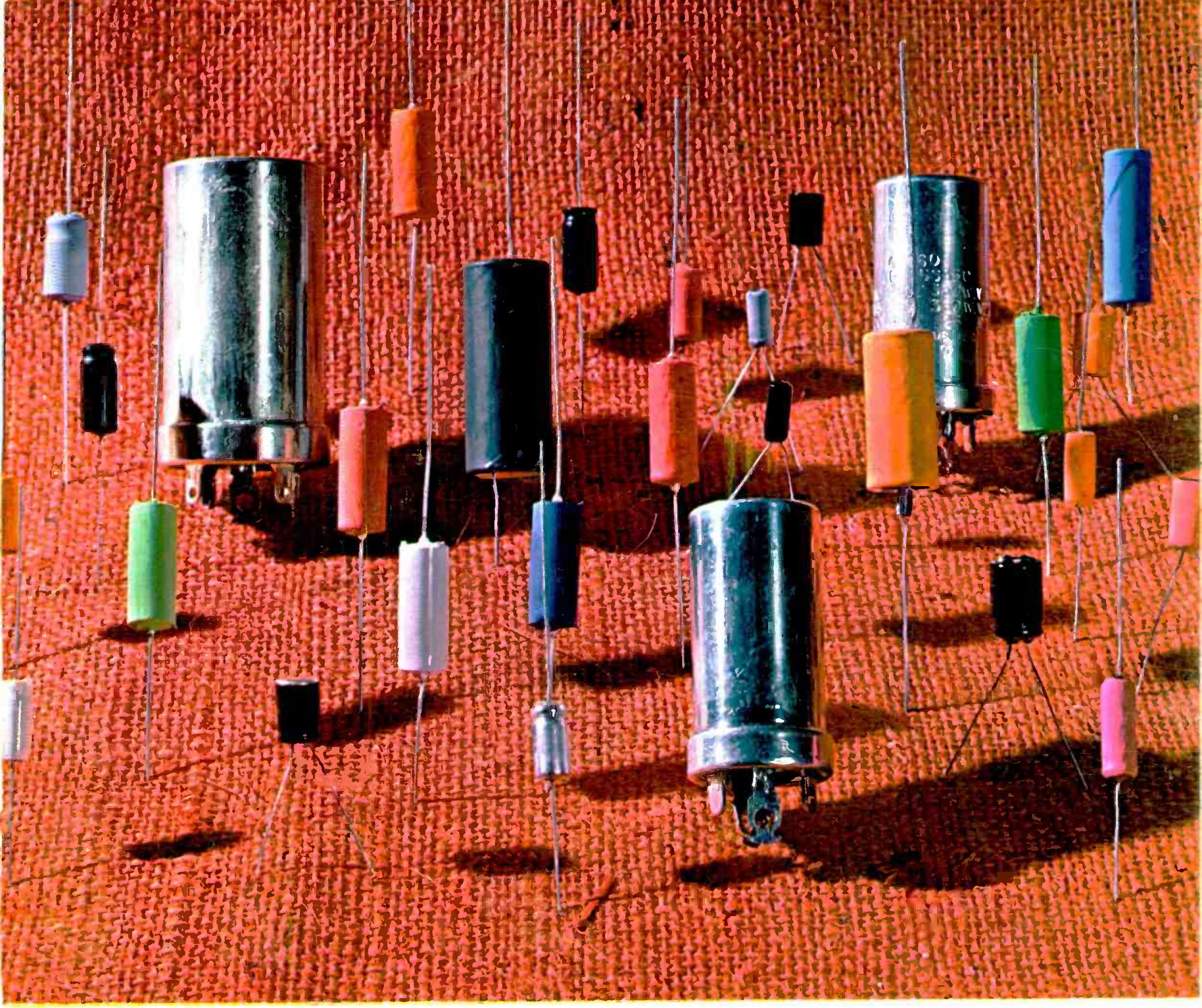
A HOWARD W. SAMS PUBLICATION

MAY 1967 75¢

PF Reporter®

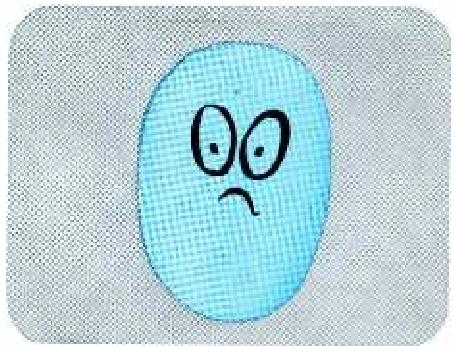
PHOTOFACT

the magazine of electronic servicing

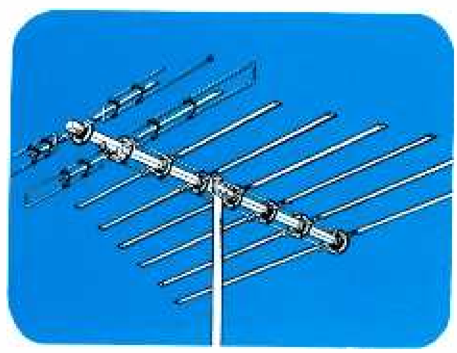


- Great Blobs of Color
- Electrolytic Capacitors in TV
- Electronic Organ Servicing
- Previews of New Sets
- Video Speed Servicing

Help stamp out blue people



Focus on Jerrold Paralog Plus™ Coloraxial Antennas for true color



Jerrold Paralog Plus Antennas show a definite improvement in the sharpness, fidelity and color stability of the image on any TV set. Sharp directivity, uniform response and perfect matching see to that! And the rugged construction insures that the quality stays high—not for months—but for years. It's the high-gain Coloraxial antenna for people who insist on VHF and FM reception—without compromise. And there are seven models to choose from.

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better reception

Circle 1 on literature card

PREVIEWS OF NEW SETS — Airline

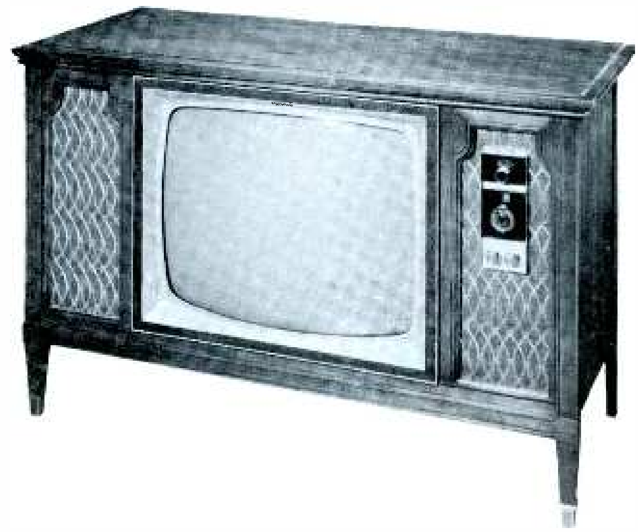
Shown here is the Airline 23" model using either a 25AP22A or 25GP22A rectangular picture tube. This is one of the family of models which also includes models GHJ7527B(B), GHJ7547B(B), and GHJ7557B(B). These sets feature the bonded faceplate picture tube; however, a series of similar models using the 25BP22A require a separate safety glass. These are assigned model numbers without the (B) suffix.

This chassis is similar to the earlier 12-150-135 chassis, but some changes have been incorporated. The power supply has been changed to incorporate a bridge rectifier instead of the voltage doubler used previously, a "fast warm-up" is included, and a "color-tracking" circuit has been added.

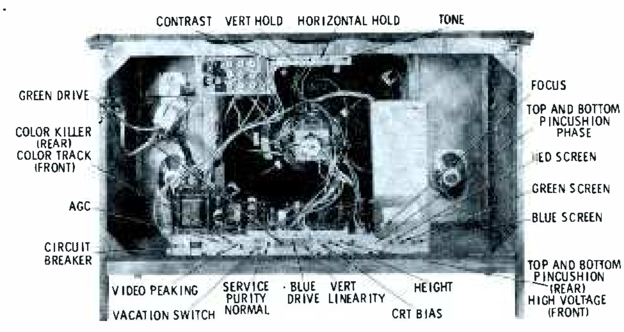
The fast warm-up has an over-riding "vacation switch" which allows all voltage to be removed if the set is not to be used for an extended period. When the vacation switch is closed, line voltage is applied across the entire primary winding of the power transformer and reduced voltage is supplied to the tube filaments. The On-Off switch has three sections which (1) shunt a section of the power transformer primary, (2) energize the pilot light, and (3) connect the rectifier to the power transformer.

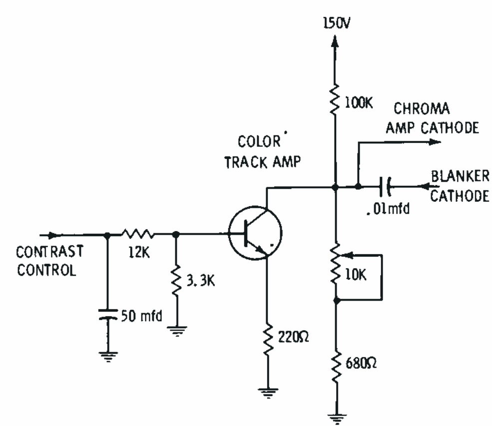
For ease in making purity adjustments, the Service-Normal switch has a third position labeled "purity". In this position, video is removed from the raster.

The contrast control located in the cathode circuit of the 3rd video amplifier also sets the base voltage of the transistor in the "color track" circuit. The cathode bias of the chroma bandpass amplifier is determined by the collector voltage of this transistor. Thus, chroma saturation "tracks" with the contrast control. The potentiometer labeled "color track" is a range control for this circuit.

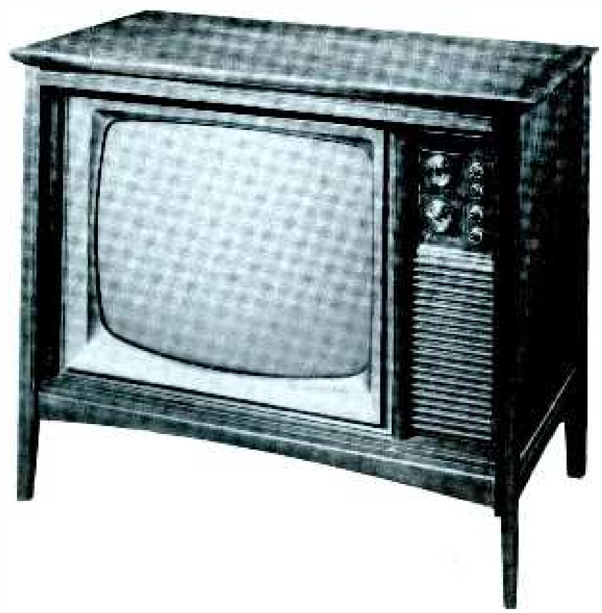


Model GHJ7537B Chassis 913-179466

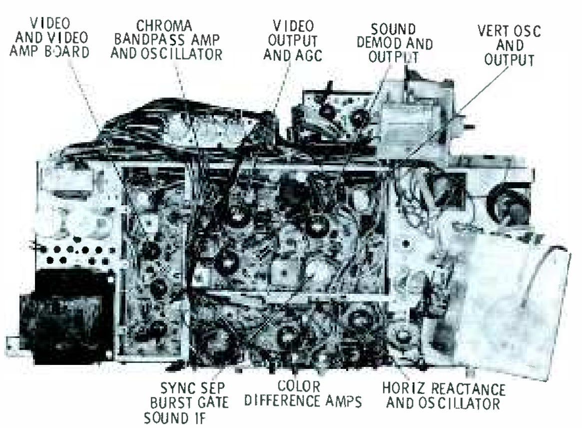


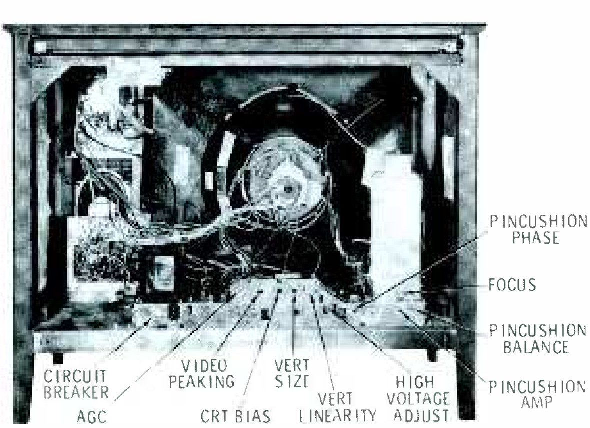


General Electric PREVIEWS OF NEW SETS



Model M980 CWD **Model M980 CWD**





The chassis used in the 23" color receiver shown here is basically similar to this manufacturer's CB chassis, introduced last year. Differences involve the tube complement, video amplifier, and pincushion circuits. Also, a tuning meter circuit has been added to the KC chassis.

Compactrons are used extensively in this chassis and include the following types: A 6BH11 double triode-pentode serving the horizontal reactance and oscillator circuits; a 6M11 double triode-pentode employed in the burst gate, sync separator, and sound IF; double pentode 6AL11 in the sound demodulator and audio output stages; a 6BW11 double pentode used in the chroma bandpass amplifier and chroma subcarrier amplifier; a double triode 6FM7 divided between the vertical oscillator and output stages; and a 6AG9 triode-pentode employed in the video output and keyed AGC circuits. Rounding out the compactron line-up are a 6JS6A pentode in the horizontal output circuit, a 6CG3 diode in the damper, a 6EF4 tetrode in the shunt regulator, and a triple triode 6AC10 used in the color difference amplifiers.

Two NPN transistors are employed in the 1st and 2nd video amplifier stages. A half-wave silicon rectifier in the emitter circuit of the 1st video amplifier stage provides bias for that stage. In addition, the bias developed by this rectifier is also applied across the brightness control circuit. A silicon rectifier in the base circuit of the 2nd video amplifier is used to rectify horizontal pulses from the damper cathode. The horizontal pulses are amplified by the 2nd video amplifier and video output stage and appear at the CRT cathodes, providing horizontal retrace blanking.

The side pincushion corrector circuit employed in the CB chassis has not been included in the KC chassis, which is designed with only a top and bottom pincushion corrector circuit.

PREVIEWS OF NEW SETS

Pilot

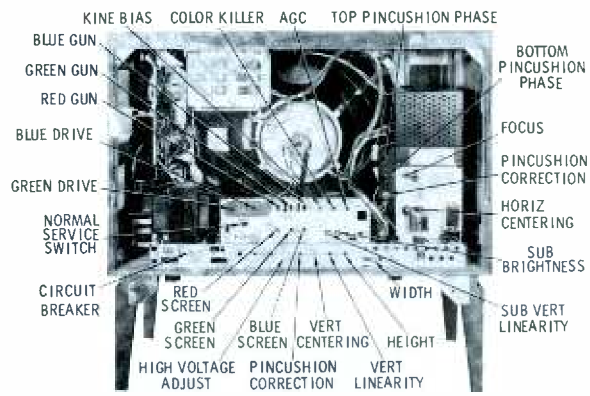
The 18" Japanese-made color consolette pictured here is one of the first color sets introduced by this manufacturer. All circuitry, with the exception of the tuners and convergence board, is contained on a single hand-wired chassis that is horizontally mounted. The tube complement consists of 28 tubes, including the CRT and one 6JS6A compactron used in the horizontal output stage.

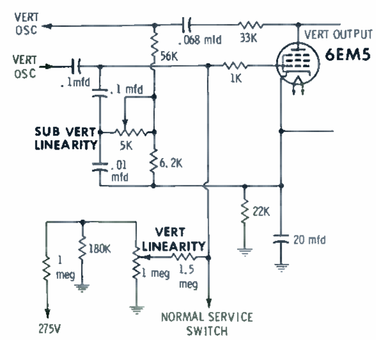
There are a number of design differences which set this chassis apart from more conventional sets. The most noteable of these is the chroma demodulators, shown here. The three separate R-Y, G-Y, and B-Y demodulators share half of a double triode 7247 with their respective difference amplifiers.

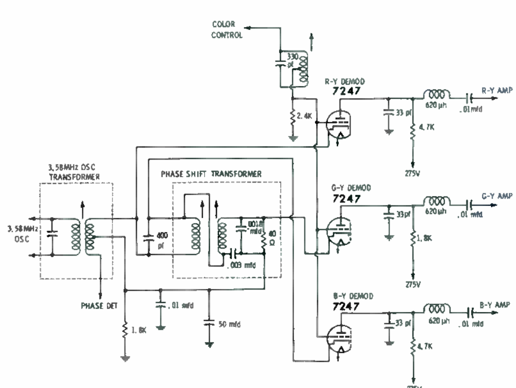
The brightness and linearity control circuits are also unusual. As shown here, both have "sub" controls. The sub-brightness control adjusts the effective range of the brightness control by regulating the amount of current through it. The sub-linearity control is part of a waveshaping network designed to alter the shape of the vertical output grid drive pulse at the plate of this stage.

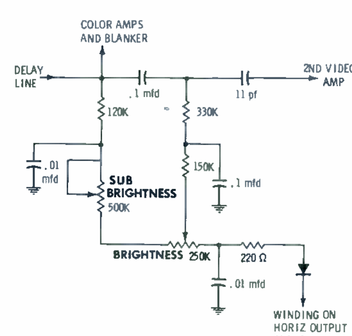
Color gun controls employed in the CRT grid circuit connect each of the three grids to ground through a 100-K ohm resistor. Thus, all three colors can be killed, either separately or together.

