases not in quadrature), there will be a defective component between the B-Y and R-Y takeoff points shown in Fig. 8. The most likely culprit is an open or leaky capacitor. However, it is possible that a coil is damaged and exhibits an incorrect inductance. A capacitor can be tested by disconnecting one end and checking it on a capacitance bridge; inductors can be checked on a good impedance bridge, or by substitution. Replacement inductors must be obtained from the generator manufacturer.

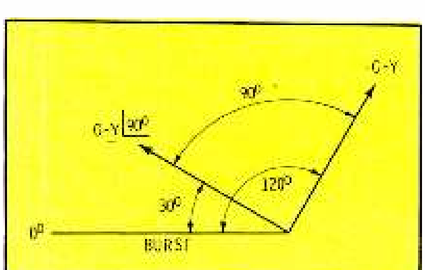


Fig. 5. Phase angle of G-Y/90° signal.

Checking the G-Y and G-Y/90° Phases

After the R-Y and B-Y phases have been checked out satisfactorily (or restored to accurate quadrature by delay-line troubleshooting), you may proceed to check the G-Y and G-Y/90° phases. Connect the scope to the output of the G-Y matrix, as depicted in Fig. 9. Set the generator to G-Y output (this may be shown as a–G-Y output, but the procedure is the same). Adjust the receiver's color-phasing control for maximum height of the color segments in the scope pattern (Fig. 7A). Then, switch the generator to G-Y/90° output. A null pattern should be observed (Fig. 7B).

Evaluation of Results

As in the R-Y and B-Y phase check, this test is highly accurate, regardless of receiver adjustment. If the test is unsatisfactory, repeat the procedure to make sure that you started with maximum output from the G-Y matrix. If you confirm the unsatisfactory test result, you can conclude that the generator is not supplying G-Y and G-Y/90° signals in quadrature to each other because of some defective component in the chroma delay line. Check the capacitors and inductors between the G-Y and G-Y/90° takeoff points. (Note that the delay line depicted in Fig. 8 does not supply these phases—hence, this test would be skipped for an instrument having this particular type of delay line).

Checking I and Q Phases

If your generator supplies I and Q chroma signals, you might suppose that you need an IQ-type receiver to make a check of the signal phases. This supposition is false—you can use an R-Y and B-Y receiver just as well. Here's how to do it: Connect the scope at the output of the R-Y demodulator; set the generator to I output; adjust the receiver's color-phasing control for maximum output as shown on the scope screen (this can be done because the color-phasing control has a wide range, and the I phase is 33° from the R-Y phase, as shown in Fig. 10): then, switch the generator to Q output. A null should be observed on the scope screen. If the Q signal does not null, repeat the test to make sure that there is no testing error. If the null does not appear on recheck, you can conclude there is a defect in the chroma delay line. The defective component will be found between the I and Q take off points.

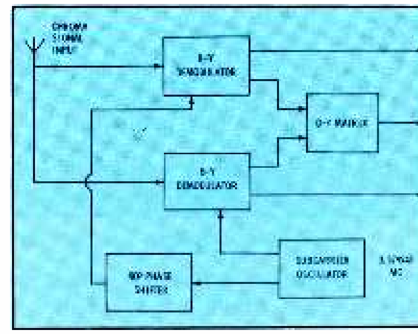


Fig. 6. The block diagram of a typical chroma section used in a color receiver.

Overall Evaluation

After the basic chroma phases have been checked out satisfactorily, you can make an additional overall evaluation of the generator. B-Y is taken off at the beginning of the delay line, and Q is taken off at the end of the delay line. The R-Y phase is known to be correct with respect to B-Y, and the I phase is known to be correct with respect to the Q phase. In turn, it is reasonably safe to conclude that the other chroma phases (red, green, blue, etc.,) will be correct. In this case, you will probably terminate your phase checks and give the generator a stamp of approval.

On the other hand, some generators have chroma delay lines which are not as simple as the circuit in Fig. 8. In these, you will quite possibly need to make additional phase checks of the green, red, blue, yellow, magenta, and cyan chroma signals. This might seem to be a difficult job, but it is really very simple. The procedure is based on the useful fact that the primary colors are 180° out of phase with their complementary colors. As shown in Fig. 11, magenta is the complement of green, and the resultant of red and blue.

Checking Color-Bar Phases by Pairs

Referring again to Fig. 10, we see that blue and yellow have phases near the B-Y axis. We will proceed to check

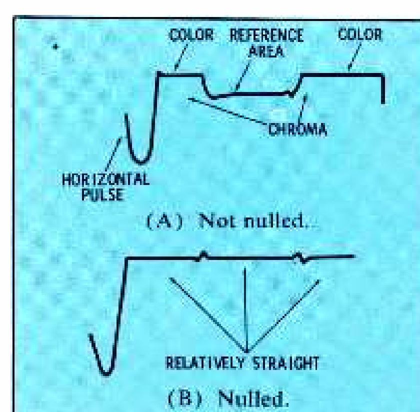


Fig. 7. Scope shows a chroma null.

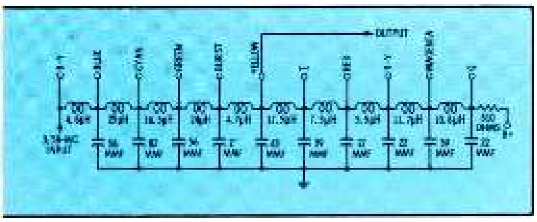


Fig. 8. Typical chroma delay line.

the blue phase and its complement, the yellow phase. Connect the scope to the output of the R-Y demodulator (directly to the picture-tube grids in newer receivers). Set the generator (Fig. 5) to blue output. Adjust the receiver's color-phasing control to null the blue signal (Fig. 7B). Then, switch the generator to yellow output; you should again see a null pattern on the scope screen. If you do not, there is conclusive evidence of a defect in the chroma delay line between the blue and yellow take-off points.

After the blue and yellow phases have been checked out satisfactorily (or corrected by troubleshooting the delay line), proceed to check the red and cyan phases. Connect the scope to the B-Y demodulator output. Set the generator to red output. Adjust the receiver's color-phasing control to null the signal on the scope screen. Then, switch the generator to cyan output. You should again see a null pattern. If you do not, there is a defect between the red and cyan takeoff points in the delay line.

After the red and cyan phases have been verified, proceed to check the green and magenta phases. The scope is left connected to the B-Y demodulator output. Set the generator to green output and adjust the receiver's color-phasing control to null the signal on the scope screen. Then, switch the generator to magenta output. You should again see a null pattern. If the null does not appear on the scope screen, there is a defect in the chroma delay line between the green and magenta takeoff points.

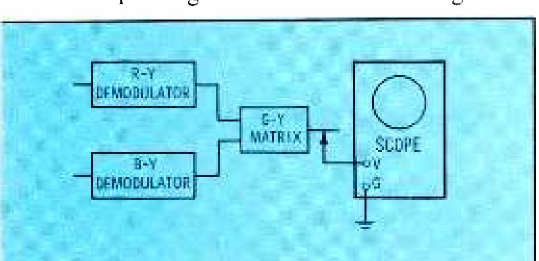


Fig. 9. Setup for G-Y phase check.

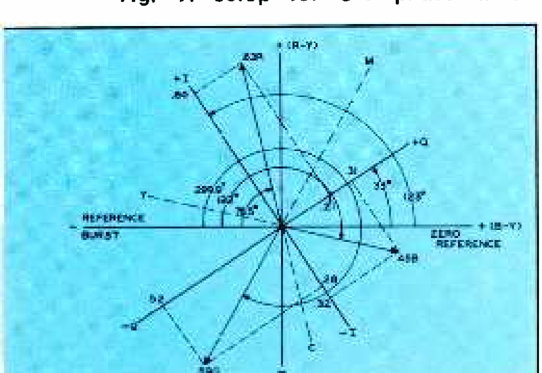


Fig. 10. Chroma phases with I and Q.

Color-Receiver Variations

Several different types of color-TV receivers are in present-day use. Hence, it is important to recognize that all receivers provide the same R-Y, B-Y, and G-Y outputs, as depicted in Fig. 12. When you check R-Y output from a receiver, the scope might connect to the R-Y amplifier output instead of the R-Y demodulator output. In all cases, the R-Y signal is applied to the red grid of the color picture tube, the B-Y signal to the blue grid of the picture tube, and the G-Y signal to the green grid. These three leads are color-coded accordingly and are easily identified in any receiver. Connection terminals are always provided at the chassis end of these grid leads; it is therefore unnecessary to pull the chassis or to use test adapters when checking phases of color-bar generators.

Multiple-Bar Color Generators

More elaborate types of color-bar generators provide six NTSC color bars simultaneously and supply R-Y and B-Y, I and Q, or G-Y and G-Y/90° signals in simultaneous pairs. The same basic principles which have been explained apply to simultaneous displays, although the pattern details and evaluations necessarily differ. Three delay lines are typically employed, and troubleshooting is somewhat more complex. Color-difference bars are ordinarily generated in pairs, as shown in Fig. 3. Since this presents a simpler situation, checking phase of color-difference bars will be explained first.

Checking R-Y and B-Y Phases

The waveform of an R-Y and B-Y signal contains the elements shown in Fig. 14. The phases of the color burst, B-Y, and R-Y elements are different. The B-Y signal is normally 180° out of phase with burst, and the R-Y signal is normally 90° out of phase with burst. These phases are set by the R-Y and B-Y delay line seen in Fig. 15. If the phases are incorrect, it is logical to conclude that there is a defective component in the delay line. It is assumed, of course, that tubes have been checked. Modulated-RF output from the color-bar generator is applied to a color-TV receiver. A scope and low-cap probe are connected at the output of the R-Y demodulator or amplifier.

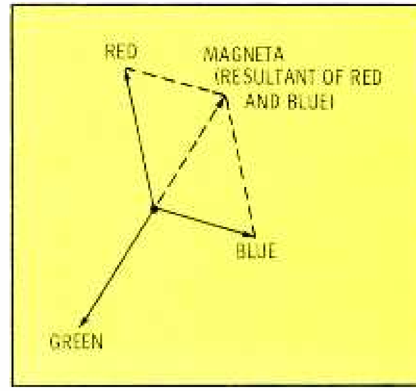


Fig. 11. Green signal nulls magenta.

The color receiver does not necessarily need to be in good adjustment, because the following test is made with respect to output from the R-Y demodulator only. Observe the pattern on the scope screen, while rocking the receiver's color-phasing control back and forth. The R-Y "square wave" should reach its peak amplitude as the B-Y "square wave" goes through zero, as seen in Fig. 16A. On the other hand, if the B-Y component does not null as the R-Y component goes through maximum (Fig. 16B), the color-bar generator is not supplying signals of the correct phase. The most likely culprit is a defective component in the R-Y and B-Y delay line.

Correcting Troubles

Fig. 17 shows the R-Y and B-Y delay line used in a typical color-bar generator. For the symptom under discussion, the defect will be found between the R-Y and B-Y takeoff points. Note that a defect between the 3.58-mc input and the R-Y takeoff point

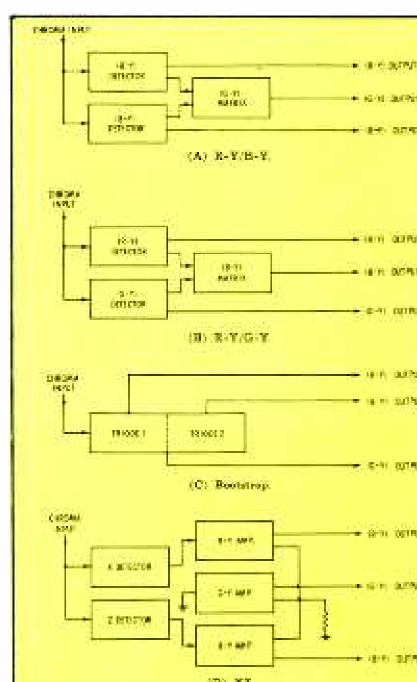


Fig. 12. Circuits give same output.

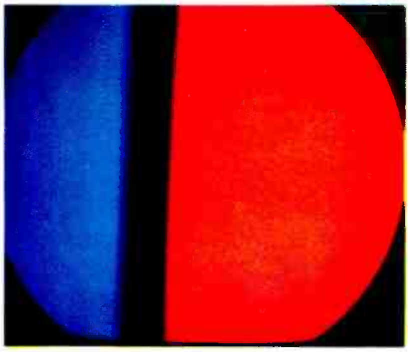


Fig. 13. Two color-difference bars.

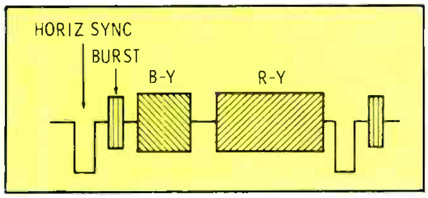


Fig. 14. The B-Y and R-Y waveforms.

will affect only the setting of the receiver's color-phasing control. The 7-45 mmf trimmer capacitors are adjusted at the factory to provide quadrature signals; they require readjustment only in case a component is replaced. The 4-30 mmf trimmer capacitors are automatically switched in and out to compensate for switch-circuit capacitances. These trimmers are also adjusted at the factory and do not require readjustment unless lead dress is disturbed.

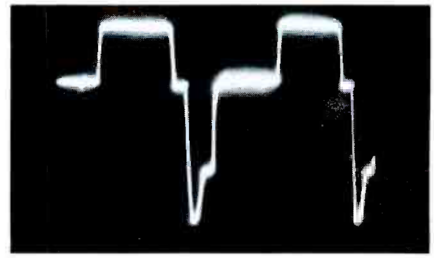
Hence, do not attempt to correct phasing problems by adjusting the trimmer capacitors. Look for the defective component in the delay line. Fixed capacitors are the most usual culprits—they may become leaky or open. One end of each capacitor must be disconnected to allow it to be tested on a capacitance checker; otherwise substitution tests can be made. In case the capacitors are cleared of suspicion, check the terminating resistor. An open or off-value resistor can disturb phases along the delay line.

Coils seldom become defective unless accidentally damaged. In some color-bar generators, the coils are mounted very close to different tie-studs or lugs, which may puncture the enamel insulation. Try pressing against coils which are suspiciously close to studs or lugs. This may clear up the trouble. Since coil inductances cannot be measured without a lab-type impedance bridge, replacement coils must be ordered from the factory in the majority of cases. After a damaged coil has been replaced, check the R-Y phase against the B-Y phase as previously explained. In case a phase error is shown by the scope pattern, touch up the 7-45 mmf trimmer nearest the new coil. This will serve to bring the two signals into exact quadrature. Do not change the adjustment of the 4-30 mmf trimmers.

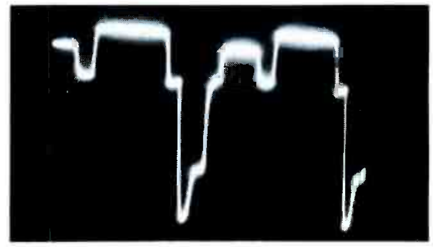
Checking I and Q Phases

The I and Q waveform has the same shape as that shown in Fig. 14. Only the chroma phases distinguish it from the R-Y and B-Y waveform. As before, you do not need an I and Q receiver to check the I and Q phases. Connect the scope and low-cap probe to the output of the R-Y demodulator (or amplifier). Apply the modulated-RF I and Q signal to the receiver. Observe the pattern on the scope screen while rocking the receiver's color-phasing control back and forth. You will see the same patterns as illustrated in Fig. 16. The I "square wave" should reach its peak amplitude as the Q "square wave" goes through zero. If it does not do so, look for a defective component in the I and Q delay line (Fig. 15).

Fig. 18 shows a typical I and Q delay line. It is similar to the R-Y and B-Y delay line in Fig. 17, except that three sections are used instead of four. The same troubleshooting principles apply. Remember not to disturb the trimmer adjustments unless a fixed capacitor or coil is replaced. Then, adjust only the 7-45 mmf trimmer nearest the replaced component to bring the two signals into exact quadrature.



(A) B-Y bar nulled.



(B) B-Y bar not nulled.

Fig. 16. B-Y and R-Y phase checks.

Checking G-Y and G-Y/90° Phases

A few color-bar generators supply simultaneous G-Y and G-Y/90° color-difference bars. In such a case, you will find another delay line somewhat similar to the I and Q delay line depicted in Fig. 18. Again, the output from the R-Y demodulator in a color receiver can be used to check the G-Y and G-Y/90° phases for exact quadrature. The same general troubleshooting principles apply as previously explained. However, some color-bar generators supply a G-Y/90° signal only; no G-Y signal is available. This type of generator has a single-section delay line (Fig. 19); checking G-Y and G-Y/90° phases is more involved.

First, you must have a color receiver *in good adjustment*. Then, apply an R-Y and B-Y signal to the receiver. Connect the scope and low-cap probe at the output of the B-Y demodulator and adjust the receiver's

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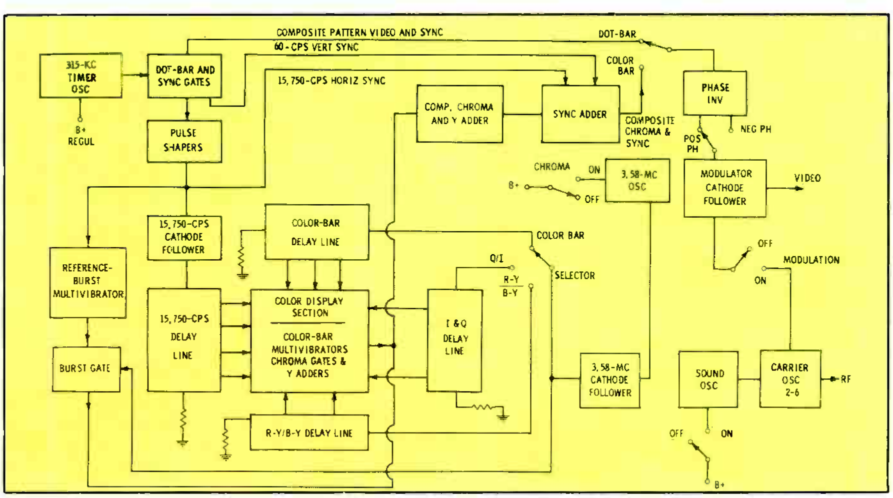


Fig. 15. Diagram of a typical color-bar generator.

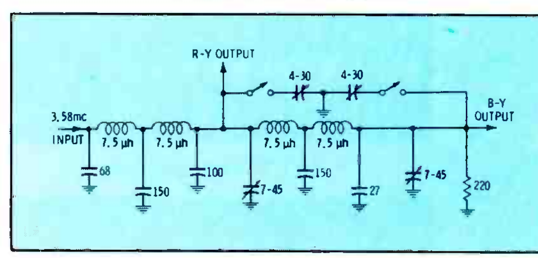


Fig. 17. B-Y, R-Y chroma delay line.

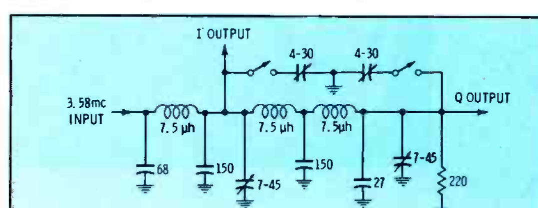
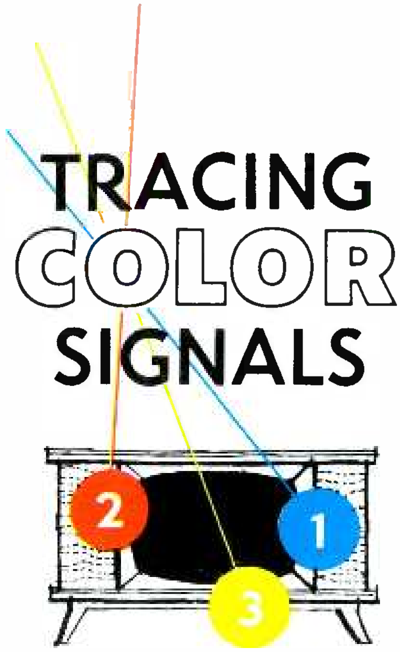


Fig. 18. An I, Q chroma delay line.

TRACING COLOR SIGNALS



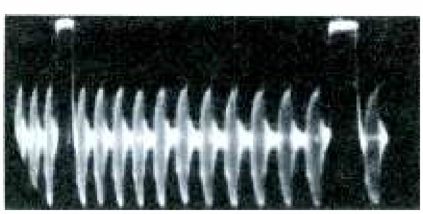
Methodical checks help locate defective stages.

Most technicians agree that the fastest way to troubleshoot color sets is by signal tracing with a scope. They commonly admit, however, that they don't fully understand the signals or the means for tracing them. This article contains the fundamental information about tracing chroma (color) signals in an ordinary color set — the instruments needed, how to connect them, and what to look for.

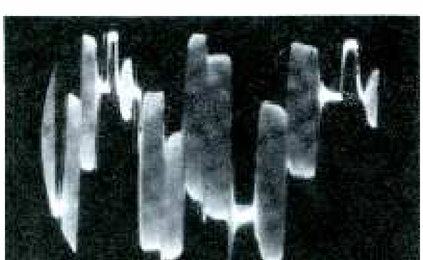
Tracing is simple if the signal has an easily recognizable shape—more so than with a complex station signal, which is constantly changing in appearance. Thus, a color-bar generator of either the keyed-rainbow or the NTSC type is used. Waveforms from both are easily identified; the keyed-rainbow signal is shown in Fig. 1A and the NTSC in Fig. 1B.

Since the signal from a generator remains the same at the input of the chroma circuits, any changes that take place in its appearance at various points are clues to correct or incorrect operation. Some changes are normal—that's what the chroma circuits are for. Other changes indicate abnormalities. The tracing steps given here show you what to expect at various tracing points in a normal set. The several types of generators can be used interchangeably, provided you learn the basic patterns and the effects of the circuits in various sets.

Note: Material in this article adapted from the Howard W. Sams book "101 Ways To Use Your Color-TV Test Equipment" by Robert G. Middleton



(A) Keyed rainbow



(B) NTSC

Fig. 1. Typical patterns obtained from different types of color-bar generators.

To Check IF Signals

Use a demodulator probe, high-gain scope, and color-bar generator. Connect the output cable from the color-bar generator to the RF-input terminal of the receiver (antenna signal can be used, if desired). Touch the demodulator probe to the grid and plate terminals of the IF stages progressively. Observe the scope pattern (Fig. 2).

With a reasonably strong signal applied to the receiver, you will be able to check for the presence or absence of an IF signal at any stage. Note, for example, that the signal may possibly seem to stop at a grid and then reappear at the plate of the same tube—this confusing symptom is caused by a detuned IF coil which happens to throw the stage into oscillation. Note also that an ordinary demodulator probe has very limited high-frequency response, and hence you can't see the color burst or chroma bars on the scope when such a probe is used. However, this is not a matter for concern, inasmuch as the purpose of the test is to establish the presence or absence of a signal at successive IF stages.

Output of Video Detector

This requires a wideband scope and low-capacitance probe. Drive the receiver with a color-broadcast signal or the output from a color-bar generator. (A color-bar generator will provide a steady and controllable test signal.) Connect the scope and low-cap probe to the picture-detector output, as shown in Fig. 3. Operate the scope at a 7875-cps deflection rate, and observe the video pattern (see Figs. 4A, B, C, and D).

Check the peak-to-peak voltage of the waveform against the value specified in the receiver service data. Note whether the sync pulses are clipped (evidence of overloading in the IF or RF sections). The burst signal should have the same amplitude as shown in the receiver service data; otherwise, there is a high-frequency loss due to poor alignment, or possibly a defective component in the signal channel. Remember that if a broadcast signal is used instead of a generator signal, the burst may be attenuated because of less-than-ideal transmission conditions. You will note from the waveforms in Fig. 4 that a signal begins to appear somewhat "ragged" after it has passed through the RF and IF stages. This is due to introduction of noise voltage and lack of ideal frequency response.

Overloading in RF-IF Sections

Use a wideband scope, low-cap probe, color-bar generator, and bias

Fig. 2. IF waveform using demod probe.

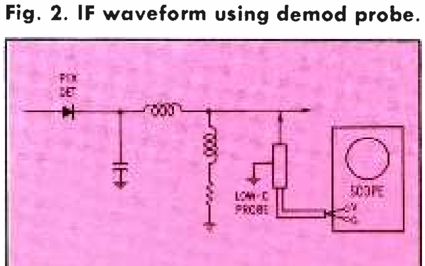
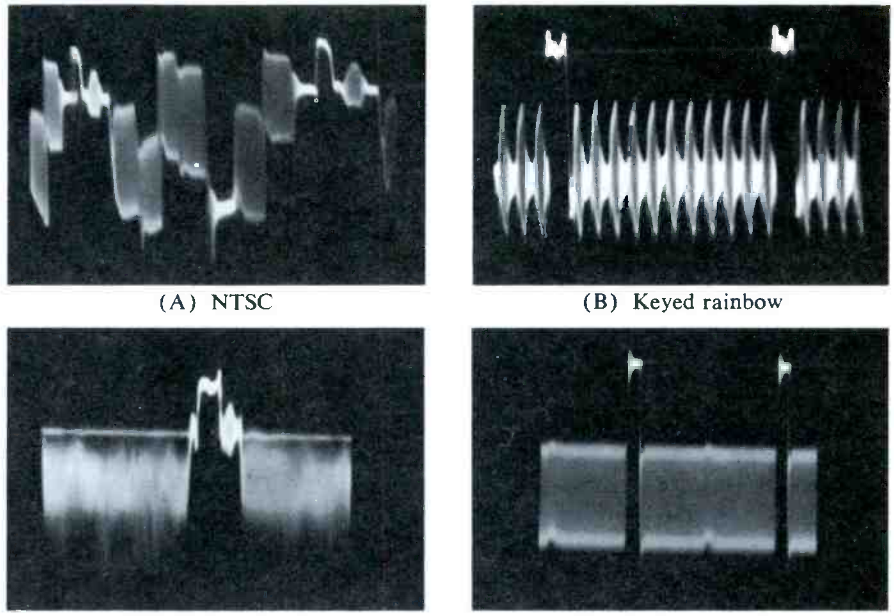


Fig. 3. Test point past video detector.



(A) NTSC (B) Keyed rainbow (C) Station signal (D) Unkeyed rainbow

Fig. 4. Waveforms at output of the video detector; result of various signals.

box(es). Connect the modulated-RF output from the color-bar generator to the antenna terminals of the receiver. Connect the scope and low-cap probe to the output of the picture detector. Connect the output leads from the bias source to the RF and IF AGC lines.

An overloaded amplifier produces waveform distortion as shown in Fig. 5A. Eliminate the distortion by setting the AGC bias voltages to suitable values and reducing the output from the color-bar generator as required to produce a waveform similar to Fig. 5B.

With the voltages set for maximum undistorted output from the picture detector, compare the waveform amplitude with the value specified in the receiver service data. If you can obtain normal output, look for AGC trouble in the chassis. In case you cannot, there is likely some circuit defect apart from AGC faults. For example, a screen or plate-supply voltage may be low, a coupling capacitor might be leaky, or a bypass capacitor could be open. Severe misalignment can also result in the inability to obtain rated detector output without distortion.

Output of Y Amplifier

An NTSC color-bar generator, test-pattern generator, or antenna signal can be used, plus a wideband oscilloscope and low-cap probe. Apply a modulated-RF signal to the antenna terminals of the receiver. Connect the scope via the low-cap probe to one of the cathode terminals on the color picture-tube socket. Adjust the receiver controls for as nearly normal operation as possible. Observe the pattern on the scope screen.

Waveform amplitude should agree with the value specified in the receiver service data, allowing for usual tolerances. The waveshape will depend upon the signal source utilized, as illustrated in Fig. 6. Remember that the Y amplifier in some receivers will pass part of the chroma signal, while others normally pass no visible chroma due to employment of a color-subcarrier trap. You must consult the service data in this regard. In any case, excessive 3.58-mc voltage at the Y-amplifier output impairs the quality of the color-picture reproduction—a color-subcarrier trap might be misaligned, or a defect in the Y-amplifier circuitry could be the culprit. Beginners should remember that unless a wideband scope is used, excessive chroma leakage through the Y amplifier will be missed in this test.

Output from Bandpass Amplifier

A wideband scope, 10-to-1 compensated probe, and color-bar generator (for steady signal) are used here. Apply the generator output to the antenna terminals of the receiver. Connect the probe to the bandpass-amplifier output (arm of the chroma control in Fig. 8). Feed the probe output to the vertical-in-

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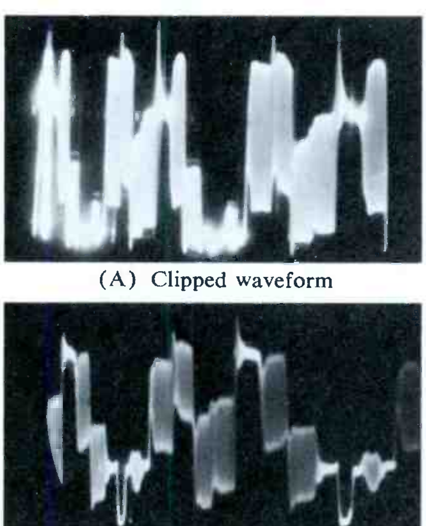
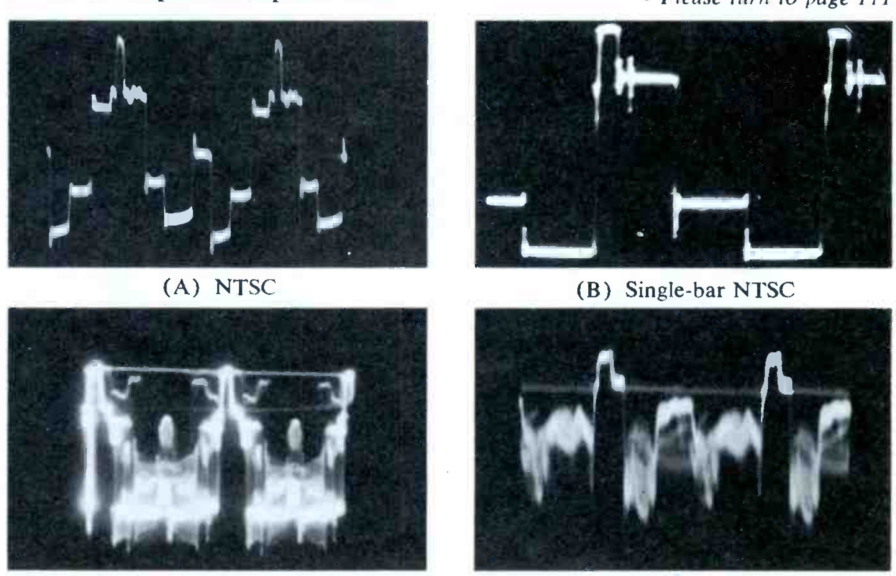


(A) Clipped waveform

(B) Normal

Fig. 5. A color signal distortion, as caused by a leaky coupling capacitor.



(A) NTSC (B) Single-bar NTSC (C) Test pattern (D) Station signal

Fig. 6. Typical output waveforms taken from normally operating Y amplifier.

QUICK WAYS OF CHROMA ALIGNMENT

by Norman D. Tanner

Many servicemen avoid alignment of black-and-white TV receivers, even when they know it is necessary. The customer's complaint usually concerns something other than poor picture quality caused by misalignment; therefore, the immediate trouble is repaired and alignment deliberately ignored. It seems that most customers have grown accustomed to living with a slightly "fuzzy" or "ghosty" picture from their monochrome receivers. People with color sets, however, are much more critical about picture quality — you might say they have a right to be. After all, who wants to see a pretty green face with blue lipstick on an expensive color set.

Realizing that the need for alignment of color receivers cannot be avoided as easily as in black and white sets, the technician must prepare himself and his shop with the knowledge and the test equipment required to perform a quick and accurate alignment job. The technician who services color TV sets must be prepared to perform the necessary alignment of chroma circuits when required or when requested.

This article will deal with several methods by which the automatic-frequency-phase-control (AFPC) circuits can be aligned properly. The coils incorporated in the oscillator and control circuits can be adjusted in the home or in the shop, and detailed procedures for both methods will be discussed at length. First, we'll briefly examine the nature of these circuits. (A comprehensive explanation of their operation is given in "Chroma Reference and Control Circuits" in this issue.)

How AFPC Circuits Work

The oscillator and control circuits in the chroma section of a color receiver function much like the horizontal-oscillator-AFC section in a TV receiver. A significant difference is that the oscillator in a color receiver operates at 3.58 mc (compared to 15,750 cps in horizontal stages) and is crystal controlled.