Model C309

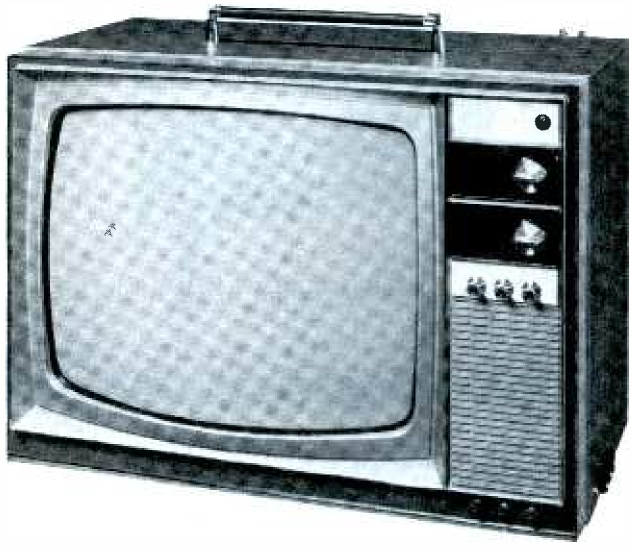




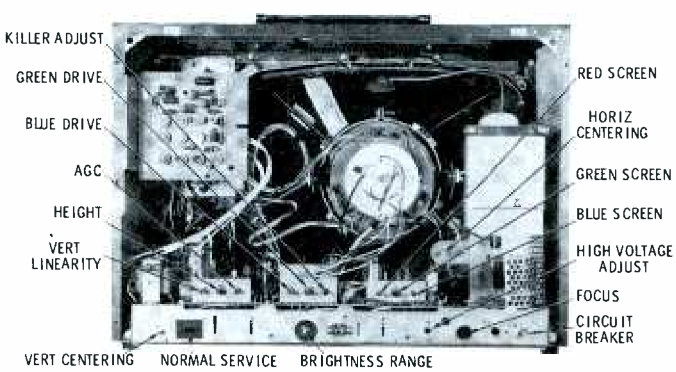


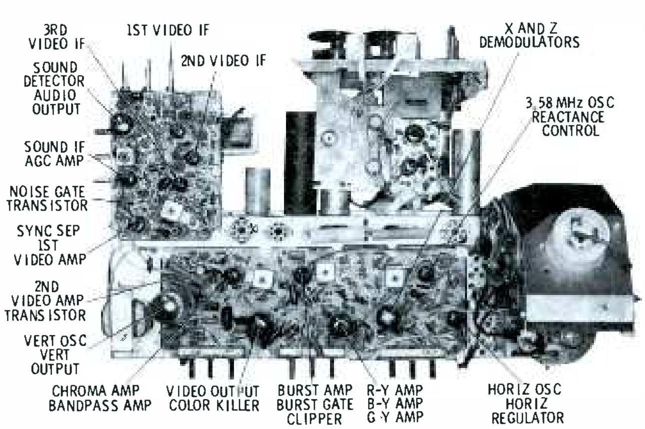


Sylvania PREVIEWS OF NEW SETS



Model 19TC14-1 Chassis DO5-1





The chassis employed in this 18" color table model is changed a great deal from the DO3-2 chassis used previously in this manufacturer's 18" color sets. Major circuit changes involve the tube complement, chroma circuits, and video IF and amplifier sections.

The chroma demodulators have been changed completely. High-level R-Y and B-Y demodulators were used in the DO3 chassis, with the G-Y signal derived from the difference between the R-Y and B-Y signals. Thus, only the G-Y signal required a difference amplifier. This system has been discarded in the DO5 chassis and more conventional low-level "X" and "Z" demodulators employed in its place. A double pentode 12BV11 compactron serves the demodulators, while a triple triode 12MD8 performs in the difference amplifiers. Other chroma circuit changes include the use of semiconductor diodes in the phase detector, replacing the twin diode half of an 8AC9 used in the DO3. Also, an additional chroma amplifier (total of two) is designed into the DO5 chassis.

Another semiconductor addition to the DO 5 chassis is found in the 2nd video amplifier, which has been changed from the triode section of a 5MB8 to an SE1002 transistor configuration. Two other transistors are also used in the chassis, one in the grounded emitter noise gate circuit and one in the UHF oscillator. A third IF stage has been added to the video IF section. The tube complement of this section has also been changed and includes a 4BZ6 pentode in the 1st stage, a 5GM6 pentode in the 2nd stage, and a 5JK6 pentode in the final video stage.

Compactrons used in this chassis include a double pentode 12T10 employed in the quadrature sound detector and audio output stages, a 21LU8 triode-pentode serving the vertical oscillator and vertical output stage, and a 34CE3 diode in the damper.

SEE PHOTOFACT Set 721, Folder 3

Mfr: Motorola

Chassis No: TS-908/A, B, YA, YB.

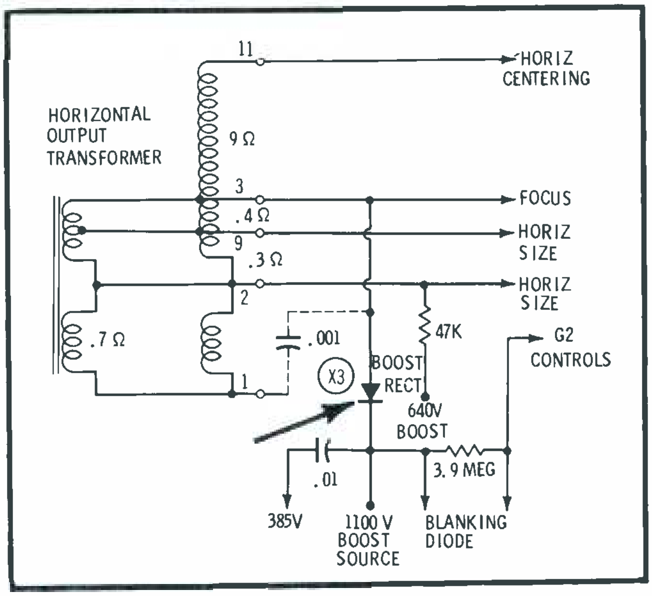
Card No: MO TS-908-7

Section Affected: Raster.

Symptom: Low brightness; G2 controls operate backwards (clockwise rotation decreases brightness instead of increasing brightness.) Voltage on high side of G2 controls low or absent, but voltage is normal on low sides.

Cause: Loss of boosted B+ voltage due to open diode X3, or defective lead between X3 and G2 controls.

What To Do: Replace X3, and check for shorted lead between X3 and G2 controls.



Mfr: Motorola

Chassis No: TS-908/A, B, YA, YB.

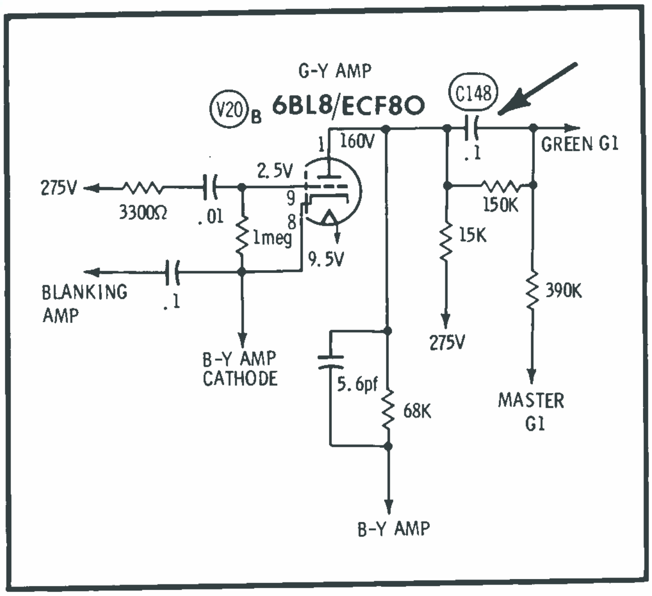
Card No: MO TS-908-8

Section Affected: Raster.

Symptom: Left side of raster turns purple; appears to have misadjusted purity. Cannot be corrected by degaussing or positioning of yoke.

Cause: Open capacitor in plate circuit of G-Y amplifier. This increases impedance of CRT grid circuit and causes it to pick up radiation from high-voltage section.

What To Do: Replace C148 (.1 mfd).



Mfr: Motorola

Chassis No: TS-908/A, B, YA, YB.

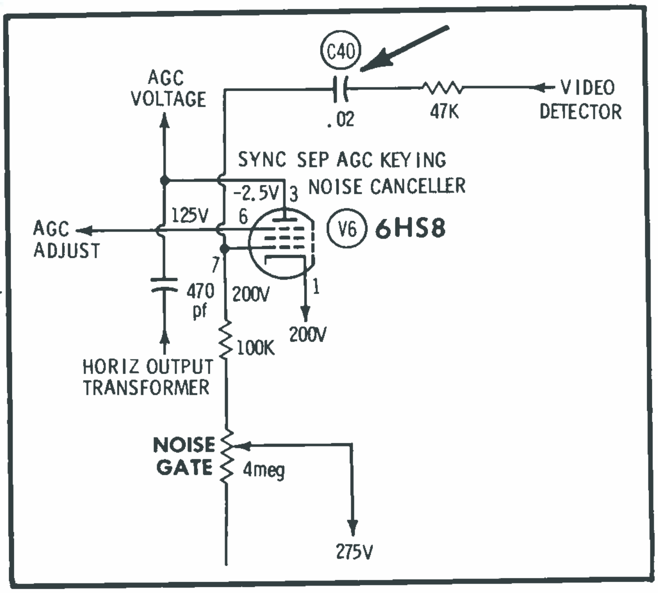
Card No: MO TS-908-9

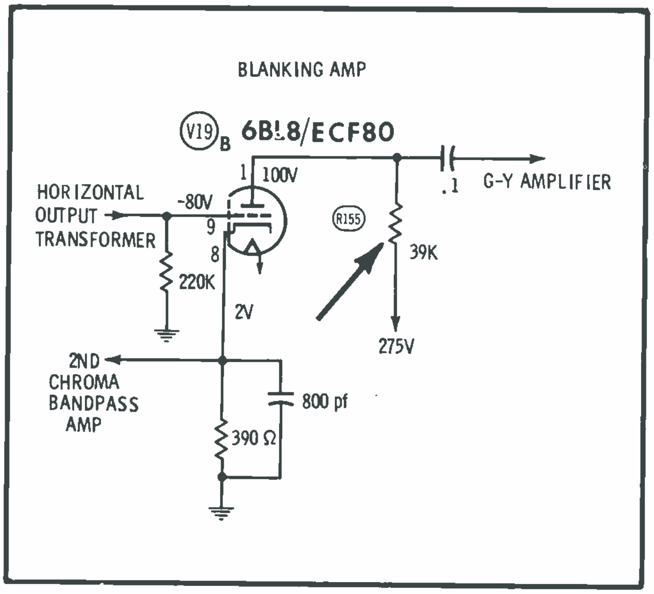
Section Affected: Pix and raster.

Symptom: Picture tears and overloads; brightness level decreased.

Cause: Leaky coupling capacitor between video detector and AGC keying decreases voltage at grid of AGC keying tube. Thus, AGC voltages are decreased, causing overload on strong signals.

What To Do: Temporarily disconnect capacitor C40 (.02mfd). If set performance returns to normal, replace the capacitor. (The set will operate normally without the capacitor in all but the most noisy signal areas.)





SEE PHOTOFACT Set 721, Folder 3

Mfr: Motorola

Chassis No: TS-908/A, B, YA, YB.

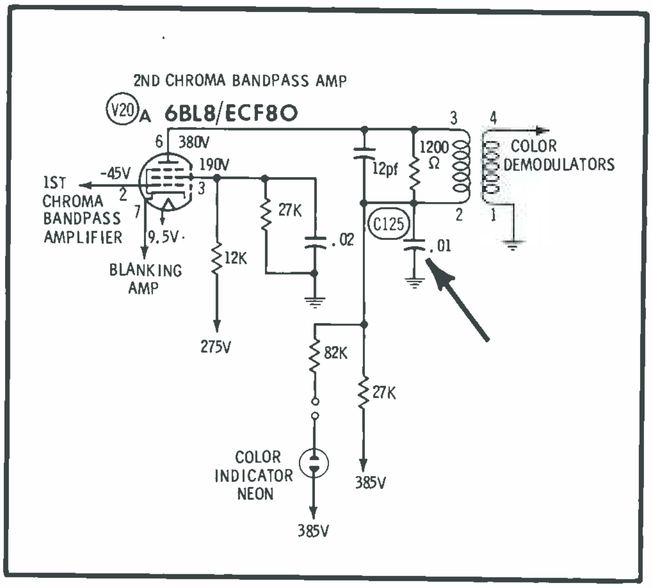
Card No: MO TS-908-10

Section Affected: Raster.

Symptom: Insufficient brightness. Customer brightness control does not have sufficient range to remove high voltage from the regulator, even when master G1 control is turned fully clockwise. Low voltage at plate (pin 1) of blanking amplifier.

Cause: Open plate load resistor in blanking amplifier circuit.

What To Do: Replace R155 (39K, 2W).



Mfr: Motorola

Chassis No: TS-908/A, B, YA, YB.

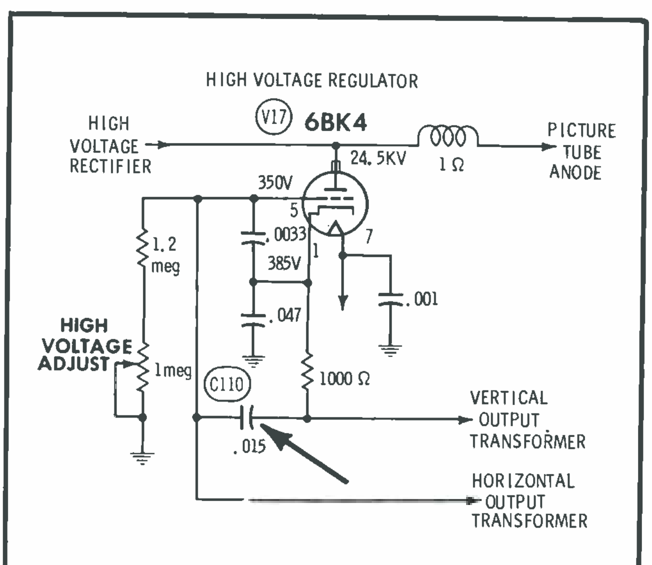
Card No: MO TS-908-11

Section Affected: Color pix.

Symptom: B-W pix normal. No color. Color indicator light is on at all times. Low B+ on plate (pin 6) of chroma bandpass amplifier.

Cause: Shorted filtered capacitor in plate circuit of 2nd chroma bandpass amplifier.

What To Do: Replace C125 (.01 mfd).



Mfr: Motorola

Chassis No: TS-908/A, B, YA, YB.

Card No: MO TS-908-12

Section Affected: Raster.

Symptom: Poor focus; brightness low; width reduced.

Cause: Shorted capacitor in grid circuit of high-voltage regulator.

What To Do: Replace C110 (.015 mfd).

SEE PHOTOFACT Set 731, Folder 2

SEE PHOTOFACT Set 731, Folder 2

Mfr: Olympic

Chassis No: CTC-15/U

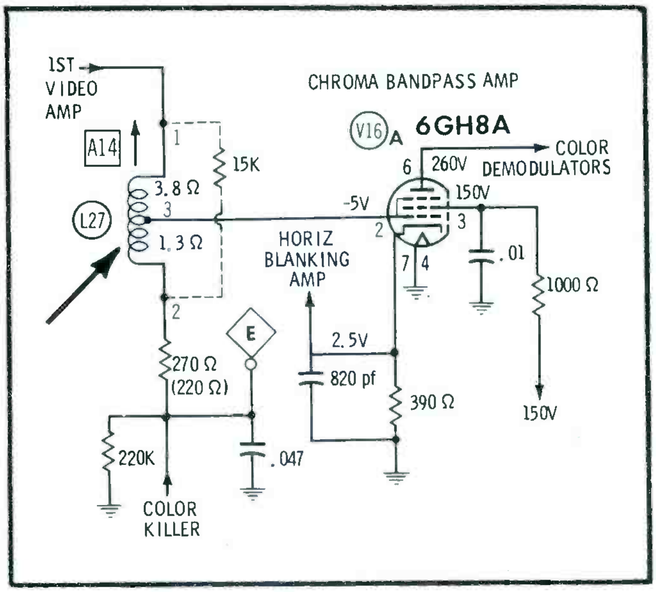
Card No: OL CTC-15-1

Section Affected: Color pix.

Symptom: No color; b-w pix normal.

Cause: Chroma takeoff coil L27 open.

What To Do: Resolder coil leads to lugs on chroma takeoff coil.



Mfr: Olympic

Chassis No: CTC-15/U

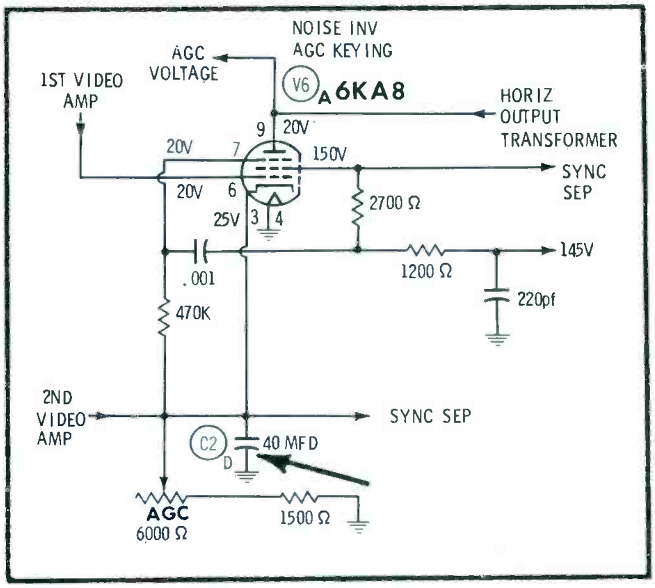
Card No: OL CTC-15-2

Section Affected: Pix.

Symptom: Video overload. Voltage at cathode (pin 3) of noise inverter/AGC keyer lower than normal.

Cause: Leaky cathode bypass capacitor C2D.

What To Do: Replace C2D (40 mfd).



Mfr: Olympic

Chassis No: CTC-15/U

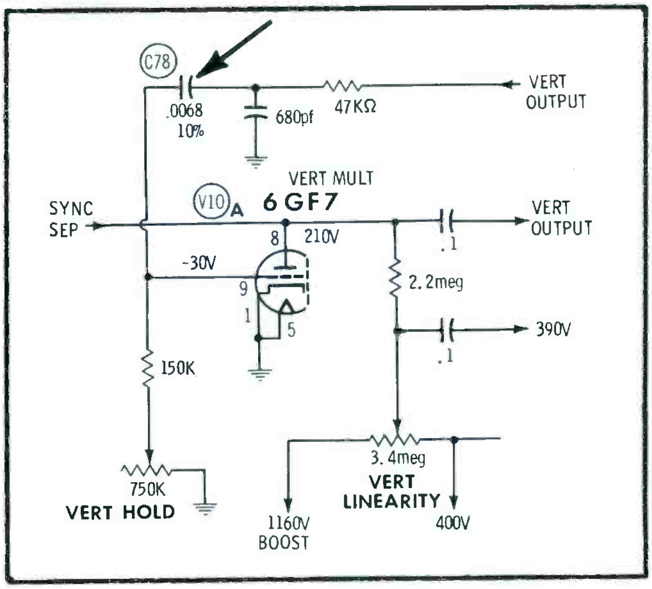
Card No: OL CTC-15-3

Section Affected: Sync.

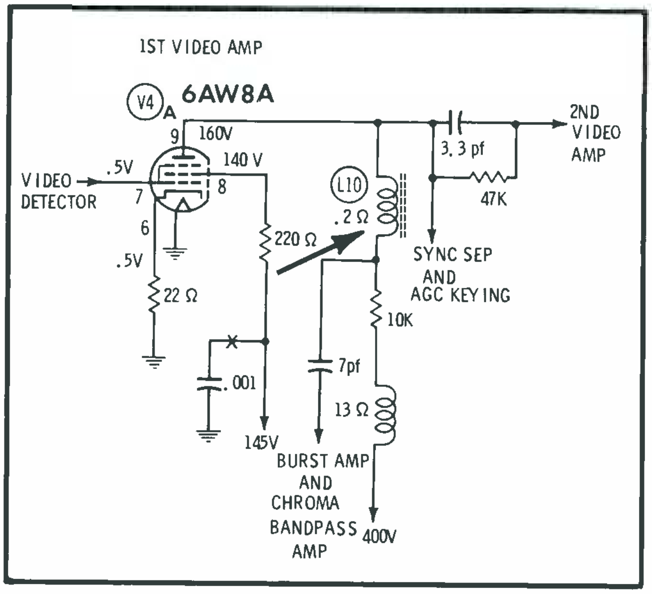
Symptom: Intermittent vertical roll. Vertical signal from integrator output is normal at plate socket connection (pin 8) of V10A with tube removed.

Cause: Leaky feedback capacitor between vertical multivibrator and vertical output.

What To Do: Replace C78 (.0068 mfd).



SEE PHOTOFACT Set 731, Folder 2



SEE PHOTOFACT Set 731, Folder 2

Mfr: Olympic

Chassis No: CTC-15/U

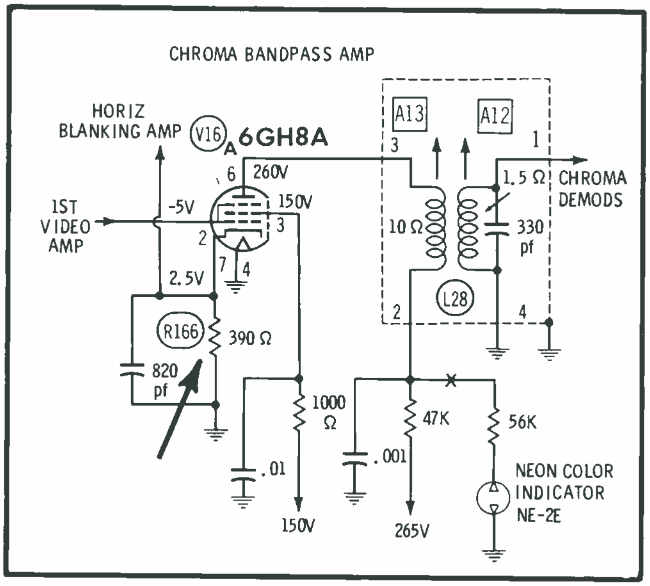
Card No: OL CTC-15-4

Section Affected: Pix.

Symptom: Pix smeared and out of focus.

Cause: Bad solder connections on RF choke in plate circuit of 1st video amplifier.

What To Do: Resolder leads on L10.



Mfr: Olympic

Chassis No: CTC-15/U

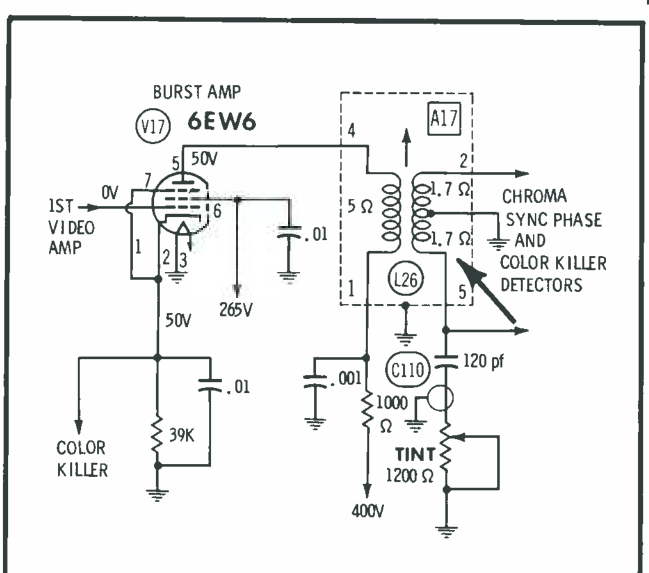
Card No: OL CTC-15-5

Section Affected: Color pix.

Symptom: B-W pix normal. Color disappears intermittently. Voltage fluctuates at cathode (pin 7) of chroma bandpass amplifier.

Cause: Cathode resistor overheats and changes value.

What To Do: Replace R166 (390 ohms), and check V16 (6GH8A).



Mfr: Olympic

Chassis No: CTC-15/U

Card No: OL CTC-15-6

Section Affected: Color pix.

Symptom: Color hues unstable.

Cause: Bad solder connections at junction of C110 and terminal 5 of burst phase detector transformer.

What To Do: Resolder connections at junction of L26 (terminal 5) and C110 (120 pf).

A HOWARD W. SAMS PUBLICATION

PF Reporter®

PHOTOFACT

the magazine of electronic servicing

VOLUME 17, NO. 5 MAY, 1967

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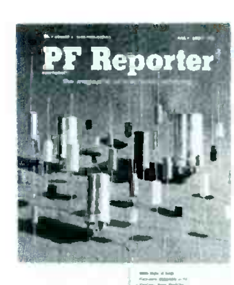

A layman might interpret this months cover photo as evidence of life on Mars. But the sharp-eyed electronics technician will quickly recognize that these celestial beings are nothing more than a wide variety of trouble-causing gremlins. Yes, behind that colorful camouflage exist the shorts, leaks, and opens that plague the earthbound serviceman. An article beginning on page 27 of this issue provides some valuable clues to the personality of these Martians.

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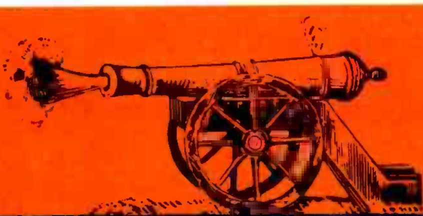

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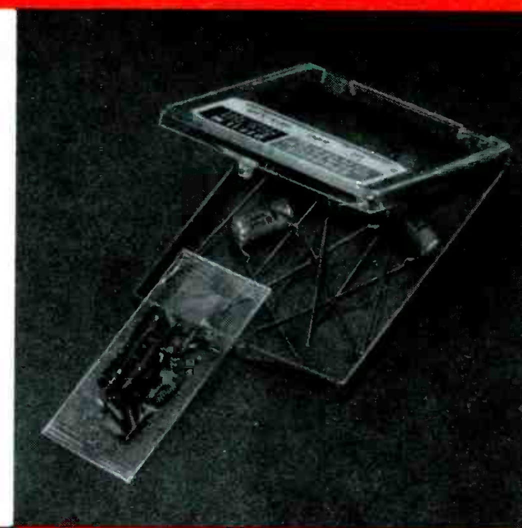

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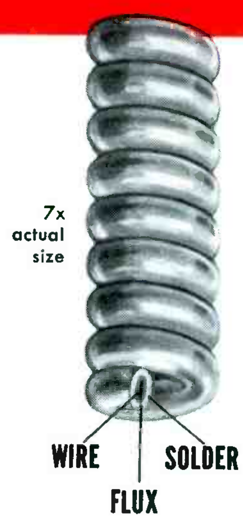

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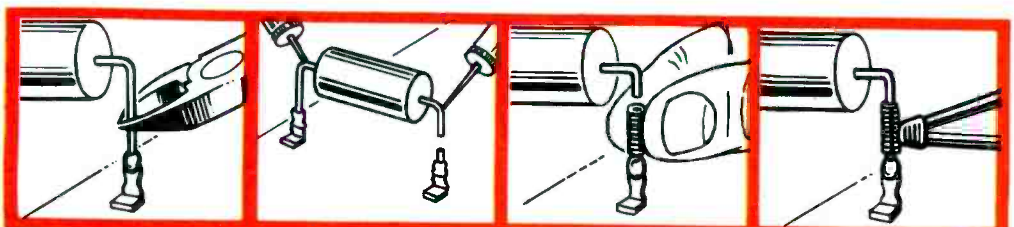

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Circle 4 on literature card

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Circle 5 on literature card

LETTERS TO the EDITOR

Dear Editor:

In "Short Cuts in Mathematics" you seem to have a friendly debate started (October, 1965; December, 1965; and December, 1966). This is all very good, but most shops will usually misplace the nomographs and more often than not, will not have a mathematics reference as part of the bench set up.

Here's one that can be set up as a formula but need not be. Suppose a resistor of 500 ohms is needed but is not in stock.

Let the needed resistor = Rt or 500 ohms.

Let the unknown resistors = R1 and R2.

To find R1 multiply Rt, or 500 ohms, by any simple number such as 5. Then divide the answer, or R1, by *one* less than first number used — in this case, 5 − 1 =4.

Then:

$$500 \times 5 = 2500 = R1$$

$$\frac{2500}{4} = 625 = R2$$

As another example, let Rt equal 500 ohms again and use four as the multiplier.

$$500 \times 4 = 2000 = R1$$

$$\frac{2000}{3} = 666 = R2$$

Using standard resistors of 2000 ohms and 680 ohms, the parallel resistance will be 507 ohms, or within 2% of desired value.

Suppose that Rt cannot be made up with two standard resistors or that one of these two is not in stock. The needed resistor is 60 ohms.

$$60 \times 7 = 420 = R1$$

If R2 value is not in stock, the divisor may be factored into two parts. Divisor should be 6. This can be factored into 2 and 4.

$$\frac{420}{4} = 105 = R2$$

$$\frac{420}{2} = 210 = R3$$

With standard values of 430, 100, and 220, the parallel resistance is 59.3 ohms, or within 2% of desired value.

M. Barker

As several readers have pointed out, there is one "theoretical" case where the method will fail and that is when any one resistor has the value of zero. —Ed.

THE ELECTRONIC SCANNER

news of the servicing industry

New Red Phosphor

RCA announced development of a new red phosphor which makes possible the brightest color television picture tubes in the industry.

Samples of RCA color TV picture tubes employing the new phosphor were demonstrated publicly for the first time at the 1967 Institute of Electrical and Electronics Engineers (IEEE) Convention in the New York Coliseum.

"The new phosphor provides on the average a 40% increase in the red phosphor efficiency and a 38% increase in high-light brightness over the best competitive color tubes now on the market," according to John B. Farese, Vice President, RCA Electronic Components and Devices.

The new color tube red phosphor also provides television viewing with high picture contrast at high ambient light levels, he added. This high brightness and high-picture contrast produce full, living color at high ambient-light levels.

"RCA's new red phosphor achieves unity current ratio which means that each of the tube's three electron guns have an equal beam current. This technical advance eliminates color fringing due to 'red blooming' in the highlights of both color and black-and-white programs," he said.

Mergers & Expansions

William B. Humes, president of **Bell & Howell's** New Business Group, announced that DeVry Institute of Technology, a subsidiary of Bell & Howell Company, will establish a new resident training school in Phoenix.

DeVry Tech presently operates resident training schools in Chicago and Toronto for more than 3,000 students, with an additional 17,000 enrolled in home study courses throughout the United States and Canada.

Top officials of **Zenith** were on hand to officially open the new $3,000,000 manufacturing facility operated by its wholly-owned subsidiary, the Wincharger Corporation. Joseph S. Wright, Zenith president, and Sam Kaplan, executive vice president and treasurer, were honored at the dedication luncheon in the new 220,000-square-foot plant in Sioux City, Iowa.

The new plant has been phasing in its operations since September. It permits Wincharger to increase production of Zenith radio receivers, provide additional facilities for manufacture of FM-AM receivers, and enable Wincharger to begin production of electronic components for a wide range of Zenith consumer products.

Sales

Consolidated net earnings and sales for **Amphenol Corporation** and its subsidiaries reached record highs in 1966, according to Matthew L. Devine, chairman of the board. Per share earnings were $1.98, an increase of 56% over earnings of $1.27 per share for 1965. Sales totaled $152,440,604, an increase of 37% over sales of $111,233,322 for the previous year.

"The increased earnings were due primarily to higher sales volume, improved efficiencies, and generally good business conditions," Mr. Devine said. "The year-end backlog was also at a record high level which assures us of a good start for 1967," he added.

Work is nearing completion on a $10 million plant expansion in Portsmouth, Va., designed to increase **General Electric's** production capacity for personal portable color television sets. The addition doubles the plant's size, and all of the new space will be devoted to production of PortaColor and personal color sets.

The original plant of GE's Personal Television Department was opened a little more than a year ago to produce TV sets—both color and monochrome—with sizes up to 16 inches (viewable diagonal).

Oaktron Industries has recently completed a major engineering expansion program. A completely new applied research, development, and testing facility has been added to provide one of the most modern speaker laboratories in the Industry. Taking over two years to complete, and with a 30% increase in staff, the new Center provides a total program—from basic design and materials analysis to prototype testing.

Production of electron guns, a vital component for color television picture tubes, has begun at the new multi-million-dollar plant of **RCA de Puerto Rico,** a wholly-owned subsidiary of the Radio Corporation of America. The 25,000-square-foot facility, located in Juncos, 30 miles South of San Juan, was dedicated at formal ceremonies attended by representatives of government, business, and the press.

Circle 8 on literature card

Record sales and earnings for **Belden Manufacturing Company** in 1966 were reported by Robert W. Hawkinson, President.

Net sales for the Chicago-based manufacturer of insulated wire and cable were $65,869,698, an increase of 23% from the previous year's record total of $53,509,682.

Capital expenditures totaled an all-time high of $5,473,259, an increase of 56% over the previous year's record outlay, Hawkinson noted. This included the opening of an electric cord plant at Franklin, North Carolina and the construction of an additional magnet wire plant at Pontotoc, Mississippi.

Dynascan Corporation sales topped $5 million for the first time and earnings soared 54% in 1966, President Carl Korn announced in the company's annual report.

Sales in 1966 by the Chicago-based electronics company amounted to $5,020,208, a 20% gain over 1965 sales of $4,174,198. Net earnings for the year of $225,505 were 54% higher than 1965 earnings of $146,645.

Korn said the firm has signed a licensing agreement with Standard Telephone & Cables, Ltd., London, a subsidiary of ITT, to manufacture and distribute Dynascan "Telemotive" radio remote crane control systems abroad.

Dynascan makes B & K electronic test and service equipment for color and black-and-white television; Precision Apparatus instruments for industrial, college, and secondary school laboratories; Citizens Band communications products; and Telemotive radio remote control systems for overhead cranes.

President Jack D. Hughes reported that the 1966 sales and net earnings of **Littelfuse** surpassed all previous annual financial records.

Net sales were $11,673,654, an increase of 19% over sales of $9,823,053 in 1965. Net earnings for 1966, keeping pace with net sales, were $398,469, rising to 19% above earnings of $334,917 in the previous year.

Thomas M. Blake, board chairman, attributed the 1966 record financial increases to Littelfuse's greater product penetration in the television and home appliance markets. Business prospects for 1967 continue to improve. New products developed in 1966 for the consumer electronics field, such as the color television degaussing switch and bimetallic television circuit breakers, together with new types of low voltage fuses, are expected to help increase the company's profits.

Sprague Electric Company reported record high net sales and net profits for the year ended December 31.

Net sales totalled $141,466,479 for the year, compared to $107,077,249 in 1965, for an increase of 32%. Net earnings for the year reached $8,831,334, an increase of 79% from $4,935,541 the previous year. ▲

Great BLOBS of COLOR

You can have a good black-and-white without color, but you can't have good color without black-and-white. Confused? Well, its all colorfully spelled out here—in black-and-white.