The schematic diagram in Fig. 1 represents the control circuits used in many modern color receivers. The free-running oscillator is kept at the correct frequency and in proper phase by the incoming burst signal. This synchronization is accomplished in the chroma sync-phase detector by comparing the burst signal (which is transmitted following each horizontal sync pulse) with the set's 3.58-mc CW signal. If the two sig-

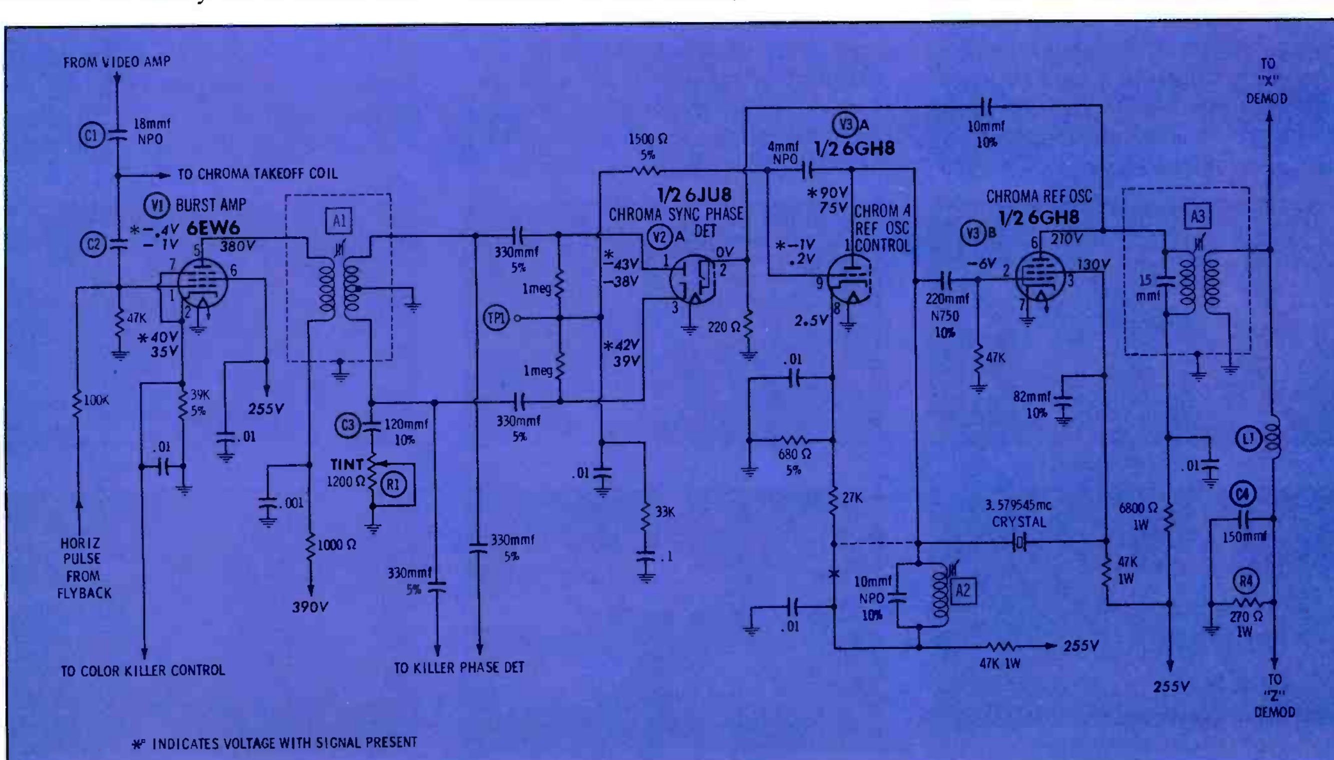


Fig. 1. Color-sync circuits supplying CW signal to the X and Z demodulators.

nals differ in frequency, a correction voltage appears at TP1 and is applied to the grid of the chroma reference-oscillator control tube, which then shifts the frequency of the reference oscillator to match that of the incoming burst signal.

The frequency-and-phase-controlled 3.58-mc output of the reference oscillator is applied to the suppressor grids of both the "X" and "Z" demodulators. L1, C4, and R4 are a fixed phase-shifting network, which alters the phase of the CW signal being fed to the "Z" demodulator. This signal, when compared with the incoming chroma signal (which appears at the demodulator grids), produces the color-difference signals. After amplification in the R-Y, B-Y, and G-Y amplifier stages, these signals are coupled to their respective grids in the CRT.

If, for any reason (misalignment or component failure, for example), the 3.58-mc signal is off frequency or out of phase, the resulting improper demodulation generates incorrect color on the screen of the CRT. Here's how you can correct this fault when misalignment is to blame.

Home Alignment

Any time a color receiver is serviced, the two final steps should be a check on the usable range of the tint control and a check for proper color synchronization. The tint control is useful for determining when alignment of the chroma circuits is necessary. This control should shift the phase of the color signals 30° in either direction. With a station signal, flesh tones should be obtained at the center of the range and should change from green to magenta as the control is rotated. With a keyed-rainbow color-bar pattern, the green bar on the right side of the screen should reappear on the left side when the tint control is rotated from one end to the other. If improper tint-control range or poor color synchonization is apparent, the following steps should be performed:

Minor Adjustments

1. Connect a color-bar generator to the receiver's antenna terminals.
2. Adjust the fine-tuning knob for a normal color pattern on the screen. (Use only enough generator output to obtain a pattern of normal brilliance on the screen.)

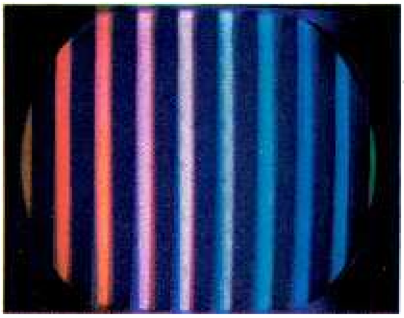


Fig. 2. Normal pattern with keyed-rainbow generator connected to a receiver.

3. Preset the tint control to the center of its range.
4. Using a short clip lead, ground TP1. This prevents the AFPC correction voltage from being applied to the oscillator's control grid and therefore permits the free-running (unsynchronized) frequency of the oscillator stage to be adjusted. TP1 is usually accessible from the top side of the chassis and is normally located near the phase-detector tube.
5. Adjust reactance coil A2 until the color bars stand still or drift slowly; this is often referred to as a "zero beat" because the oscillator is then very near to the 3.58-mc burst frequency of the generator's signal.
6. Remove the jumper from TP1 and view the color-bar pattern; it should now be in proper sync —and holding.
7. Check the range of the tint control; if it's still improper, set the tint control to the center of its range and adjust A1 (the burst transformer) until the fourth bar is magenta in color. The proper presentation of the keyed rainbow is shown in Fig. 2.

A complete and more detailed alignment of these circuits can also be performed in the home using the same equipment in conjunction with a VTVM.

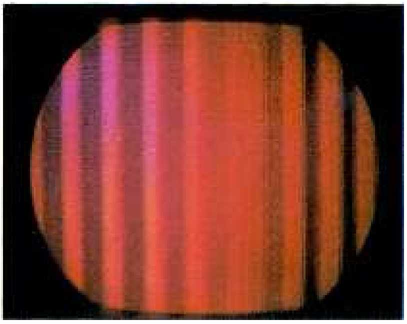


Fig. 3. Correct pattern with blue and green CRT grids shunted with 100K's.

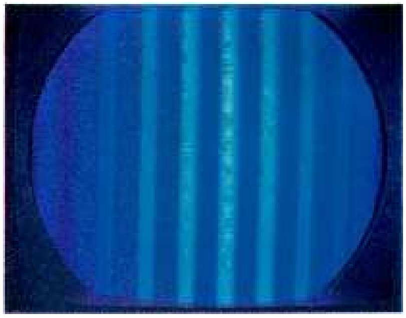


Fig. 4. Correct pattern with red and green CRT grids shunted with 100K's.

Complete Alignment

A thorough alignment will very seldom be required, unless someone has been "twiddling" the slugs. But, remember; a complete chroma alignment *can* be performed in the home, and much time can be saved by not taking the chassis to the shop. Usual symptoms of misalignment are incorrect colors or no color at all (the oscillator may be dead). A thorough alignment isn't really difficult—nor is it time consuming.

The following steps apply to all color receivers that use a reactance tube and a crystal-controlled oscillator. (A few manufacturers have a different oscillator circuit, and the specific alignment information for that set should be followed.) First of all, the oscillator transformer should be adjusted in the following manner, to provide a 3.58-mc CW signal.

1. Connect the DC probe of a VTVM (set to read negative voltage) to the plate (pin 1) of chroma sync-phase detector V2A; common lead of the meter goes to ground.
2. With a short clip lead, ground the grid of the burst amplifier (pin 1, V1)—this prevents the burst signal from being fed to the phase detector where it would cause erroneous indications.

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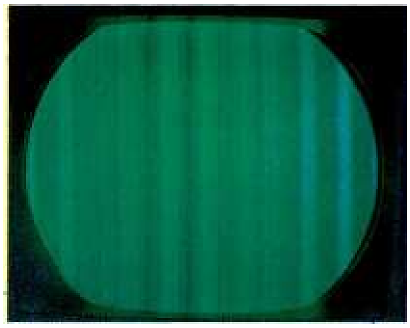

Fig. 5. Correct pattern with red and blue CRT grids shunted with 100K's.

a study of LUMINANCE CHANNELS

Spotlights of video activity from detector to picture tube.

by Norman D. Tanner and George F. Corne, Jr.

Color television has in the past few years become a most welcome source of entertainment in many American homes. And, indications are that many more people will soon be buying color sets. This means the technician should become more familiar with all aspects of servicing these receivers. Many articles have been written to help the serviceman understand the new and modified circuits used in color receivers. However, it seems that most of these articles have dealt primarily with chroma circuits. This is understandable, as the chroma circuits are probably the most unfamiliar; however, a second group of circuits (those in the luminance channel) is necessary to produce a normal black-and-white *or* color picture on the screen. A closer examination of the purpose and function of the circuits in the luminance channel will help you to determine if trouble exists in these stages, and, if so, what is responsible for this trouble.

Basically, the purpose of this separate channel is to provide amplification and delay to the video frequencies not containing color information. In most modern color receivers, one of two types of circuits is found in the luminance channel—the three stages of amplification

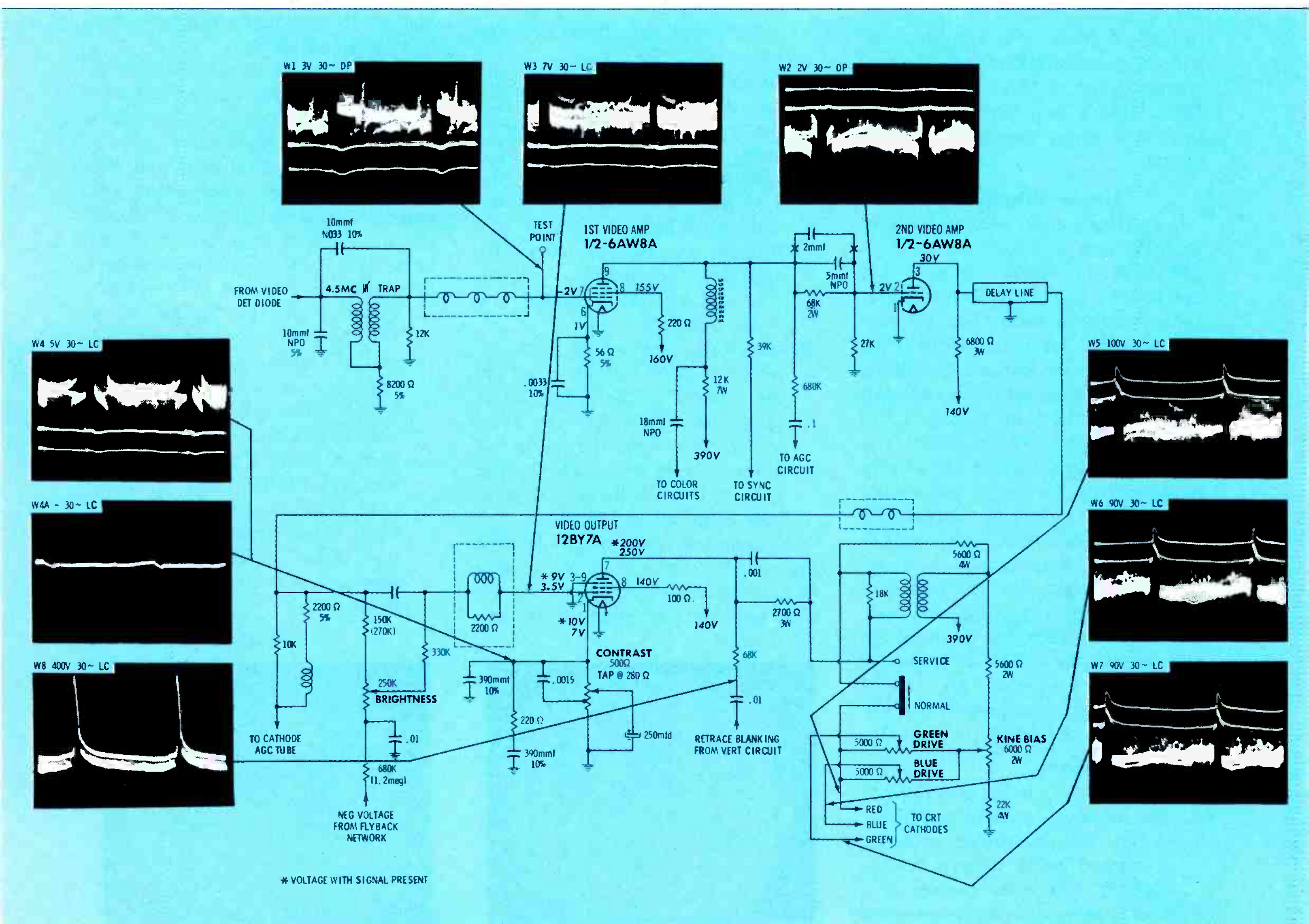

Fig. 1. Three-stage luminance channel has signal path divisions in plate circuit of first stage.

shown in Fig. 1 or the two-stage arrangement of Fig. 2. First, let's examine the three-stage circuit and see what effect it has on the luminance video.

Three-Stage Luminance

The signal at the grid of the first video amplifier is the composite video waveform (with chroma signal) taken from the output of the video detector. This first tube is a conventional pentode amplifier and is the final stage in which the composite video appears intact. At the plate of this tube, the signal is separated among five individual paths:

1. It is coupled to the grid of the bandpass amplifier to extract the chroma signal.
2. It is applied to the burst amplifier to develop the color-synchronizing signal.
3. It is fed to the sync circuits to extract the vertical- and horizontal-sync pulses.
4. It is supplied to the AGC circuits to develop an AGC bias voltage.
5. The luminance signal (video) is applied to the grid of the second video amplifier for further amplification. It is the processing of this signal we are discussing in this article.

The signal at the plate of the first video amplifier is approximately 50 volts peak-to-peak; however, the amplitude at the grid of the second stage is considerably reduced (notice the low amplitude of W2). The resistive divider network, in the grid of the second stage, reduces the signal to a level within the operating characteristics of the tube.

This second video amplifier stage has very little gain; its main purpose is to provide an impedance match between the video signal and the delay line. This stage is operated with a positive grid voltage, which lowers the plate impedance to match the low impedance (1500 ohms) of the delay line.

The delay line in the luminance channel is necessary to delay the video signal for a fraction of a second, thus enabling the luminance and chrominance signals to reach the CRT at exactly the same time. The chorma signal undergoes an unavoidable delay while passing through the narrow-band chroma circuits. An error in the relative phase of the luminance and chroma signals would result in color information being displaced to the left or right of the monochrome signal as shown on the CRT.

The following statement may be a reiteration from past articles, but

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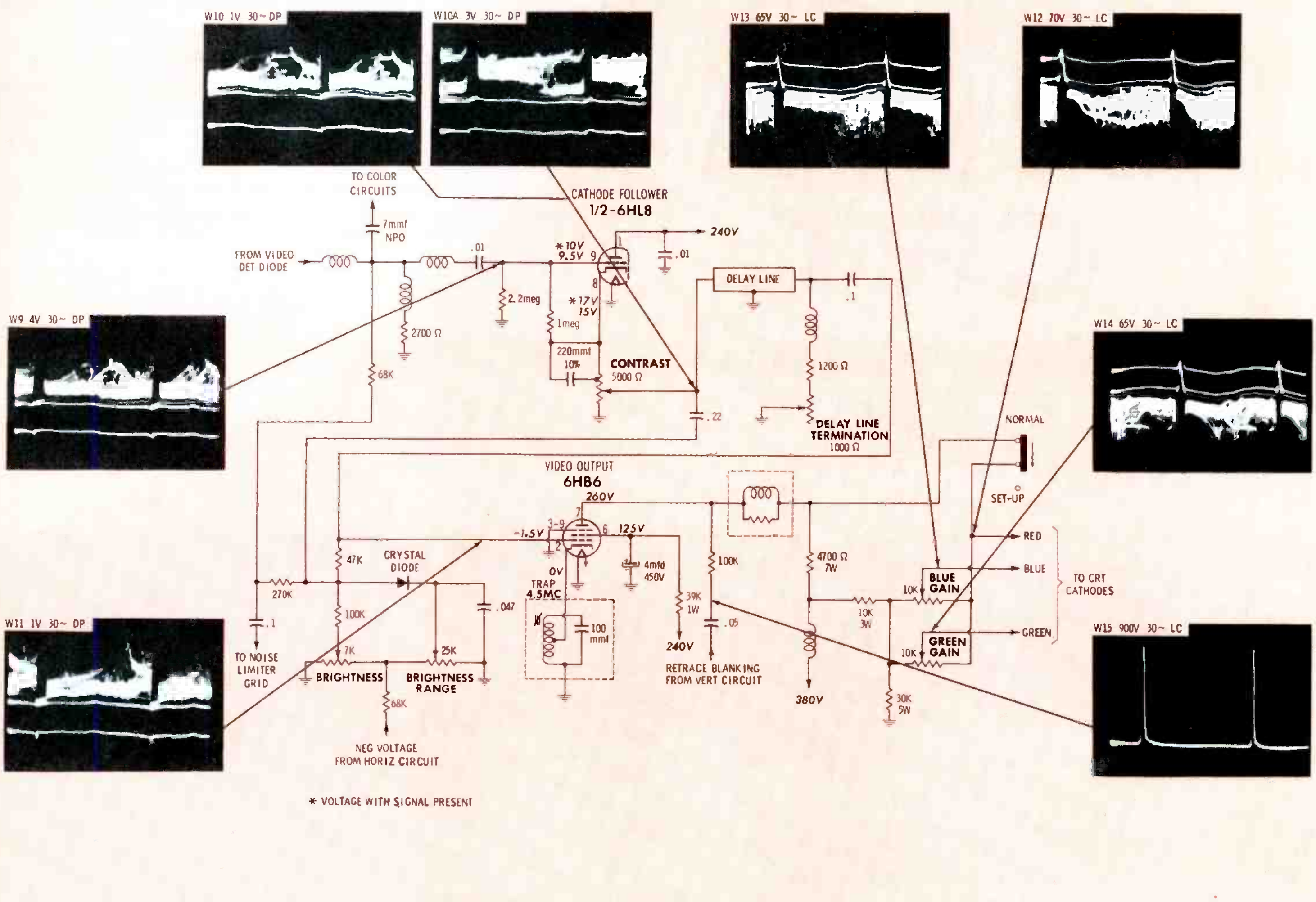
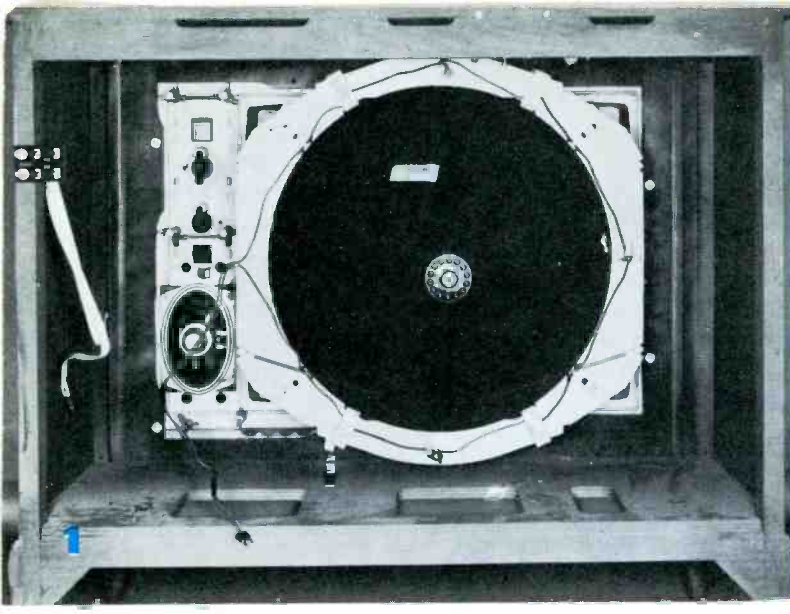
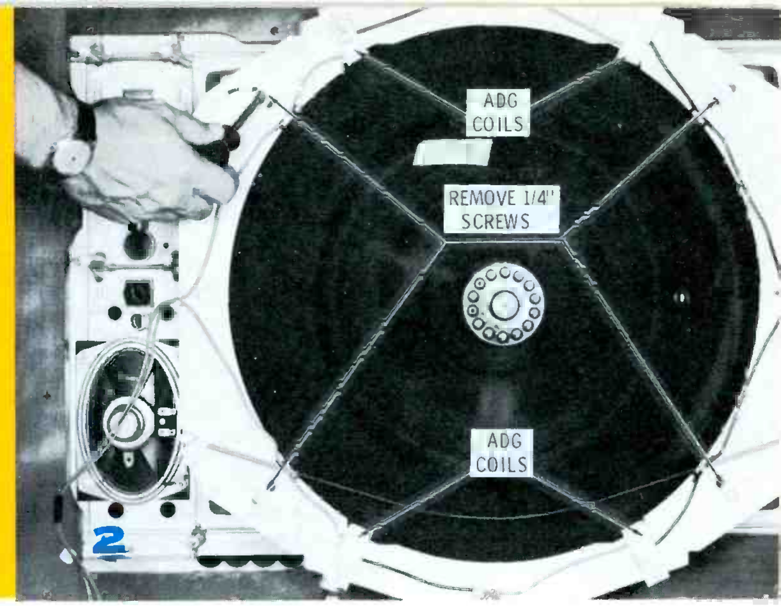


Fig. 2. Two-stage circuit utilizes cathode follower for impedance matching to delay line.

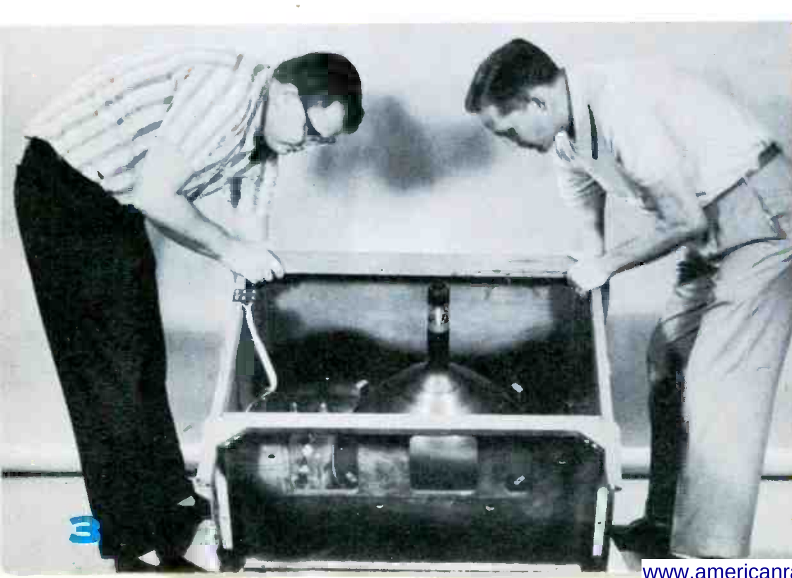


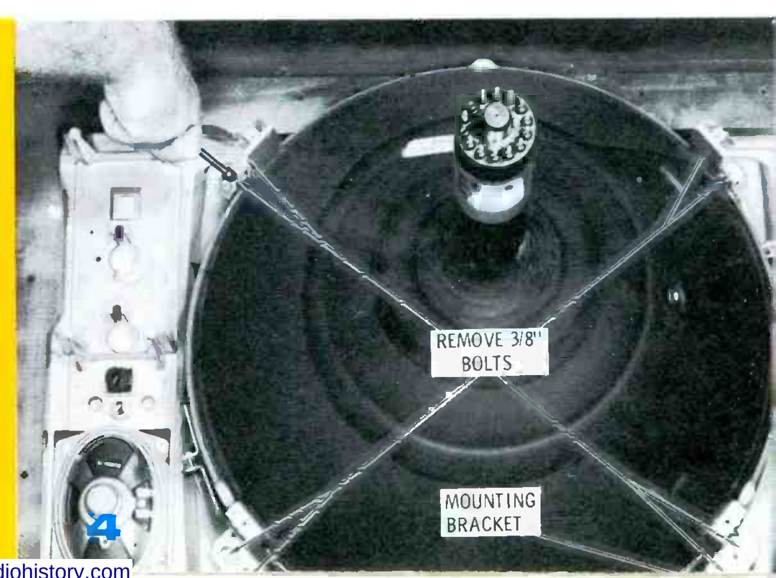


REPLACING A COLOR CRT

Here's a picture-tube job that entails more than simply placing an order for and installing a new CRT. The exacting placement of a color tube's mounting strap, to match the cabinet brackets, can't be approached without a well-planned procedure firmly in mind. The size and weight of a color tube also contribute to the difficulty of the task.

The sequence of photos shown here contains instructions and installation tips to prevent "backtracking" on the installation and physical realignment replacement tube. In and out of the cabinet once is tough enough!





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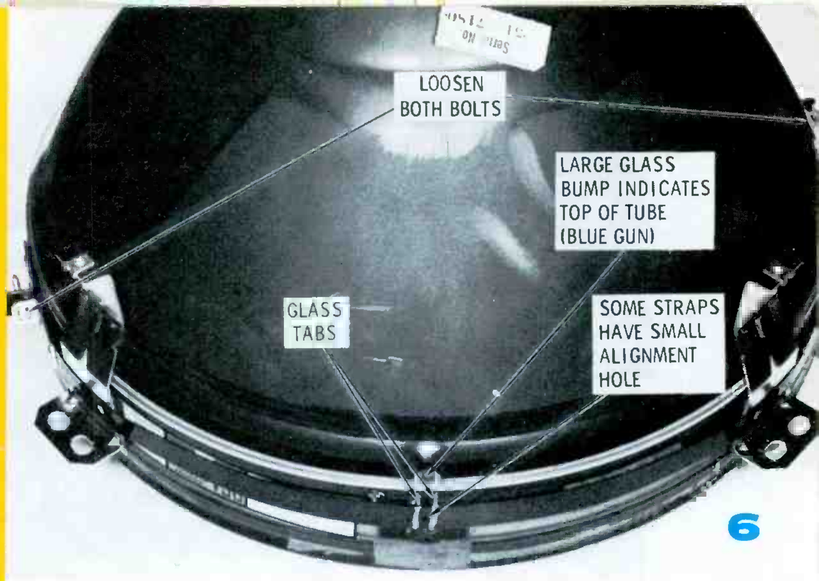

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1 Initial preparation consists of taking the chassis from the cabinet and removing all components—lateral magnet, purity coil, convergence yoke, and deflection yoke — from the neck of the tube. If you're not too familiar with the correct location of the components, it's a good idea, before you remove them, to make a visual and/or measurement check of their location on the neck of the tube and in relation to one another.

2 In some receivers (as here), you'll find a metal flange surrounding the tube. The flange serves as a mount and core for the automatic degaussing coils (ADG). In other sets, this flange is omitted, and the bracket ends are bare — see photo 4. If there is a flange, it will be necessary to remove four 1/4" screws and remove the flange from the cabinet in order to gain access to the master mounting bolts of the CRT strap.

3 The next step is common-sense insurance — and good customer relations — to prevent scratching the cabinet. First, spread a heavy, large-sized pad or blanket on the floor to protect the cabinet. Also, prepare a similar cushion on which to place the picture tube after it's removed from the cabinet — it's heavy. Now, if possible, use two men to lower the cabinet carefully onto the blanket, face down. If you're alone, be extra careful.

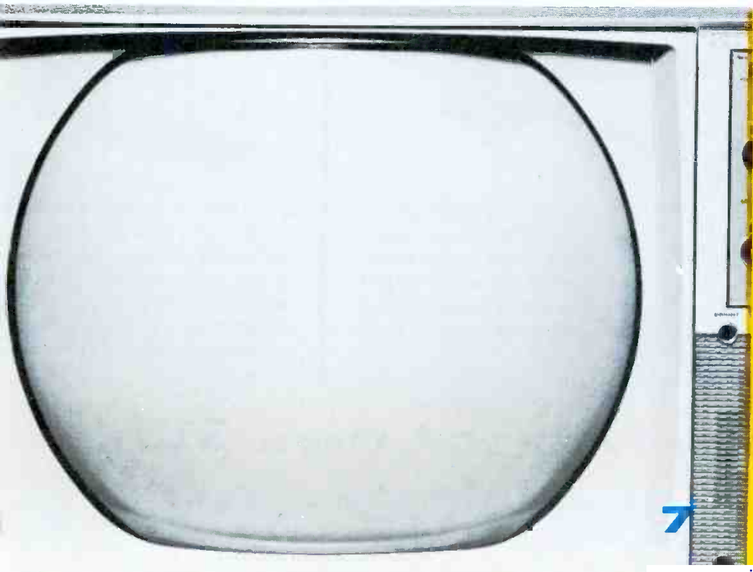
4 Now is the time to make sure you're wearing safety glasses! It's also time to be especially careful not to rap the CRT with a tool or any other heavy object. A CRT is fairly safe from implosion when handled with the proper care, but be careful. Shown in this photo are the four mounting brackets that hold the CRT strap; they're held by eight 3/8" bolts (two at each of the brackets), which must be removed to release the CRT from the cabinet.

5 To lift the tube, plant your feet firmly. Notice that the feet are placed next to the cabinet for extra support. Reach down and grasp the CRT by two opposite brackets; let your fingers slip around the front of the tube as you start to lift. As you lift, you must tilt the picture tube slightly to clear the cabinet. If necessary, rest the tube gently on the cabinet to get a better hold; then, set it down on the pad.

6 Before removing the strap from the CRT, inspect its physical position. Observe the raised glass tabs on the bell of the tube (see photo); these tabs are in line with the blue gun and indicate the top center of the tube. Mark the position of the strap at the tabs. Some straps have a small hole that may be used for alignment. Loosen both of the bolts holding the strap; this makes centering the strap on the new tube easier.

7 Install the strap on the new tube and return the assembly to the cabinet. Position the blue gun toward the top of the cabinet (use bump on bulb as a guide). Start all eight mounting bolts and be sure that the tube fits flush with the mask. Black tape at each side will prevent stray light from entering. Tighten the eight bolts and set the cabinet upright. Check the front to be sure the tube is centered within the mask area.

8 Install the ADG assembly, and remount the deflection components. Leave the deflection-yoke clamp loose for purity adjustments. Place the convergence components in their proper position. (The correct positions — and measurements — appeared on page 33 of the September 1964 PF REPORTER.) Return the chassis to the cabinet and connect all leads. Make purity and convergence adjustments. Give the set a thorough operational check.



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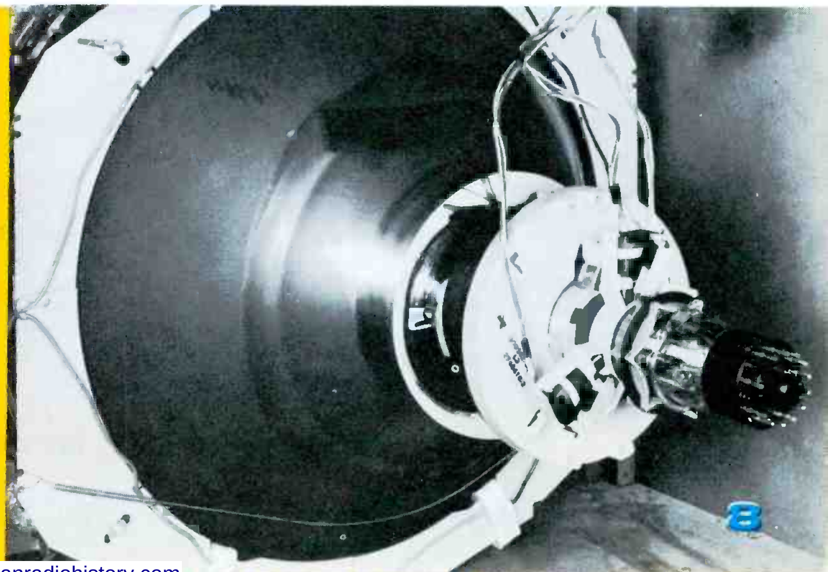

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The antenna that challenges

NEW *Swept Element*

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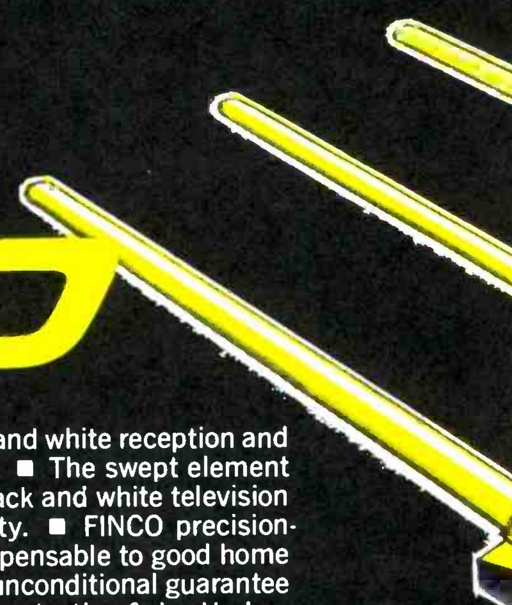
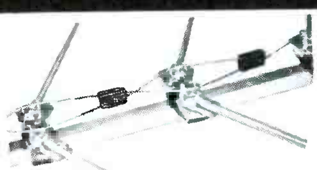
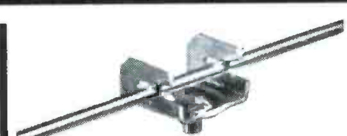


Finco's Color Ve-Log challenges all competition on color or black and white reception and stands behind this challenge with a "Guarantee of Supremacy". ■ The swept element design assures the finest in brilliant color and sharply defined black and white television reception – as well as superb FM monaural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

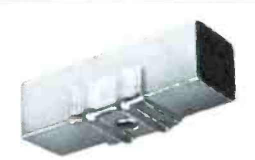


One-piece cross-over drive line assembly has no joints between adjacent driven elements. Eliminates loose connections, shorts, broken drive line sections. Polystyrene snap-lock spacers, with center 'air insulator' space.