By JACK DARR

THE video amplifier stages of a color set have no business bothering the color. They just sit there along the top of the schematic and black-and-white pictures, while the color demods and all the other color stages sweat and strain down below, trying to keep up with vectors and things going in all directions. The video stages will bother the color, though—yes, indeed they will. Under certain circumstances, they can turn a nice picture into great blobs of color, streaks, stripes, and more odd things than you can shake a diddle-stick at. Now, let's find out Y. (Little obscure technical pun there.) (*A little too obscure, if you ask me—Ed.*)

Seriously speaking, the video amps are a nice straight-forward DC-coupled circuit. They build up the Y or video signal to the amplitude needed for color picture work, which is a good deal more than the 50 volts p-p or so found in B/W sets. The color signals generally are taken off back about the first video amplifier stage and go their separate ways. The two signals must rejoin at the picture tube, and at the proper time, amplitude and polarity. If this is fouled up, we can get some very confusing troubles!

All colors we see on the screen are the sum of two components; the pure color itself, and the brightness or 'white' component. If the white isn't right we'll see just the color signal, and this will be distorted—usually oversaturated. The colors will also be pretty blurry, because of the narrow bandwidth of the color subcarrier.

There are a lot of color shows on the air now, especially in the daytime, and our natural tendency is to check a color set on a color show. If we see "color troubles," we may waste a good deal of time looking for them in the color circuits while the real trouble could be in the video circuitry. Therefore, it's a very good idea to make a quick check of the picture in B/W. Turn to a channel with a B/W show or simply turn the color control off. This will give you a much better idea of what's going on.

So, the main object of this discussion will be "color troubles that aren't color troubles." To clear up that

Fig. 2. Picture shows faint raster with a colored bar.

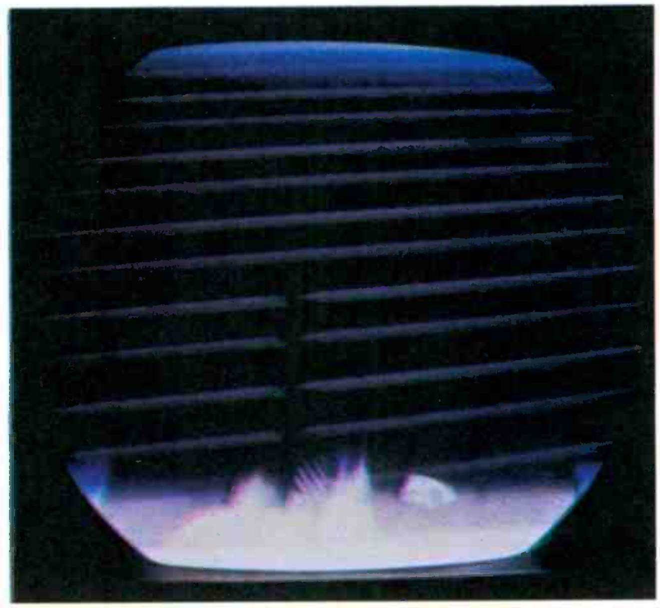
Fig. 3. Black raster, heavy, retrace lines due to H-K short.

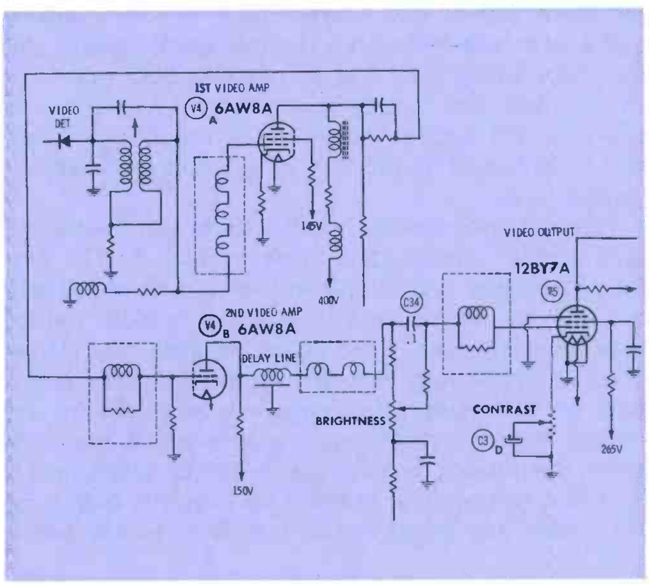

Fig. 1. Video amplifier circuits of the RCA CTC15.


Fig. 4. Same pix after bar crept up.

lucid little statement, this means troubles which cause a poor color picture, but which are not due to defects in the color circuitry itself. The brightness or Y component will be missing, distorted, etc. To be quite frank about it, these are rare cases, from my experience. But when I ran into them they've been real buggers, for the reasons given!

Most video troubles can't be seen at all. Why? Because there won't be a raster for you to see them! The standard video amplifier circuitry in a color set is DC coupled all the way back to the video detector. The plate voltage on the video output tube sets the bias for the three cathodes of the color CRT. Anything that upsets the video circuits, even as far back as the 1st video amplifier, will cause the video-output plate voltage to shift—usually in the direction which causes the picture tube to cut off. The screen goes dark. This has caused a lot of unnecessary checking of high voltage, etc. Fig. 1 shows the video amplifier circuitry of an RCA CTC15, typical of those used in the majority of color sets up until the last year or so.

Here we have three stages, fed by a negative-going video signal from the detector. Everything is DC coupled; a change in the grid bias of the first stage changes the plate voltage of the last stage. For instance: measured voltages in an actual set; 12BY7 control grid, +1.0 volt, plate +240, screen grid +150, and +300 volts on each cathode of the CRT. This is for a picture of normal brightness, with signal.

The DC voltages are fed to these circuits from several places. The 12BY7 control grid actually gets its bias from two sources; one of which is the plate of the 2nd video amplifier tube. If the delay line should open, the control grid would lose a part of its normal supply. It will drop to a −1.5 volts, the plate rises to +360, the screen grid to +260, and the CRT cathodes jump up to +360 volts apiece. This is enough to cut the picture tube off, and the screen will turn black. So, if you can't get any raster, you should check the HV first, then take some readings at the base of the CRT. The great majority of troubles in the video circuit seem to have the above effect. Not all of them, though. Like any other circuit, we can have troubles that will cut off the signal while having no effect on

Fig. 5. Results of an open C3 on contrast control.

Fig. 6. Sylvania DO-5 with negative Y and positive color.

the DC voltage readings! And therein lies the source of our great blobs of color. Let's look at a few cases.

A simple one happened in a CTC15. The picture looked odd. It was almost black and white, though I knew the program was in color. Crawling up through the picture was a bar about two inches high; there was color in this bar, but nowhere else in the picture! (Fig. 2). This looked a lot like the old "light bar crawling up through the picture" trouble that we used to find in sets with insufficient filtering. Since there was only one bar, this had to be some kind of 60-Hz trouble, and I did think of filters first. However, this set has a voltage doubler, which makes 2 bars (120 Hz), so that was out. This being one of my better days, I thought of a heater-cathode short in one of the tubes. Up tube-check and at 'em. Going through the video amplifiers, IF's, etc., got nowhere. Hmm. . . . So, I went on.

When I got to the 6GU7 green amplifier, there it was; a good sized flicker of the short lamp. Oh, ho! But wait—green? This trouble wasn't in the green, it affected all colors, and it was blanking most of the color right out of the picture—BLANKING? That's

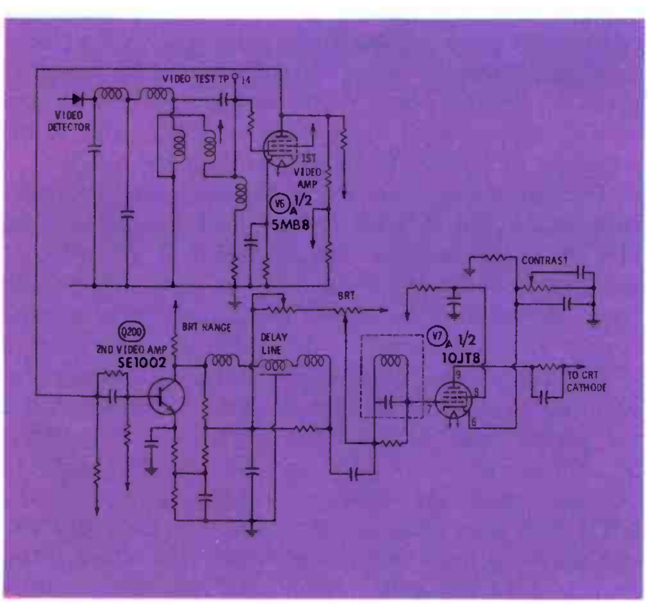

Fig. 7. Video amplifier circuit of Sylvania DO-5.

the secret word! Checking the schematic showed that the other half of that shorted tube was the blanker, and a new tube cleared up the trouble. Evidently, the short was killing the colors by affecting both the video circuits and the bandpass amplifier, which gets its bias from the blanker cathode. The brightness control had to be turned all the way up to get a good enough picture to see.

Heater-cathode shorts in other tubes can have some very distinct effects, too. Look at Fig. 3. The first time I saw this one, the screen was almost completely blacked out. There were very heavy vertical retrace lines showing, with three colors in each one. However, I stopped long enough to remember that retrace lines are always out of convergence, since they're out of step with the convergence waveforms. While I sat there idly musing like the guy with the raven on his shoulder, a bright bar crawled up from the bottom of the picture and things began to look more like home. (Fig. 4.)

Now it looked familiar. This was a good old 60-Hz hum bar! A bad one, since it was blacking the raster completely out in some places, but a hum bar just the same. In the place where you could see the picture, the colors were there, but very fuzzy and over-saturated. So, up tube-check again. This time I was lucky; I started with the last video amplifier tube, and this was it. (It's usually the one on the other end of the string from where you begin, as everyone knows!) The 12BY7 had a big fat H-K short. Since a lot of the important circuitry is in the cathode circuit of this tube, including the video peaking and the contrast control, the short was really playing hob with things. Once again, a new tube cured the trouble. Just for luck, I checked out the contrast control, electrolytic, and so on, in case there had been any damage. These were OK this time, but it never hurts to check.

While we're in this particular circuit (Fig. 1), let's see what effect some other possible troubles could have. If C34 opens, it will kill the Y signal, but won't affect the color signals. The picture will looke something like the title illustration; the thing will be 'pale' and the colors will be pretty odd looking. An open

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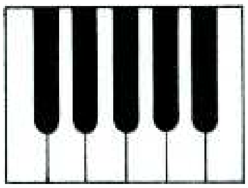


You don't have to know middle C from F sharp, or be a Brahms or Bach—if you are a competent electronics technician, you can repair electronic organs.

Getting Started in ELECTRONIC ORGAN SERVICING

By MONTE J. HASSO

Electronic organs are a potential source of income for *any* competent technician. Then, why don't more TV men offer this service? Primarily because they have preconceived objections to organ servicing as a business or sideline. The most popular objections are:

1. I can't read music.
2. Organs are complicated, both mechanically and electrically.
3. There is not enough business to make it worth while.

Let's get these misconceptions out of the way right now. The truth of the matter is:

1. A large percentage of organ owners can't read music; even more significant, nearly all of the organ repairmen I have known couldn't either. Sure it helps, but it's not essential.
2. The electronic circuits found in organs are no more complicated than a color TV receiver, while the mechanical functions are much simpler than most record changers.
3. Before you make up your mind that there is no market for your services, ask an organ owner. In the larger towns, owners often have to wait several weeks for the repairman to get to them. Today, the organ serviceman is about as busy as a family physcian. People is smaller towns have organs too, and because repair service is not available locally, they usually end up having a repairman from a nearby large city come out to do the job.

And by the way, organ servicing is an area where a competent technician can charge what he's worth and not have the customer raise an eyebrow.

Okay, so now the business doesn't seem so alien to a TV man. Let's take a closer look at electronic organs.

Organs and Music, Briefly

The first thing we notice about the organ (Fig. 1.) is, of course, the *keys*. Note that these are laid out in a definite pattern—5 dark and 7 white keys—that is

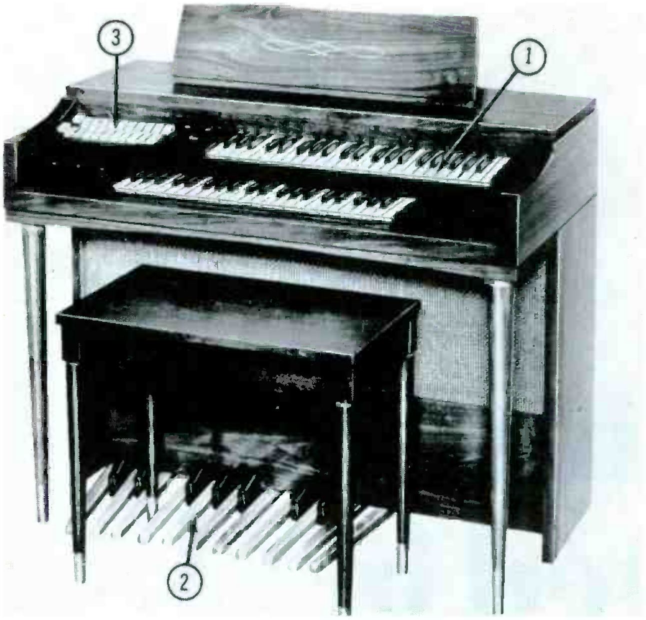
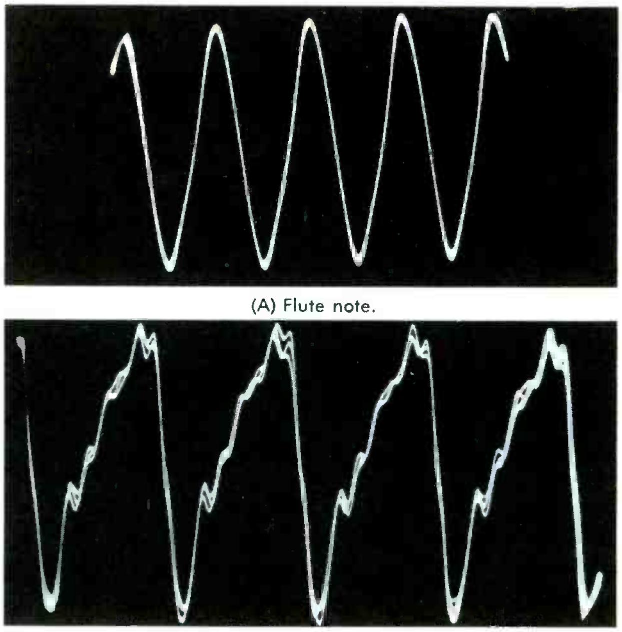


Fig. 1. The Thomas "Sernade" showing (1) keys, (2) pedals, and (3) stops.



(A) Flute note.

(B) Horn note.

Fig. 2. Waveforms of typical musical notes.

repeated several times. To the service man, the only thing of importance about the keys is the letters and numbers assigned to them. Nearly all parts lists are made up so that the various components are listed by key letter and number. The numbers may be different from one organ to the next, but the letters are the same. However, regardless of model, the lowest number is always assigned to the lowest frequency key.

The second thing we notice about the organ is the *pedals*. Actually, these are keys also. Notice that they are laid out in the same pattern as the white and dark keys. The lowest pedal is nearly always assigned the number 1C1. (The highest key is often labeled 7C73, which means that the note is the 7th harmonic of the lowest C-note, developed in the 73rd tone generator).

Near the keys will be found a number of switches called *stops*. These shape the waveform of the note so that it sounds like the instrument named on the stop. The simplest waveforms are produced by the *flute stops,* while more complex waveforms are produced by the *reeds* (horn). Fig. 2 illustrates these waveforms, which are shaped by adding components in an integrator. Other stops perform different functions, such as adding reverberation, changing the decay rate of a note, etc.

Basic Organ Theory

The basic block diagram of a typical organ is shown in Fig. 3. Each note has its own tone generator, typi-

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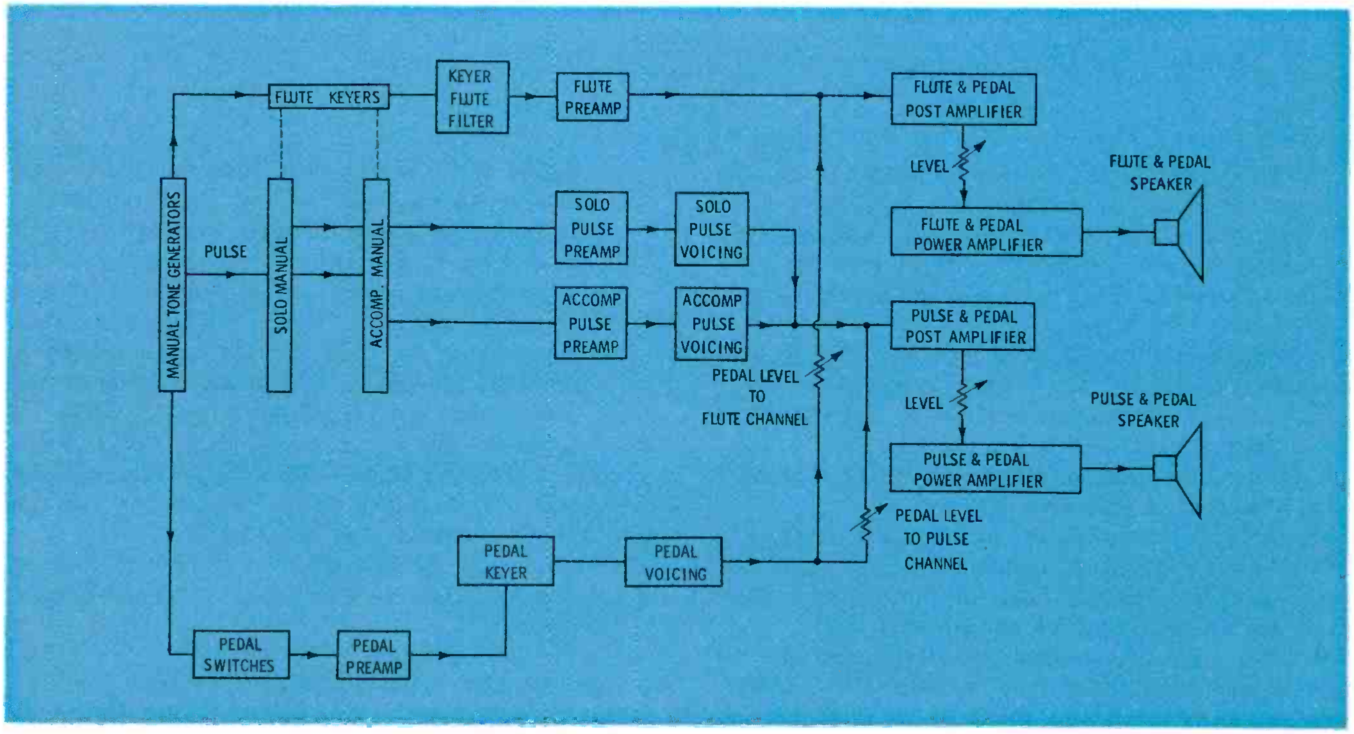
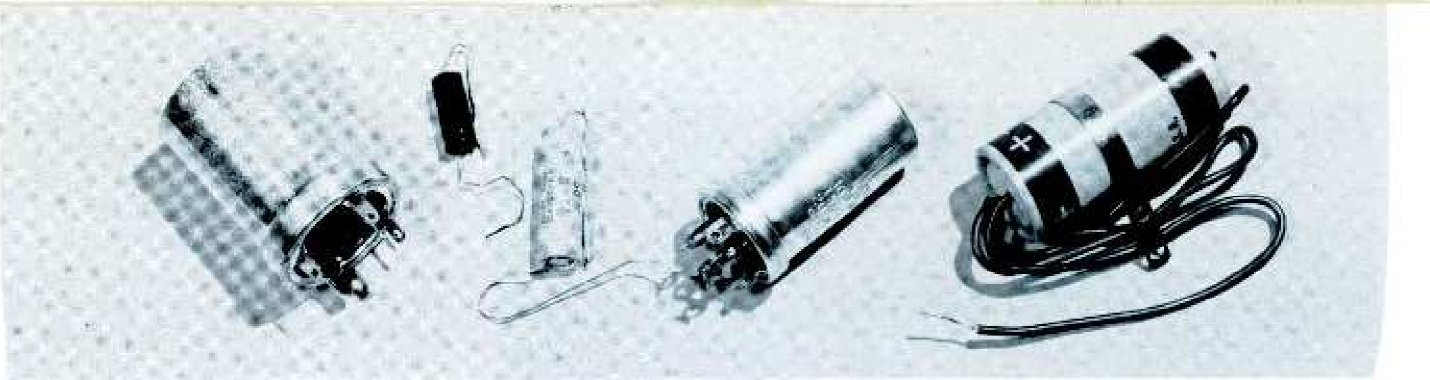


Fig. 3. Block diagram of a typical organ.



Electrolytic Capacitors in TV Receivers

By ALLAN KINCKINER

Failure of an electrolytic capacitor can lead to exasperating trouble symptoms. A review of the signals present in circuits employing electrolytics, together with an analysis of trouble symptoms and troubleshooting techniques saves time and temper.

No model or make of TV receiver has been entirely immune from electrolytic capacitor failure. Depending upon the type of failure, a great many different trouble symptoms have resulted. While many of these troubles have symptoms readily identifiable with filter defects, a considerable portion do not; in fact it is often surprising to find that a tough-to-correct marginal trouble stems from a defect in an electrolytic filter capacitor. In many troubles of this kind appreciable troubleshooting and repair time can be saved by use of the oscilloscope.

Capacitor Defects and Testing

A low resistance or dead short resulting from breakdown or puncturing of the dielectric is the easiest of all electrolytic capacitor failures to pinpoint. It invariably causes at least one section of the receiver to be totally inoperative (and in most instances the entire receiver). A shorted electrolytic capacitor always causes some component to overheat to a level where it is damaged or destroyed, unless a fuse or other protective device is included in the circuit. An ohmmeter will quickly trace down these problems.

A capacitor defect somewhat less common than the dead short is one in which the dielectric becomes leaky. In this defect the capacitor assumes a DC resistance much lower than normal and passes DC current much higher than normal. The resistance reads less than 10,000 ohms on the average ohmmeter. The resistance check is abnormal in another way; instead of the ohmmeter deflecting to zero and then dropping back to a high value, it settles immediately at the leakage value. While trouble symptoms are not as pronounced as those produced by a shorted capacitor, this defect does produce two definite side effects; the capacitor or the can in which it is included will get quite warm after a short period of operation, and the capacitor's electrolyte will eventually boil out through a vent or ooze out at points where terminals are inserted. Receiver symptoms such as weak sound, decreased raster size, low brightness, or weak contrast are typical for this type of failure.

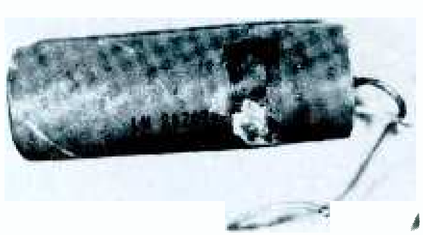
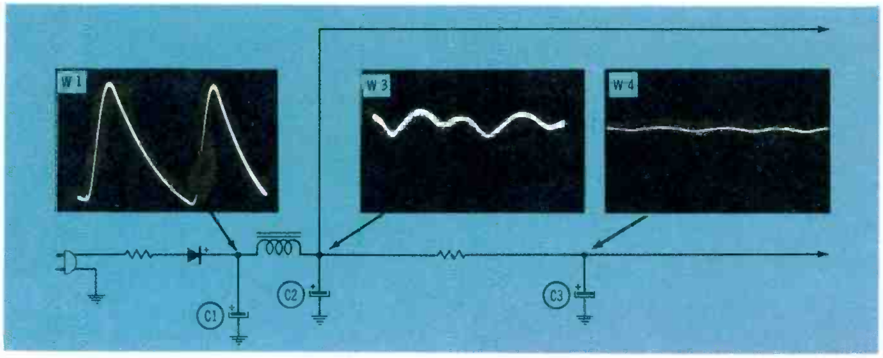


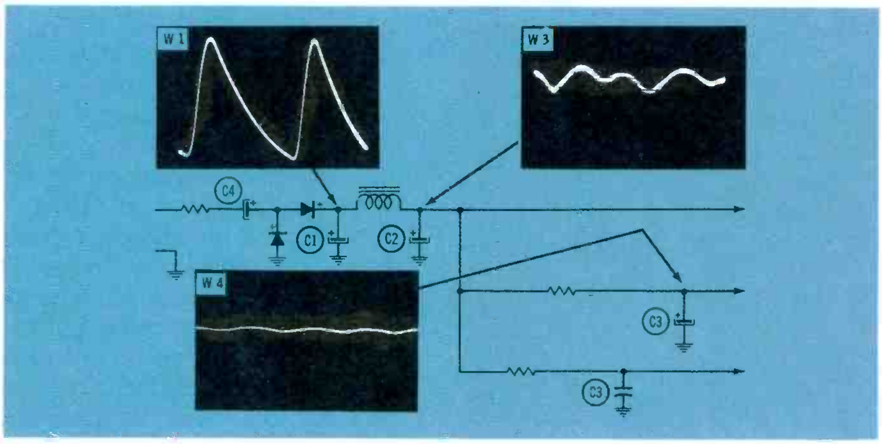
Fig. 1. Deterioration of paper casing.

Loss of capacitance however, is the most common electrolytic capacitor failure. This condition prevents the capacitor from smoothing ripple, bypassing unwanted signals, or decoupling sections on the filtered line—the basic purposes of any electrolytic filter. Trouble symptoms vary infinitely from this condition—hum in sound, hum in picture, twist or other picture distortions, raster shading or shading bands, and poor sync are typical. Severity of the trouble is determined by the extent of capacitance loss. Mild loss introduces barely perceptible troubles, while considerable capacitance loss or a completely open filter produces extreme picture or sound troubles. In some instances capacitance loss assumes a frequency characteristic, affecting only high frequency bypassing or low frequency ripple smoothing. In the first noted condition, unwanted coupling between different stages takes place, the second condition (excessive low frequency ripple) will produce vertical instability, decreased vertical deflection, or picture twist. Examination of the filtered lines via scoping is the easiest and surest way to locate loss of capacity defects.

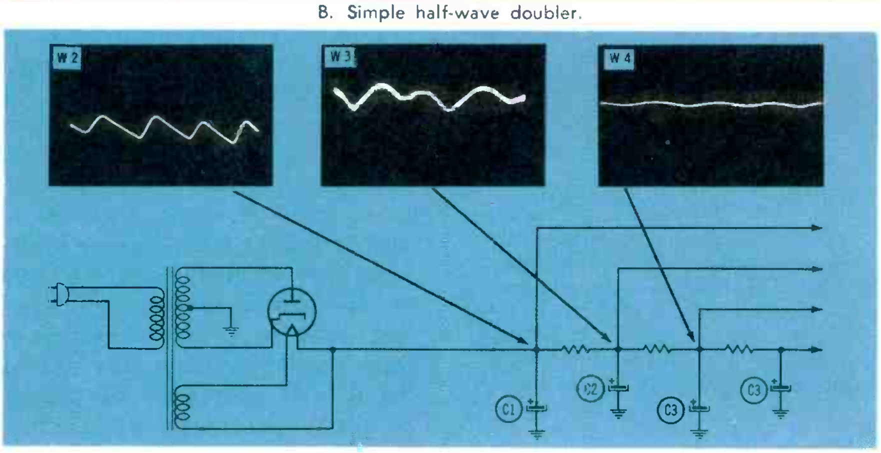
One of the least common electro-



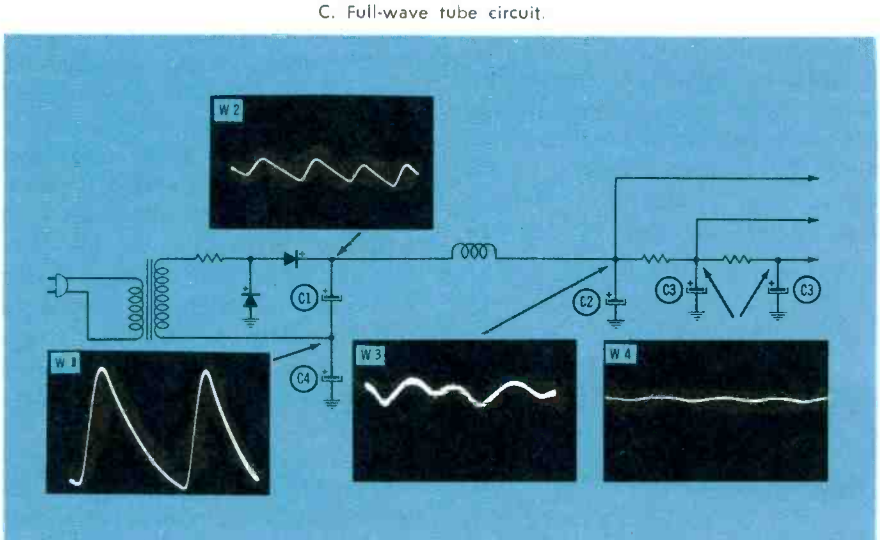
A. Simple half-wave circuit.



B. Simple half-wave doubler.



C. Full-wave tube circuit.



D. Full-wave doubler.

Fig. 2. Circuits representative of modern TV receivers.

lytic filter defects is AC leakage between sections in cans containing more than one capacitor. The product of this defect is the introduction of alien signals into certain receiver stages from other receiver stages. Several examples of this condition will be covered later in this article. Scoping is the only means by which this condition can be detected; the old trick of shunting suspected filters with external units will be nonproductive even when the shunting units have several times the capacity of the defective units.

Current leakage through the casing of paper-encased electrolytics is another very rare defect. Fig. 1 shows a unit having this defect. The stained area indicates the current path through the casing to the capacitor mounting strap. In one such case we found, the only symptom was that the fuse would blow after about one hour of operation. In another case with this leakage defect, severe hum resulted.

Because the shorted or leaky capacitor defects are not difficult to locate or check they will not be discussed further in this article. The loss of capacity defects and the AC leakage between sections defects though, will be covered in depth, primarily because they produce many of the so-called 'Tough Dog' troubles. However, before digging into defective filter case histories, we shall study normal signals on filtered lines. It is quite helpful to examine the signals on these filters when they are normal.

Primary Circuits

The group of circuits shown in Fig. 2 are typical and representative of B-plus supplies employed in virtually every TV receiver designed and manufactured in the past fifteen years. The filter capacitors and the choke or resistor preceding each capacitor are considered as primary filter circuits. A minimum of three filter capacitors are used in economy models such as shown in Fig. 2A, but in most monochrome receivers more than three are employed and in color receivers as many as nine electrolytic filter capacitors will be found.

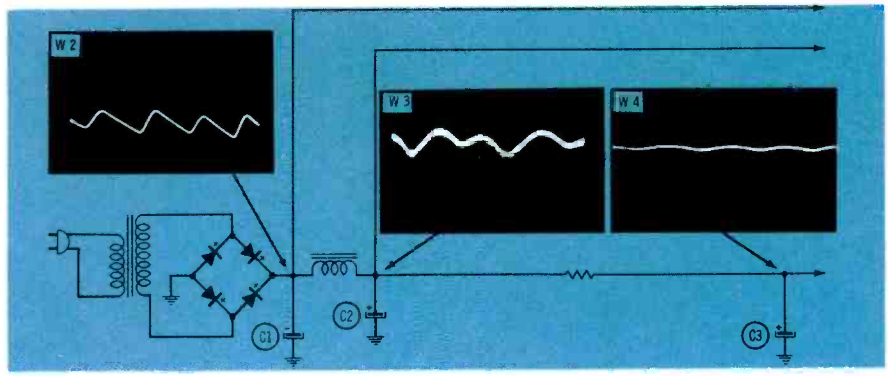
Four basic functions are served by the capacitors in Fig. 2 (any circuit). C1 refines the pulsating DC supplied by the rectifier into a steady DC voltage having ripple of not more than 10 per cent. C2 in each circuit (in conjunction with the choke or resistor preceding it) reduces the ripple, producing a smoother DC having a semi-sine wave ripple of about 2 percent. In addition, C2 bypasses signals from the various circuits fed by its line, preventing signals from one stage being coupled into other stages. C3 smoothes the DC further, provides increased decoupling between stages, and provides a ground return for all signals on the line.

C4 (in the voltage doubler circuits) functions quite differently, as it is not a filtering capacitor. Operating in conjunction with the first rectifier, C4 charges to the peak value of the applied AC voltage. Using this DC charge as a base, the second rectifier then produces a DC voltage approximately equal to the peak-to-peak value of the supplied AC voltage. Thus the DC obtained in Figs. 2B and 2D is approximately two times the RMS value of the supplied AC voltage.

Normal waveforms are included in the Fig. 2 circuits. W1 in Figs. 2A and 2B has a sawform ripple of 60 Hz, and as previously noted, has an amplitude of ten percent of the DC voltage. The ripple amplitude varies inversely with size of C1 and directly with the current drain requirements of the supplied circuits. W2 in the full-wave circuits Figs. 2C, 2D, and 2E has a frequency of 120 Hz. Except for this frequency difference W2 is identical to W1 in all respects. W3 in all the Fig. 2 circuits has a semi-sine wave shape with an amplitude of less than three volts. In the half-wave circuits its frequency is 60 Hz. and in the full wave circuits 120 Hz. W3 is reasonably steady when the vertical deflection is synced, but when vertical deflection is out of sync, W3 becomes slightly distorted and contains a small amount of bounce. W4 in all the Fig. 2 circuits should have an amplitude of less than 1 volt with a smooth waveshape as shown.