Elements are made of triple thick aluminum to stand up in severe weather. Die stamped bracket fastened with tough, thick-gauge rivet holds proportional length sleeve reinforcing shell into which element fits.



First from Finco and exclusive — double contact between drive line and driven element bracket assembly for perfect drive-line support and electrical continuity. Positive, vibration-free, non-corrosive contact.



Boom reinforcing back up brackets at elements add triple strength to the riveted assembly, mounted on a rigid, non-crushable 1" heavy duty square boom. Boom rolled square from 1¼" diameter round aluminum for increased strength.

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

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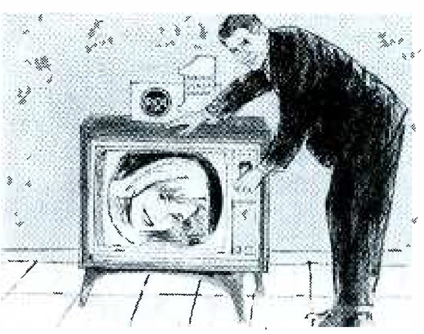

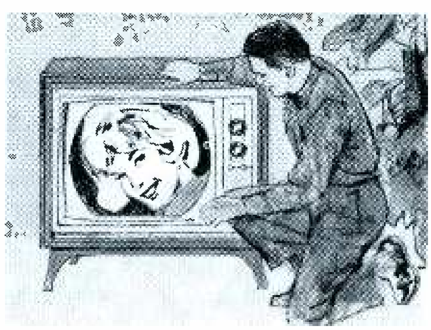

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CHROMA REFERENCE and CONTROL CIRCUITS

Analysis of the color oscillator and Associated stages.

by Thomas A. Lesh

Although most color-signal circuits have been greatly simplified and improved through ten years of color-TV evolution, the chroma reference oscillator and its control stages are still essentially the same as in the earliest color sets. Manufacturers who have tried simpler systems have gone back to the original type of control loop using a reactance tube and dual-diode phase detector.

The schematic in Fig. 1 (based on RCA Chassis CTC15) shows a typical example of this highly stable circuit in its present form. To gain a detailed understanding of its operation, let's begin by considering its function.

The use of a chroma reference oscillator makes it possible to eliminate the 3.58-mc color subcarrier from all but a brief segment of the transmitted color signal, thus removing a potentially troublesome source of beat-frequency interference. Only the sidebands of the chroma signal are broadcast continuously; a substitute carrier, generated by the reference oscillator of the receiver, is mixed with the sidebands to permit demodulation.

The locally generated subcarrier must have exactly the same frequency as the signal produced in the transmitter (3.579545 mc); furthermore, the original and regenerated subcarriers must agree in phase within ±5°, so that phase modulation of the sidebands may be accurately detected.

This high degree of precision is accomplished by using a crystal-type reference oscillator, stabilized by a closed-loop control system that is sensitive to minute amounts of drift. The synchronizing signal for the control system is a short burst of the original subcarrier, transmitted during the horizontal blanking period when no interference can appear in the picture. Only about 8 cycles of the subcarrier signal are included in each burst; the control system must keep the oscillator locked in during the approximately 220-cycle intervals between the subcarrier color bursts.

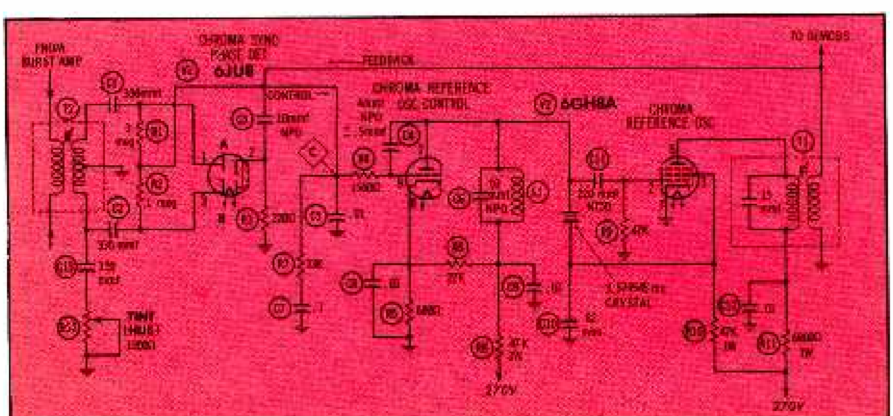

Fig. 1. Feedback control loop including phase detector and reactance tube.

Phase Detector

The error-sensing portion of the control system is a dual-diode phase detector (V1 in Fig. 1), which compares the burst signal with the output of the reference oscillator, and develops a DC voltage proportional to the phase or frequency difference between these two signals. The phase detector is basically similar to those used in certain types of horizontal AFC systems, except that it is designed to accept 3.58-mc sine waves instead of low-frequency sawtooth and pulse signals.

The plate of one diode section is tied to the cathode of the other, and a sample of the reference-oscillator signal is fed to this common connection. A low-resistance path to ground (through R3, in the circuit of Fig. 1) keeps the average value of the signal voltage close to zero.

The burst signal, after being stripped away from the rest of the chroma signal, is coupled to the opposite side of the phase detector via T2. Since the secondary of this transformer is center-tapped, the burst signals applied to diodes V1A and V1B from opposite ends of the secondary are 180° apart in phase. Their peak-to-peak amplitude is generally from two to four times that of the oscillator sample signal.

C1 and C2 become charged in proportion to the amount of conduction through V1A and V1B, respectively. These charges are of the proper polarity to reverse-bias both diode sections during the intervals between bursts. In these intervals, the capacitors slowly discharge through the matched pair of resistors R1-R2 to ground, via network C5-R7-C7. The direction of current is from C1 through R1 to ground in the A side of the circuit, and from ground through R2 to C2 in the B side. Equal conduction of both diodes results in equal and opposite discharge currents, yielding a net output voltage of zero at point C. Whenever the circuit becomes unbalanced, the output shifts away from zero—in a negative direction if diode A conducts more than diode B, or in a positive direction if B conducts more than A.

The reference-sample voltage lags the actual output voltage of the oscillator by nearly 90°, since the impedance of the coupling circuit C3-R3 consists mostly of capacitive reactance. (X_c at 3.58 mc is over

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Circle 16 on literature card

4K, whereas R equals only 220 ohms.) The control system seeks to maintain the phase of this sample signal midway between those of the two burst-signal inputs to V1—i.e., lagging one burst waveform by 90° and leading the other by the same angle.

Fig. 2 contains a group of simplified waveform drawings that will make it easier to visualize how a change in oscillator-signal phase can cause unbalanced conduction of the dual-diode circuit. The large and small waveforms depict the burst and reference inputs to diode A; their relative amplitudes and DC levels are an approximation to actual operating conditions. The inputs to diode B can be visualized by turning Fig. 2 upside down and interchanging the PLATE and CATH labels on the waveforms.

The shaded areas in the drawings represent the intervals during which the plate of a diode is positive with respect to its cathode, and the diode can conduct. Note that these conduction periods are lengthened by increasing the phase difference between the burst and reference signals.

When the reference signal leads the burst signal on diode A by 90° (middle waveform), it lags the burst signal on diode B by the same angle. Therefore, the conduction periods are equal for both diodes, and the output voltages cancel each other.

If the reference oscillator tends to run too slowly, the leading phase angle of the reference signal on diode A becomes less than 90° (top waveform), and conduction of this diode is reduced. At the same time, the reference signal on diode B begins to lag the burst signal by more than 90°, and B conducts more than before. The resultant output is a positive correction voltage that acts to advance the oscillator phase. If the oscillator tries to run too fast, the dual-diode circuit becomes unbalanced in the opposite direction, and a negative correction voltage is produced.

Only 1 mv change in correction voltage will advance or retard the oscillator phase by over 90°. The control system has sufficient range to correct deviations ranging from a minor phase shift to a frequency error of several hundred cps.

Reactance Tube

The output of the phase detector, filtered by C5-R7-C7, is applied to the grid of the oscillator-control tube (the triode section of V2). This stage is wired as a reactance-tube circuit; in effect, it places a variable capacitance across the tuned tank of the oscillator. The amount of capacitance is adjusted by varying the grid bias of the reactance tube to increase or decrease its average plate current.

The capacitive effect of the stage

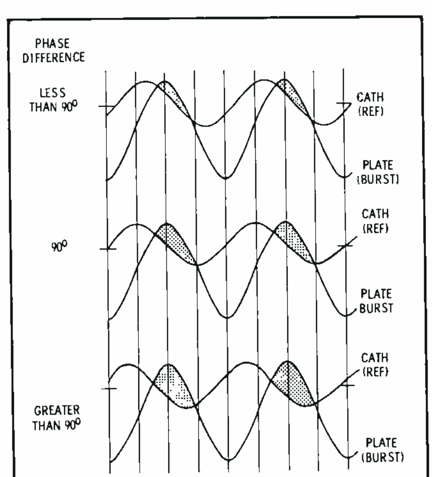

Fig. 2. Diode conduction increases as the phase angle becomes greater.

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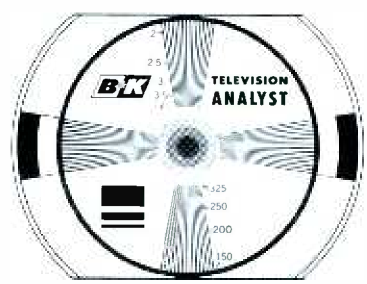

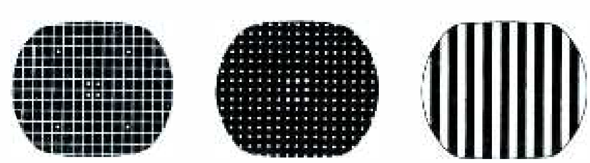

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is established by the signal path through it, which is unique: both the input and output are via the plate circuit. We can make sense out of this apparent paradox by observing that we are primarily interested in the relationship between input *voltage* and output *current*. To simulate a variable capacitor, we wish to produce a current that will lead the tuned-tank voltage by 90°. Here's how it's done:

The signal voltage from the oscillator grid circuit is fed back to the plate of the reactance tube, and thus is impressed across network C4-R4-C5. At 3.58 mc, the capacitive reactance of C5 is negligible, but that of C4 is over 10K ohms—much greater than the resistance of R4. Consequently, C4 is the main factor in determining the current through the network. This current, being primarily capacitive, leads the applied voltage by nearly 90°. A voltage in phase with the current is developed across R4—i.e., between grid and ground. The plate current of the tube is forced to fluctuate in phase with the grid voltage; therefore, it leads the applied plate voltage.

Tank-circuit elements active at 3.58 mc are shown in Fig. 3. The crystal oscillator is designed to resonate slightly above the desired operating frequency, and the parallel capacitance supplied by the reactance tube slows down the oscillator as required for correct tuning. Accuracy of tuning is increased by including a parallel LC network (or simply an RF coil, in some designs) in the plate circuit of the reactance tube.

Reference Oscillator

In most sets built during the last few years, the crystal is connected between the screen grid and control grid of the oscillator tube. A signal is impressed on the screen grid and coupled back to the control grid, undergoing a 180° phase shift in each step of the process; thus, it returns to the control grid in the proper phase to reinforce the oscillations.

Output signals are taken from the plate circuit of the pentode oscillator tube; this arrangement minimizes loading of the oscillator by the output circuitry. The two most popular types of output connections are shown in Fig. 4.

The first circuit, used by many manufacturers, contains a single-tuned output transformer. One secondary winding supplies reference signals to both demodulators—fed directly to the X circuit, and via a phase-shift network to the Z circuit. The phase shift induced in the Z channel is fixed at approximately 70°. Note that the outputs are applied to the suppressor grids of the 6GY6 demodulator tubes, which function as secondary control grids.

The second circuit in Fig. 4 is the latest version of Zenith's beam-switching demodulator system. The oscillator transformer has two independent center-tapped secondary windings that are individually tunable; so there are four outputs, phased at approximately 0°, 90°, 180°, and 270° with respect to burst.

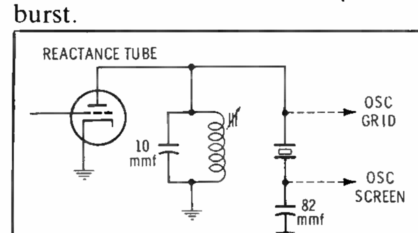

Fig. 3. Reactance tube acts as capacitive shunt across the tuned tank.

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Adjustment and Troubleshooting

One operating control and three or more service adjustments directly affect the functioning of the chroma reference system; thus, a check on these adjustments should receive high priority in cases involving wrong colors, a loss of color sync, or a complete absence of color.

In some instances, an apparently dead oscillator can be restarted by a simple touchup adjustment of the reactance-tube plate coil (L1 in Fig. 1); or, a trial alignment may help solve a serious sync problem by revealing that the oscillator is being thrown off frequency by a defective phase detector.

Correcting some complaints of poor color fidelity may involve nothing more than instructing the customer in the proper adjustment of the hue (tint) control. This component serves as a convenient set-point adjustment for the chroma reference system—providing a means to adjust the phase of the oscillator signal so it will mesh properly with the chroma sidebands at the demodulators. The immediate effect of the control is to shift the phase of the burst signals applied to the phase detector; this is done either by slightly detuning the burst transformer or by modifying a phase-shifting network in the plate circuit of the burst amplifier.

Chroma-sync alignment should be tried if the hue control has insufficient range to restore normal color rendition—assuming that all hues are visible (though out of place) in a color-bar pattern, and all tubes in the reference section are okay. The exact alignment procedure is explained elsewhere in this issue, so only a few pertinent reminders will be given here.

The first step is to make sure the oscillator is able to operate at the correct frequency, with reasonably good stability, without being controlled by the phase detector. This can readily be checked by disabling the correction voltage fed to the reactance tube, and then attempting to adjust the oscillator.

The method used to clamp the reactance-tube grid at zero volts DC for this test must not interfere with the RF operation of the stage. Thus, a grounding jumper may be connected to point C (or to some point in the burst amplifier, if so recommended in service data), but not directly to the reactance-tube grid.

All color-sync adjustments should be made with an eye to final results; the "correct" oscillator phase is that which produces the proper sequence of colors on the CRT. ▲

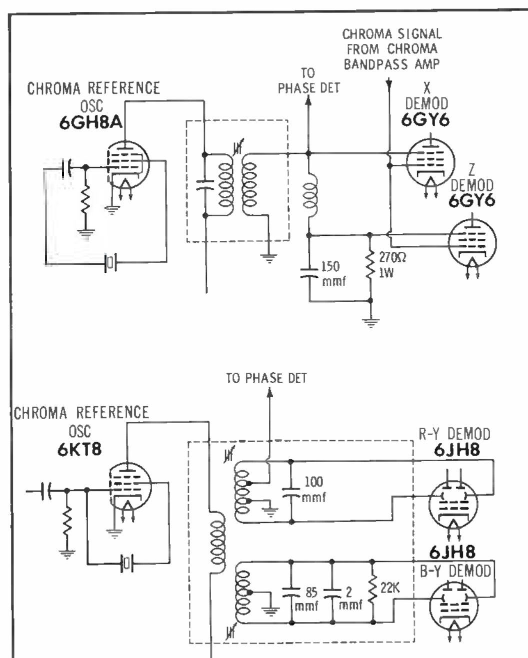

Fig. 4. Two types of circuits used to couple CW signals to demodulators.

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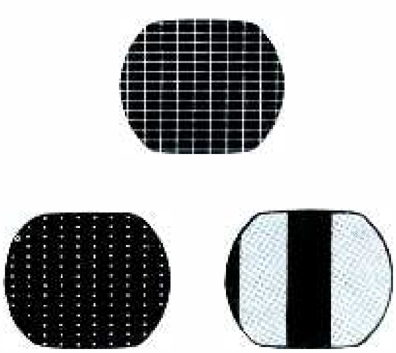

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BLUNDERFUL WORLD OF COLOR

The tinted receiver often colors up clues—and minds!

by Wayne Lemons

Somewhere in the shadowy past, every technician has had his own especially embarrassing moments with color TV. Here are a few that still make me blush just writing about them.

One of my most painful experiences with color TV was my first attempt to change a color picture tube. There was no question that the old one was defective; that is, there was no question when, after I had worked more than three hours in the color circuits, an upstart high school kid asked me if all three guns in the picture tube shouldn't be lit. I said, "Sure," and he said, "Well, they're not." That simple observation made it perfectly clear why I couldn't get any red in the picture. But this was only the beginning. This first picture-tube job left me with mixed emotions: I was almost hoping that the customer would decide not to have the tube put in—on the other hand, I could use the money and, by all means, the experience. I got the go-ahead and proceeded to order a new tube.

I carefully marked every fixture of the old tube, laid the set on its face in the middle of a blanket, struggled with the picture-tube mountings, and finally got the tube disengaged from some rather reluctant brackets.

Cautiously, I inserted the new tube. I then attached all the coil assemblies, brackets, and rings on the neck in measured position, returned the chassis to its moorings, and turned the set upright.

As the set warmed up, the raster that blinked its way into the world was horrible—it seemed to be a classic case of impurity. Wielding my new degaussing coil, I religiously demagnetized everything but the speaker (and maybe a little bit of it too!), but the impurity was still there. I worked the yoke back and forth, checked the position of the convergence coils, and tediously positioned the purity rings. I managed to move the impurity from one part of the screen to another, but none of my extraordinary efforts made any headway toward eliminating it.

After a few hours of twiddling controls, reading instruction manuals, and cursing under my breath the day that color was invented, I fell on the colossal idea of calling the picture-tube distributor. "Needs degaussing," he said and hung up the phone—a mite too quickly, it seemed to me.

I retrieved my degaussing coil from the corner where I had thrown it and, wearying of holding it in position, hung it from a wooden stick secured on top of the set by the weight of a signal generator. I left the colorful pattern churning on the screen and slipped out for a cup of coffee.

Returning to the shop some twenty minutes later, I was startled by a small crowd gathered in front of the place. Someone recognized me as "that fool TV man" and yelled, "Yer shop's on far!" Sure enough, a telltale odor and ugly smoke hung over the area around the color set. My poor plastic-coated $24.95 degaussing coil was suffering from the heat like a polar bear in the African jungle. Color purity? Not a bit better.

Luckily, I called the local service manager for one of the better known brands; after I told my story, he clued me in. "I'll bet it's not the tube," he said. "You just didn't check DC convergence; I'll wager that it's way off." I hadn't, and it was. After five minutes spent roughing in the convergence with a dot generator and just a little maneuvering of the yoke, you never saw such purity!

Moral: Don't try for perfect purity until you rough in the DC convergence—then go through the whole purity-convergence procedure another time or two.

Another Bad CRT?

While I'm on this picture-tube kick, I may as well make another "true confession." This happened so recently that the memory still burns in the pit of my stomach like an unbuffered pill.

The set was an RCA CTC-12, and the original problem was arcing inside the picture tube. I ordered a new tube and carefully installed it. There was now no arc, but the brightness increased very slowly and never really attained that "new-set sparkle" we like to advertise. "Oh no!" I muttered. "They've sent me a bad tube!" I grabbed an old picture-tube checker that had been adapted for color-tube checking. It showed all three guns to be "low and slow." I returned the tube, with a few unkind remarks to the distributor salesman, and asked for another.

When the new tube arrived the next day, I installed it. There was the same trouble—slow warmup, low brightness. When I checked the second CRT, all guns measured "low." I was boiling as I called the head man at the distributorship.

"What kind of CRT checker are you using?" he asked. I told him.

"That kind nearly always checks color tubes 'bad'," he said.

I told him I thought he was hedging. "The raster is dim and slow to get any brightness at all," I argued.

"But doesn't it seem a little fishy that two new tubes in a row are giving exactly the same trouble?" he asked.

I admitted that it was and promised to check some more. I started by asking myself what else could cause the trouble. I even went so far as to consult the schematic. The brightness control is in the 12BY7 video-amplifier circuit (Fig. 1); had

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anyone checked this tube? Nobody had, and when I checked it, it appeared to be dead. That was strange; how was I getting any picture at all if the 12BY7 was dead? Then my mistake became apparent. The 12BY7 had a tapped heater. In the set it was connected so that the two heater sections were in parallel; in the tester they were in series.

There are several morals to this story: (1) Check the tubes. Here, just one half of the filament was operating. This made the brightness slow to increase and kept it from reaching the desired level. (2) Watch out for temperamental video tubes—they give all sorts of peculiar troubles in all makes of color sets. (3) Some picture-tube checkers just don't supply enough heater current for accurate checking.

Vertical Arcing

Blunders all too often occur because we get our minds locked in on a side issue and disregard the obvious. Take, for example, this case involving an RCA CTC-7 chassis. The complaint was flicker and streaking through the picture. Vertical and horizontal hold were passable. When I arrived on the scene, an unusual thing happened—the set was behaving just as the customer had said! The flicker and streaking were concentrated near the bottom of the picture. I adjusted the height (the picture was pulled up some at the bottom) and the linearity and then set off looking for a bad connection at the regulator tube or some other place where an arc might occur. There was nothing I could detect, even in the dark corner where the set was located.

I changed the regulator, focus, and high-voltage rectifier tubes. After each change, I would turn the

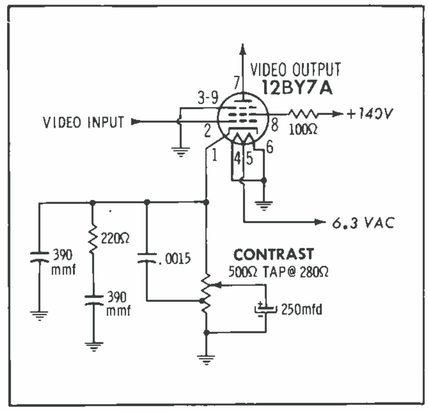


Fig. 1. Filaments of twelve-volt tube are parallel-connected in video circuit.

set back on; everything would appear wonderfully normal until just about the time I would say to the customer, "There! I think that's got it!" Then the flicker would start gently and gradually build up momentum. Ignoring it didn't help.

Only the unsure color technician (which includes all of us at one time or another) can really appreciate the frustration felt on these occasions. Panic begins to take over. "What do I do now? Where can I best poke to make the customer think I'm a professional?" The malady has struck again! An otherwise logical mind refuses to look at the problem from another angle. An unfortunate mental block prevents a re-evaluation of the symptoms. The technician is siezed by a fervent hope that the trouble will go away by itself and an even more conscious assuranee that it won't.

This time I was more fortunate than is commonly the case (less than two hours elapsed). I noticed that the height of the raster was diminished a half inch or so. This jarred me onto the right scent again, and I was off in wild pursuit of the foxy trouble. Could the trouble be in the vertical circuit? Indeed, it could be —and likely was. However, new

Circle 27 on literature card

Receiving Tubes

AN OLD FASHIONED GOOD DEAL

Get in on a deal like you haven't seen for years.

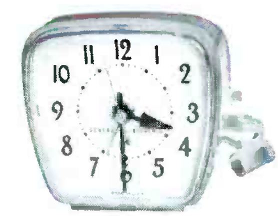
From October 15 through December 15, your General Electric Receiving Tube Distributor is offering an old fashioned good deal on top quality merchandise. It is all available to you with the purchase of G-E tubes.

During this limited time, only you limit how much and how often you choose. And, from the wide choice of merchandise, you can select gifts for yourself, your wife, your home, or your shop.

Ask your G-E Distributor*, he can tell you how easy it is to have AN OLD FASHIONED GOOD DEAL on General Electric Receiving Tubes. Stock up on merchandise and tubes at the same time. *Distributor Sales, Owensboro, Ky.*

*Premiums available at option of your G-E Distributor.

Perfume set by D'Orsay comes in gift box. "Intoxication" scent will send you as well as your playmate. Order ETR-3916.



General Electric alarm clock is compact, fits crowded night table. Beige case with white dial and contrasting numerals. Order ETR-3917.

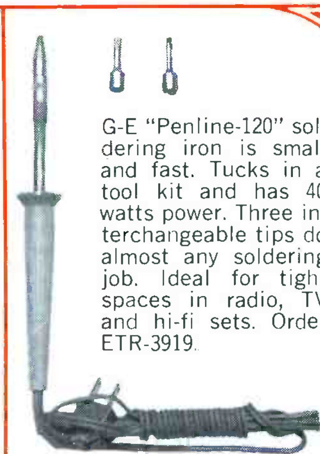
Steak knives—four to a set—have serrated edges, stainless-steel blades. Knives have good looking stag handles. Order ETR-3927.

Insulated tumblers—set of eight—in popular 6-oz. size. Keeps drinks hot or cold, perfect for home and the kids. Also good for coffee at the shop. Assorted colors for identification on refills. Order ETR-3920.

Party-Perk makes 25 cups of coffee—keeps perfect serving temperature too, all automatically. Plenty of coffee for parties at home — or for a coffee break at the shop. Order ETR-3922.

Black and Decker ¼" utility drill is the jack-of-all drills . . . the handiest home tool you ever saw. UL listed drill from a top-name manufacturer. Order ETR-3918.

G-E electronic speed control lets low cost power tools do work of costly more powerful tools. Use at work or home for any universal motor-driven tool with nameplate rating up to 5A, 120V, ac. Particularly good for resistive type soldering irons to give low-heat tip temperatures for printed circuits. Order ETR-3921.



G-E "Penline-120" soldering iron is small and fast. Tucks in a tool kit and has 40 watts power. Three interchangeable tips do almost any soldering job. Ideal for tight spaces in radio, TV and hi-fi sets. Order ETR-3919.

Three pair of Anchor Knit stretch nylon socks in stylish Fisherman knit. Vyrene elastic tops. One each of blue, brown and black. Order ETR-3923.

Shirt-jacket of 100% Ban-Lon[R] with long or short sleeves. A style introduced this summer and now available in winter weights. Your choice of assorted colors. Order ETR-3924.

5-piece stainless steel kitchen set with wall bracket. Heavy-duty insulated handles with popular provincial decoration. Order ETR-3925.

GENERAL ELECTRIC

270-04

Circle 28 on literature card

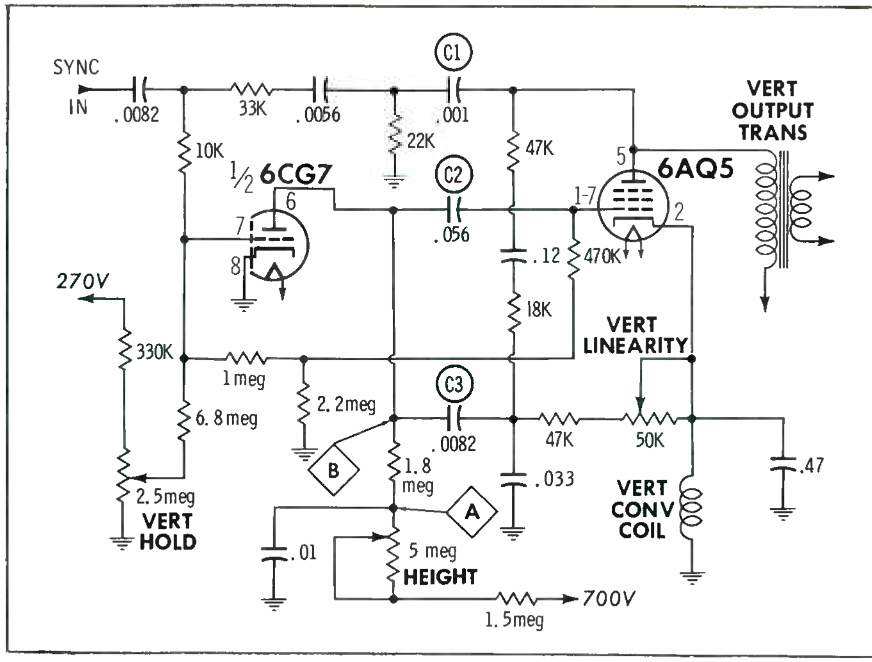


Fig. 2. Shorted C3 causes heavy current in resistors, lowering plate voltage.

vertical tubes didn't help.

I borrowed a low stool from the customer and pulled the chassis out, propped it up so I could attach most of the cables, and dug out a worn schematic from between two slats in the roof of the truck. The vertical circuit was like the one shown above in Fig. 2.

From past experience, I knew that sometimes capacitors at the plate of the output tube break down during pulse passage and cause jitter symptoms. My first replacement was C1 (.001 mfd). Result: something ventured but nothing gained.

In the past, I have written some crusading articles praising the virtues of the good old voltmeter for solving all sorts of complicated problems. It took me almost an hour of blind floundering before I managed to recall my own advice. Perhaps even then I wouldn't have thought to get out the voltmeter, but I accidentally bumped the height-control shaft, and this seemed to produce a symptom almost identical to the one bothering the customer and me. I disconnected one lead from the height control and then used my 20,000-ohms-per-volt VOM as a substitute resistor, changing its value by rotating the DC range switch. This didn't remove the trouble, but it did get the VOM in my hand. What I did find out was that I had sufficient height only when the DC range was set to 3V. This meant that the resistance was only 60K. This made me check the position of the height control, and I found that, sure enough, it was rotated almost to minimum resistance.

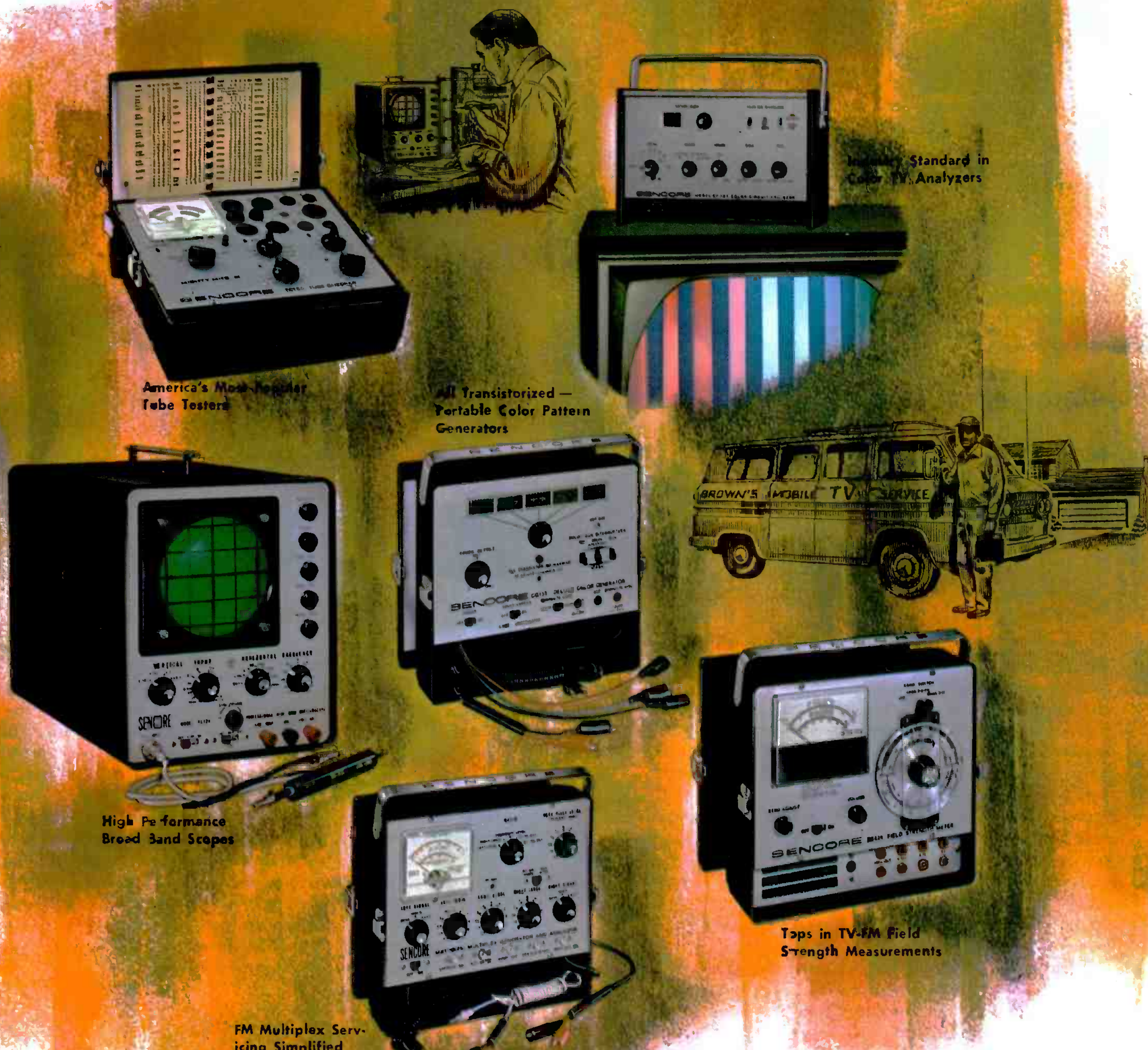
I reconnected the height control and measured the voltage at point A: it was about 425 volts. There was a reading of about 165 volts at the plate of the oscillator (point B). This might have seemed normal, except for the setting of the height control. I pulled the oscillator tube and checked the voltage again. This was the turning point; the voltage went up to only 185 volts. A look at the circuit proved that the tube provided the only DC load. What was sapping the voltage? Only capacitor C2 and C3 could be responsible. I decided on C3 first (luckily). I snipped it out, and the voltage at point B went to more than 600 volts. Installing a new .0082-mfd capacitor and drastically readjusting the height and linearity controls brought the troubles to an end for that night.

The story just told has an obvious moral: Look at a color-TV problem in more than one way. And here's another precaution: Don't let an unusual trouble in the set you fixed yesterday affect your thinking about the problem in today's set. It's not likely they're related.