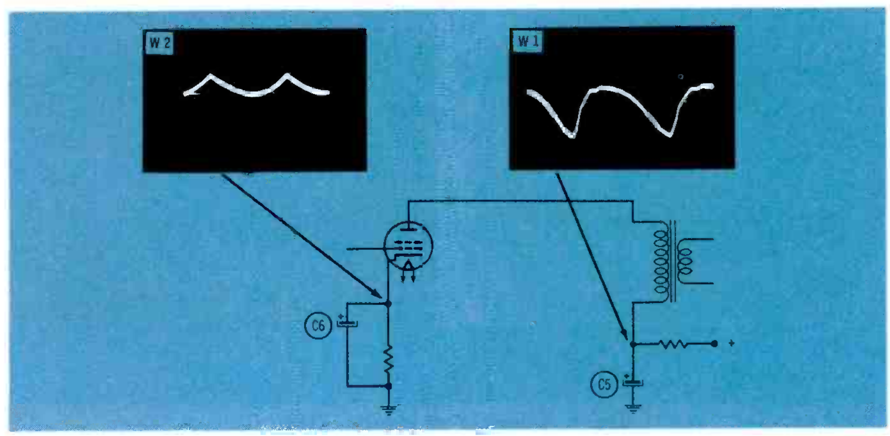
Secondary Circuits

In addition to the primary filter

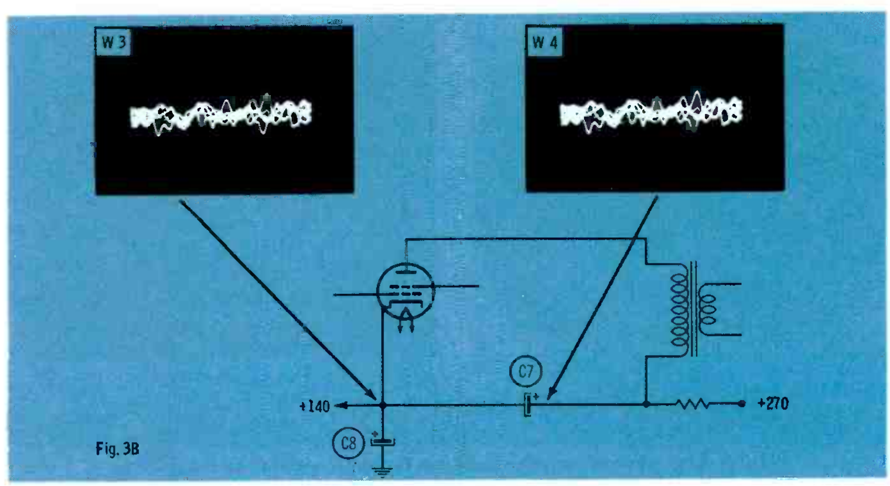


E. Bridge circuit.

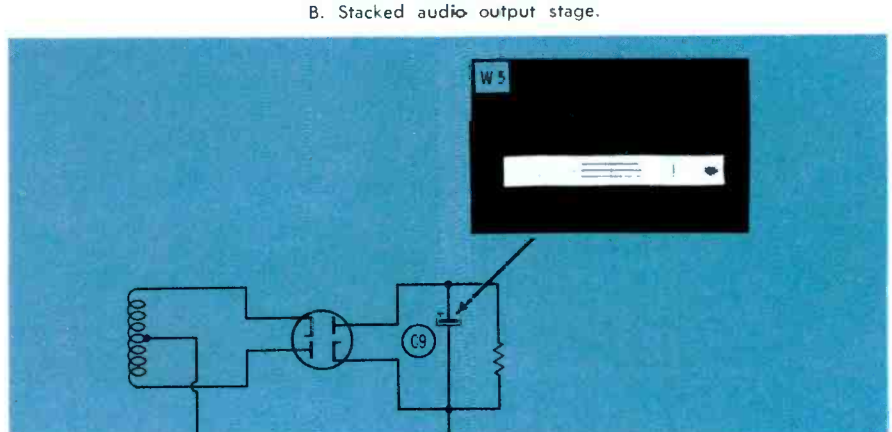
Fig. 2. Circuits representative of modern TV receivers.



A. Audio or vertical output stage.

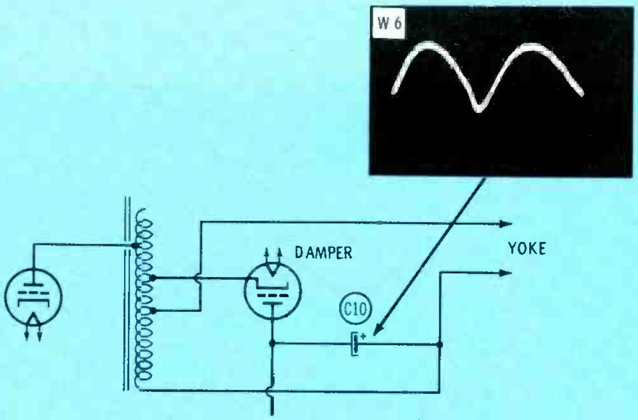


B. Stacked audio output stage.



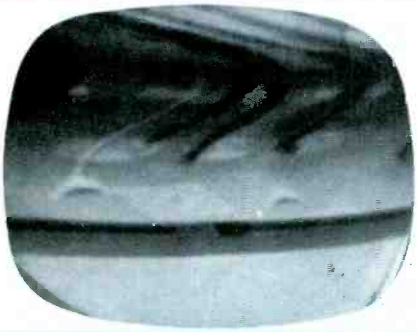
C. Ratio detector.

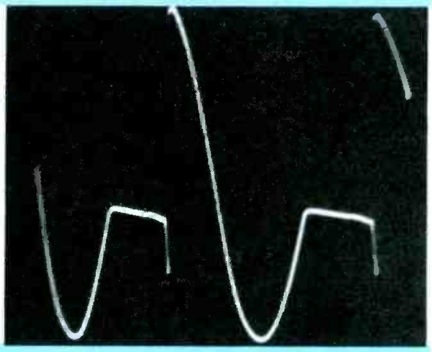
Fig. 3. Secondary filtered circuits often employed.



D. Boost filter.

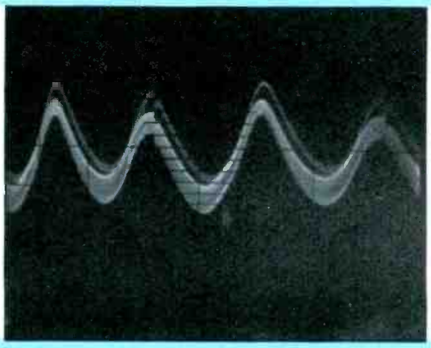
Fig. 3. Secondary filtered circuits often employed.





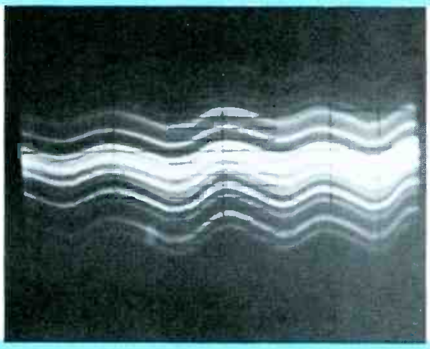
A. Screen symptoms. B. Ripple at C1.

Fig. 4. Example of severe twist.



A. Screen symptoms. B. Ripple at C2.

Fig. 5. Less severe twist caused by secondary filter capacitance.



A. Screen symptoms. B. Waveform at C3.

Fig. 6. Mild twist normally associated with trouble in C3.

circuits, most TV receivers employ other electrolytic capacitors in circuits similar to those in Fig. 3. The average black-and-white TV set contains four or five capacitors in supply circuits and between one and three more in circuits similar to those in Fig. 3. Color receivers generally have nine to eleven electrolytic capacitors. Purposes and functions of the filtering in the Fig. 3 are discussed in explanations of the individual circuits.

Fig. 3A is typical of either an audio or vertical output stage. C5 is the plate supply filter and C6 is the bypass for the cathode-bias resistor. C5 further filters any ripple from the B+ supply, minimizes voltage variations resulting from varying current demands of the tube, and thus assures maximum output efficiency. C6 prevents cathode-bias degeneration and provides increased low-frequency efficiency. Considering Fig. 3A as a vertical output stage, the capacity of C5 is normally greater than 20 mfd and C6 is 20 to 100 mfd. As an audio output stage, C5 and C6 are usually about 10 to 20 mfd.

Fig. 3B is the familiar stacked B+ circuit using the audio output stage. C7 normally has a capacity greater than 40 mfds. It smooths B+ voltage fed to the tube and reduces voltage fluctuations at the B+ end of the transformer. These fluctuations result from varying current demands induced by audio signal levels. C8 (usually between 40 and 100 mfd) reduces cathode circuit degeneration at low frequencies and supplies a smooth supply voltage to circuits in the fed portion of the stacked arrangement.

Fig. 3C is a ratio detector used for sound detection in FM and TV receivers. C9 charges to the carrier amplitude and, because of the long time constant of this capacitor and the resistor paralleling it, retains the charge despite carrier amplitude variations. The diodes are thus biased and respond only to frequency variations of the signal. The circuit therefore detects only the frequency modulation of the signal while limiting or clipping amplitude modulation to very small levels. In most designs C9 has a capacitance between 2 mfd and 10 mfd.

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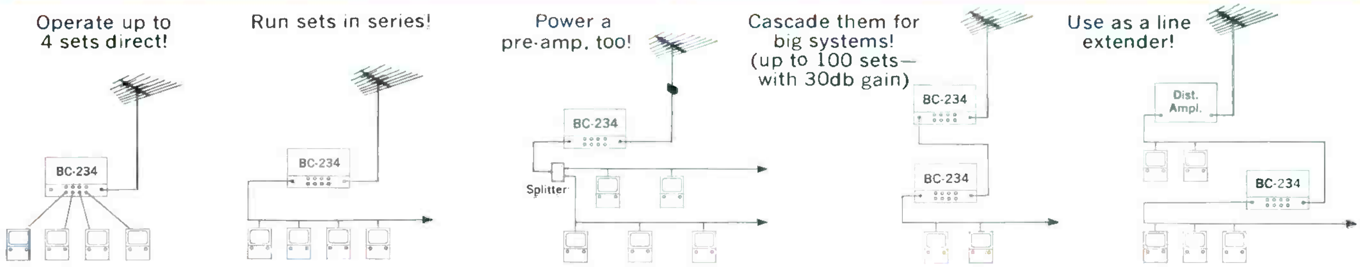

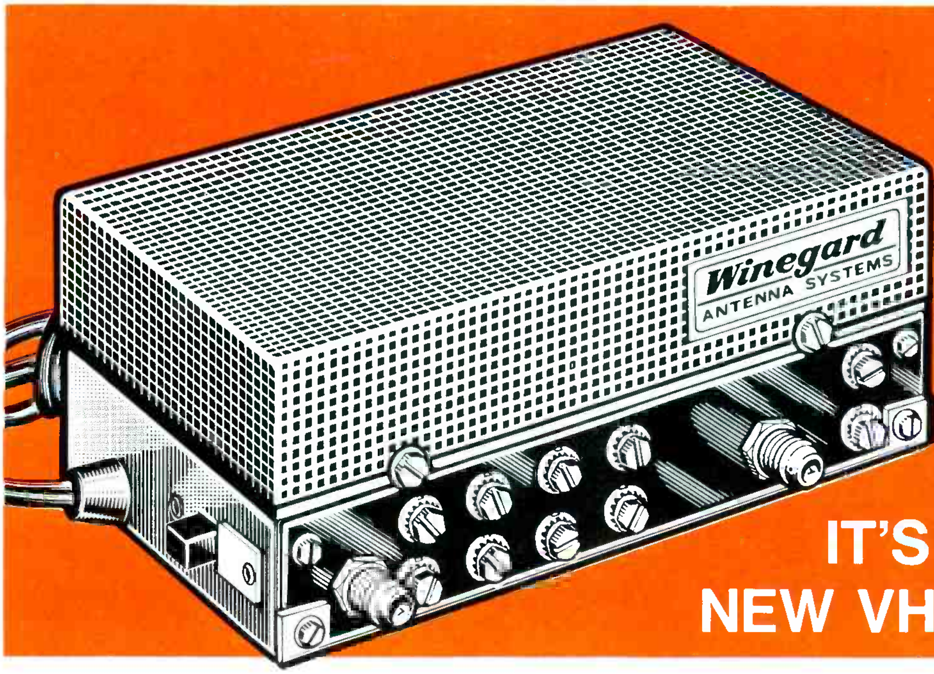

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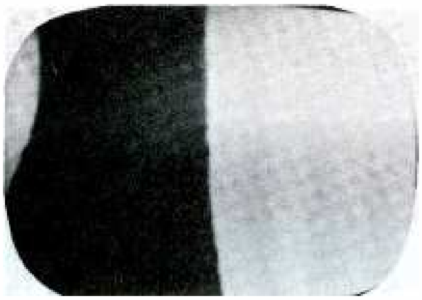
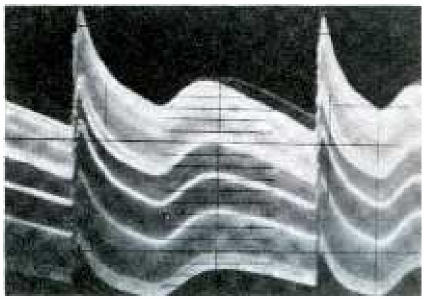
Circle 9 on literature card

Fig. 7. Raster caused by open C4.



A. Screen symptoms.



B. Waveform at any filter.

Fig. 8. Complete loss of filtering caused by open common negative lead.

designs use an electrolytic capacitor from the boost source to the damper plate as shown in Fig. 3D. It usually has a capacitance of 10-20 mfd, and is sometimes a nonpolarized unit. The signal across it is normally less than 20 volts. This signal incidentally is scoped at ½ horizontal frequency; all other scopings in this article are done at ½ of vertical frequency.

Just as the circuits in Fig. 2 have normal shaped and sized waveforms so also have the Fig. 3 circuits. Considering the Fig. 3A circuit as a vertical stage, both W1 and W2 scope as shown, with an amplitude of less than twenty volts; actual amplitude of either is subject to capacitance of the electrolytics involved. In an audio output stage similar to Fig. 3A, W1 and W2 waveforms are more similar to those of Fig. 3B, with the audio content dominant.

W3 and W4 (Fig. 3B) are virtually identical in waveshap and amplitude. Amplitude value is limited to approximately seven volts and if it becomes greater, it invariably produces bounce in the picture corresponding with sound signal levels. Occasionally excessive levels in the W3 and W4 signals produce sound bars in the picture.

Signals across the electrolytic capacitors in the ratio detector circuits (W5 in Fig. 3C) have the shape shown and an amplitude of only a few tenths of a volt.

Normally the signal across C10 in the Fig. 3D circuit will have an amplitude of less than 15 volts with, as previously noted, a horizontal wave-shape similar to that shown.

Scoping

Knowledge that all filter circuits in TV receivers have definite signal ripple amplitude limits can reduce troubleshooting time immeasureably. With a calibrated scope the filtering capability of any electrolytic capacitor can be determined as quickly as the scope probe can be applied. Therefore, all filtered circuits in any set can be checked in less than one minute. Not only can the ripple amplitude be measured but scoping will also quickly reveal the presence of hash or other unwanted signals.

Filter Defects and Picture Troubles

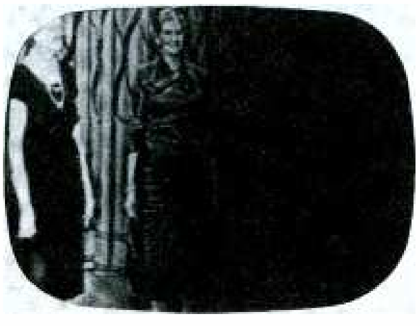
The most common trouble symptoms associated with filter defects are shown in Figs. 4A to 6A. Because these bend, twist, and curvature conditions are common, they are readily associated with filter defects by experienced TV technicians. The extreme condition in Fig. 4A has been found in numerous sets using voltage doubler circuits; when C1 in Fig. 2B or C4 in Fig. 2D suffer from considerable loss of capacitance, the waveform at the B+ supply source scopes as in Fig. 4B and has an amplitude of more than 100 volts. A less severe twist distortion (Fig. 5A) usually results from a fault in a filter corresponding to C2 in any of the Fig. 2 circuits. The odd waveshape (15 VP-P) shown in Fig. 5B wil be present at C2 because the low frequency portions of the signal across the filter increase much more than do the higher frequency signals. The very mild twist and bend in Fig. 6A is often traceable to defects in filters corresponding to C3 in any of the Fig. 2 circuits. Generally a scope trace similar to Fig. 6B results, indicating that the higher frequency bypassing efficiency is affected most.

Small and/or partially blanked rasters as presented in Figs. 7-10 are also the products of defective filters. The picture in Fig. 7 stemmed from an open capacitor corresponding to C4 in a circuit similar to Fig. 2D.

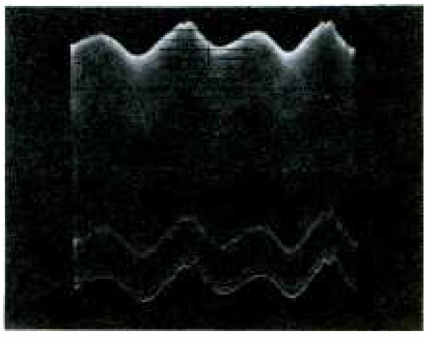
When the common negative opened in a four-section can containing filters corresponding to C1, C2 and two C3's in a circuit similar to Fig. 2E, the picture shown

• *Please turn to page 36*

Fig. 9. Open C1 in full-wave circuit produced this raster.



A. Screen symptoms.



B. Waveform on the filter.

Fig. 10. Open filter on horizontal B+.