We all sometimes make mistakes that cause us to feel miserably stupid. But, even these experiences can be of value to us if we learn something from them; we won't be so likely to make the same mistake again. And, maybe we can develop better servicing habits that will help avoid making other mistakes the next time around. ▲

see the "look-ahead" designs from

SENCORE in '65

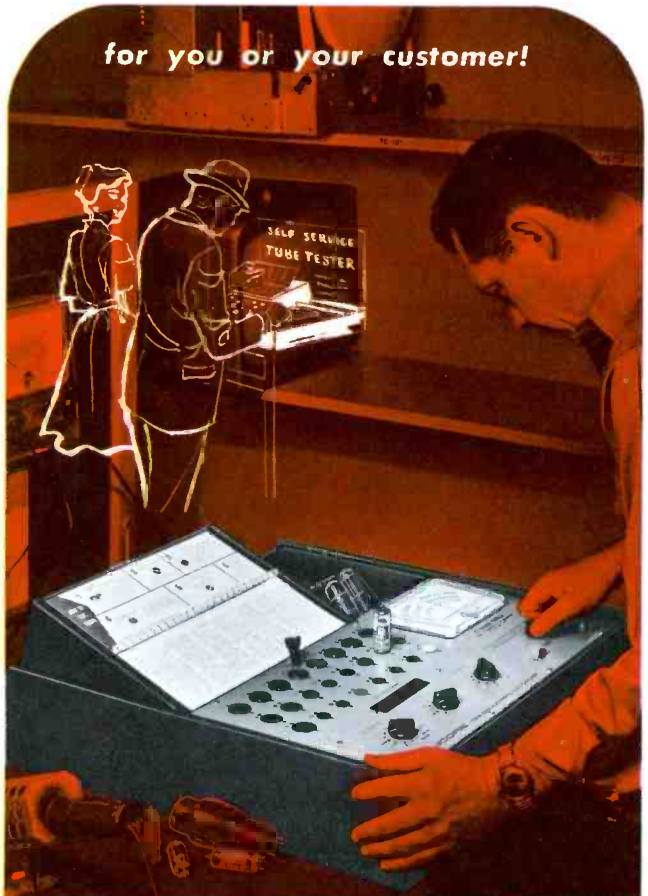


SEE YOUR DISTRIBUTOR FOR THE ALL NEW SENCORE CATALOG FOR '65 and see all that is new in the top line of money-making, time saving, test instruments.

professional quality - that's the difference

ON THE FOLLOWING PAGES ARE JUST A FEW OF THE NEW "look-ahead" DESIGNS FOR '65 . . .

SENCORE 426 South Westgate Drive — Addison, Illinois *a new money-making, traffic-building tube tester*



THE ALL NEW SENCORE TC131 SEMI-AUTOMATIC TUBE CHECKER

After thousands of requests here is the "counter/bench" version of the famous Sencore Mighty Mite Tester; designed for the ultimate in tube checking thoroughness and operational simplicity! Designed for two-way use — as a professional shop tester and customer self-service unit. Tests over 2500 tubes — including Nuvistors, Compactrons, 10-pins, Novars, Magnovals and foreign tubes with a big 6-inch meter for easy reading. Semi-automatic; simply turn function control to any test and watch lighted arrow on meter automatically stop on right scale. User can't go wrong — no guess work — everything is read right on the meter (no tricky neon lights to misread); only 3 set-up controls. Easy to read, speed-indexed set-up cards make every test fast and sure. Like the famous Mighty Mite, the TC131 uses 100-megohm grid leakage sensitivity to spot those "tricky" tubes other testers miss; tests inter-element shorts and makes cathode emission tests under full operating levels. A real profit maker as a counter checker or self service tube seller in your shop . . . and it's only **$129.95**

See your distributor about the big TC131 trade-in deal.

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The new, improved CR133 CRT Checker is designed to test all present picture tubes — and it's ready for future tubes too! Two plug-in replaceable cables contain all sockets required. The compact, 10 lb., CR133 checks CRT emission, inter-element shorts, control grid cut-off capabilities, gas and expected life. Checks all tubes: conventional B&W, new low drive B&W, round color tubes and new rectangular color picture tubes. Exclusive variable G2 Volts from 25 to 325 Volts insures non-obsolescence when testing newly announced "semi-low" G2 CRT tubes. New Line Voltage Adjustment insures the most accurate tests possible. Uses well-filtered DC for all checks to avoid tube damage and reading errors. Color guns are individually tested as recommended by manufacturers. Exclusive automatically controlled rejuvenator applies rejuvenation (ACR) voltage as required by individual tube condition; precisely timed to prevent over-rejuvenation or tube damage. The ACR feature is most useful for color tube current equalization to insure proper tracking. Hand-wired and steel-encased for protection of meter and panel in truck or shop, the new improved CR133 is only . . . **$89.95**

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

see these and more of the "look-ahead" designs in

add an fm-stereo service center with this one new sencore unit!

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SIGNALS AVAILABLE FOR ALIGNMENT, TROUBLE SHOOTING AND ANALYZING:

FM-RF carrier with composite multiplex audio signal with 38kc suppressed carrier, 19kc pilot and 67kc SCA signals • Multiplex signal formed by 60 or 1000 cycle internal tones or any external signal • Full control over left and right channel amplitude (modulation) • External 67kc SCA signal available for trap adjustment • Composite signals available for signal injection FM detector •

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

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

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Circle 31 on literature card

COLOR QUESTIONS & ANSWERS / THEN AND NOW

Prospective buyers of color television sets invariably pose many different questions, and only the salesman or technician who has the answers will succeed in selling or servicing color sets. An inaccurate or incomplete answer will quickly lose a sale or repeated service.

New Set Sales

Here are a few questions that confronted a typical TV shop owner, with the thoughtful answers given for each.

The action takes place on the showroom floor—not elaborate, but large enough to display four color sets, a good choice of black-and-white receivers, and several stereo units. Comfortable chairs are provided for customers; the windows are covered with venetian blinds to darken the room (mainly for color demonstrations). Too much light can destroy the impact of the best color program and discourage a possible buyer.

Let's pick up the conversation from the beginning. The customer has just entered the room and is examining a metal-cabinet table model.

Customer: Is this the lowest-priced color set you have?

Salesman: Yes, this particular set can be purchased for less than $400.00. You know, color sets are priced lower this year than ever before, and the price reduction is remarkable when you consider that the sets have been improved so much in the last few years. There's a color program on now; let me show you what a *good* color picture looks like. (Turning the set on, the salesman attaches the clip lead coming from the *outside* antenna.)

Customer: Yes, it's a nice picture, but I think I'll wait awhile before buying. If they're cheaper this year than they were last year, the price will probably be even lower next year.

Salesman: The price cut on these new models is the first substantial price reduction in over five years. An additional price cut next year is unlikely for several reasons. As you know, the selling price of any item is determined by supply and demand. Manufacturers and distributors both relinquished a portion of their profit to promote sales in the coming year. These people hope the increased demand will justify the price reduction. However, it seems certain that they can't afford to cut their profit margin any more. Manufacturing a color picture tube is much more complicated and expensive than building a black-and-white tube. Furthermore, there are more tubes and other circuits involved in a color chassis. Therefore, barring a major design change or a reduction in the quality of receiver's, the price is already near its practical minimum.

Customer: I see; that sounds reasonable. Are color sets available with any size picture tube except the 21″?

Salesman: Yes, several other CRT sizes are available this year, one 16″ color set, a Japanese import, is being sold in this country for the first time this year. Motorola is again offering a 23″ set using a rectangular tube, and RCA and Zenith have just introduced 25″ rectangular tubes. The latter two are just now on their way to our showrooms. However, the 21″ round version is expected to remain the most popular type for some time. This is due mainly to the proven reliability of this tube; also, sets using the larger tubes have much higher prices.

Customer: I think I'll just watch my black-and-white set for another year or so; there aren't that many programs in color, anyway.

Salesman: I'm afraid I have to disagree — a recent survey in the New York area showed that during the evening hours, from 7:30 PM to 1 AM, two-thirds of the total programming is devoted to color. The same relative increase in color is evident in our area. Take a look at the schedule, and you'll be surprised at the increase in color programs this fall.

Customer: What about color programs on UHF channels?

Salesman: Well, several UHF stations are already devoting some of their time to color transmissions; several other stations plan to so in the near future. All color sets are now factory equipped for UHF reception, as are all new black-and-white sets.

Customer: My wife can't seem to decide on a permanent location for the furniture in our living room. I understand that a color set shouldn't be moved once it is situated and working properly.

Salesman: This is true only to a limited extent. Color adjustment in the older sets was affected much more drastically by relocation than it is in the new ones. As a further help, some new models feature a special automatic circuit this year, which demagnetizes the picture tube each time the set is turned on. This greatly eliminates many of the impurity problems which before could have been corrected in older sets only by a service call. We often deliver these new sets to homes and find setup adjustments are not required. Troubles will seldom crop up when a receiver is moved from one location to another in the same home, provided reasonable care is exercised when the set is moved. You should be careful not to bump the set, as this may displace slightly some of the critically adjusted color convergence components.

Customer: You've just about convinced me to buy a color set, but I am not sure I should buy it from you. A set identical to this console model here sells for almost $100 less in a discount store. What causes this difference in price, and why would I be better off buying a set from you?

Salesman: Large chain stores do have their sets priced a little lower than we do; however, there are many other factors to take into consideration, in addition to price, when you buy a color television set. The large stores are interested only in the initial sale of the item. We want to service your receiver after it is sold; in fact we depend, in large part, on service for our existence. When we deliver a new color set, we take great pains to assure you the best color and black-and-white picture quality. We adjust the set so it will give you the color picture you expect to see.

The discount stores usually don't have their own service departments. They generally have a contract with a TV repair shop to do their installation and service work. We don't say this type of operation is completely inadequate, but we do feel that we give that "little bit extra" during our installation when we deal with our own customer. This can, of course, be very important to your satisfaction.

During the warranty period, if something in the set needs repair, we are always prompt in making the service call and repairing the set. When you buy from a chain store, the usual warranty is for parts only. You can, of course, buy a service policy to cover labor charges, but this amount is added to the purchase price of the set. Most service policies are then transferred to the shop that has contracted to perform the service. From this, I think you can see that an organization engaged in both sales *and* service will generally provide better overall service than when two separate businesses are involved. When we sell a set, any customer's complaint is made directly to us, whereas when two different establishments are involved, the customer complaint is received first by the seller, then transferred to the person responsible for service. Communication sometimes breaks down, and you miss your favorite programs.

Customer: Do I have to pay cash if I buy the set here, or do you have a plan for financing?

Salesman: No, you don't need to pay cash; we have different ways to finance your purchase.

Customer: Okay, I'll take the set. Will I need a new antenna? I'm using an indoor antenna on my black-and-white set.

Salesman: There is no way to determine whether rabbit ears will be adequate for good color reception, until we install the set and see how the picture looks with your present antenna. Sets in some areas require an outside antenna, while others get perfectly satisfactory reception from an inside antenna. An outside antenna is usually preferable, as it will supply a stronger signal to your set and will be less susceptible to the movement of people within the room that may cause interference or "ghosts" if an inside antenna is used. When the set is delivered you, the technician can determine if you'll need an outside antenna for good color.

The salesman's answers convinced the customer. The new color receiver was delivered, and a few touchup adjustments were made. The new color-set owner decided against an additional antenna system, but he was extremely pleased with his new set and the service practices of the dealer. Equally important is the fact that other sales were made upon his recommendation of the organization.

Service Calls

The technician engaged in making service calls on color receivers is asked a different type of question. Here are some he most frequently faces. His correct answer will increase the customer's confidence and will often promote a new set sale. Here's the way one alert technician handles these questions. Let's listen in as the neatly dressed serviceman enters the front door of the customer's home.

Customer: I realize this set is about six or seven years old, but it always seemed to have a good picture until I saw the neighbors new set; then I realized this one must have trouble. The picture isn't bright enough and if I turn up the brightness or contrast the picture gets fuzzy looking. Another thing, too; it seems there isn't enough red in the picture. What do you think the trouble is?

Serviceman: Well, first of all, you can't expect as bright a picture on this set as the neighbor has on a new one. An improved picture tube is used in late-model receivers. The new tube is considerably brighter than those used in sets like yours. It isn't uncommon in older sets for the picture to "bloom" when the brightness and contrast are rotated toward maximum. This condition is simply a natural characteristic of the set that has been eliminated in the newer sets. In fact, practically every aspect of color reception has been improved by new and modified tubes and circuits. The lack of red in the picture may be the fault of a weak picture tube. The red often weakens before the other two, because the red phosphor is the weakest of the three and the red gun is subjected to a higher voltage. Let me check the picture tube. (The technician connects a CRT tester to the picture tube and shows the customer the difference in readings obtained from the blue and green guns as compared to the red, which would barely move the needle on the tester.) The red gun is extremely weak; a new picture tube will have to be installed to adequately improve the picture.

Customer: How much does a new picture tube cost, and do you think it's worth replacing the tube in this set?

Serviceman: If you decide on a new CRT, several other tubes should probably also be replaced to provide a tip-top picture. The total bill would probably be pretty close to $150. Personally, I don't feel a set this old warrants a new picture tube. A color set can, in some ways, be compared to an automobile. You probably spend considerably more time watching television than you spend in your automobile. When a major overhaul is required on a car, most people are ready to get a later model or new one. An automobile overhaul represents a figure that is about 10% of the price of a new one; an overhaul of your color set will approach 25% of the purchase price of a new set. Also, the improved picture quality you'll see on a new receiver will make you readily forget the cost.

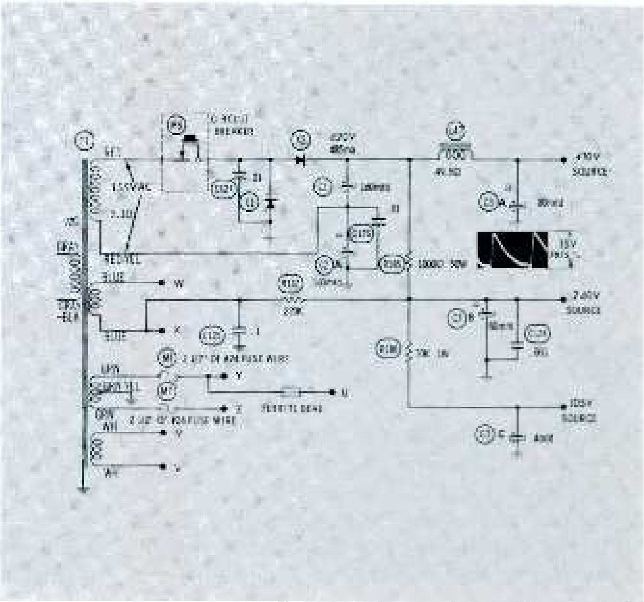
This serviceman's answer led to the sale of a new color receiver. This is not to say that a new set will always (or should) be sold when a defective picture tube is found. But remember, a truthful, honest answer will lead in most cases to a happier customer—whether he decides to repair the old set or purchase a new one. ▲

"Your former employer speaks highly of you—says you never have anything on your mind but work."

COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: Zenith 26KC20, 25LC20, 25LC30, 25MC30, 25MC33
Symptom: Circuit breaker kicks out intermittently for unknown reason.
Tip: The circuit breaker used in these chassis is rated at 1.79 amps with a break current of 2.75 amps. Wire a 3-amp fuse into the circuit in place of the breaker. If the fuse blows, the trouble is in the set. If the fuse does not blow, replace the circuit breaker. Caution: When replacing silicon recitfiers in color receivers be sure to use those of ample rating (700 ma).



Chassis: All color receivers.
Symptoms: Difficulties pertaining to the color picture tube.
Tip: A. Raster blinked and changed hues intermittently. Red raster gave evidence of rapid changes in purity. Scan was changing because microscopic inspection showed that during the "blink" the red beam was striking the edge of the blue dots, causing magenta impurity. Trouble was traced to a defective picture tube.

B. Raster blinked rapidly from white to cyan and back, which gave evidence of a bad red gun. Trouble was eliminated by resoldering all picture-tube socket pin connectors pertaining to the red gun.

C. Poor tracking, unstable white raster. Check CRT filaments for good hot glow; if heaters are not burning brightly, resolder filament pins 1 and 14. One isolated case was attributed to a defective 6.3 volt winding on the power transformer.

D. If the picture on a color receiver has a "metallic" look after the black-and-white tracking has been adjusted (and the brightness circuit and high voltage are correct), suspect **low** emission in the picture tube. This appearance may present itself in receivers several years old and out of warranty. It may be accompanied by negative smears or splash-over of one color or another in the black-and-white picture.

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Full-Line Merchandiser.
Only 11½" wide

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For transistor types.
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"Top Six" Sampler.
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Give 'em an inch... **and they'll take a foot** **but ONLY a foot...** **and really put it to work.**

Counter space is money. That's why these RCA Radio Battery Counter Merchandisers are designed to pack maximum selling power into a few inches.

With RCA Batteries you have the brand name people associate with radio . . . a name that's immediately recognized and respected by the buying public. It's the brand that's *nationally advertised over network TV on Walt Disney's "Wonderful World of Color" to over 30 million viewers.**

Remember — the radio battery market is big . . . over 65 million transistor radios now in use. And YOU can capitalize on it! Improve your profit picture today — with a modest stocking order of RCA Radio Batteries.

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*Estimate of average viewing audience per show for the Fall season based on Nielson National Television Index.

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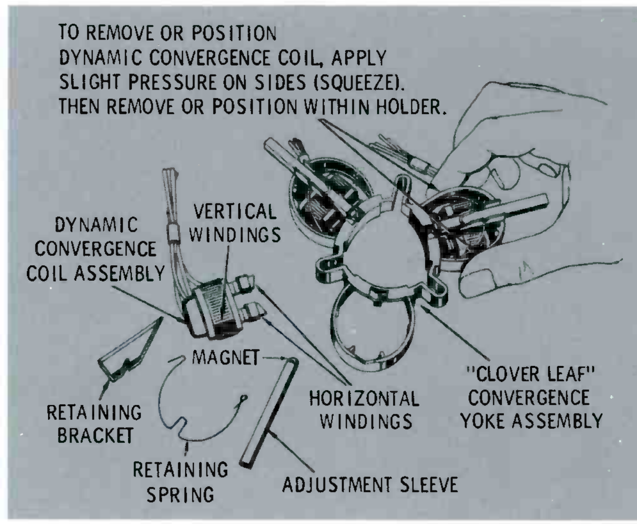
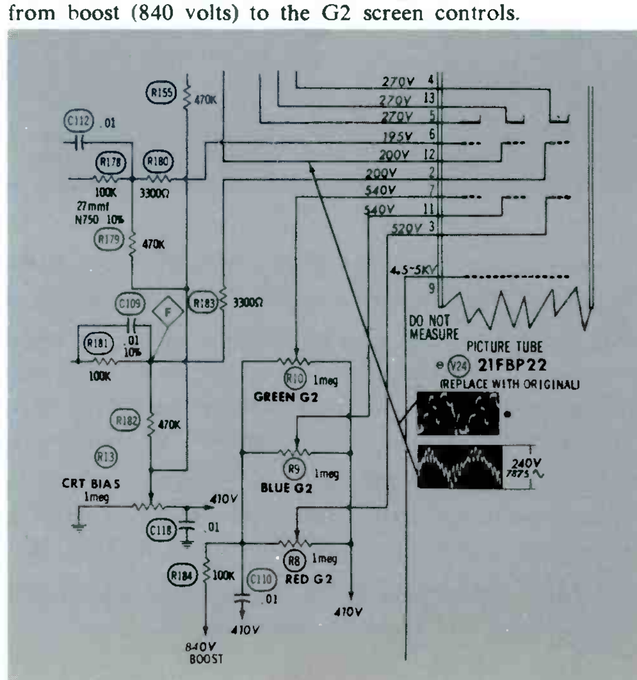
E. High-voltage collapse on warm up that overheated the anode resistor was traced to a shorted gun in the picture tube. This trouble was located by disconnecting one gun at a time and unsoldering its associated cathode and grid connections where they terminate on the chassis. Occasionally, a short of this type can be removed with a CRT tester-rejuvenator or by discharging an electrolytic capacitor (40 mfd, 450V) across the suspected electrodes.

Chassis: Zenith 29JC20, 27KC20, 26KC20, 25LC20
Symptoms: Errors in purity, and lack of convergence control in some areas of the screen.
Tip: Check the plastic convergence yoke housing for warping. This yoke assembly houses the static and dynamic convergence magnets and may warp with age. The twisting of this "cloverleaf" plastic housing may cause misconvergence and blushes of impurity in the raster. Replace with Zenith part No. 43-473 and position according to manufacturer's specifications.



Chassis: Zenith 29JC20, 27KC20, 26KC20, 25LC20, 25LC30, 25MC 30, 25MC33
Symptom: Erratic CRT bias action; misregistration of black-and-white set-up procedure; drifting of black-and-white picture from one color to another; unstable convergence.
Tip: Check R184 (100K) voltage-dropping resistor connected from boost (840 volts) to the G2 screen controls.



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1. **Ready For The Future**—Untuned, broad-coverage RF signal injects signal directly into antenna terminals, covers both VHF and UHF. Interchangeable CRT assemblies assure coverage of all present and anticipated color tubes, including new 25" tubes.
2. **Gun Killers**—Individual pots and switches control each of the CRT guns separately. You can check the picture for emission, gas, shorts, in addition to individually checking the R-Y, B-Y and G-Y signals.
3. **5:4 Crosshatch**—Means more vertical lines, more horizontal lines and complete screen coverage including hard-to-converge areas at the edges.
4. **Single Color Bar**—Simplified color reference bar at 3.58MC color burst frequency for definite color performance checks, impossible with gated rainbow generators.
5. **500-Dot Pattern**—Superior to 150-dot system because dot size is smaller (actual size, 1 line or 0.1 μsec) for accurate convergence and complete screen coverage—no *blank* spots.
6. **Separate Horizontal and Vertical Bars**—Quickly determines major areas of misconvergence, saves time by showing you where to start first.

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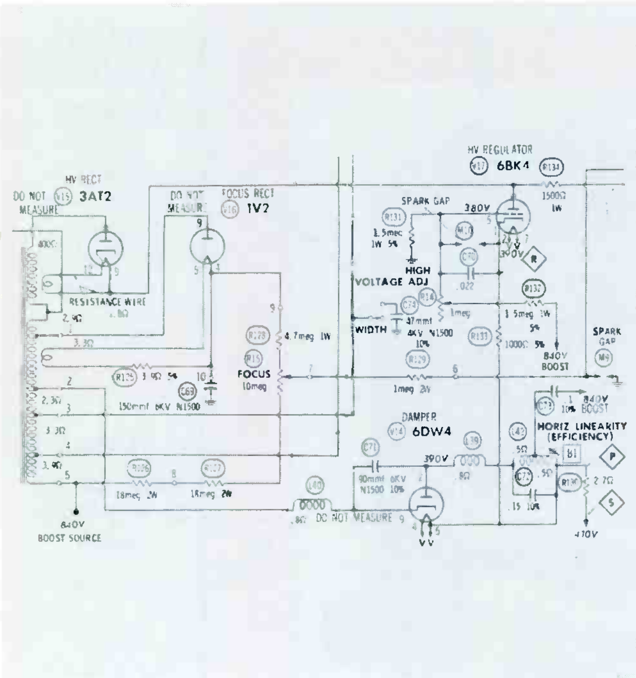
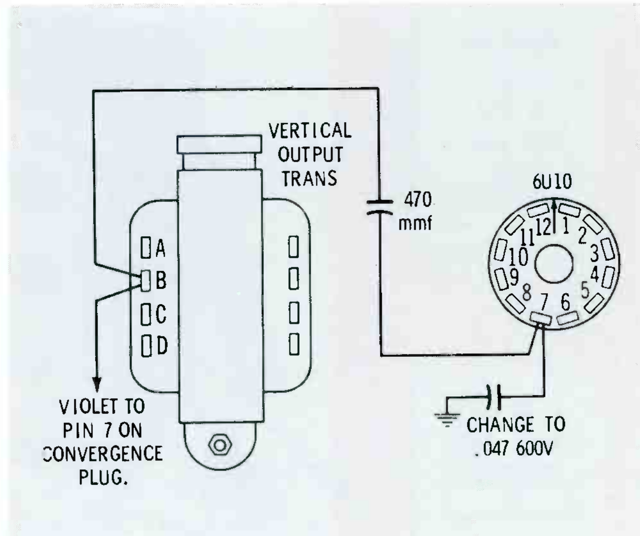
Circle 35 on literature card

Chassis: Zenith 29JC20, 27KC20, 26KC20, 25LC20, 25LC30, 25MC30
Symptom: Poor vertical sync. Vertical rolls when brightness or contrast is adjusted, or with changes in video level.
Tip: This is a good indication of excessive high voltage, usually caused by defective 6BK4 regulator tube or misadjusted high voltage. Check and reset the high voltage according to manufacturer's specifications, paying particular attention not to deviate from the prescribed overall set-up procedure.



Chassis: Zenith 25LC20, 25LC30, 25MC30
Symptom: "S" hook or bend at top of raster.
Tip: During certain types of broadcast transmissions, these chassis may display an "S" hook or curve at the top of the picture which may be objectionable, since all vertical lines appear to be crooked. Circuit modification consists of adding a 470-mmf capacitor from tap "B" on the vertical-output transformer to pin 7 on the 6U10 horizontal-control tube. The capacitor from pin 7 of the 6U10 (connected to chassis) should be changed to a .047, 600V unit, unless a unit of this type is already installed. After making the modification, reset the horizontal-hold control to midrange, so that the set maintains sync when changing channels. This wiring change can be done without removing the chassis from the cabinet. (Remove the easy-off bottom plate while receiver is resting on its side.)



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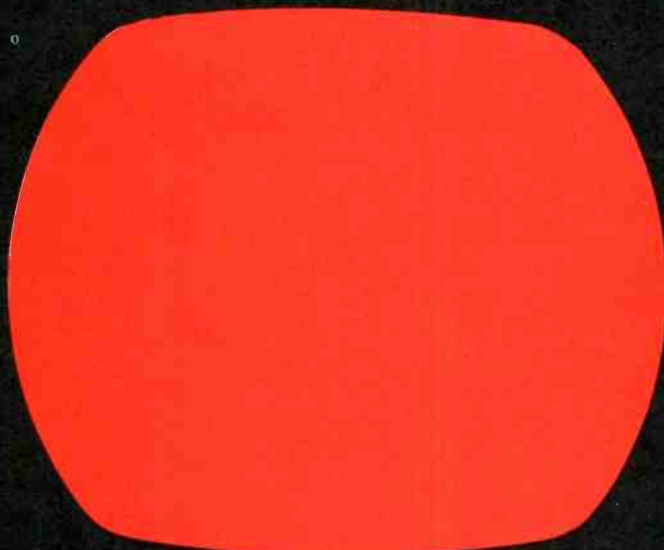
COLOR TV HAS A NEW RED STANDARD



Sylvania's new **EUROPIUM RED.**

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

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

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

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

Another thing, black and white performance is far better than you've ever seen before in a color tube. Besides the increased brightness, there's improved contrast in a sharp, vivid picture.

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

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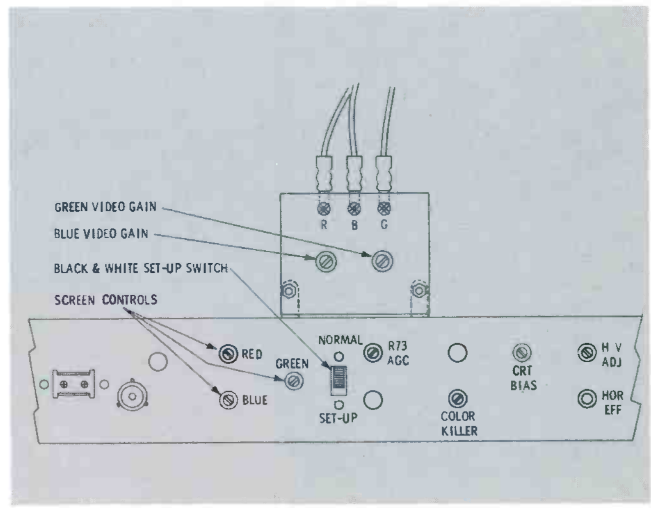
NEW CAPABILITIES IN: ELECTRONIC TUBES • SEMICONDUCTORS • MICROWAVE DEVICES • SPECIAL COMPONENTS • DISPLAY DEVICES

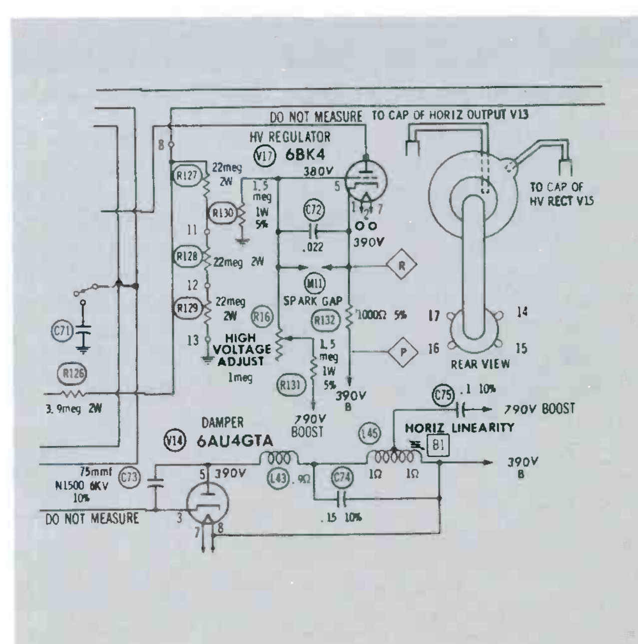
*Tests show the COLOR BRIGHT 85 tube is 43% brighter, on the average, than standard color picture tubes.

Circle 37 on literature card

Chassis: Zenith 25LC20, 25LC30, 25MC30
Symptoms: Blushes of impurity at the outer edge of the raster.
Tip: On these particular chassis, this difficulty can sometimes be attributed to improper adjustment of black-and-white tracking. After the service or set-up switch is engaged, the green and blue gain controls should be turned **full on** in a clockwise direction. The red, blue, and green screen controls should then be adjusted for a horizontal line of **medium** brightness. Any tint in the picture can be removed by adjusting the necessary screen control after the service switch is returned to normal operation. The CRT bias control should **always** be left in a full counterclockwise or "off" position on all Zenith chassis—unless adjustment is needed to correct for a screen control that fails to register. Never use the CRT bias control to compensate for a lack of brightness. In cases of low brightness, change the 12GN7 luminance amplifier tube and reset the high voltage according to the manufacturer's specifications.



Chassis: Zenith 29JC20, 27KC20, 26KC20, 25LC20, 25LC30, 25MC30, 25MC33
Symptom: No high voltage; tubes check okay.
Tip: Check the .1-mfd, 600-volt capacitor (C75) connected from the center lug of the horizontal efficiency coil to the 790-volt boost voltage. This capacitor is mounted on the terminal strip running parallel and adjacent to the high-voltage cage. In cases of high-voltage failure, this capacitor should be checked before beginning other preliminary circuit testing. ▲



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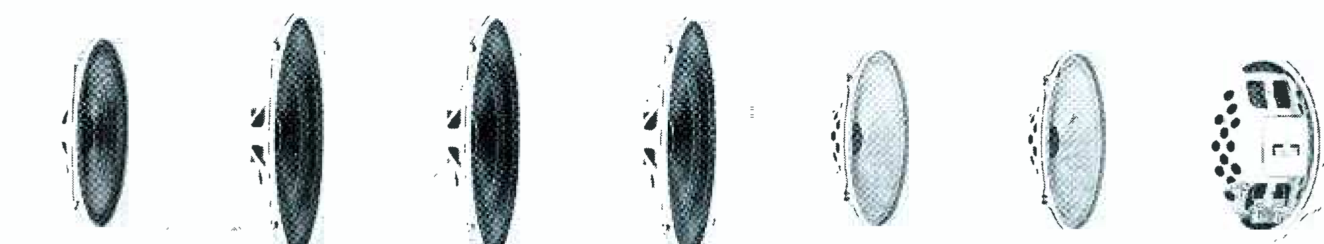
What have we done for you lately?

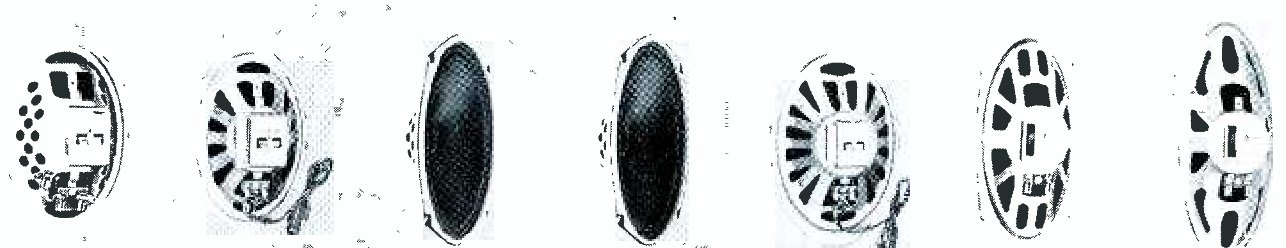
Maintaining our position as the number one independent producer of automotive speaker equipment, we've added many new oval speakers for automotive and general use. Some are quite specialized in their application, for example: model P5X8U9 is the exact replacement for the Ford Motor Company Falcon, Fairlane, Comet and Meteor passenger cars; the P6X10U9 is the exact replacement for Ford and Mercury 1962-63-64 passenger cars. All model numbers with the suffix U3 and T3 are of 3-ohm impedance for use in several General Motors vehicles. The P5XT20 and P5X7T40 models having center-tap voice coils are for Motorola auto radios.

The Viking series models 4X8W3 and 4X10W3 are 3-ohm impedance economy speakers used in some General Motors vehicles.

For our complete line of Concert, Viking and Weather Master series speakers, send for Jensen Catalog 1090.



P4X8U3 P4X10U3 P4X10T3 P4X10T9 P5X7T3 P5X7T9 P5X7T20



P5X7T40 P5X8U9 P6X9T3 P6X9T9 P6X10U9 VIKING 4X8W3 VIKING 4X10W3

CONCERT SERIES

Nominal Size, Inches	List Price	Model Number	Magnet* Wt., Oz.	Voice Coil			Dimensions, Inches		
				Imped. Ohms	Power Watts**	Dia. Inches	H & W	Depth	Baffle Opening
4 x 8	$7.50	P4X8U3	1.73•	3.2	7.0	1	4 x 8	2 7/32	3 5/8 x 7 9/16
4 x 10	8.10	P4X10U3	1.73•	3.2	7.5	1	4 5/16 x 10	2 21/32	3 13/16 x 9 1/2
4 x 10	8.70	P4X10T3	2.5••	3.2	8.5	1	4 5/16 x 10	2 11/16	3 13/16 x 9 1/2
4 x 10	8.70	P4X10T9	2.5••	8-10	8.5	1	4 5/16 x 10	2 11/16	3 13/16 x 9 1/2
5 x 7	8.20	P5X7T3	2.5••	3.2	9.0	1	5 x 7 1/4	2 1/2	4 1/4 x 6 1/2
5 x 7	8.20	P5X7T9	2.5••	8-10	9.0	1	5 x 7 1/4	2 1/2	4 1/4 x 6 1/2
5 x 7	8.85	P5X7T20	2.5••	20 CT	9.0	1	5 x 7 1/4	2 1/2	4 1/4 x 6 1/2
5 x 7	8.85	P5X7T40	2.5••	40 CT	9.0	1	5 x 7 1/4	2 1/2	4 1/4 x 6 1/2
5 x 8	8.00	P5X8U9†	1.73•	8-10	8.0	1	5 x 8 3/16	2 1/4	4 1/4 x 6 1/2
6 x 9	8.50	P6X9T3	2.5••	3.2	10.0	1	6 3/8 x 9 1/8	3	5 1/4 x 8 1/8
6 x 9	8.50	P6X9T9	2.5••	8-10	10.0	1	6 3/8 x 9 1/8	3	5 1/4 x 8 1/8
6 x 10	8.40	P6X10U9†	1.73•	8-10	9.0	1	6 3/8 x 10 3/16	3	5 1/4 x 8 1/8

VIKING SERIES

4 x 8	6.00	4X8W3	1.00	3.2	6.0	9/16	4 x 8	2 5/8	3 1/2 x 7 1/2
4 x 10	6.50	4X10W3	1.00	3.2	6.0	9/16	4 5/16 x 10 1/16	3	3 5/8 x 9 3/8

*DP-Alnico 5 magnets. **Program power. Peak power is twice program rating. †Two-eared speaker housing. •Performance equivalent to EIA 2.15 oz. ••Performance equivalent to EIA 3.16 oz.

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Circle 39 on literature card

TiPS

FOR COLOR SERVICING

If you already understand color — skip this article.

There are many ways to service any particular piece of electronic gear, and color TV is no different. While most technicians find a logical procedure is the best approach, others still like to service by the "memory" system. These latter servicemen learn by doing, and, while they may learn slowly, many of them learn well.

While the "logic" technique demands knowledge of circuits and functions, the memory system hinges around tips, hints, shortcuts, and a recollection of symptoms and troubles that "happened before." Sometimes these tips enable a serviceman with a good memory to go straight to the problem without troubling to trace through circuits he doesn't fully comprehend. Other times, the "memory" technician is forced to turn the set over to a more qualified "system" man.

Note: Material for this article was adapted from the Howard W. Sams book "Color TV Servicing Made Easy" by Wayne Lemons and Carl Babcoke.

Technician—don't be misled! Neither servicing tips nor logical procedures will make you a good color-TV technician, if you don't understand the sets. Your most important tool for troubleshooting is a knowledge of how color receivers work. But, for many of you, this need has always introduced another problem—how to reach this understanding.

For the technician who already grasps the basic operation of color sets and needs specific information on servicing various circuits, the rest of this issue is shock-full of helpful articles and tips. This article, however, is for the technician who understands monochrome reception but needs some fundamental explanation of chroma or color receivers. First, we'll analyze the chief differences (and similarities) between color sets and the more familiar black-and-white ones, and then examine the characteristics of a few tools and test instruments needed for color servicing.

General Functions

Fig. 1 shows a color receiver in block form. This diagram is representative of all late-model receivers. Although many of the circuits in a color set are also used in black-and-white receivers, there are some special qualifications for various circuits if the color picture is to be good.

The *tuner* should have equal gain on each channel. A slope in tuner response will distort the overall response curve and may result in no color. The tuner should develop minimum internal noise, as snow is more objectionable in a color picture than in a monochrome picture. The oscillator should be stable—the best setting of the fine tuning control is critical on color sets.

The *video-IF* section must have adequate gain, and the response curve should not tilt with changes in sig-

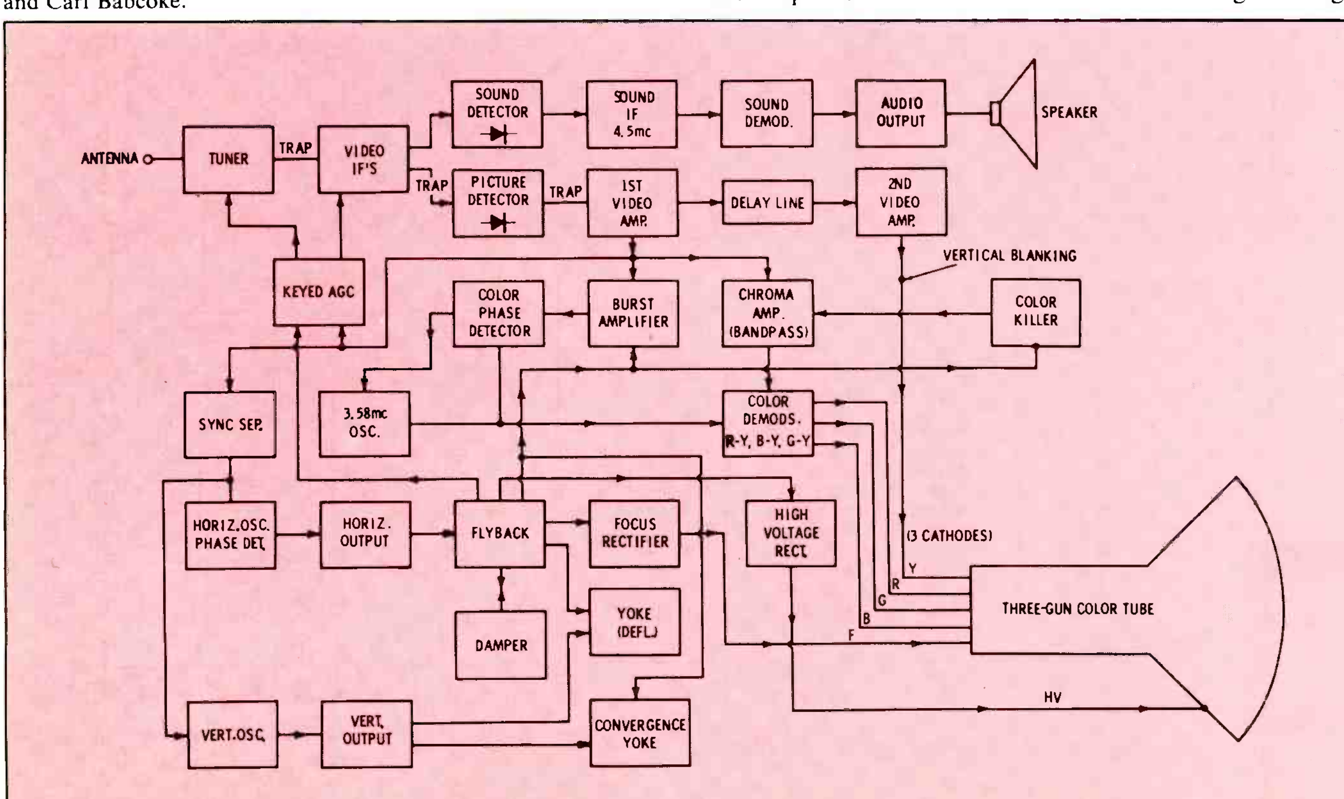
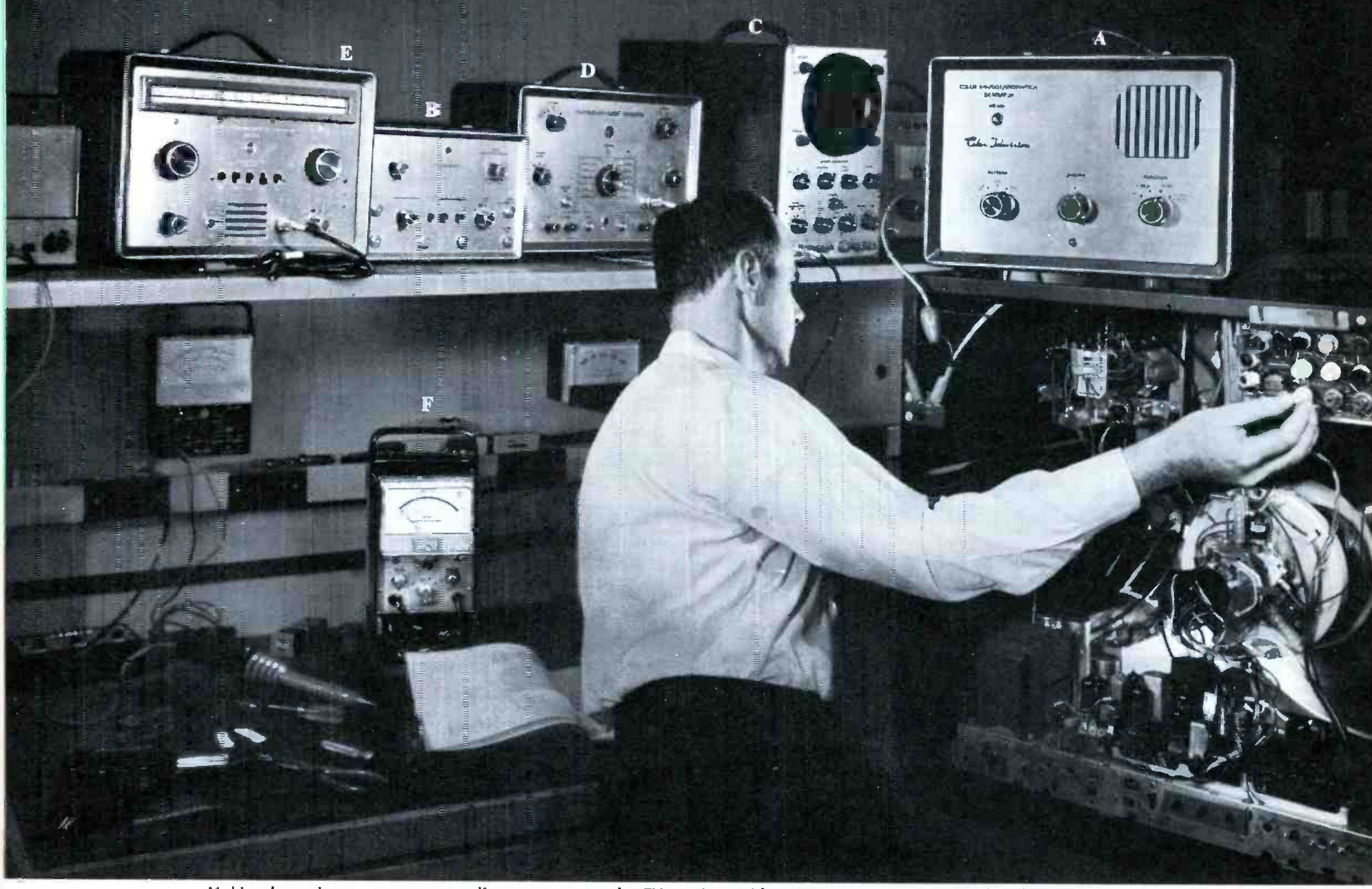


Fig. 1. Block diagram shows interrelation among stages of color TV receiver.

Color-TV servicing is profitable

GET THE MOST OUT OF IT WITH COLOR-TV TEST INSTRUMENTS FROM RCA—PIONEER OF COLOR TV



Making last-minute convergence adjustments on a color-TV receiver with an RCA WR-64A Color-Bar/Dot/Crosshatch Generator.

(A) RCA WR-64A COLOR-BAR/DOT/CROSSHATCH GENERATOR

Low-cost, lightweight, portable instrument that provides all essential Color-TV test patterns:
- *Color-bar pattern:* ten bars of color for checking phase and matrixing, and for automatic frequency and phase alignment.
- *Crosshatch pattern:* thin sharp lines for adjusting vertical and horizontal linearity, static and dynamic convergence, raster size, and overscan.
- *Dot pattern:* small dots to facilitate accurate color convergence.

$189.50* with output cables

(B) RCA WR-70A RF/VF/IF MARKER ADDER

For use with a marker generator and a sweep generator. Used for RF, IF, and VF sweep alignment in color and B&W TV receivers.
- Choice of four different marker shapes
- Provides very high-Q markers of high amplitude and narrow bandwidth

$74.50* complete with cables

(C) RCA WO-91A 5-INCH OSCILLOSCOPE

A wideband scope for checking colorburst signals and general troubleshooting.
- 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

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

(D) RCA WR-69A TELEVISION FM SWEEP GENERATOR

For visual alignment and troubleshooting of color and B&W TV receivers, and FM receivers.
- 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

$295.00* including all necessary cables

(E) RCA WR-99A CRYSTAL-CALIBRATED MARKER GENERATOR

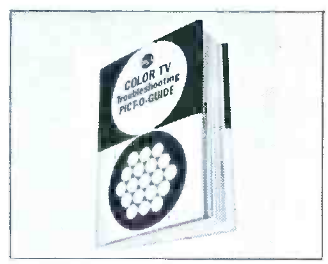
Supplies a fundamental frequency RF carrier of crystal accuracy for aligning and troubleshooting color and B&W TV receivers, FM receivers.
- Most-used IF and RF frequencies indicated on the dial scale
- Sound and picture carrier markers available simultaneously

$256.50* complete with output cable and phone tip

(F) RCA WT-115A COLOR PICTURE TUBE TESTER

Designed specifically to test color-TV picture tubes, either in or out of the set. Tests each gun for emission quality, inter-electrode leakage and shorts.
- Large sensitive meter with separate 3-color scales
- Provision for accurate adjustment of cut-off point for each gun

$89.50* with cable, carrying case and socket assembly



New RCA Color Pict-O-Guide is now available through Authorized RCA Electron Tube Distributors.

See them all at your Authorized RCA Test Equipment Distributor.

**Optional Distributor Resale Price. All prices are subject to change without notice. Prices may be higher in Alaska, Hawaii and the West.*

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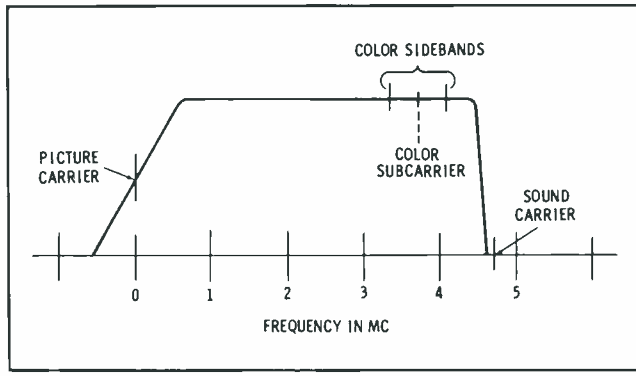


Fig. 2. Ideal overall response curve of typical color set.

nal strength. A precisely contoured alignment curve is vital and cannot be overstressed (see Fig. 2 for overall curve from antenna to detector).

Traps are essential to good color reproduction. The 4.5-mc sound signal must be completely trapped out of the video and chroma channels to reduce the 920-kc beat that results from the heterodyning action between the 4.5-mc sound carrier and the 3.58-mc color subcarrier.

Video amplifiers must have enough gain to give a high-contrast picture. They should have a flat frequency and phase response up to 2 or 2.5 mc. Most sets today restrict video response to get less interaction between the video and the color beat signals. Because the brightness of three guns must be controlled simultaneously, the brightness circuit (as well as the contrast circuit—and, sometimes, blanking) is part of the video amplifier. Direct coupling to the picture tube is used to prevent changes in tint with changes in brightness.

The *delay line* must have the correct delay time so that the black and white and the color pictures are in proper register (overlap). It is necessary to delay the black and white (luminance) signal because the color (chrominance or chroma) is delayed by its passage through the color amplifiers. Each model usually requires a different delay time. In general, delay lines are not interchangeable. An open delay line may result in the loss of both raster and picture. An open ground on the delay line may cause multiple black-and-white pictures similar to ghosts.

The *sound* circuit is essentially the same as in a black-and-white receiver. Many receivers use a separate 4.5-mc detector diode, because the 4.5-mc traps that keep sound out of the video and chroma sections would reduce the sound-IF signal to so low a level that the audio output level would be inadequate.

The *AGC* circuit is generally the same as for black-and-white sets, is normally keyed, and often has noise-immunity functions.

The *sync* circuit has the same requirements as for black-and-white sets, except that the phase of the horizontal oscillator must be maintained within closer tolerance so as not to key the burst amplifier improperly and cause possible loss of color or color sync.

The *burst amplifier* is keyed into conduction (and amplification) by a horizontal pulse that has been delayed in phase (time) so that the pulse reaches the grid at the same time as the 3.58-mc burst signal. The plate circuit is usually a part of the color-phase detector and is tuned to 3.58 mc. A few sets use one tube as both a

bandpass amplifier and a burst key-er-amplifier, but most use separate tubes. When only one tube is used, the tube must also conduct during the burst time, regardless of the setting of the color control.

The *chroma bandpass* must have sufficient gain to give full color saturation. The gain should be adjustable to provide control of the color. It must have a very special frequency-response curve so that the falling response curve of the video IF's, added to the peaked detector response and the bandpass response, results in a flat chroma output at 3 to 4.1 mc. Some chroma bandpass circuits have additional 4.5-mc traps as aids to the IF traps.

The *chroma oscillator* must be crystal controlled for stability, while still permitting a small variation, so that color can be locked in exact phase with the station's 3.58-mc burst. This frequency is controlled by a reactance tube which acts essentially as a variable RC combination when the grid bias is changing. The oscillator must trigger the demodulators, the phase detector, and sometimes the color killer.

The *color phase detector* compares the frequency and phase of the incoming burst signal with the locally generated 3.58-mc signal (chroma oscillator) and also supplies a correction voltage for the reactance tube. In many sets, it also supplies a negative control voltage for the color killer and/or automatic color control (ACC). The tint control is in this circuit and usually affects the tuning so that the phase of the color burst is changed.

The *color* sidebands transmitted from the station and the locally generated chroma (3.58-mc) signals are *demodulated* by a process called synchronous detection. Ordinary detection by diodes is possible only when the frequency and phase are tightly locked together. Here, however, the phase of the sidebands and the two-phase signals from the oscillator never stay in phase with each other.

The sidebands and the phase-oriented oscillator signal are inserted into two elements of a tube. These can be the grid, suppressor grid, plate, cathode, or deflector plates, but the basic concept is identical—both instantaneous voltages must be of the right polarity or plate current will not flow. Two demodulators are used, and the third color signal is derived by combining these two and inverting the phase; or, four demodulators are used in two pairs of opposite polarity, and the third signal is derived from a portion of the outputs of the two demodulators. The three chroma signals are fed to the grids of the color picture tube.

The same general *vertical* circuits are necessary in color receivers as for black-and-white receivers, except that in color receivers excellent linearity is essential to achieve the best dynamic convergence. Vertical retrace blanking is always used. Pulse voltages of opposite polarity are supplied to the convergence coils for tilt correction, and a sawtooth voltage is provided for amplitude correction. Wide-angle tubes also have pincushion correction voltages taken from the vertical-output transformer.

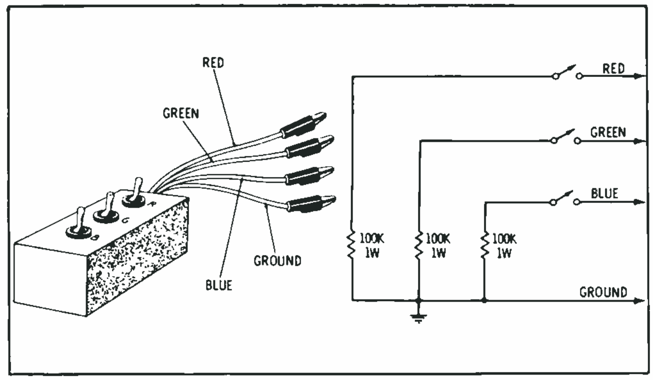


Fig. 3. A CRT control-grid switch box for color alignment.

The same general *horizontal* circuits are used as for monochrome sets, except that linearity must be better to provide good dynamic convergence. The flyback and high-voltage circuits must supply at least 24 watts of high-voltage power, which is considerably more than is required in black-and-white sets. Horizontal pulse samples are filtered and used as correction voltages for dynamic convergence. The boosted B+ voltage usually runs above 700 volts, and some sets have "boosted boost" supplying as much as 1100 volts.

The *focus* voltage required is about 4000 to 5000 volts. It is adjusted by either a potentiometer or a slug-tuned coil that varies the AC voltage on the focus rectifier. Complete loss of focus voltage will make the raster invisible.

Newer sets have 24 to 25 kv of *high voltage*. Good regulation is important. If the high-voltage circuit is unregulated, size, focus, and linearity of the raster (and convergence) will be affected. All present-day sets use a shunt regulator—a vacuum tube wired as a variable load resistor. This maintains the high-voltage current and voltage at a constant level. When the CRT draws more current, the regulator draws proportionately less and vice versa.

Control voltage for the regulator tube is taken from the boosted B+, because this voltage varies inversely with the load on the horizontal-output stage. One 1964 model takes some voltage from the plate of the video stage to provide an additional regulating grid voltage for the regulator tube. Another model uses a voltage-dependent resistor (VDR) in the grid circuit to give better regulation of high voltage.

Test Equipment

Hand tools and alignment wands are the same as those required for black-and-white receivers. These include the usual assortment of wrenches and screwdrivers.

The diagram of a gun-killer switch box is given in Fig. 3. You can substitute for this box by connecting a 100K resistor from the CRT grids to ground with clip leads or by turning down the screen controls of a particular color to be killed. The great value of the switch box is in its speed, since any color or combination of colors is instantly available without adjustment of any screen controls. The box as shown will slightly smear or blur the chroma signal because of stray lead capacity. To eliminate this, wire the 100K resistors at the clip end of the leads. Commercial gun killers that plug directly into the picture tube socket are available. Some

Fig. 4. An example of a commercially made degaussing coil.

color-bar generators have built-in gun killers.

Degaussing coils are an absolute necessity. Commercial coils are available; or, you can wind your own using about 425 turns of No. 20 enamel wire wound on a form about 12″ in diameter. Good-quality insulation on the wire is necessary, since 120 volts AC is used as a source voltage. A line feedthrough switch will add convenience. The AC cord should be attached and insulated and then the entire coil wrapped with plastic tape (Fig. 4). *Caution: Do not leave any undercore degaussing coil connected and energized any longer than necessary—it probably will overheat.* This warning applies to most commercial models as well as home-built ones.

There are many good dot-bar generators on the market (some with and some without color bars). A good generator should have: a stable pattern and, preferably, be crystal controlled; small, sharp-edged bars and dots; a means to attach it directly to the antenna terminals; a sound carrier to aid in setting the fine tuning; and a standby position.

A magnifying glass is not absolutely essential, but it can be a big help in marginal or difficult purity adjustments. It should have at least 10-power magnification—preferably 25 power. Commercial microscopes are available for this purpose.

A large mirror is a great time saver, but be sure it is made of glass. Metal mirrors nearly always distort the pattern and are easily scratched or marred. A small mirror is a useful aid in making center convergence adjustments. In most sets, the adjustment magnets are on the neck of the picture tube, and it is virtually impossible to get a direct view of the screen and still reach the adjustments.

To check out completely and adjust the horizontal and high-voltage circuits, you need: a VTVM with a high-voltage probe to read 30 kv or better, or a sensitive VOM with HV probe; a 300-ma meter, or a similar scale on a VOM; and a 1.5-ma meter, or a similar scale on a VOM. The VTVM or the VOM is for measuring various operating voltages in the horizontal stage; the probe is necessary for safety when measuring the high voltage. The 300-ma meter or scale is used to measure cathode current of the horizontal-output tube during linearity adjustments. The 1.5-ma meter is used to set or check the cathode current of the HV shunt-regulator tube. This is a vital adjustment, if you want proper receiver performance and long regulator-tube life. Analyzing current readings at various brightness settings can

Circle 45 on literature card

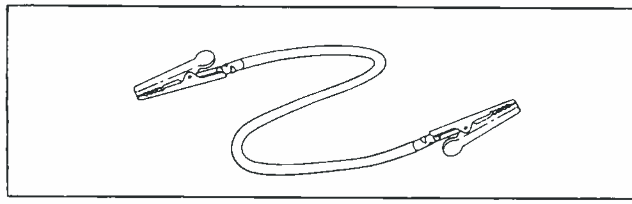


Fig. 5. Simple homemade clip test lead for color servicing.

also point up defects in the regulator circuit.

Extension cables are helpful (and often essential), if the set must be operated with the chassis removed from the cabinet. Remember that extension cables connected to the picture tube may smear the picture slightly. Many experienced color technicians do most of their servicing in the home and eliminate the expensive and time-consuming job of taking the set and cabinet to the shop. Some shops have a test picture-tube jig so that only the chassis need be brought in when major repairs are required. Make sure the chassis and picture-tube mounts are connected together.

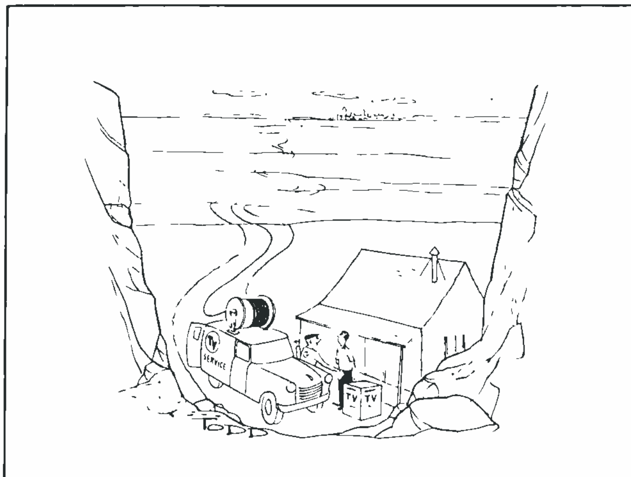
Clip leads are probably the least expensive equipment of all. You should have a variety of lengths with an insulated clip on either end. Use very short clip leads where capacitive or inductive effects are a problem. (Fig. 5).

Many new dot and crosshatch generators also have color-bar functions; however, it is still possible to buy the color-bar generator separately. Three kinds are available.

The simplest is the rainbow or offset-carrier type. The color-oscillator frequency in these generators is offset 15,750 cps from the 3.58-mc oscillator in the set. This will give one complete phase change for each horizontal scanning line—a continous change in tint from one side of the screen to the other. This kind of generator will tell you whether you have color and whether the tint is working correctly, but it is useless for scope tracing through the color channels.

The keyed-rainbow generator is popular for most kinds of receiver adjustments and for scope tracing, since the pulses of a color carrier can be used for crossover adjustments as well as for visual tracing.

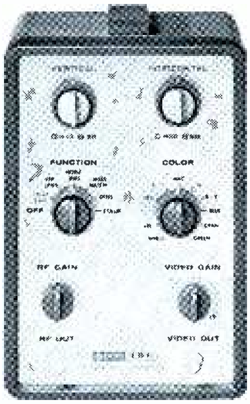
The NTSC generator is both phase and amplitude modulated to give vertical color bars in all three primary colors at full saturation. ▲



"That'll be $128 for the set, and $1,203 for the extension."

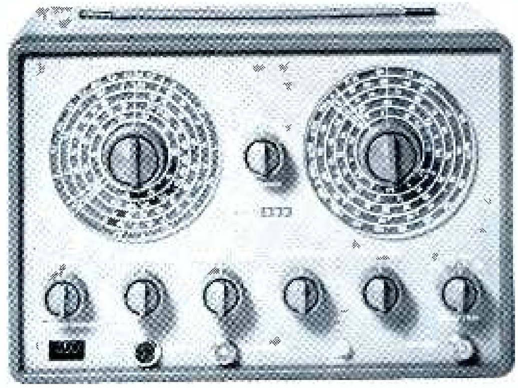
EICO's complete new color TV lab for the pro

A.



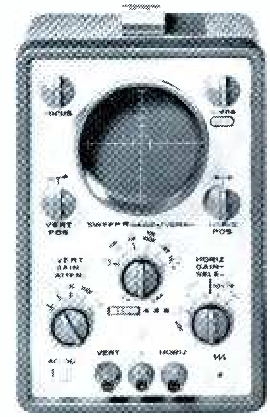
Model 380

B.



Model 369

C.



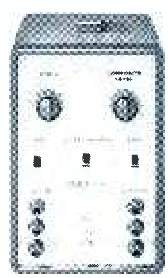
Model 435

Color TV servicing is a job for professionals—and **Eico's new color TV test equipment** is designed to their requirements. Professional service engineers can't afford to waste time on apparent set troubles caused by makeshift, inaccurate test signals, or on test equipment that is inherently difficult to use or incapable of fast, accurate determinations. Critical professionals know they can depend on EICO for accuracy, reliability, and laboratory standard performance. Moreover, EICO has now successfully reduced equipment size while improving performance, to permit convenient on-location servicing. No wonder the pros choose EICO!