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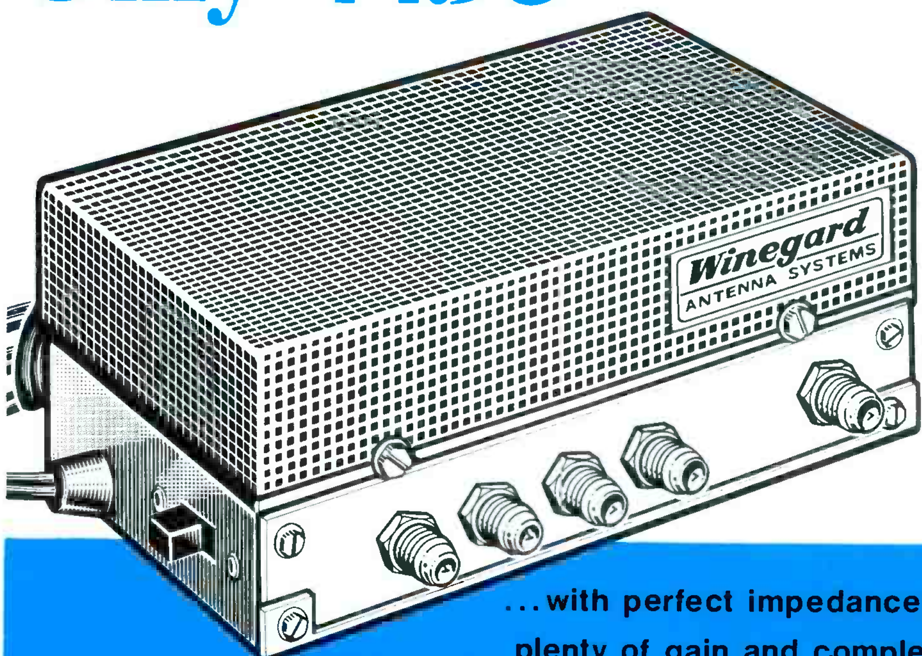

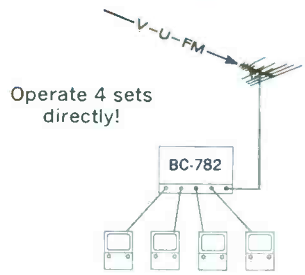

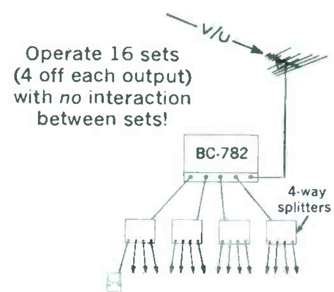

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Electrolytic Capacitors

(Continued from page 32)

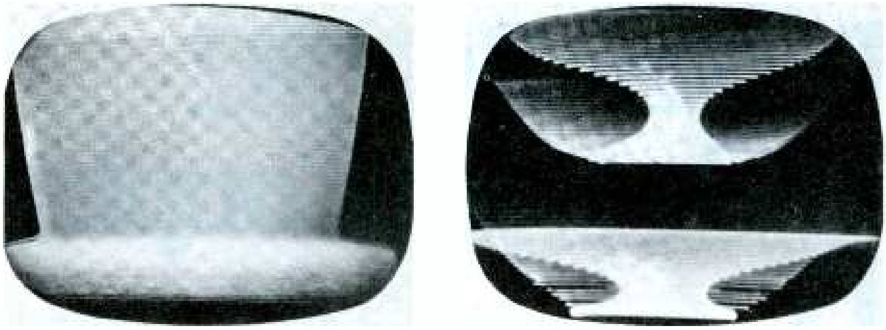

Fig. 11. Incomplete rasters produced by more than one open filter.

in Fig. 8A resulted. The waveform in Fig. 8B was scoped on all four terminals of this multisection filter. The condition shown in Fig. 9 has been seen in several receivers when the first section filter in a full wave rectifier circuit opens; amplitude of the ripple across this filter rises to several hundred volts P-P.

In an older Philco the unusual blanked raster in Fig. 10A resulted from an open filter on a separate B-supply line feeding the horizontal deflection circuit. The signal across this filter, Fig. 10B, attained an amplitude of over 100 volts and the filter choke preceding the capacitor overheated and charred.

Incomplete and odd shaped rasters are also symptomatic of electrolytic filters having lost capacitance. Invariably more than one filter is involved. Generally the first filter off the rectifier plus the filter on the horizontal deflection B-supply line cause the condition. Typical cases of this condition are shown in Figs. 11A and 11B.

Conclusion

Some technicians will question the idea of scoping filters. "Why not just shunt suspected units?" they'll ask. In addition to the fact that not all filter-caused troubles draw suspicions to filters, there are several other good reasons; 1, Shunting only individual sections when many sections are bad is invariably ineffective. 2. Shunting always presents the hazard of temporarily curing a bad filter by shocking. 3. Scoping definitely and absolutely indicates the condition of filters. 4. Scoping every filter in a set can be done in less time than it takes to shunt even a few of them.

The normal ripple and signal levels given in this article can be used to pinpoint defective capacitors. Analyzing these normals will reveal that sawform wave shapes are found at only one or two filters, and their maximum peak-to-peak value should be less than ten percent of the B voltage. Only two other filters will scope over ten volts signal; those at the vertical output tube's cathode, and at the vertical B voltage line. No capacitor should have hash or video signal greater than a few tenths of a volt. Knowing these normal conditions it becomes simple to determine a filter capacitor's efficiency. ▲

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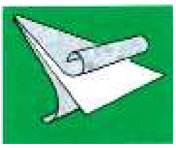
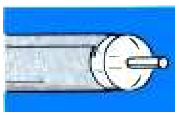
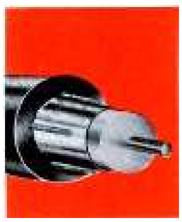


Channel Master's over-all shield is created by laminating aluminum foil to both sides of high tensile strength mylar.



This shield is then totally wrapped and over-lapped around the virgin polyethylene dielectric core containing the copper clad center conductor.



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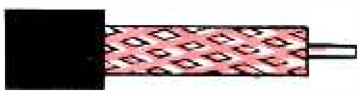

In ordinary braided shielding, air spaces are formed between the wire strands, reducing both the conductivity and the shielding effect from 80 percent in the best quality coax to as low as 50 percent in lower grade cable where fewer strands have been used in the braid.

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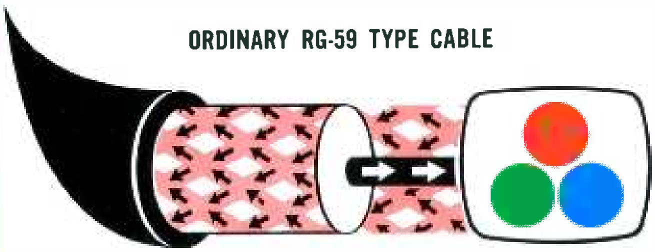

While current in the center conductor flows in a straight line with minimum resistance, to complete the circuit between set and antenna, return current must traverse individual braid strands in a "maze" pattern that creates a resistance loss. In lower grade standard coax with fewer strands, this loss is even greater.

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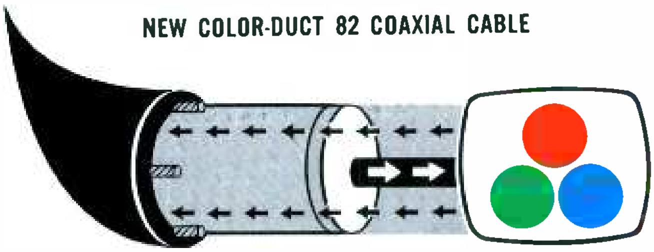

The over-all shield, plus four wires, conducts current through the same low resistance, straight-line path as the center conductor. The result is lower db loss per 100 feet at both VHF and UHF. In fact, at higher UHF frequencies in the average installation, use of Color-Duct 82 instead of ordinary coax is actually the equivalent of adding a 3 db amplifier to the installation! This is a tremendous advantage for UHF color as well as VHF fringe area coaxial installations.

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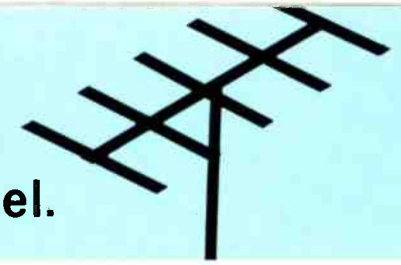

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Fig. 1.

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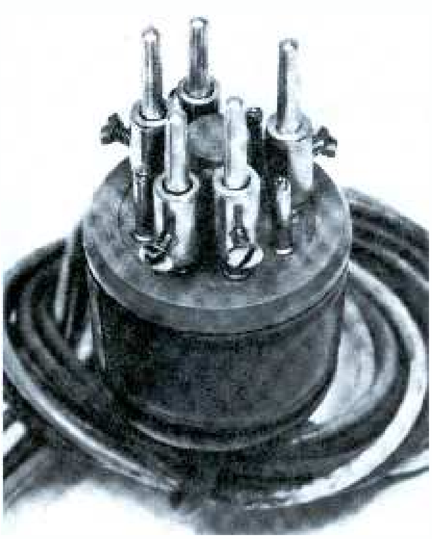

Fig. 2.

must be of the type having bent springs over a central rod. On each remove the springs, the setscrew, and the insulating shell. File the central rod smaller until it fits snugly into one of the holes on the socket. The pins of an octal plug normally are between .090″ and .096″ in diameter. The central rod on the banana plug we used measured .115″. There may be some plugs from various manufacturers with a central rod closer to .093″.

Position one adapter on each of the male pins that needs to be extended and tighten the setscrew. Position the adapters so that adjacent setscrews do not short together.

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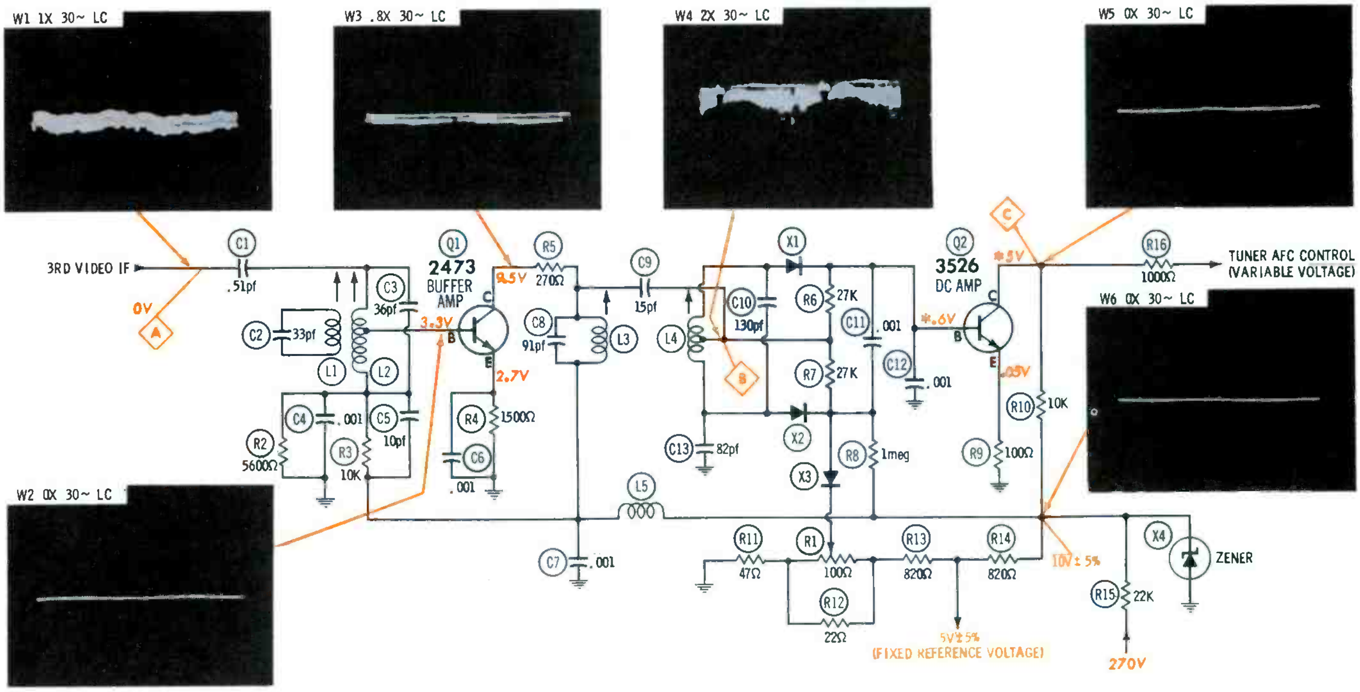


DC VOLTAGES taken with VTVM, on local station signal. *Indicates voltage will vary according to fine tuning adjustment — see "Operating Variation."

WAVEFORMS taken with wideband scope; TV controls set to produce normal picture and sound. Low-cap (LC) probe used to obtain all waveforms.

Normal Operation

Purpose of tuner automatic frequency control (AFC) is to correct any frequency error in tuner local oscillators caused by either incorrect fine tuning adjustments or any "drift" that might occur in tuners. This is accomplished by monitoring IF picture carrier signal and developing a voltage to correct oscillator frequency. The oscillators are paralleled by "voltage-dependent-capacitance" circuits; circuit capacitance varies with changes in DC voltage and, in turn, controls oscillator frequency. Output of 3rd video IF is coupled to point A of circuit shown here (RCA CTC21C), then through L2 to Q1 base. Input and output tanks of buffer amplifier are tuned to 45.75-MHz picture carrier frequency, providing maximum transfer of this signal. Bandpass of stage is intentionally narrow to prevent discriminator from operating on wrong signal, such as adjacent channel sound, color, and co-channel sound. L1 and C2 form trap to limit high-frequency pull-in range of unit. Output of Q1 coupled through C9 to discriminator coil L4, tuned to exactly 45.75 MHz. Discriminator circuitry develops correction voltage whenever there is a difference between L4 frequency and incoming IF signal (positive if high, negative if low). Discriminator output connects directly to DC amplifier base and controls bias. This in turn varies collector voltage which is connected to one side of control component in tuner. Other side is connected to fixed reference voltage from junction of R13 and R14. Collector voltage rises above or drops below reference voltage (according to discriminator output). This varies bias of control component, which then changes capacitance.

Operating Variations

Disc. R1, (with R8) sets reference level for discriminator. Narrow pull-in range (±.75 to 1.25 MHz either side of picture carrier) prevents "lock-in" on wrong carrier. R1 determines pull-in range above and below picture carrier—at one end of control pull-in is good, even if oscillator increases about 2 MHz, but will not correct decrease in frequency. Opposite is true with control at other end. At optimum setting, pull-in is equal with either high- or low-frequency error.

Q2 Base bias determined by R6, R7, R8, and discriminator output. Voltage is about .6 volts with tuner oscillator on freqency—varies ±.1 volt with picture carrier frequency error. Emitter changes from 0 to .1 volt according to amount of transistor conduction. Collector voltage deviates from normal (oscillator on frequency) 5 volts to about .45 volts in one direction and 9.5 volts in other.

Waveforms Since p-p readings are extremely small, value of W1 is designated 1X and amplitude of other waveforms compared to it. Normal W1 is approximately .1 to .2 volts p-p. Even low-C probe detunes input to Q1 to extent that no waveform can be seen at base. Probe also affects W3—reading (.8X). W4 varies somewhat with signal strength from 2X to about 4X. Any AC present at point C or at B+ source (W5 and W6) indicates malfunction—normally only DC voltages present at this point.

Symptom 1

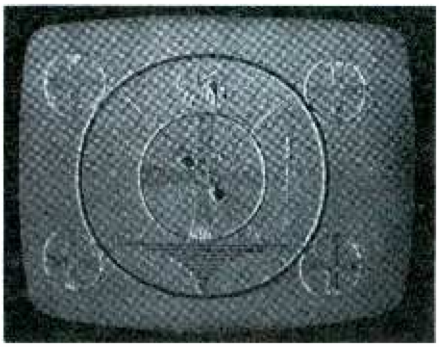
AFC Range Narrow

Fine Tuning Must Be Exact

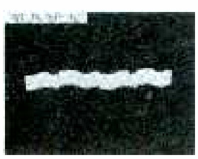
C4 Open

(Bypass capacitor — .001 mfd)

Symptom Analysis



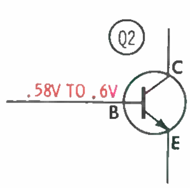
Most noticeable on color programs since fine tuning must be exact for proper color reception. Weak stations are worst—color "comes and goes"—no AFC action. Pull-in range is quite narrow—small oscillator drift or fine tuning error will cause loss of color.



Waveform Analysis

Highly peaked tuned circuits, along with very low amplitude signal in both input and output circuits of Q1, make signal tracing difficult, even with low-C probe. W1 appears normal with 1X. W3 (not shown) measures about .5X, versus normal .8X. Best place to obtain indication of Q1 stage gain is at point B. W4 shows only a trace of waveform (.1X, normally 2 to 4X). Best clue to trouble is presence of waveform at junction of L2 and C4—normally only DC present at this point.

Voltage and Component Analysis



Normally, Q1 element voltages do not change between "signal" and "no signal" conditions; therefore, voltages measure normal with symptom present. Slight variation of Q2 base voltage—.02 volts, normally about .2 volts. Rotating fine tuning in both directions shows discriminator output is insufficient. C4 is RF ground to input signal. With C4 open, signal is dropped across R2 and R3, instead of Q1. Result: Q1 has little signal to amplify and discriminator circuitry has insufficient signal to operate properly.

Best Bet: Scope; VTVM; component substitution

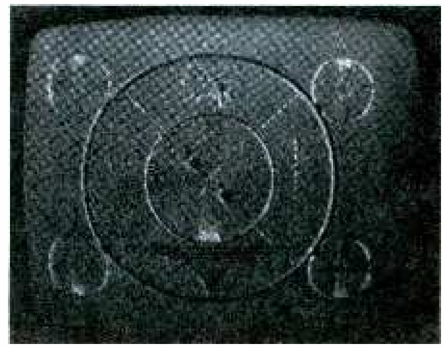
Symptom 2

No AFC Action

Manual Fine Tuning Not Affected

Q1 Leaky

(Buffer Amp — NPN Transistor)

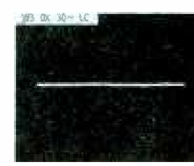


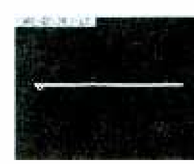
Symptom Analysis

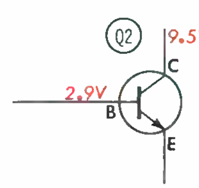
Fine tuning operates just like set that is not equipped with AFC or has AFC turned off. No pull-in action —mistune either direction, release fine tune knob, and picture stays same. Normally, AFC circuitry will correct tuner oscillator frequency error.