PROFESSIONAL PERFORMANCE IN COLOR TV TEST INSTRUMENTS/ (A) MODEL 380 SOLID STATE N.T.S.C. STANDARD COLOR SIGNAL & DOT-BAR GENERATOR (PAT. PEND.) Entirely unique in both providing completely standard 100% fully saturated N.T.S.C. color signals, including both chrominance and luminance signals exactly as specified, and in being **completely transistorized.** Color burst is precisely gated and delayed according to N.T.S.C. standards, and phase angles are permanently established by taps on a linearly distributed delay line, so that no adjustments are ever required. Use of saturated transistors for switching and delay provides square "clean" waveforms without significant overshoots or ringing for excellent signal definition. The design of the 380 is an absolute protection against obsolescence, and assures the professional service engineer that apparent set trouble is not caused by a non-standard test signal. In addition to **generating 11 different color signals, one at a time,** for hue and demodulator adjustments, the Model 380 generates dots, crosshatch, horizontal lines, and vertical lines for convergence and linearity adjustments. Both video and RF outputs are provided, with gain controls. Three crystal-controlled oscillators are employed for color burst and color information, convergence and sync signals, and RF output on TV channel 3 (exchangeable for TV channel 4). Entirely stable and inherently rugged by solid state design, the Model 380 is also outstandingly compact and weighs only 4 lbs. SIZE (HWD): 8½ x 5¾ x 6⅜ inches. Kit **$129.95.** Wired **$169.95.**

(B) MODEL 369 TV-FM SWEEP & POST-INJECTION MARKER GENERATOR (CRYSTAL-CALIBRATED) For easiest, fastest visual alignment of color or B&W TV, and FM receiver RF & IF circuits. Five sweep ranges from 3-220 mc and four marker ranges from 2-225 mc, plus a crystal marker oscillator that turns on when a crystal is plugged into the panel socket (4.5 mc crystal supplied for TV sound alignment). Controllable inductor sweep circuit is purely electronic and has no mechanical parts to wear out. Retrace blanking, and a 3-stage AGC circuit that keeps the amplitude of the swept signal even when the widest sweep width of 20 mc is used. With the 369, circuit response is not affected by markers and markers are not affected by traps in the circuit. Only the sweep signal is applied to the circuit under test. A demodulator cable picks up the output signal and feeds the demodulated signal to a mixer stage in the 369 where the markers are added. Then the combined signal is fed to a 'scope. Separate trace size and marker size controls can be used independently. SIZE (HWD): 8½ x 12½ x 7½ inches. Kit **$89.95.** Wired **$139.95.**

(C) MODEL 435 DC WIDEBAND 3" OSCILLOSCOPE You'll be able to complete many more color or B&W TV service calls on location if you can take your 'scope with you. EICO's 435 is **really portable** (⅓ the size of conventional 5" scopes) and fully equipped to do the job. Quality equal to or better than the finest 5" TV service scopes is achieved with a **far sharper, brighter trace** on a flat-face CRT. Direct-coupled, push-pull V amplifier, with 4-pos. frequency-compensated decade attenuator has no low frequency phase shift, and **is flat from DC—4.5mc** (+1, —3db). Far more accurate p-p voltage measurements than ever before with a **Zener diode-controlled square wave calibrating voltage,** and an **edge-lit calibration grid.** Easier to use for TV servicing with pre-set TV-V and TV-H positions in addition to 4 sweep ranges, **automatic sync** limiter and amplifier, and **full retrace blanking.** Amazingly easy to build because of professional interior packaging that has eliminated crowding and permits easy access to any component. SIZE (HWD): 8½ x 5¾ x 12⅝ inches. Kit **$99.95.** Wired **$149.95.**



ONE MORE MATCHING INSTRUMENT EQUIPS YOU FOR FM STEREO SERVICING, MODEL 342 FM MULTIPLEX SIGNAL GENERATOR. The EICO Model 342 is a compact, efficient instrument essential for test or alignment of the multiplex circuits of FM Multiplex Stereo tuners, receivers, and radios. FM Stereo is a field as fast-growing as color TV, and a multiplex generator is an absolute must for getting a share of the increasingly important and profitable service business. The circuitry of the Model 342 is of the design lab quality needed for restoring original performance quality to the costliest equipment, but the controls have been simplified for fast, uncomplicated operation. With it, you can quickly measure and adjust channel separation and balance, or the input level needed for synchronization or switch-over to stereo operation. The Model 342 provides signals as perfect as those available from generators costing many hundreds of dollars. It provides both a controlled amplitude composite audio output for direct signal injection beyond the detector into a multiplex section, and the same signal modulating an FM RF carrier at about 100mc (adjustable) with controlled deviation ± 75kc (100% modulation) for connection directly to the antenna terminals. Either a built-in 1kc oscillator (below 0.3% distortion) or an external audio oscillator may be used to provide the left only, right only, difference, or sum signals. **The 19kc pilot signal is crystal controlled** and may be switched on or off independently of the composite signal. The signal may be obtained without audio information and only the 19kc pilot injected. An oscilloscope sync output is provided, with a choice of either 19kc sync or internal 1kc/external oscillator sync. In addition, an input is provided for connecting an external audio oscillator to provide an SCA signal when required. **Another important and valuable feature of the Model 342 is dual inputs and amplifiers for a stereo source to permit FM MULTIPLEX STEREO demonstrations to customers when there are no stereo programs being broadcast. Modern compactron tubes are used to obtain a lightweight, compact package that is easily portable.** SIZE (HWD): 8½ x 5¾ x 12½ inches. Kit **$99.95.** Wired **$179.95.**

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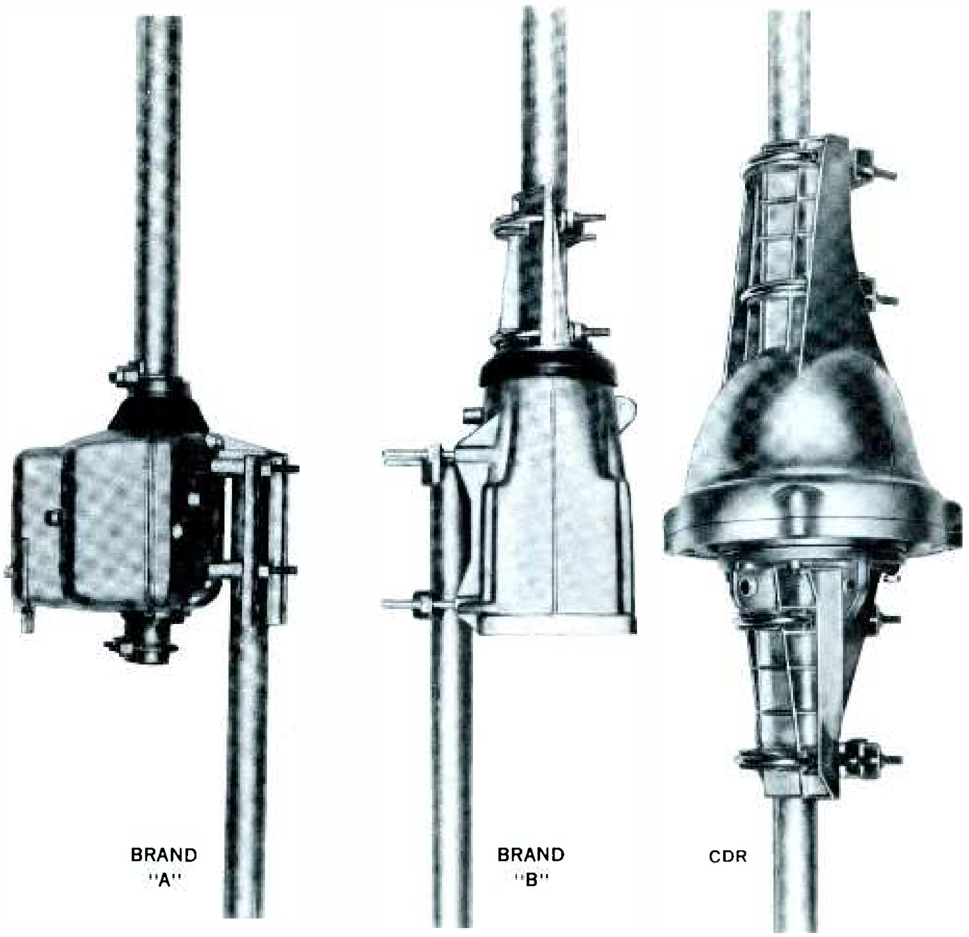

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Stall Torque*	115 in. lbs.	75-112 in. lbs.	525 in. lbs.
Brake Torque*	Exceeds stall torque	Exceeds stall torque	435 in. lbs.
Rotation Time* (360°)	60 sec.	60 sec.	45 sec.
Housing	Cast zinc	Thin die-cast alum.	Heavy re-inforced die-cast alum.
Weather 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)

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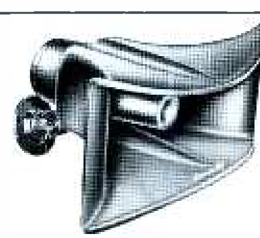
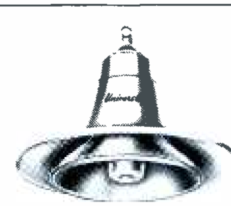
Same as above and where overhead obstructions are encountered.	Same as above but with greater control of dispersion pattern, reducing reverberation and spill over. *OLB	 UNIVERSITY MODEL CMIL-A	7.5 watts 350-13,000 cps 120° x 60° dispersion 6$\frac{1}{4}$" high, 9$\frac{1}{2}$" wide, 8$\frac{1}{2}$" deep In 4, 8, and 45 ohm impedances.
Coverage of sizeable areas with moderate ambient noise level. Amusement parks, warehouses, loading docks, portable P.A. systems.	High power handling capacity, high efficiency, greater low frequency response. Utmost reliability. Weatherproof. *OLB	 UNIVERSITY MODEL IB-A	25 watts 250-13,000 cps 90° dispersion 10$\frac{1}{4}$" dia., 9" deep In 4, 8, and 45 ohm impedances.
Same as above and where overhead obstructions are encountered.	All of the above, but with exclusive University Wide Angle horn for reducing reverberation. *OLB	 UNIVERSITY MODEL CIB-A	25 watts 250-13,000 cps 120° x 60° dispersion 7$\frac{3}{8}$" high, 14" wide, 12" deep In 4, 8, and 45 ohm impedances.
Ceiling suspension of speakers to cover wide area. Using minimum number of units. Factories, department stores, depots.	Uniform 360° sound dispersion. Built-in driver. High power handling capacity. *OLB	 UNIVERSITY MODEL IBR-A	25 watts 300-10,000 cps 360° dispersion 13" dia., 10$\frac{1}{4}$" deep In 4, 8, and 45 ohm impedances.

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Color Instruments for 1965

There's new equipment designed especially for color . . . by James M. Moore

Advances in color TV receivers and accessories are taking place all the time, and the conscientious service technician engaged in color work tires to keep up-to-date with these developments. Of equal or even greater importance to him are changes and advancements in color-TV test equipment. To help pinpoint current trends in this area, here is a brief look at some instruments introduced in recent months or planned for release by the year's end.

CRT Checkers

The Jackson Model 825 picture-tube tester and booster (Fig. 1) incorporates a switch that enables each gun in a color CRT to be tested separately. The instrument provides continuity and leakage tests (the latter at low voltages, for safety), a cutoff test, and a life test. By proper manipulation of the push buttons, the operator can, in many cases, clear grid-cathode shorts, weld open cathode connections, or boost emission.

Two features have been included in an effort to avoid obsolescence: Eleven different second-grid voltages are available to accommodate a variety of present and anticipated tube types. The plug-in socket cord is supplied with a duodecal socket, but adapters are included so that the tester can be used with tubes having different basing arrangements.

Other features of the instrument include a line-voltage control that contributes to more accurate test voltages, a tuning-eye indicator for leakage and conduction tests, separately variable voltages for the first and second grids, and provision for shorting the meter movement to avoid damage during transit.

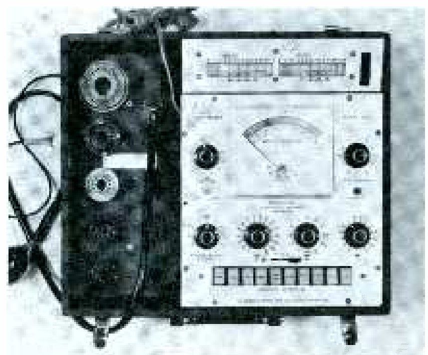

Fig. 1. Checker tests guns individually, has additional socket adapters.

The SENCORE CR133 CRT checker (Fig. 2) also has been designed with an eye toward avoiding obsolescence. The second-grid voltage can be varied from 25 to 300 volts to test tubes that require lower voltages on this electrode. Two plug-in cables have sockets to accommodate virtually all tube bases.

A line-voltage adjustment is included, and filtered DC is used for all checks. Tests include emission, interelectrode shorts, cutoff capabilities, gas content, and life expectancy. The guns in a color CRT are each tester separately. The rejuvenator voltage is automatically controlled to protect the tube during the rejuvenation process; this feature also serves as an aid in obtaining gun-current equalization in color CRT's.

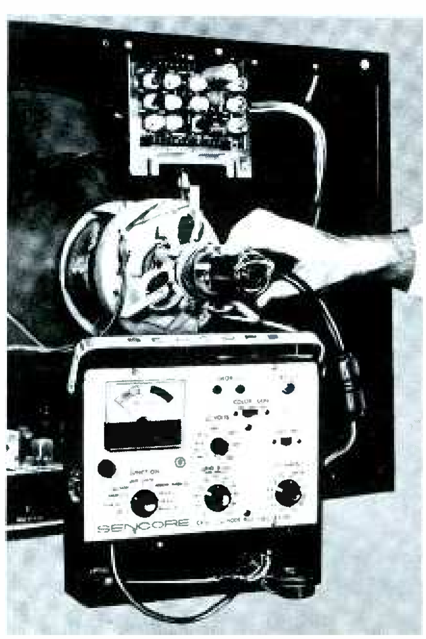

Fig. 2. Unit has variable G-2 voltage as an assurance against obsolescence.

Signal Generators

Many new instruments are available to provide test signals for color receivers. Some of them differ significantly from the others in the outputs they provide, but all are compact in size and portable. A significant trend is indicated by the use of solid-state circuitry in some newer instruments.

Keyed-Rainbow Generators

Keyed-rainbow color generators are used in many of the new units. Although circuits differ, the basic principle follows: A crystal oscillator produces a signal that is offset 15,750 kc from the color subcarrier frequency. This signal and the output of the receiver's 3.58-mc oscillator coincide in phase during the color burst; then, during each horizontal scan, their relative phase shifts from 0° to 360°. When demodulated in the receiver, this changing phase of the signal produces a rainbow pattern on the screen of the color CRT. A multivibrator in the generator is used to interrupt the offset-frequency signal to produce dark bars that separate each color on the screen. Other multivibrators, all synchronized by a crystal-controlled master oscillator, produce pulses that provide sync signals and horizontal-line, vertical-

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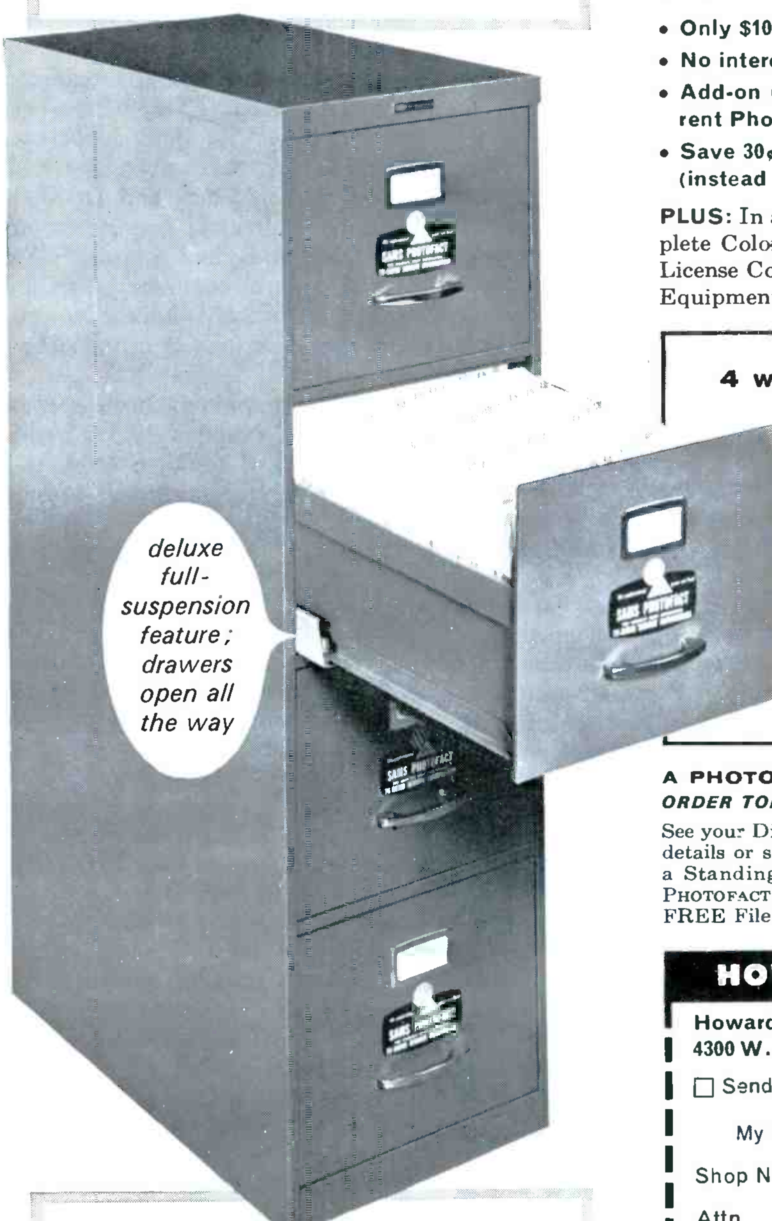

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Fig. 3. Generator provides 5 patterns; gun killer is available as accessory.

line, crosshatch, or dot patterns. In most designs, the test pattern information modulates an RF carrier that can be tuned to an unoccupied low-band VHF channel.

The keyed-rainbow pattern aids the serviceman in aligning the color demodulators, testing color sync, and checking the range of the receiver's hue control. The dot and line patterns are used to adjust convergence, sweep linearity, etc.

The B & K Model 1240 (Fig. 3) provides all the patterns just described, and a color-gun killer is available as an optional accessory. (This is a switching arrangement that permits operating any combination of guns in the color CRT.) The unit is designed to produce dots and horizontal lines just one raster line thick. It is provided with adjustable dot brightness, a function selector, and a chroma-level control. The RF output may be adjusted to channel 3, 4, or 5. The unit weighs 9 lbs. and has a carrying handle for easy portability.

The Seco Model 980 (Fig. 4) is a compact, portable instrument designed with ruggedness in mind. Its RF carrier can be modulated with dots, vertical lines, horizontal lines, crosshatch, and keyed-rainbow color bars. Color level and dot size can be varied with appropriate controls.

Fig. 5. Color generator features solid-state design, individual gun killers.

Fig. 4. Keyed-rainbow generator also provides dots, lines, and crosshatch.

The Model 990 is similar to the earlier 980 except that the 990 also provides a selective gun killer, a rainbow pattern (unkeyed), a choice of 54 or 144 dots, a choice of 6 or 16 horizontal lines in the crosshatch pattern, a choice of 6 or 18 lines in the horizontal-line pattern, and a gray raster. Both models have power transformers.

Solid-state design is a feature of the SENCORE CG135 color generator (Fig. 5). This model produces color bars, dots, horizontal lines, vertical lines, and crosshatch pattern. Individual gun interrupters are included, and optional CRT adapters are available. The unit weighs 8 lbs and is housed in a steel carrying case for use in the shop or in the field.

The same manufacturer now has an adapter (Number 39G12) which can be added to its older CA122 Color Analyzer to permit selective operation of the guns of the new Motorola 23" rectangular color CRT.

Other Patterns

The EICO Model 380 color generator, shown in Fig. 6, provides the usual dot, line, and crosshatch patterns, but its color output differs from those of the generators previously discussed. Instead of using an offset color subcarrier to produce a keyed-rainbow display, this instrument uses a tapped delay line to produce 11 separate color signals. The color burst is gated and delayed according to NTSC standards. The unit has both video and RF outputs; each is provided with a gain control. The RF carrier frequency, the color signals, and the sync and pattern signals are derived from crystal-controlled oscillators. The Model 380 is fully transistorized and weighs 4 lbs.

The GC Electronics Model 36-610-A (Fig. 7) provides dots, vertical lines, and horizontal lines for making convergence checks. This

Fig. 6. Color-bar generator uses delay line to produce single NTSC colors.

updated version of the Model 36-610 connects to the receiver through an adapter socket placed between the CRT and its socket. Sync for the pattern-generating circuits is obtained from a clip-lead connection to the "hot" side of the horizontal yoke winding in the receiver. A "standby" position on the pattern selector switches the test-instrument out of the CRT circuits separately, without otherwise changing the test setup; thus, the results of adjustments can be readily observed. Separate gun-killer switches are also provided. A mirror inside the lid makes it easier to observe the CRT face while making adjustments. A "width/contrast" control varies the size of the dots and the widths of the lines; it also controls pattern brightness.

Other New Instruments

The EICO Model 435 (Fig. 8) is a wideband oscilloscope designed for use in color and black-and-white servicing. Its frequency re-

Fig. 7. Dot and line generator is synchronized from receiver yoke winding.

Next Month, the
December Issue...

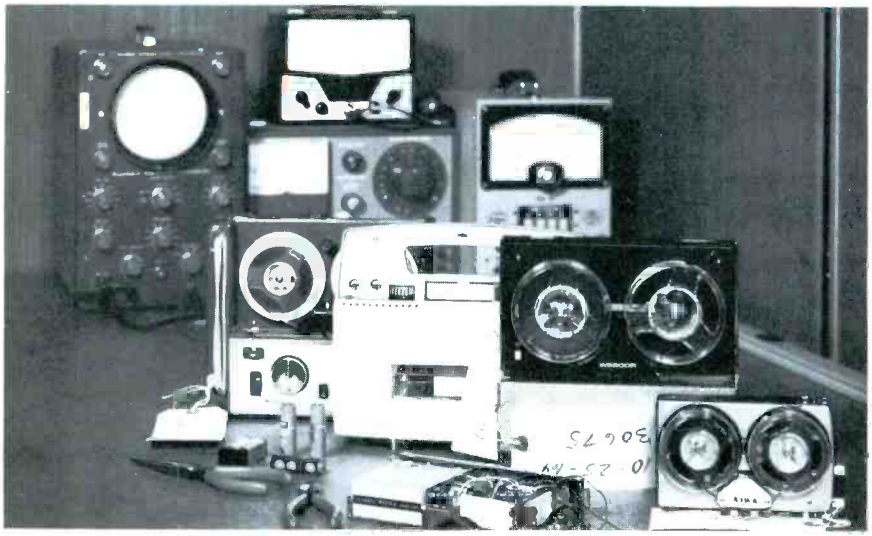

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Fig. 8. Compact wideband scope is intended for servicing color or B & W TV.

sponse from DC to 4.5 mc varies from +1 to —3 db. The amplitude of the square-wave calibration voltage is controlled by a zener diode. The unit has a flat-faced, 3" CRT; direct-coupled, push-pull vertical amplifier; and full retrace blanking. As with most modern test gear, this scope is compact and portable.

The Lectrotech Model V-7 (Fig. 9) is the most unusual new color-TV test instrument this year. It consists of a signal generator and a "vectorscope" display section. (The Model V-6, containing only the generator functions of the V-7, is also available.) The generator produces dots, horizontal lines, and vertical lines, and crosshatch and keyed-rainbow patterns. The pattern signals are available either as video or as modulated RF. Separate gun-killer switches are included. Except for two tubes, the unit is fully transistorized.

The instrument plots electronic-

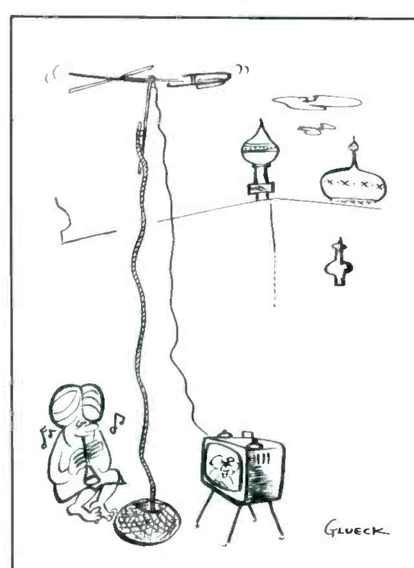

Fig. 9. Instrument combining a color generator and a color-vector display.

ally, on its own CRT, a vector diagram of the color signals that produce the keyed-rainbow pattern. Some of the information used to produce the display is derived from the color section of the receiver; therefore, the vector diagram can be used to analyze defects in this portion of the set. Provision is also made for using the scope tube to aid in adjusting the frequency dividers in the pattern-generating section.

Summary

In the latest color-TV test instruments, emphasis is placed on compactness, ruggedness, and portability. Some units are either partly or wholly transistorized. Among the color-signal generators, the keycd-rainbow pattern is most common. All generators described here offer dot and line patterns, and most of them provide crosshatch patterns and selective switching of the CRT guns. In most cases, manufacturers have tried to reduce the possibility of obsolescence by providing versatile adapters. Test equipment, like everything else, is always changing, and the instruments just described are indicative of the current trends in the color field. ▲

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Notes on Test Equipment

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

by Stephen Kirk

Bad Picture Tube?

Newer picture tube designs with various heater voltages, sockets, and socket connections have made older CRT Tester-Rejuvenators a bit obsolete. In addition, many testers will not check color tubes correctly, even with an adaptor, since they cannot supply sufficient current for color tube heaters.

The G-C Electronics 36-616 (Fig. 1), designed for testing all black and white as well as color CRT's, is a clean looking instrument mounted in a fabric-covered wooden case 8" x 16" x 5". The instrument panel itself is only 10" long, leaving plenty of room (8" x 6" x 5") inside the case for stowing the multiple socket cable and line cord.

Three unusual features of the 36-616 are (1) small neon indicator lights located around the function switch (Fig. 2) to indicate which function is in use, (2) a "heater-continuity" lamp, and (3) the method of measuring tube quality.

This last feature is unusual in that the 36-616 reads cathode emission through the second anode lead of the CRT. In most testers, the first anode or "screen" lead is connected in series with the tester's meter to read relative cathode current; in the 36-616, a lead with a clip on the end is attached to the second anode button for the emission check. You read cathode current, then, at its normal destination. This method has the advantage that it will uncover the fairly rare open or shorted second anode, which could be missed by other testers.

About 300 volts is used on the second anode for the emission test, and a limiting resistor eliminates the possibility of a dangerous shock. If the TV set has been on immediately before the test is made, a jumper should be used to remove the charge on the second anode.

Two large neon lamps (NE-51H) are used to indicate heater-cathode and grid-cathode leakage. Small (and often inconsequential) leakage may cause the neons to blink slowly; more leakage will result in a steady glow.

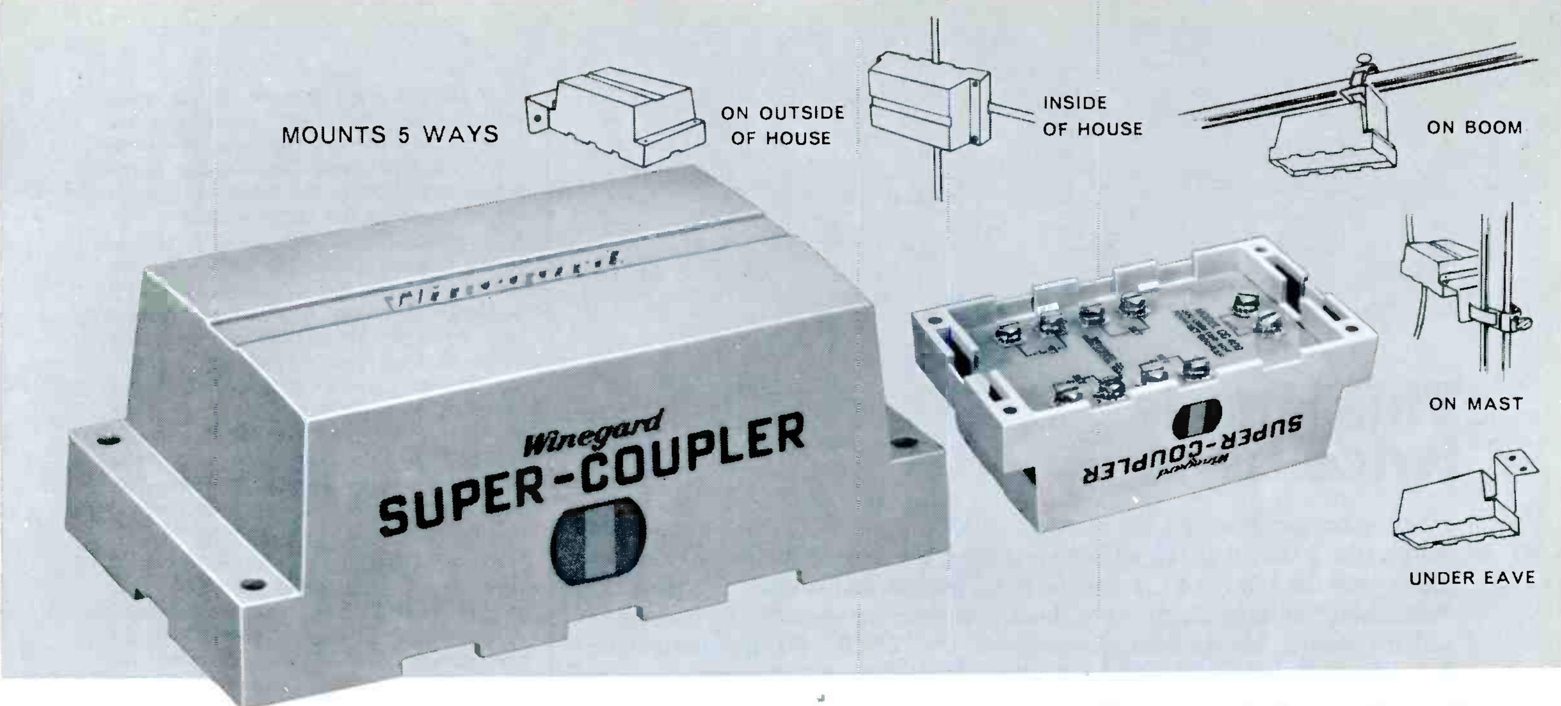
In addition to three 110° CRT sockets and the regular duodecal CRT socket, there are two color sockets on the multiple socket cable. No adaptors are necessary. The color sockets are wired permanently for six volts on the heater. When a color CRT is checked, the heater switch, that selects either 2.5, 6.3, or 8.4 volts AC for black-and-white tubes, becomes the RED, BLUE, or GREEN color gun selector; each section of a color tube is checked separately and may be rejuvenated individually.

Other features of the G-C unit are the "Bias" check that determines the grid voltage necessary to cut off cathode emission (meter will read in the *OK* or *bad* area) and the "Life" test. In the life test, the heater voltage is removed from the CRT. By observing the decay of second anode current on the meter you can predict fairly well the probable life expectancy of any picture tube. Though there is no hard-and-fast rule, the instruction booklet suggests that if the meter reading drops from *good* to *bad* in less than four seconds, the tube is hopeless; from four to eight seconds is considered fair; and anything above eight seconds is considered encouraging.

The first picture tube we tested was slow—it couldn't be seen in the daytime unless the set had been on for several hours. Since this was a classic example of low CRT emission, we discharged the second anode with a jumper, plugged the tester-rejuvenator into the CRT, and connected the second anode clip to the tube. We then turned the tester to "Leakage." The leakage lamps did not light, but the "heater-continuity" lamp indicated there was nothing wrong with the heater. We moved the function switch to "Test" and the reading on the meter, even after 5 minutes, was nil. Obviously there was no point in making either the "Bias" or "Life" tests.

We were now ready to try rejuvenation. G-C suggests two different methods. The first is the filament-boost method: This consists simply of raising the filament voltage, either by 40% (Medium) or 80% (High), operating the CRT at this increased voltage for 10 minutes, and then making another test reading. If the emission has increased significantly, you continue for up to 30 minutes.

Fig. 1. Picture tube tester-rejuvenator has detachable cover and single socket.



Never before couplers like these! New Winegard Super Color Couplers ...the 2 most efficient TV-FM 2 and 4 set Couplers ever built!

- **Constant Isolation between sets . . . 22db minimum across all channels (2-13 and FM)**
- **Lowest Loss of Any Coupler . . . —3.2db maximum**
- **Best Impedance Match from Antenna to Coupler and Set to Coupler**
- **Allow Best Possible Reception on Color or Black & White Sets**

There is a wide difference in the performance of TV-FM couplers. And now, with the new Winegard 2-set and 4-set Super Color Couplers, there is a greater difference than ever.

For example, no resistors are used for isolation of outputs. No resonant coils are used in the circuit. Instead, our research labs have developed an entirely *new coupler circuit* using three high frequency, ferrite core transformers in a unique "Balanced Bridge" circuit.

What does this do to performance? Well, for one thing, the 2-set Super Coupler provides an isolation figure of 22db minimum across *all* channels (2-13 and FM). Until now, the minimum isolation between sets with 2-set couplers was about 10db or 3 times, and was not constant on all channels. With the new Super Color Couplers, it's 12.8 times—*four times better* than the previous best. In fact, isolation is so good, you can put a dead short across one set of output terminals without affecting the set connected to other output.

LOSS is another key factor in measuring the performance of a coupler. The lowest possible theoretical loss in a 2-set coupler is —3db but no coupler on the market had ever approached this ideal. Now, with Winegard's new 2-set Super Coupler (CC200), the MAXIMUM loss is —3.2, nearly perfect and by far the best on the market.

One more very important factor—IMPEDANCE. There are two impedance matches to consider . . . "Forward" from coupler to antenna, and "Backward" from set to coupler. A perfect coupler would have a VSWR of 1.1:1 on both matches. Some couplers have good match one way but, until now, no coupler ever had a good match both ways. Winegard Super Couplers have a near perfect VSWR of 1.2:1 both *forward and backward* . . . and on *all* channels. This far exceeds other couplers on the market.

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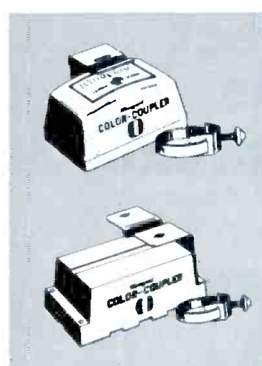
Try the new Winegard Super Couplers now and *see* the difference. Ask your distributor for a 6 pack dispenser. Try them on your next six installations. If they aren't the finest you've ever used, take them back for a *full refund.*

CC200 — For VHF and FM Specifications as above.
List $4.50 includes 5-way mounting bracket and strap.

CC400 — For VHF, UHF and FM (replaces LT-43).

Max. loss —6.23DB (A theoretical perfect loss for 4 way coupler would be —6.0DB); Isolation 12DB min; Response ± 1/4DB per 6MC; VSWR: Input 1.15:1; Output 1.4:1 Max; Bandpass 20MC-1000MC; Impedance: Input 300ohm, Output 300ohm. List $5.50 including 5-way mount and strap.



Winegard's Famous CC23 Color Coupler Finest VHF/FM color coupler on the market next to our new Super Color Couplers. List Price $3.95.

Winegard All New CVU-2 UHF-VHF Coupler Efficiently transfers UHF and VHF signals from antennas to sets. Serves as coupler or splitter for channels 2-83 (UHF-VHF). List $3.95.

	UHF	VHF/FM
Splitter loss	3.5db	4.3db
Isolation	20 db	12 db
VSWR	1.4:1	2:1

Winegard Co.
ANTENNA SYSTEMS
3009K Kirkwood, Burlington, Iowa

Circle 48 on literature card

If the emission is now in the *good* range, make the "Life" check and see how quickly the reading falls off. If the fall-off is rapid, you should either install a brightener or use the "shot" method of rejuvenation. In this latter method, a high DC voltage (about 300 volts) is applied to the control grid of the CRT when the red REJUVENATE button is depressed. This suddenly increases the cathode current and tends to knock off contamination which may be affecting cathode emission. To prevent over-rejuvenation which can destroy a tube, the heater-continuity lamp is automatically switched into the power supply circuit. As soon as the lamp comes up to full brilliance the REJUVENATE button should be released, to prevent damage to the CRT grid.

On this particular CRT, we used the heater-boost method and found we could get pretty good emission (about 400 ua—the *good* scale starts at 250 ua) with the rejuvenation switch on "Medium" for about fifteen minutes. Since the reading dropped off to *bad* in just about five seconds, we decided it would be best to install a brightener; that would tend to hold the emission up for at least a few months more of service.

The second tube appeared to be another classic case of low emission, but using the 36-616 we found the emission was good (about 700 ua). At first we didn't believe the tester was telling the truth, but another checker confirmed that cathode emission was adequate. We then checked the voltages on the CRT and found they were near normal. To make a long story short, we found the trouble was an open peaking coil in the video amplifier. This changed the effective plate load resistance from 5000 ohms to about 17K and produced the milky picture that we had falsely attributed to a bad CRT. Thus, a CRT tester can save you from the embarrassing situation of having replaced a CRT needlessly.

The third CRT we checked had a brightener already installed. We wanted to try the "shot" rejuvenation process of the G-C unit, and this seemed like an ideal place to do it. We placed the proper test socket on the CRT and checked leakage, which was okay. In the "Test" position we had a *bad* reading (less than 100 ua). We turned the function switch to the "Low" rejuvenate position and pushed the red REJUVENATE button. The center lamp on the panel flickered and then started to brighten up. When it was fairly bright we released the REJUVENATE button and rechecked the emission. It had increased to just over 250 ua, on the borderline between *good* and *bad*. We turned the function switch to "Life" and the reading fell back pretty fast, but this was to be expected; the tube had been running with increased heater voltage for several months, and the rejuvenation and test were made on regular voltage. We reinstalled the brightener and the picture looked better than it had before. There was no apparent burning of the grid aperture, which can result in "white out" through inability of the grid to control the electron beam. ▲

For further information, circle 82 on literature card

10 Years of COLOR / a report

Here's the family tree to date.

by Allen B. Smith

Ten years from now, 1964 may very well be known as the year in which the long-awaited breakthrough to consumer acceptance of color television finally arrived. And now, in November of 1964, we may all nod reflectively and observe that it's about time—color has been a long time a-coming.

On December 17, 1953, the FCC approved the NTSC (National Television System Committee) recommendations for color television broadcasting and authorized regular service to begin on January 22, 1954. From that beginning, the industry has grown, slowly until about 1961, then more rapidly, until today it represents sales that approach one billion dollars in all facets of broadcasting, consumer sales, and servicing. Industry spokesmen predict attainment of this magic figure sometime next month, an achievement made possible in large part by the significant price reduction for color receivers that occurred in May of this year and by increased color programming by independent stations and the networks.

From 1956 until mid-1963, prices were pretty well stabilized at the $500-and-above mark. In July 1963, industry managed a $50 reduction in that price. The May 1964 figure (announced first by RCA, then soon followed by other major manufacturers) was under $400—and it has added substantially to the growing share of the domestic television market captured by color.

As we near the end of 1964, color TV's share of the total TV dollar is estimated to range between a one-in-seven ratio and a one-in-nine ratio, depending upon whose figures you go by. In any case, it is generally expected that the ratio will reach one-in-four by the end of 1965.

Color Growth to Continue

Rectangular 90° CRT's, now appearing in many manufacturers' top-of-the-line sets, promise to increase public acceptance of color consoles because of the slimmer cabinet lines possible and because the rectangular format is what the consumer has been conditioned to expect. Improved color saturation and purity, along with automatic demagnetization of the CRT, will also make color sets more appealing to the average viewer who wants to do nothing more complicated than to turn a set on and watch programs in color.

Improved picture quality of the newer CRT's, greater viewing area in the more popular rectangular format, and more hours of programming in color sets will continue to spiral upward. The question is no longer whether or not color will become a significant part of the service industry, but, rather, how soon the dollar volume of color-set repairs in the average shop will surpass that of black-and-white sets. Considering the higher per-unit servicing figure, growing familiarity with color circuitry, and the fact that predictions suggest 22% of American homes will have color sets by 1969, the year 1974 may well see color-servicing revenues exceeding those from black and white.

In 1963, one major manufacturer (RCA) reported that dollar volume of color-set sales exceeded that for monochrome sets. The same company predicts that color-set purchases in 1964 will amount to more than the total income from all other home entertainment products, including radio, phonos, and tape recorders.

The Service Technician

What does all this mean to you? Well, it means that broadcasters and set manufacturers are gradually breaking the old vicious circle in which there were no color-set viewers because there were no color sets because there were not enough programs in color because there were not enough viewers! And, too, it means that despite the initial heavy investment required to service color, and the temporarily questionable profit increase because of the time involved in troubleshooting color circuits, more shopowners are preparing the way for future growth and income by staying current with (or even ahead of) the demands of the industry. These wise operators are training themselves and their employees to work quickly, efficiently, and profitably in servicing, selling, and promoting color. Furthermore, great assistance is now available from the service clinics and/or seminars conducted by several manufacturers.

How Sets Have Changed

In basic principle, little has changed; and yet, every month that passes sees improved technology bringing broadcast equipment and receivers alike closer to the theoretically perfect system. Improvements in color phosphors, sweep and deflection circuits and components, masking techniques, and increased circuit reliability in the receiver have been combined with more efficient color TV cameras to enhance the color picture seen in homes today.

At the time of the NTSC demonstration to the FCC in New York City on October 15, 1953, prototype color receivers were shown by the following firms: Admiral, CBS-Columbia, Crosley, Emerson, G-E, Hallicrafters, Hazeltine, Motorola, Philco, RCA, Sylvania, Westinghouse, and Zenith. In the years that followed, only Crosley, Hallicrafters, and Hazeltine failed eventually to produce a receiver for the consumer.

Although most companies produced color sets sporadically through the years until recently, RCA alone has produced an unbroken string of sets from the early CT-55 chassis using the 15GP22 CRT, the CTC4 using the metallic 21AXP22, the CTC5A that used the aluminized 21AXP22A, on through the CTC7 with the 21CYP-22, right up to the recently announced 25″ rectangular CRT in the CTC17 chassis.

Each time increased emphasis was lent to color, first one manufacturer and then another would try for a share of the market; limited color programming and marginal quality always doomed these efforts. Motorola introduced a set with a 19″ CRT in July of 1955 as did CBS-Columbia in October of the same year. RCA, however, offered a wide line in December that featured the 21AXP22 that soon became the standard picture tube for color.

Early in 1956, RCA produced the CTC4 chassis using printed-circuit boards in the video and sound IF stages and, a year later, offered the CTC5 series with PC boards throughout, although later CTC5's had hand-wired chroma circuits. By this time, Arvin, Capehart, Hoffman, Philco, Sentinel, Sparton, and Stromberg-Carlson had tried with limited success to promote their own lines, but the consumer continued to sit on his wallet and watch the more familiar (albeit less colorful) monchrome set.

In May of 1957, Westinghouse made a strong bid with a rectangular format CRT, the 22EP22, but once again public demand failed to justify continued production. Admiral, Raytheon, Silvertone, and Sylvania tried again in late 1957 and early 1958, falling victim to the now rather expected public reluctance to purchase an expensive set for limited use.

By the time RCA came out with the CTC7A in early 1959, most major manufacturers had given up all thought of penetrating the color market in sufficient numbers to justify full-scale production planning, and decided to use complete RCA chassis and circuitry in their own cabinets for distribution through their own marketing organizations. This became the general rule through 1963, when RCA concluded production of the CTC12 chassis. From that time until now, some manufacturers have used components and/or slightly modified circuits from later CTC-series designs, under license from RCA.

During color's first five years, then, sets progressed from multiple-chassis designs with as many as 45 tubes and a 15" CRT to the CTC-7AA chassis with 26 tubes and a 21" CRT. Most sets on the market after that time were RCA all the way, or based on RCA designs, because that company alone had managed a foothold. By October 1962, however, market predictions began to look more rosy, and once again there was a flurry of activity — sparked by Zenith's full-scale entry with a 21" chassis (the 21JC20) of their own, followed shortly afterward (in mid-1963) by Motorola's 23" rectangular CRT in another new chassis design. By recent mutual agreement between RCA and other manufacturers to whom they had been supplying chassis and component assemblies, future emphasis will be placed on independent development to allow each manufacturer of color TV sets the opportunity to develop his own strong sales features. This approach will, of course, intensify the competitive nature of set production and sales, and the consumer is the natural recipient of reduced prices.

Recent Developments

As this year of 1964 draws to a close, there is a grand flurry of activity as RCA and Zenith take their positions as combatants in marketing 25" rectangular color sets; as Motorola and National Video Corp. begin final preparations to incorporate a rectangular 25" CRT into new Motorola sets and increase production of 23" rectangular CRT's; as Philco announces development of their 90°, 19″ shadow-mask color tube; as Sony completes a new plant for the construction of rectangular 19″ single-gun color-picture tubes; and as most other set makers formulate plans to take advantage of rapidly expanding color program schedules in prime viewing time.

The following recap of late press releases and news items from various trade magazines and journals[1] indicates the level of interest in color television:

1. National Video Corp. expects to produce 100,000 23″ rectangular color tubes in 1964.
2. Philco's Lansdale, Pa. plant is 90% finished with its preparation to build their 21″ round tubes.
3. The Electronic Industries Association (EIA) expects color-set production to reach 1.3 million by the end of 1964.
4. Sylvania has begun sample deliveries of its 25″, 90° rectangular CRT which uses rare-earth phosphors that give brighter pictures. 19″ rectangular color tube will be available early next year.
5. Zenith predicts industry color-set sales in 1966 will reach 2.5 million. Subsidiary corporation, Rauland, is producing 25″ rectangular tubes, with 19″ bulbs available early in 1965.
6. RCA plans an $8 million addition to its Lancaster, Pa. plant to provide replacement color TV tubes for the expanding market.
7. More than 90 major TV client advertisers are preparing or using color in commercial spots. TV executives now estimate that two of every three commercials run during color shows are in color. This means more revenue for the networks, and that will engender even more color programming.
8. Network color schedules run: 45 hours a week at NBC; over 30 hours at ABC; and, while CBS is still scheduling only specials in color, they are ready for full-scale color production as soon as sponsors will pick up the tab.

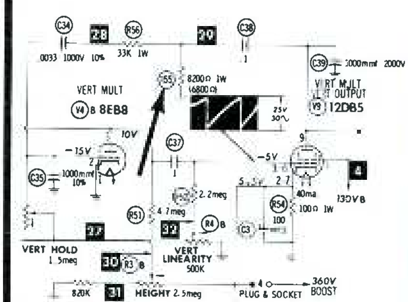
The above items only suggest the sweeping activity in the industry, but must be considered impressive evidence of the belief by the "big money" that color is here to stay—and in a very big way.

Your opportunities as a serviceman and/or retailer are plain enough; all you have to do is prepare yourself and your organization for your share of that billion-dollar industry. ▲

[1]Electronic News, Home Furnishings Daily, Radio-Television Daily, Television Digest with Consumer Electronics, Wall Street Journal.

Feedback *Resistor* Failure

(for a Change)



In vertical multivibrator-output circuits, capacitor failures in the feedback circuit are so common as to be a prime suspect whenever sweep trouble occurs. Leakage in the most highly stressed capacitor (C38 in the schematic) is especially troublesome, frequency causing intermittent or complete vertical collapse.

But in the particular circuit shown here (from Emerson Chassis 120507-A), field reports indicate more trouble with resistor R55 than with C38. This 1-watt unit opens, and although it does not break the feedback path from the output stage to the discharge section of the multivibrator, it interferes with proper shaping of the waveform. The result is a shifting of multivibrator frequency that makes it impossible to lock in the picture with the vertical hold control. In plain words, the complaint is uncontrollable rolling.

R55 may be either 6800 or 8200 ohms, depending on chassis run; replace with the same value as the original.

—*The Troubleshooter*

Luminance Channels

(Continued from page 41)

it is a most valuable point to remember: A change in any characteristic of the delay line may result in "ghosts" on a monochrome picture. Always be sure, when replacing a delay line, to use an exact replacement.

The signal from the output of the delay line is coupled through video-peaking coils to the grid of the third video amplifier. This third and final stage of amplification is provided by a 12BY7 pentode power amplifier. The brightness control is in the grid circuit of this tube, while the contrast control is in the cathode circuit. Adjusting the brightness control changes the grid voltage, thus changing the level of the plate voltage that is ultimately coupled to the CRT cathode.

Location of the contrast control (cathode circuit) isn't uncommon; however, the manner in which the control affects the stage is unusual. The arm of the potentiometer is connected to ground through an electrolytic capacitor; therefore, rotation of the control does not change the DC bias on the stage. Rather, the electrolytic acts as an AC bypass that changes the gain of the stage in proportion to the percentage of the signal that is bypassed. W4 shows the signal at the cathode with contrast set for a normal picture; W4A was taken with the contrast control at maximum and scope vertical gain unchanged.

A vertical-retrace-blanking pulse is added to the video signal in the plate circuit of the third amplifier stage. This positive vertical pulse is taken from the plate of the vertical-output tube and biases the CRT into cutoff during vertical-retrace time. W5, W6, and W7 depict normal video signals applied to the red, blue, and green CRT cathodes; notice the vertical-blanking pulse that extends above the normal sync signals.

Worth Remembering

Store these few circuit-operation factors in the back of your mind for valuable assistance when servicing any color receiver that uses a three-stage amplifier circuit in the luminance channel:

1. The 4.5-mc trap is located between the video detector and the grid of the first video amplifier.
2. It is normal for the signal at the grid of the second video amplifier to be equal to or less than the amplitude of the signal at the grid of first stage.
3. Signal level at the cathode of the video-output tube decreases as the contrast control is rotated toward maximum resistance.
4. The vertical-blanking pulse is inserted at the plate of the video-output stage.
5. Defects that alter the plate voltage of the video-output stage will also affect the brightness.

Two-Stage Luminance

Fig. 2 is the schematic diagram of one type of circuit found when two stages are used in the luminance channel. The cathode follower in the first stage provides an impedance match between the video signal source and the delay line. The output of the video detector is divided among three paths:

1. The composite video signal is coupled to an additional amplifier stage (not shown on schematic) for further amplification before it is applied to the sync

and AGC circuits.

2. The second path is to the color circuits—the bandpass amplifier and the burst amplifier.
3. The third signal path is to the grid of the cathode follower.

The contrast control located in the cathode circuit of the cathode follower determines the amplitude of luminance (video) signal fed to the delay line.

W10 (taken with contrast control set at normal) reflects the loss of amplitude normally encountered in any cathode-follower stage. W10A (with contrast at maximum) is still lower in amplitude than the grid signal. Notice that, with contrast at maximum resistance, the cathode signal is also maximum; whereas, in the three-stage circuit, maximum setting of the contrast control produced the minimum cathode signal.

The delay line delays the signal approximately .6 microseconds and is terminated with a 1000-ohm control, used to avoid signal reflections. The termination control is normally factory adjusted and should require resetting only if the delay line or associated components are replaced. If adjustment becomes necessary, it can be performed in the following manner:

1. Connect generator with crosshatch pattern to antenna terminals.
2. Set contrast control to maximum.
3. Set brightness control to normal or slightly above normal.
4. Adjust 1000-ohm termination control for minimum reflections, which appear on the screen as video ringing.

The brightness and brightness-range controls are located in the grid circuit of the video-output stage. A negative DC voltage—approximately −75 volts from the grid of the horizontal-discharge tube — is applied to one side of the brightness control. Adjusting either the brightness or brightness-range control changes the grid voltage on the video-output stage. Brightness is determined by the CRT cathode voltages, which vary as the plate voltage on the video-output tube changes.

The crystal diode in the video-output grid circuit permits setting the contrast and brightness controls at higher levels without blooming.

The diode conducts on excessive white peaks of the video signal, thus effectively clamping the bias voltage at the control grid and preventing overconduction of the tube. The 4.5-mc trap in the cathode prevents a 920-kc beat interference between the 4.5-mc and 3.58-mc signals. This 920-kc beat will appear as a herringbone pattern on the screen.

The vertical - retrace - blanking pulse is appled to the video signal in the same way as in the three-stage circuit. The video signal and blanking pulse are applied to all three CRT cathodes. W12, W13, and W14 show the cathode signals.

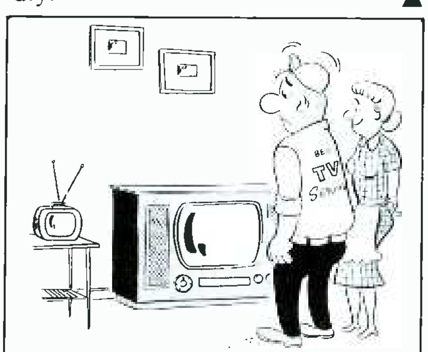
Worth Remembering

These few tips may save you valuable time when a two-stage luminance channel requires servicing:

1. Chroma signal pickoff precedes the first stage in the luminance channel.
2. Video to AGC and sync circuits is derived from a separate circuit (luminance channel does not affect these signals).
3. The 4.5-mc trap is located in the cathode circuit of the video-output stage.
4. The signal from video-output plate is DC coupled to CRT cathodes; altering plate voltage on output stage changes brightness.

Summary

Regardless of whether the luminance channel has a two- or three-stage circuit, defects in these stages may cause trouble during a color program as well as during a monochrome transmission. A general knowledge of the function of this portion of a color receiver (and normal scope-and-meter servicing procedures) can help you isolate the defective component more rapidly. ▲



Guess which set has to be brought down to the shop for repairs.

Color-Bar Generator

(Continued from Page 35)

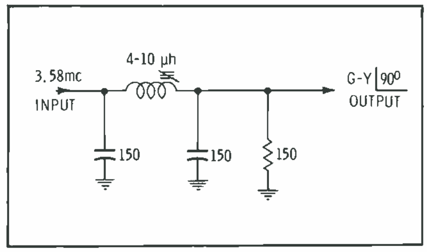


Fig. 19. A G-Y/90° chroma delay line.

color-phasing control to null the R-Y bar as seen in Fig. 20A. Then, transfer the low-cap probe to the output of the R-Y demodulator. The B-Y bar should be at a null (without touching the receiver controls) as shown in Fig. 20B. If the B-Y bar is not nulled, you must adjust the subcarrier phases in the receiver until it is. Refer to the receiver service data for instructions.

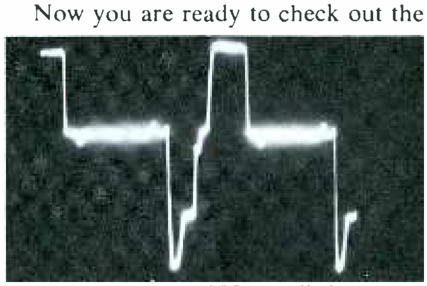
After exact nulls are obtained from the R-Y and B-Y demodulators, you are ready to check the phase of the G-Y/90° signal. Connect the scope and low-cap probe at the output of the G-Y matrix (or amplifier). Apply a modulated G-Y/90° RF signal to the receiver. Without touching the receiver controls, a null pattern should appear on the scope screen. If a null is not obtained, adjust the slug in the 4-10 μh coil (Fig. 19) as required to obtain an exact null. The G-Y/90° signal phase will now be correct, barring defects in the receiver's G-Y matrix. Unfortunately, without a G-Y signal available, the G-Y matrix must be taken on faith. If you get good G-Y/90° nulls on two different color-TV receivers, the chances are very good that there are no G-Y matrix defects.

Checking Multiple Color-Bar Phases

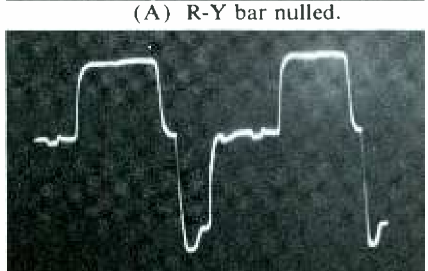
Now you are ready to check out the color-bar delay line (see Fig. 15). A typical multiple color-bar video signal is illustrated in Fig. 21. The sequence of colors in this example is: green, yellow, red, magenta, white, cyan, and blue. Connect the scope and low-cap probe to the output of the R-Y demodulator in the receiver. Apply the modulated-RF color-bar signal to the receiver. As you rock the receiver's color-phasing control back and forth, you will see a pattern such as shown in Fig. 22. All the "square waves" change in height except the white bar, which remains fixed at a zero reference level.

Since yellow is the complement of blue, these two chroma phases are normally 180° apart. This simply means that the yellow and blue bars should null simultaneously. This is the condition shown in Fig. 22. The yellow and blue bars both appear lined up with the white zero-reference level. Note that this situation corresponds to equal heights of the red and magenta "square waves" which appear as a wide "square wave." If you can null the yellow and blue components simultaneously, the delay line (Fig. 23) is given a clean bill of health. Any component defect between the red and green takeoff points will show up as a null that is not simultaneous.

You can make a cross-check, if you wish, by connecting the scope and low-cap probe to the output of the B-Y demodulator. Since green is the complement of magenta, their chroma phases are normally 180° apart. This means that the green and magenta bars should null simultaneously, as seen in Fig. 24. If an unsatisfactory null is observed, the components in the delay line (Fig. 23) must be checked systematically. Although it would be convenient to make a waveform analysis to localize the defective component in the delay line, this is not practical with service-type scopes.



(A) R-Y bar nulled.



(B) B-Y bar nulled.

Fig. 20. Receiver adjustment check.

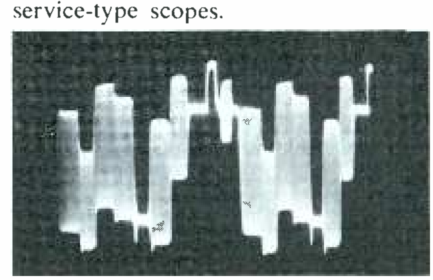


Fig. 21. Multiple color-bar signal.

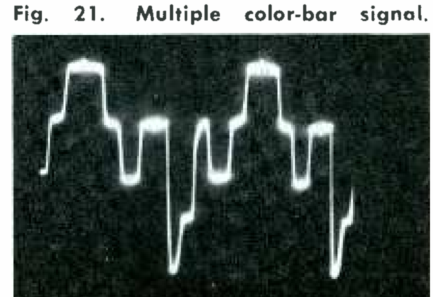


Fig. 22. Yellow, blue bars nulled.

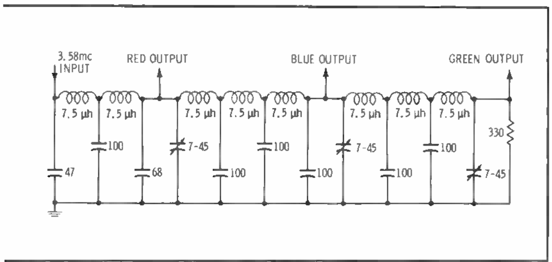


Fig. 23. A typical RGB delay line.

Rainbow Generator Phases

It is comparatively easy to check the chroma phases in a rainbow generator of either the keyed or unkeyed variety. All phases will be correct when the generator is operating at its correct frequency (3.563795 mc). The chroma phases will still be essentially correct, even if the generator operates slightly off frequency. On the other hand, when the generator is so far off frequency that the receiver operates in the vicinity of color-sync loss, all the rainbow hues are shifted appreciably to the left or the right of their normal positions in the keyed pattern. This defect can mislead the technician into misadjusting the receiver's chroma circuits.

Hence, an accurate check of the rainbow generator's oscillator frequency is desirable. This can be done easily by using a color-TV program as a reference. Tune in the color program and disable the receiver's color-AFC circuit; the colors will "run" in the picture. Carefully adjust the receiver's color-subcarrier oscillator to free-wheel the hues into correct picture positions. The subcarrier oscillator is then operating very close to 3.579545 mc. Disconnect the antenna lead-in and connect the output cable of the rainbow generator to the receiver. Then, carefully adjust the rainbow oscillator in the generator to free-wheel the rainbow hues into correct pattern positions. The rainbow oscillator is then operating very close to 3.563795 mc. Finally, reactivate the receiver's color-AFC circuit. Both generator and receiver will be in good frequency adjustment, because color-TV stations hold the subcarrier frequency to very tight tolerance. ▲

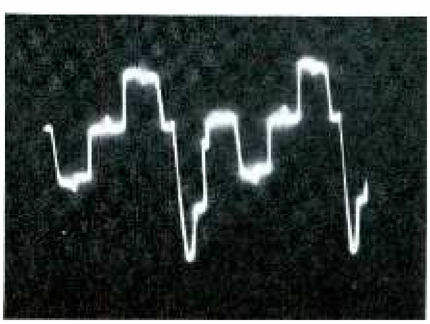


Fig. 24. Green, magneta bars nulled.

Chroma Alignment

(Continued from page 39)

3. Adjust oscillator transformer A3 for maximum indication on the meter. (If no reading can be obtained, the oscillator is not functioning; try adjusting A2 to start the oscillator and then adjust A3 for a maximum negative indication.) A reading of approximately —50 volts should be obtained. If the meter dips slightly before it reaches maximum, reduce the generator output and readjust A3.
4. Leave the VTVM connected and remove the clip lead from the grid of the burst amplifier.
5. Adjust burst transformer A1 for a maximum indication on the meter. If adjusting this transformer has no effect on the meter reading, it indicates that the burst signals are not being fed to the phase detector. Localizing the trouble is rather simple; if color is present on the screen, the trouble must be somewhere between the grid of the burst amplifier and the phase detector. The fault may also be caused by a defective coupling capacitor (C2) at the grid of the burst amplifier.
6. Reactance coil A2 should be aligned for a *zero beat,* as previously described, using the color-bar pattern as a guide.

If trouble is encountered when aligning A2, the symptoms on the screen will help determine which stage is defective. For example, when the jumper is removed from TP1, the color bars should be in proper sync; if they are not, trouble in either the reactance tube or phase detector is indicated. A large change in the phase of the color bars, when the jumper is removed, denotes trouble in the phase-detector circuits. No change, when the jumper is removed, points to the reactance-tube circuits. The remaining check on the operation of these circuits is for correct demodulator phasing. Proper phase of the demodulator output (R-Y, B-Y, and G-Y) can be confirmed by viewing the screen with one of the CRT grids fed separately while the other two are disabled. Here's the procedure:

1. With the color pattern on the screen, ground the blue and green CRT grids through individual 100K resistors. A correct presentation of the R-Y signal under these conditions is shown in Fig. 3. The sixth color bar (zero) should be of the same brilliance as the background (the space between the bars). This condition should be obtained at the approximate center setting of the tint control. It may be necessary to retouch burst transformer A1 for a proper presentation. The tint control should have enough range to shift the pattern 30° in either direction. To check this, see if the fifth and seventh bars can also be matched to the background, using the control.
2. Remove the 100K resistor from the blue grid and connect it to the red CRT grid; this allows the normal signal to reach the blue grid. The pattern shown in Fig. 4 should be obtained. The third and ninth bars should have the same brightness as the space between the bars. This presentation indicates the correct phase of the demodulated B-Y signal.
3. Remove the 100K resistor from

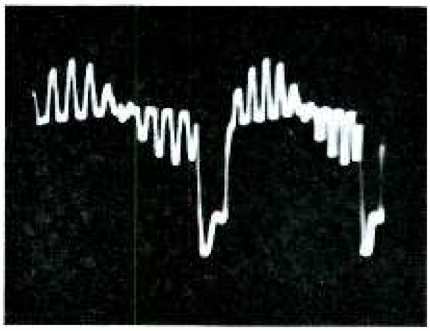


Fig. 6. R-Y signal, third bar maximum.

the green grid and connect it to the red grid; this allows the normal signal to reach the green grid. A correct bar pattern for the G-Y signal is illustrated in Fig. 5; the seventh color bar should match the background. Remove both the 100K shunt resistors, and the normal color-bar pattern of Fig. 2 should be seen on the screen.

This concludes the procedure for a complete home alignment. Now, let's view the same alignment procedure when performed in the shop with the aid of an oscilloscope.

Bench Procedures

Color-sync or demodulator-phasing alignment may be required quite often in the shop, especially if repair work has been performed on that section of the receiver. A check for correct operation of these circuits should always be made before the set is returned to the customer.

A performance check or touch-up alignment of the oscillator and control circuits in the shop is identical to that made in the home. However, a more complete and precise alignment can be performed on the service bench with an oscilloscope.

The burst transformer, reactance coil, and oscillator transformer should be adjusted using the VTVM and color-bar pattern as described previously. The same steps should be followed as for the complete home alignment, except that the oscilloscope is used to check the CRT color grids for the final setting of the burst transformer. The procedure for alignment follows:

1. Connect the vertical input of the oscilloscope (use a low-capacitance probe) to the red CRT control grid; common lead of the scope goes to ground. Adjust the scope for two stationary cycles of the waveform (7875 cps).
2. Adjust burst transformer A1 until the pattern shown in Fig. 6

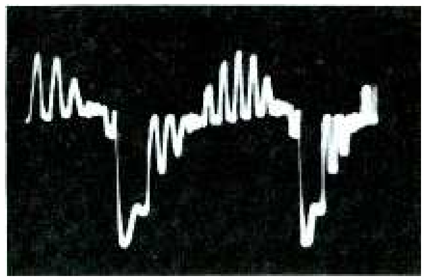


Fig. 7. B-Y signal, sixth bar maximum.

is obtained. The sixth bar should be at zero reference; the third bar (R-Y) should reach its maximum amplitude at this setting.

3. Move the vertical input of the scope to the blue CRT control grid. As illustrated in Fig. 7, the third and ninth bars should correspond to the zero reference, with the sixth bar at maximum amplitude. If these bars do not appear in the proper amplitude relationships, trouble is indicated in the oscillator's phase-shifting network or the color-difference amplifier stages.
4. Connect the scope to the green CRT control grid. The overall amplitude of this signal will be lower than that obtained at the red and blue grids; therefore, the waveform illustrated in Fig. 8 was taken at a higher vertical gain scope setting. The first and seventh bars should correspond to zero reference, with the tenth bar indicating a maximum positive amplitude. Remember, all of the above checks should be made with the tint control at the center of its range.

Conclusion

Troubles in the burst-amplifier and color-sync circuits have varying effects on the color picture. A quick check on the operation of these circuits can aid greatly in determining the origin of the defect and save valuable time by concentrating your troubleshooting effort on the stage at fault. Also, a few minutes spent making sure that the proper hues are being represented on the screen can increase customer confidence in your servicing ability and gain additional color business for your shop.

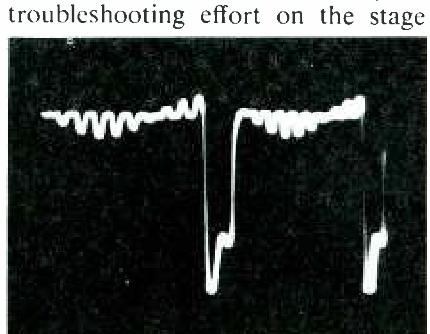


Fig. 8. G-Y signal, tenth bar maximum.

Repair Powdered Iron Cores

Have you transistor-radio technicians ever been plagued with a broken ferrite antenna core which couldn't be conveniently repaired or replaced? A bottle of GC Electronics No. 38-2 Magnetic Cement can solve this problem for you.

The repair of all types of powdered-iron cores is easy: Apply the cement generously to both surfaces and to the outside of the areas to be joined; then, press the pieces of the broken core firmly together and hold them for one minute, so the substance can partially harden. Let the repaired core dry from 4 to 8 hours, and performance will be equal to that of a new part.

We tested this cement with a new ferrite-rod antenna of the type found in regular AM radios. First, we made inductance and Q measurements of the unit. Next, we purposely broke the rod in half. After following the directions given on the bottle and repairing the broken core (see photo), we repeated the measurements. Since the readings were essentially the same as those obtained before the test, we concluded that the cement did not alter the tuned-circuit characteristics of the antenna. The rigidity of the repaired joint was completely satisfactory.

This cement comes in a 2-oz. bottle with its own applicator. The substance is dangerous if placed in the mouth, and the fumes should be avoided. These and a few other storing precautions appear on the label. ▲

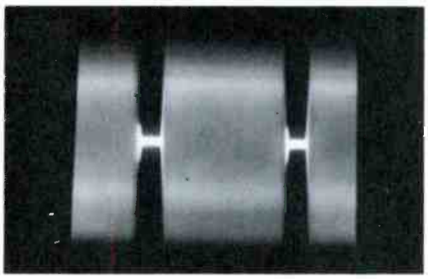
For further information, circle 81 on literature card

Tracing Color Signals

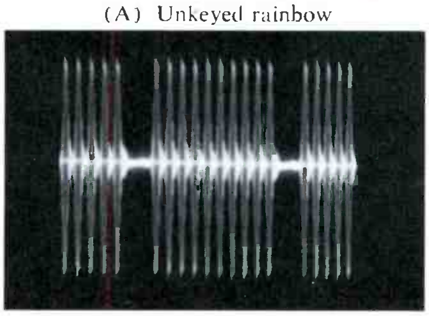
(Continued from page 37)

put terminals of the scope. Adjust the receiver and scope controls for a typical pattern, as shown in Fig. 7.

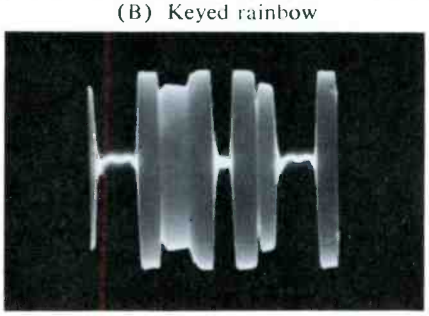
Lack of signal output is usually due to a defective component, provided good tubes are in use. Weak and/or distorted signal output can be caused by misalignment of the bandpass circuitry, or by a circuit defect such as an open capacitor. Alignment is checked last, unless you have reason to suspect that the adjustments may have been tampered with. In any case, do not guess at the proper waveshape and peak-to-peak voltage—consult the receiver service data.



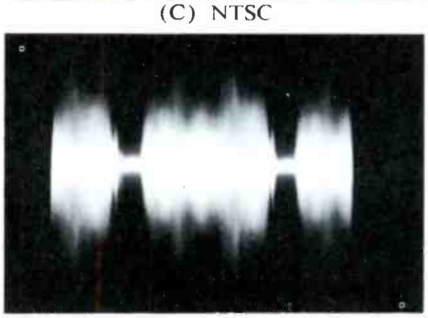
(A) Unkeyed rainbow



(B) Keyed rainbow



(C) NTSC



(D) Station signal

Fig. 7. Normal band-amplifier output waveforms with various input signals.

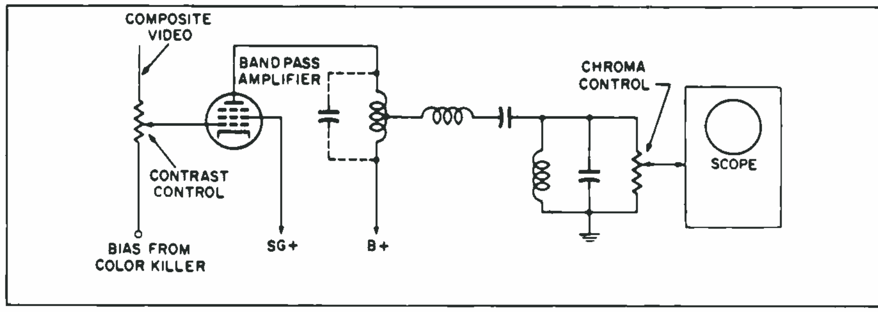


Fig. 8. Check point in bandpass amplifier stage.

Chroma Demodulator Output

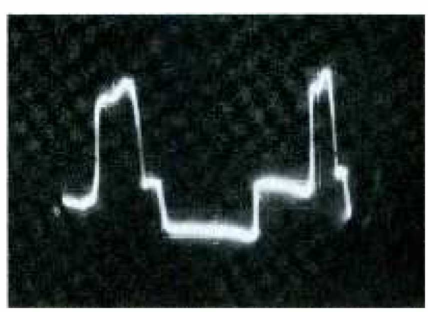
Color generator (antenna signal can be used), low-capacitance probe, and scope are the instruments. Apply an RF color signal to the receiver. Connect the scope via the low-capacitance probe to the output of the chroma demodulator. Adjust the receiver controls for as near normal operation as possible. Observe the pattern (if any) on scope screen.

Absence of a pattern indicates a dead circuit. A weak signal output points to a defective circuit (check the peak-to-peak voltage against the value specified in the receiver service data). The waveform observed depends upon the type of RF color signal applied to the receiver (see Fig. 9). Finally, remember that a dead circuit also can result from misadjustment of the color-killer threshold control, which merely biases off most of the chroma circuitry. Sometimes you will find a defect in the killer section making normal bias adjustment impossible.

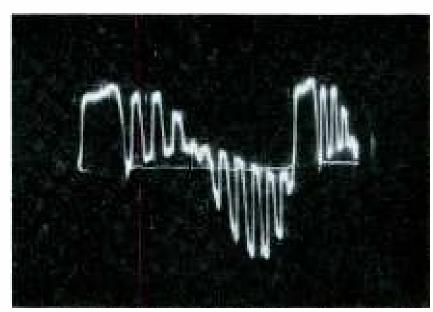
Signal From Burst Amplifier

Use a color generator (color-broadcast signal can be used), wide-band scope, and low-cap probe. Apply a modulated-RF color signal to the antenna terminals of the receiver. Connect the scope through the low-cap probe to the output of the burst amplifier. Adjust the receiver controls for as near normal reception as possible.

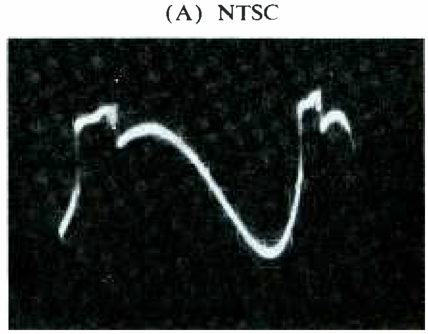
A clean burst display should be obtained, as in Fig. 10. The pattern will be the same whether a color-broadcast signal or some type of color generator is used. However, a weak station signal may result in a waveform that has a ragged outline, due to noticeable noise voltage. If no pattern is obtained, troubleshoot the associated chroma circuitry for a defective component. A weak signal output can be caused either by a defective part or by misalignment of the burst-takeoff transformer. Note that the burst-amplifier section normally is always operative, regardless of color-killer action.



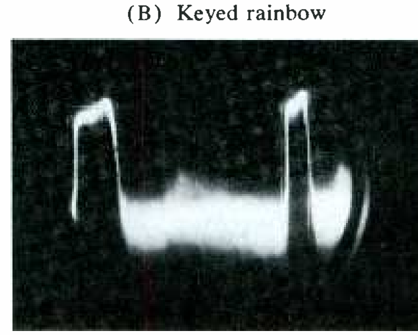
(A) NTSC



(B) Keyed rainbow



(C) Unkeyed rainbow



(D) Station signal

Fig. 9. Waveforms taken through low-cap probe at chroma demodulator.

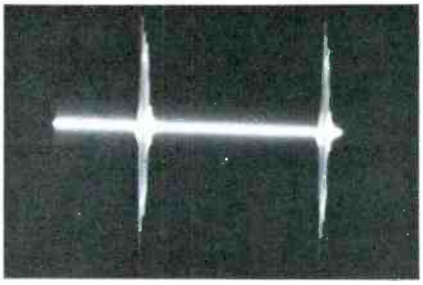
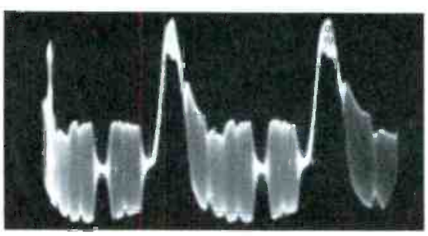


Fig. 10. A burst-amplifier waveform.

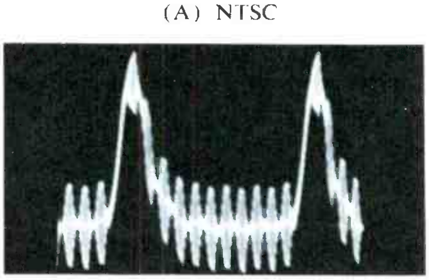
Drive Signal to Burst Amplifier

This requires a color generator (color-broadcast signal can be used), wideband scope, and low-cap probe. Apply the modulated-RF color signal to the receiver antenna terminals. Connect the scope via the low-cap probe to the grid of the burst-amplifier tube. Adjust the receiver controls for normal operation and observe the waveform on the scope screen.

The drive signal consists of a gating pulse (supplied by the flyback section) combined with the chroma component of the video-amplifier signal. The photo in Fig. 11 illustrates a normal waveform. In case the chroma signal is present but the gating pulse is absent, check the circuit branch from the grid to the flyback. On the other hand, if the gating pulse is present but the chroma signal absent, an open grid-coupling capacitor would be the first suspect. Note that either type of defect will "kill" the signal output in the plate circuit. A fault in the gating circuit sometimes weakens and distorts the pulse without killing the signal passage completely; check the waveform and peak-to-peak voltage of



(A) NTSC



(B) Keyed rainbow

Fig. 11. Normal input waveform for the burst amplifier, using either signal.

the drive signal against the receiver service data.

Chroma Matrix Output

A color generator (color-broadcast signal can be used), wideband scope, and low-cap probe are necessary. Apply a modulated-RF signal to the input terminals of the receiver. Connect the scope via the probe to an output terminal of the matrix, as shown in Fig. 12. Adjust the receiver controls for as near normal operation as possible. Observe the scope pattern.

The normal output from a G-Y matrix should appear similar to the one shown in Fig. 13. In case there is little or no output signal, even though the R-Y and B-Y amplifiers are operating, look for a defective grid-circuit component in the matrix. For example, if C is open, the matrix output will be very weak and distorted. This defect cannot be found by DC voltage and resistance measurements, but a scope test will show that the grid of the matrix tube is not at AC ground potential. Beginners sometimes ask why C is returned to B+ instead of to chassis ground. The reason is that there is a ripple voltage on the B+ line; since the R-Y and B-Y amplifiers are driven from the chroma demodulators, the two amplifiers "see" a residual ripple voltage. This ripple is equalized and compensated at the matrix tube by returning C to the B+ line through a series resistor.

Input to Chroma Phase Detector

Use a color generator (or color signal from antenna), wideband scope, and low-cap probe. Apply a modulated-RF color signal to the antenna terminals of the receiver. Connect the scope via the low-cap probe to first one of the phase-detector input terminals and then to the other (Fig. 14). Adjust the receiver controls for best operation and observe the scope pattern.

A typical waveform is shown in Fig. 15. The most important component is the burst signal — if absent, signal-trace back through the chroma circuits to find out where it is being "killed." The waveform amplitude is important—check against the receiver service data. You should also find equal amplitudes at each of the phase-detector inputs; if you do not, look for a defect in the driving circuit, such as faulty capacitors or a defective coupling transformer.

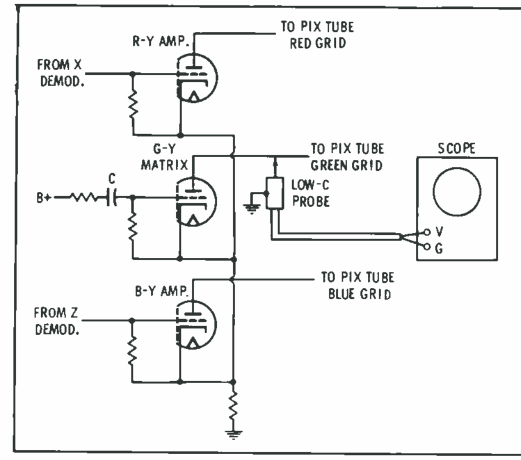


Fig. 12. Test setup for matrix check.

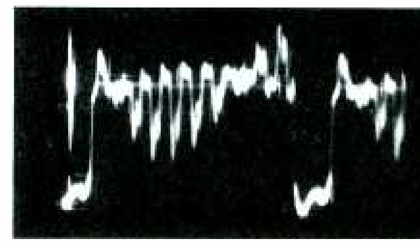


Fig. 13. Output of the chroma matrix.

Conclusion

We have described the major test points in the chroma section of a color receiver, listed the instruments needed to trace signals, and shown the signal waveforms to be expected at each point. If the waveforms found at these points don't agree with the expected signals, you'll have to troubleshoot the circuits involved. By using signal-tracing procedures, however, you've isolated the problem to a very small section of the seemingly complex color circuitry. ▲

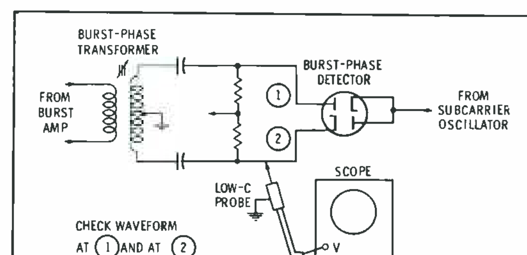


Fig. 14. Chrome phase detector setup.

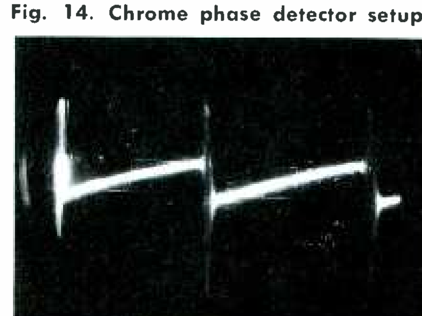
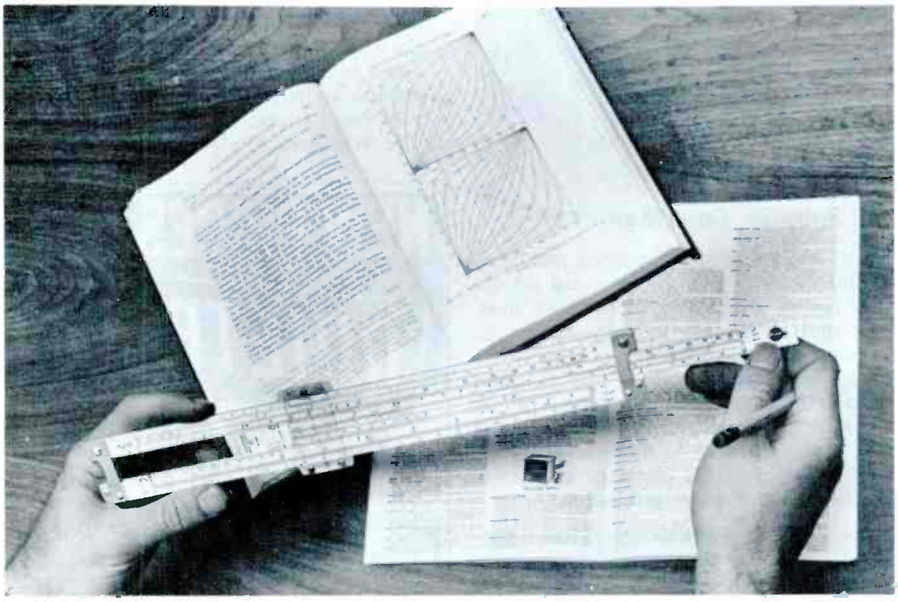
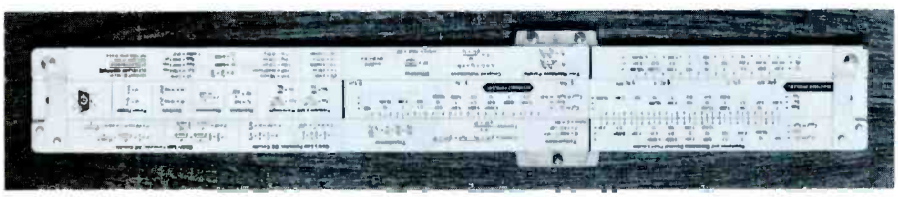


Fig. 15. Waveform from phase detector.

Product Report

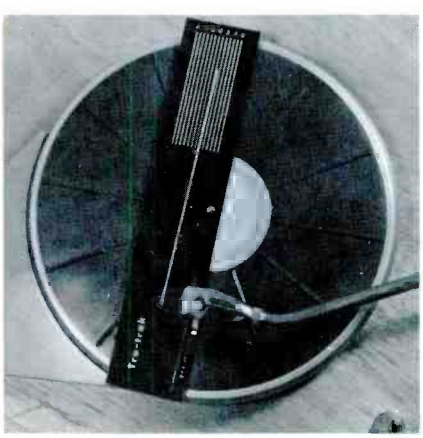
For further information on any of the following items, circle the associated number on the Catalog & Literature Card.





Mathematics Simplified (149)

A slide rule for electronics engineers and technicians is now being marketed by **Cleveland Institute of Electronics.** The instrument is extremely accurate and quickly finds correct solutions to many problems in electronics, including those in reactance and resonant frequency, with its easily read scales. The slide rule comes in a protective leather case and includes a 123-page instruction manual that gives users a complete course of instruction for using the rule.



Check Tone Arm Tracking (150)

A device that shows visually the amount of tracking error in record players and positions the tone arm for optimum performance is **Alard Products'** "Tru-Trak." As the tone arm is moved across the turntable, the pointer indicates the tracking variations. The proper mounting position of the tone arm is the one that produces the minimum amount of movement on the scale. The instrument fits any standard cartridge mount and is priced at $6.95.

Portable Color Generator (151)

In-home or shop setup and servicing of color-TV receivers is possible with the **B & K** Model 1240 portable color generator. It provides a crystal-controlled keyed rainbow color display on the TV screen to align demodulators, test color sync circuits, and check the range of the hue control. Dot pattern, crosshatch, vertical lines, and horizontal lines are obtained from a crystal-controlled counter circuit. Horizontal lines and dots are only one scanning line thick; dot brightness is adjustable by means of a control. RF output in excess of 5000 uv, on channel 3, 4, or 5, can be connected directly to the receiver antenna terminals. Net price is $134.95.

Two-Way Radio (152)

Two HF base stations (CSB-50-1) and three mobile unit configurations, both with 50-watt output, are available for operation in the 30- to 50-mc band. The basic base station is a compact desk-top unit with a transistorized dynamic microphone. An alternate, remote-control version of the base station has a separate control head and a 25-foot control cable. Mobile versions CSM-50-1 of **Hallicrafters** equipment operate on 12 volts DC and provide a number of installation options.

Watch and Listen (153)

Children may now have their own educational and entertainment center with **G-E's** "phono-viewer." This unit consists of a transistorized, four-speed phonograph and a slidefilm viewer with 11″ screen. Operated together, they tell a complete story with full-color pictures changing automatically in time with the sound. Operation is very simple; put the record on the turntable, place the tone arm on the record, insert the show film, and turn the switch. Retail price of the phono-viewer is $29.95; picturesound programs are $.99 each.

Electrical Tape (154)

An electrical tape (No. 104), for outside cold-weather applications or warm-weather and indoor use, is being marketed by the distributor division of **International Resistance Co.** The tape provides protection against acids, salt water, sunlight, and many oils and other organic solvents. A dielectric strength of 10,000 volts and insulation resistance of more than 100,000 megohms are additional features.

Snap-in Cartridge (155)

Easy installation and increased standardization of inventory are provided by the new **Jensen** "Dynalever" series cartridges. The unit is suitable for console-type or portable phonographs using either high- or low-mass tone arms. A standardized snap-in bracket, with or without retractor springs, is available in the new series. The bracket fastens to the tone arm with two screws, and the cartridge snaps into the bracket for easy installation.

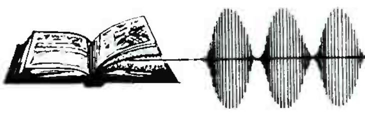
Auto-Radio Reverberation (156)

The listening pleasure of stereo-like sound can be added to any car radio with the Stereo-Verb Model 445. The **Gibbs Special Products** reverberation sound system may be mounted away from the radio (in the trunk or on the firewall), making it suitable for use in compact or sport cars. This unit comes complete with 6" x 9" rear speaker and grille, mounting hardware, fader control, and interconnecting cables. Retail price of the complete unit is $39.95.

Clearer FM (157)

The "FM Supercharger" makes possible the reception of more FM stations, cuts down background noise, and improves reception on stereo and monaural units in suburban, fringe, and deep-fringe areas. The **Winegard** Model FM-318 is a com-

BOOK REVIEW



Color TV Troubleshooting Pict-O-Guide

Prepared under the direction of John R. Meagher; RCA Institutes, Inc.; Harrison, New Jersey; 153 pages; RCA tube premium offer.

With color television making its strongest bid yet in all phases of the industry, the service technician must achieve a good understanding of the requirements for color servicing in order to compete successfully and increase his profits. This book, prepared by a well-known authority on servicing techniques and procedures, is an excellent source of information on color television concepts and services.

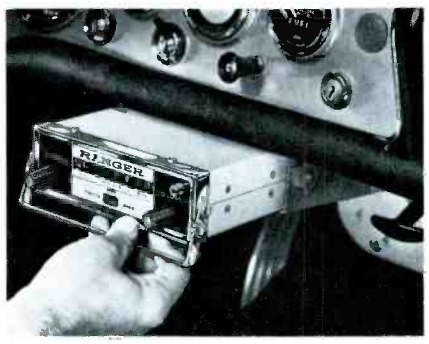
The first 2 or 12 sections in this book present a basic explanation of color-mixing theory, and a comprehensive discussion of the compatible color television system used in American telecasting. All facets of the system, from the color camera to the color CRT in the receiver, are described fully. Each color circuit is examined in block form, and its effect on the composite color signal is analyzed and defined.

Section 3 gives detailed steps for receiver setup adjustment and explains why each element in the convergence, deflection, and purity group has the effect it has on the electron beams that generate the color picture. Shadowmasking techniques, magnetic field effects, static and dynamic convergence and black-and-white setup are broken into easily understood operational steps. Section 4 defines the effect of the receiver's operating (hue, tint, brightness, etc.) controls.

The remaining 7 sections offer a wealth of information on the use of test equipment and techniques, how to analyze troubles (in both color and black-and-white circuits), and AFPC checks and adjustments. Suggestions are also given to determine when a tricolor CRT must be replaced. Section 11, on servicing techniques, describes troubleshooting in the home, time-saving hints, chassis removal, shop setups, use of test jigs, and other information often overlooked in other texts. The final section (on alignment) is equally comprehensive.

Although concerned only with RCA receivers and chassis, this book will be valuable to any service technician who works with color sets and their accessory equipment.

pact amplifier for the FM broadcast band; it has a maximum signal output of 360 mv, a minimum gain of 17 db: input and output impedance is 300 ohms. The unit operates from 117 volts AC and has a list price of $17.95.



Portable Auto Radio (158)

This all-transistor radio may be operated in an automobile from the normal 12-volt storage battery, or it can be used outside the auto as a normal portable using four penlite batteries. When used in the car, the **Tenna Corp.** Playmate locks in a theft-proof case that unlocks with a special key. The radio is gold with black and gold dial glass trimmings and measures 2″ x 5″ x 6½″.

Thorough Tube Test (159)

This portable industrial and laboratory tube tester has a complete range of test potentials that permits setting test conditions directly from a tube handbook without reference to the roll chart. The **Hickok** Model 580 features a completely solid-state design and a gas-test circuit that permits measurement of gas effects down to .05 ua. Plate, grid, and cathode jacks permit access to these elements under test conditions. Other features include umho ranges to 60,000 umhos and direct reading of leakage on the illuminated meter.

Solid-State Components (160)

A new line of replacement transistors and silicon rectifiers which will cover approximately 95% of all replacement needs consists of 9 transistors, 12 silicon-rectifiers, 4 silicon diodes, and 3 dual-diode types. Also included in the **I.E.H.** line are epoxy molded silicon rectifiers in standard or miniature sizes. A cross-reference catalog is available.

Weatherproof Speakers (161)

These weatherproof paging and talkback speakers incorporate features intended to assure high efficiency and penetration in areas of high ambient noise level. The close-coupled inner horn and diaphragm eliminate phasing plugs and insure impedance match to the exponentially flared outer bell. These **Oxford Tranducer Corp.** units feature heavy Alnico-V center-pole magnets and a heat sink to enhance the handling of high power. Both the OP-6 and OP-8 are molded from a durable material that is highly resistant to weather, salt water, oil, acids, and temperature extremes. They are available without transformers or with built-in 25- or 70-volt constant-voltage transformers having 45-ohm taps. With either option, standard transformer-mounting brackets are provided within the rear enclosure.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Act of October 23, 1962; Section 4369, Title 39, United States Code)

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9. Paragraphs 7 and 8 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. Names and addresses of individuals who are stockholders of a corporation which itself is a stockholder or holder of bonds, mortgages or other securities of the publishing corporation have been included in paragraphs 7 and 8 when the interests of such individuals are equivalent to 1 percent or more of the total amount of the stock or securities of the publishing corporation.

10. This Item Must Be Completed for All Publications Except Those Which Do Not Carry Advertising Other Than the Publisher's Own and Which Are Named in Sections 132.231, 132.232, and 132.233, Postal Manual (Sections 4355a, 4355b, and 4356 of Title 39, United States Code)

	Average No. Copies Each Issue During Preceding 12 Months	Single Issue Nearest to Filing Date
A. Total No. Copies Printed (Net Press Run)	89,503	86,211
B. Paid Circulation		
1. To term subscribers by mail, carrier delivery or by other means.	67,731	65,593
2. Sales through agents, news dealers, or otherwise.	15,033	14,603
C. Free Distribution (including samples) by Mail, Carrier Delivery, or by Other Means.	4,328	3,869
D. Total No. of Copies Distributed (Sum of lines B1, B2 and C)	87,092	84,065

I certify that the statements made by me above are correct and complete.

(Signaure of editor, publisher, business manager, or owner)
FOREST H. BELT, Editor

UHF Converter (162)

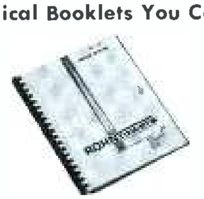
A new series of UHF converters, covering channels 14 to 83, has solid-state circuits that assure lower operating temperatures than those of tube types. The frequency stability and signal-to-noise ratio of the transistors used are appreciably higher than those of tubes. Frequency drift is less than 250 kc/second; once tuned to a specific frequency, the **JFD Electronics Corp.** converter remains on channel and needs no retuning. Two models are available—CR1-J for local and suburban use and CR2-J for fringe areas.

Automatic Selective Signaling (163)

"Uti-Call" is a fully automatic tone-signal device which can be used on most Citizens-band and Business Radio equipment. When the microphone is removed from the clip, the receiver is activated and the station automatically monitors the frequency. The unit remains on standby while the microphone is in its clip. Keying the microphone generates a tone used to activate the receiver of the station called. **Utica Communications Corp.** also offers a similar mobile unit which will actuate the horn in a vehicle. The latter unit is priced at $62.50, the former at $59.95.

New Literature

Technical Booklets You Can Buy



Broadcast and Communication Towers (164)

Rohn Manufacturing Co. offers a complete catalog that gives a comprehensive listing of broadcast and communications towers built by them. More than a simple catalog, the book also contains a wealth of technical information on self-supported and guyed towers of all types. Guying methods, lightning protection, wind-loading effects, ice removal, and lighting methods are among the topics covered. Complete price schedules for standard towers and accessories are included. The catalog is available from **Rohn Manufacturing Co., Peoria, Illinois,** and is priced at $1.25. ▲

FREE Catalog and Literature Service

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

Please allow 60 to 90 days for delivery.

ANTENNAS & ACCESSORIES

83. *ALLIANCE* — Colorful 4-page brochure describing in detail all features of the famous *Tenna-Rotors*.*
84. *ANTENNACRAFT* — Latest information on FM antennas, featuring new omnidirectional model for multiplex or monophonic broadcasts.*
85. *FINNEY* — Catalog No. 20-307 listing four newly announced multielement, single-boom, VHF-FM antennas.*
86. *JERROLD*—Colorful brochure describing new type of UHF antennas. Paracyl antennas are designed for large vertical capture area and minimum number of connection points.
87. *JFD*—Literature on complete line of VHF, UHF, FM, and FM- stereo antennas. Brochure showing converters, amplifiers, and accessories; also complete 64-65 dealer catalog.*
88. *MOSLEY ELECTRONICS* — Illustrated catalog giving specifications and features on large line of antennas for Citizens band, amateur, and TV applications.*
89. *STANDARD KOLLSMAN*—Catalog sheet on UTC-051 transistor UHF converter kit with IF amplifier.
90. *TRIO*—Brochure on installation and materials for improving UHF translator reception.*
91. *WINEGARD* — "Factfinders" describes channel coupler that couples, equalizes, and matches any number of yagis to single downlead; also information on twin-transistor antenna pre-amp.*
92. *ZENITH*—Informative bulletins on universal loudspeakers and a new line of log-periodic vee-type antennas for FM and monochrome or color TV.*

AUDIO & HI-FI

93. *ACTION* — Brochure titled "We make sound work for you" shows how sound fits into every type of business.
94. *ADMIRAL*—Parts and accessories catalog listing replacement components; also includes cross reference for phono needles and cartridges.*
95. *ATLAS SOUND*—New 1964 catalog No. 564 contains illustrations and specifications on PA speakers, microphone stands for commercial and industrial installations, and other new products.*
96. *CBS LABORATORIES*—Technical bulletin on a new series of professional test records.
97. *CLEVELAND ELECTRONICS* — Informative brochures covering custom manufactured transformers; Cletron auto reverberation kit and audio distribution speakers.
98. *ENTRON*—Catalog sheet on distribution amplifier (LHD-404R), designed to feed low and high VHF and FM into as many as four distribution lines.
99. *EUPHONICS* — Literature covering ceramic cartridges, communications microphones, and general purpose microphones.*
100. *GIBBS SPECIAL PRODUCTS*—Folders describing principles of sound reverberation and *Stereo-Verb* reverberation units for automobiles.
101. *NUTONE*—Two full-color booklets illustrating built-in stereo music systems and intercom-radio systems. Includes specifications, installation ideas, and prices.
102. *OAKTRON*—"The Blueprint to Better Sound" an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.*
103. *OXFORD TRANSDUCER* — Product information bulletin describing complete line of loudspeakers for all types of sound applications, including replacements for public address and intercom systems.*
104. *PERMA-POWER* — New catalog sheet describing Ampli-Vox Model S-300 and Sound Cruiser sound system Model S-310.
105. *QUAM-NICHOLS*—General catalog listing replacement speakers for public address, hi-fi, and radio-TV applications.*
106. *SAMPSON* — Full-color catalog pages showing new line of Waltham transistor radios, tape recorders, and portable televisions.
107. *SONOTONE* — New audio-products catalog SAH-76, containing photos and specifications on phono needles, cartridges, microphones, and speakers.*

COMMUNICATIONS

108. *AMECO*—New literature on 2 and 6 meter transmitter, and communications test equipment.
109. *LAFAYETTE*—Complete information on obtaining a dealership for new line of equipment.
110. *TURNER*—Brochure No. 1025 on new line of microphones for base-station and mobile use; includes list prices.

COMPONENTS

111. *BUSSMANN*—Bulletin SFB listing complete line of Buss and Fusetron small-dimension fuses by size and type; indicates proper fuse holders and gives list prices.
112. *CHANNEL MASTER*—Booklet containing information on *Contact Shield*, a silicone-base contact conditioner that cleans, lubricates, and protects.*
113. *COMPONENTS SPECIALIST*—Catalog listing line of *Speco* electronic replacement components.
114. *CORNELL - DUBILIER* — Replacement component selector, TV-FM reception booklet, and 4-page rotor brochure.*
115. *GC ELECTRONICS*—68-page industrial catalog FR-65-1 showing newly introduced products.*
116. *IEH*—Catalog listing television accessories including brightners, switches, service harnesses, and etc. Transistor interchangeability list; also cross-reference chart for auto-radio transistors.
117. *J-B-T-INSTRUMENTS*—General catalog 563A has information on frequency meters, elapsed-time meters, and numerous relays and switches.
118. *PARKER* — Information on insulators that keep the lead-in wire away from metal; specially for UHF and color.
119. *RCA BATTERIES*—Brochure 1P1162 illustrating various selections of counter display racks and promotional items for radio batteries.*
120. *SARKES TARZIAN* — Service bulletin 64-SB-6 gives quick cure for focus problems in color television receivers.*
121. *SPRAGUE*—Latest catalog C-616 with complete listing of all stock parts for TV and radio replacement use, as well as *Transfarad* and *Tel-Ohmike* capacitor analyzers.*
122. *STANCOR*—Color TV replacement guide shows cross-reference from manufacturers part No. to replacement item on all transformers.
123. *SWITCHCRAFT*—New product bulletin No. 145 describes a new stack switch kit of "Tini-Stack" switch components, for use in new switching arrangements and in-the-field switch repair.

SERVICE AIDS

124. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included.*
125. *PRECISION TUNER*—Literature supplying information on complete, low-cost repair and alignment services for any TV tuner.*
126. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight aluminum construction.*

SPECIAL EQUIPMENT

127. *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.*
128. *CBC INDUSTRIES*—Bulletin on constant torque motor speed control—suitable for shops and hobbyists.
129. *GREYHOUND* — The complete story of the speed, convenience and special service provided by the Greyhound Package Express method of shipping, with rates and routes.
130. *SLEP ELECTRONICS*—Colorful bulletin on transistorized ignition systems and coils for automobiles, trucks, buses, and industrial engines.
131. *TERADO*—Information on new line of voltage adjusters, includes specifications and list prices.*
132. *VOLKSWAGEN*—Large, 60-page illustrated booklet, "The Owner's Viewpoint," describes how various VW trucks can be used to save time and money in business enterprises, including complete specifications on line of trucks.
133. *WALLIN-KNIGHT*—Folder on Reflect-O-Scope, an effective tool for static convergence of color TV receivers.

TECHNICAL PUBLICATIONS

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

TEST EQUIPMENT

137. *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 *Dynamic* VTVM, Model 360*V-O-Matic VOM*, Models 700 and 600 *Dyno-Quik* Tube Testers, and Model 1070 *Dyna-Sweep* Circuit Analyzer.*
138. *EICO*—New 32-page, 1964 catalog of test instruments, hi-fi components, tape recorders, and Citizens band and amateur radio equipment.
139. *HICKOK*—Complete description and specification information on newly introduced Model 662 installer's color generator, portable FM multiplex generator, Model 235A VHF-UHF field strength meter, and Model 800 tube tester.*
140. *JACKSON*—Complete catalog describing all types of electronic test equipment for servicing and other applications.*
141. *MERCURY*—Complete catalog on line of test equipment to help the serviceman.*
142. *SECO*—New color folder describing complete line of test equipment, including color-bar generators, tube testers, and semiconductor testers.*
143. *SENCORE*—New color catalog on complete line of company products; oscilloscopes, generators, testers, and many others.*
144. *SIMPSON* — Complete 16-page brochure on entire line of electronic test equipment.*
145. *TRIPLETT*—All new test equipment catalog No. 46-T showing complete line of VOM's, tube testers, transistor analyzers, and signal generators.*

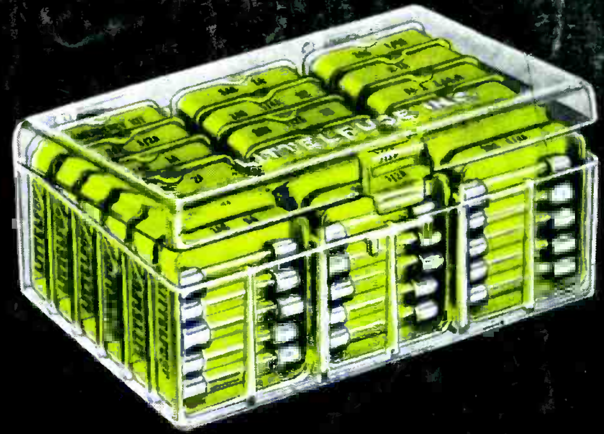
TOOLS

146. *ADEL*—Literature on "Nibbling Tool" that cuts, notches, and trims round or irregular holes to any size over 7/16"; ideal for radio chassis, templates, or shims.
147. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.

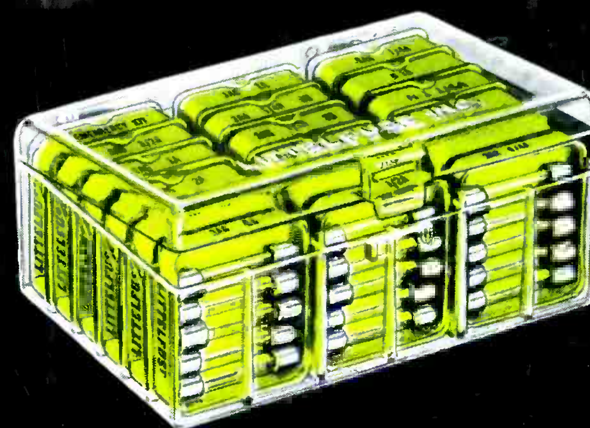
TUBES & SEMICONDUCTORS

148. *GENERAL ELECTRIC* — New pocket-folder wall chart with condensed, but comprehensive, listings of semiconductor rectifiers, zener diodes, controlled rectifiers, etc.*

See the caddy



See the fuse box through the caddy



See the fuses through the fuse box through the caddy

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