Waveform Analysis

W1 shows sufficient amplitude and content for proper AFC action. Since this waveform is from output of third video IF, amplitude is dependent upon RF amplification, fine tuning, AGC, and IF amplification. Also, vertical gain of scope is a factor. Maximum scope vertical amplifier setting necessary to get 1X reading at A (W1). W3, normally .8X, is almost nonexistent, as is W4, which should be at least 2X. Waveform analysis indicates input signal is lost in buffer amplifier stage.







Voltage and Component Analysis

Best voltage clue is comparison of Q1 emitter and base voltages—although bias is correct polarity, only .1 volt difference between two elements (normally .6 volts difference). Emitter is .1 volt high, base .4 volts low. Shorted transisor is good suspect. Q1 and associated circuitry is essentially another IF amplifier stage, except bandwidth is very narrow so that signal transfer is limited to 45.75-MHz carrier. Any trouble that blocks input signal kills AFC action since discriminator has no reference signal.

Best Bet: Preliminary checks; VTVM

Symptom 3

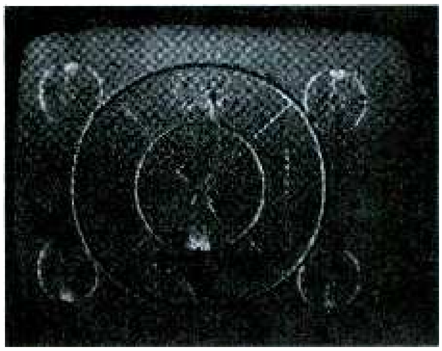
Oscillator Frequency Incorrect With AFC on

Normal With AFC Off

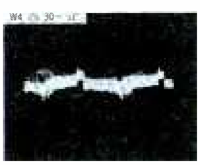
X1 Open

(Discriminator Diode)

Symptom Analysis



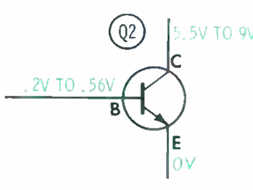
AFC is automatically made inoperative during fine tuning by shorting variable and reference voltages together. Adjusting fine tuning for best picture and sound, then releasing knob, results in badly mistuned picture —AFC adjusts oscillator to wrong frequency.



Waveform Analysis

Tracing input signal through Q1 to point B shows operation is normal. W1 measures 1X. W3 (not shown) at Q1 collector is acceptable (.7X). W4 also has sufficient amplitude (2X) for good AFC action. Waveform at Q2 base indicates trouble in discriminator since only DC voltage is normally measured here. Although only IF picture carrier is fed to AFC circuitry, signal is rectified to some extent and looks similar to composite video waveform.

Voltage and Component Analysis



Collector and base voltages, with fine tuning set for good picture, are good clue—8 and .5 volts, respectively. Collector should read same reference voltage when fine tuning is correct. Normal "on frequency" reading at base is .6 volts, and .5 to .7 volts when varying fine tuning. Now base is .5 volts, and .2 to .56 volts—limiting collector to reference voltage or above. With X1 open, discriminator output always negative going (Q2 base wrong)—Q2 collector voltage causes tuner control circuit to vary oscillator.

Best Bet: VTVM will locate.

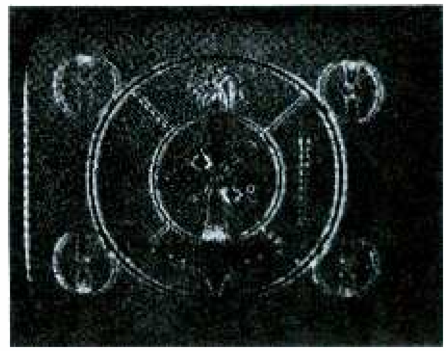
AFC Detunes Oscillator

Frequency Low

X1 Shorted

(Discriminator Diode)

Symptom 4

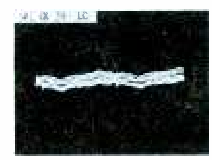


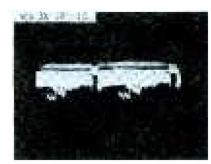
Symptom Analysis

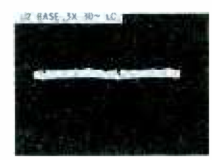
Symptom here is similar to that described in symptom No. 3—fine tune for good picture, then release knob, and picture is badly mistuned—sound in picture and poor sound. Normal picture possible with AFC on by mistuning, but pull-in action is not correct.

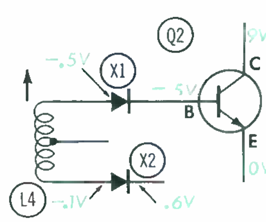
Waveform Analysis

Waveform taken with AFC off so that good strong station signal is available. AFC switch in off position shorts variable and fixed reference voltage sources together so that no correction voltage is fed to control circuit of tuner. This does not affect AFC input or discriminator circuitry. W1 and W4 read 1X and 3X, respectively—show discriminator has good input. Presence of waveform at Q2 base again throws suspicion on discriminator.









Voltage and Component Analysis

Voltage at Q2 base after fine tuning for good picture is −.5 volts—transistor is cut off, with near maximum voltage at collector. Variable and fixed reference voltages normally are near same potential when fine tuning is correct. Best clue is same voltage reading at both cathode (Q2 base) and anode X1. Shorted X1 sets off chain reaction: Q2 base bias is wrong; causes incorrect collector voltage; control circuit in tuner changes capacitance and produces incorrect local oscillator frequency.

Best Bet: Scope isolates; VTVM locates.

Symptom 5

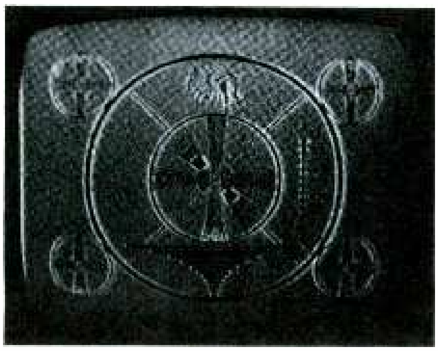
AFC Detunes Oscillator

Error Slight

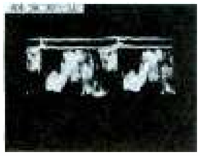
R14 Increased

(Voltage divider — 820 ohms)

Symptom Analysis



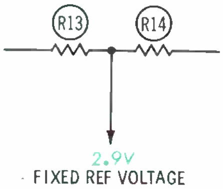
Good picture and sound can be received by adjusting fine tuning with AFC off. But when AFC is turned on, tuner local oscillator frequency is changed and sound and/or picture is affected. Normally, AFC would only "lock-in" on correct frequency—not change it.



Waveform Analysis

Strong W4 (3 to 4X) clears input circuitry. Second and third waveforms are taken at top and bottom of L4 (junction of L4, X1 and L4, X2) and amplitude of each is approximately 1X. While input signal is rectified to some extent by circuit and looks similar to composite video, discriminator operates only on frequency error between IF video carrier (input signal) and tuned circuit L4. Waveform analysis indicates discriminator is receiving necessary signal.

Voltage and Component Analysis



Q2 collector voltage (variable source) shows normal range of readings from 2 to 9 volts with different fine tuning settings. However, collector potential relative to ground not only consideration—its relation to fixed reference voltage (± 5 volts) controls variable capacitance unit in tuner. If variable voltage rises above reference, oscillator frequency increases—if lower, frequency decreases. Incorrect reference voltage produces wrong correction voltage across tuner control circuit, causing local oscillator to shift.

Best Bet: Circuit analysis and VTVM.

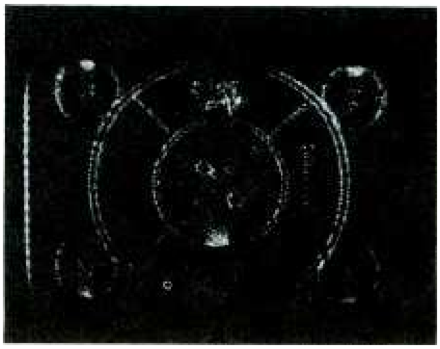
Symptom 6

Detuned Picture With AFC On

Normal With AFC Off

Q2 Leaky

(DC Amplifier — NPN Transistor)

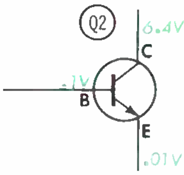


Symptom Analysis

Receiver operates in normal manner with AFC off, but when on, picture is detuned after fine tuning knob is released. Good picture and sound can be received by mistuning in opposite direction from sound bars, but there is no AFC "lock-in" action.

Waveform Analysis

First W1 waveform taken with symptom present (oscillator off frequency) shows slightly low amplitude (.7X, normally 1X) and content is mostly noise — snow on screen. Second W1, with AFC off, is normal in content and amplitude (1X). W4 shows good input signal to discriminator. Again, normal input waveforms can be observed with AFC switch off since switch only shorts variable and reference voltages together and does not affect input circuitry.



Voltage and Component Analysis

Most important clue is Q2 base voltage—remains at .1 volt through changes in fine tuning. Since base bias does not change, collector (variable voltage source to control circuit in tuner) remains at same level. Normally, base varies maximum of about .1 volt above or below .6 volts according to discriminator output and, in turn, sets collector voltage above or below fixed reference voltage. Leaky transistor (base to emitter) holds bias at constant level—doesn't allow discriminator output to control operation of stage.

Best Bet: VTVM for voltage and resistance checks.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NOTES ON

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

by T. T. Jones

The Unijunction Transistor

During the past few years many equipment manufacturers have introduced new color generators. The prices have steadily decreased, while the signal quality and reliability has increased. So we're getting a lot more for our test equipment dollar. One of the biggest reasons for this increased value is the use of solid-state components. We're all of course aware of the reduction in power requirements afforded by transistors, which allows us to use lighter and less expensive components.

To most of us however, a multivibrator is still a complex circuit, using two triodes (or transistors) and a lot of other components—something like the circuit in Fig. 1. This has been our old standby frequency divider—and a good one. It oscillates at its own frequency, triggered by pulses of another oscillator working at a higher frequency. In recent color generator designs, the tubes have been repaced by transistors.

About two years ago the unijunction transistor started appearing in color generators. The UJT multivibrator also oscillates at it's own design frequency, triggered by higher frequency pulses. And there the similarity ends. The circuit is so much different that it warrants a closer examination.

Fig. 2 shows the basic UJT multivibrator circuit. Note that the waveform on the emitter closely resembles the waveform on the grid of the tube circuit. (Disregard the number of pulses; the circuits are dividing at different rates). So this simple little circuit produces the same useful output with less than half as many components as the tube circuit—and with less expensive components.

The operation of a UJT is really quite simple. For those of you who like to draw analogies between solid-state devices and tubes, the UJT is roughly comparable to a gas thyratron. However, it has some characteristics of its own, and does not have all the characteristics of the thyratron, so there is no exact counterpart in the tube world. Our discussion will omit the theory of holes, carriers, depletion layers and the like. (This information may be found in GE Application Note 90.10 5/65.)

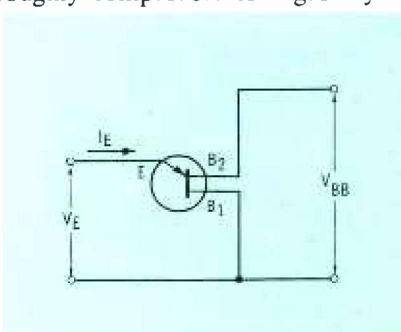


Fig. 3. Diagram shows important UJT nomenclature.

The three elements of the UJT are called Emitter, Base 1, and Base 2 (Fig. 3). The emitter is the heart of the device. Signals are often taken from the emitter as well as inserted upon it. V_{BB} is the applied positive bias on the device. As long as the emitter voltage is kept below a critical point (determined by the parameters of the UJT in use) no current will flow in the emitter circuit. As the emitter voltage is raised past the critical point, current will flow between the emitter and Base 1.

The emitter characteristics are shown in Fig. 4. Note that as the emitter voltage reaches the critical point (called the peak point), the device displays a negative resistance characteristic. The current rises as the emitter voltage falls, until they parallel at the valley point. The regions of the curves to the right of the valley are saturated.

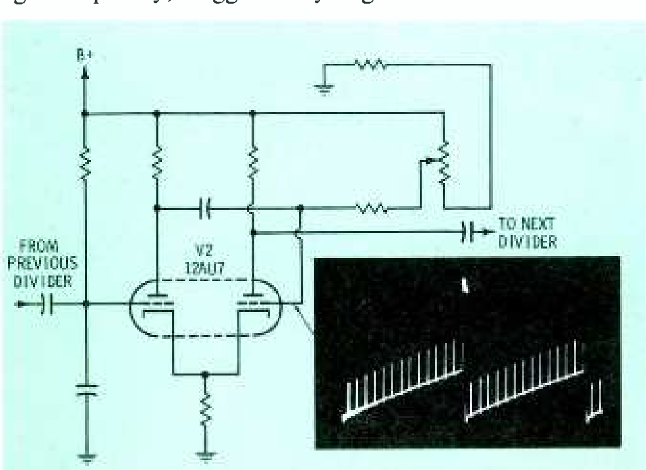


Fig. 1. Typical tube-type multivibrator.

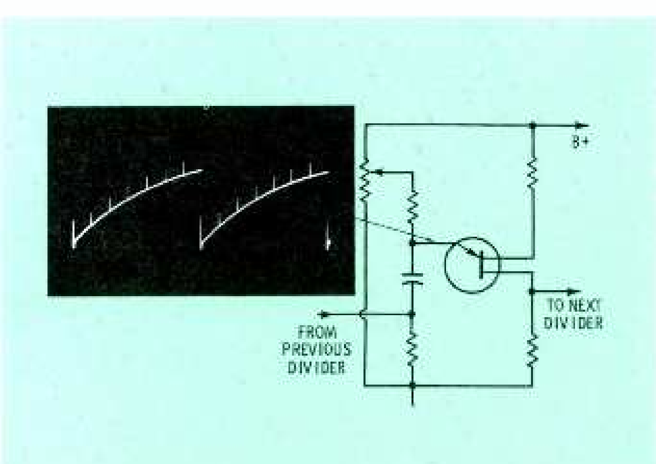


Fig. 2. The UJT multivibrator.

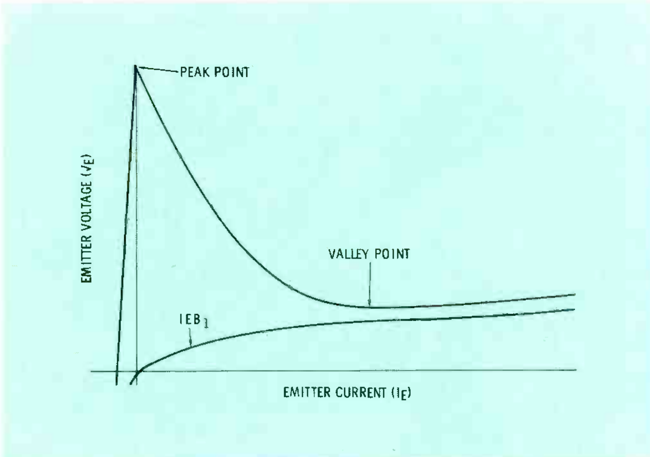


Fig. 4. Static emitter characteristic curve.

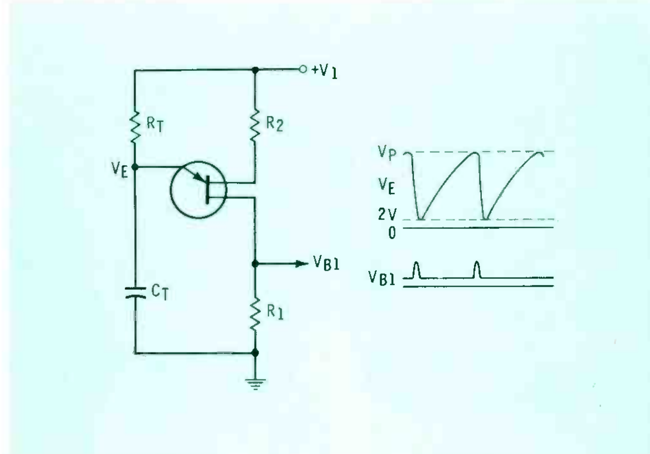


Fig. 5. Typical UJT relaxation oscillator.

Fig. 5 shows the UJT in a typical relaxation oscillator circuit. The voltage waveform on the emitter will be a sawtooth with a frequency determined by RT and CT. The output, V_{B1}, is a series of pulses corresponding to the discharge of the capacitor. The capacitor discharges at the peak point of the emitter curve. By adjusting biases of the elements it is possible to synchronize the UJT relaxation oscillator to incoming pulses, as in Fig. 2. The circuit then becomes a multivibrator for our purpose, which is countdown circuits.

New Color Generator

Hickok's new Model GC 660 color generator is pictured in Fig. 6. With the cover in place, the instrument bears a strong resemblance to the older Model 660. It's about the same size, and housed in the same style leatherette-covered wood case. As soon as you pick-up the GC 660, you'll realize that there's been some changes. The old 660 weighed 15 pounds; the GC 660 weights but 6¼ pounds.

The outputs of the GC 660 are essentially the same as older model, with two very important differences. Now included is a set of gun killers.

Hickok Model GC 660 Specifications

Patterns:

Vertical bars (18).
Horizontal bars (18).
Crosshatch (18 × 18).
Dots (324).
Keyed rainbow.

Outputs:

Composite Sync, 2V P-P.
Composite video, 2V P-P, + or −.
RF carrier channels 3-5, adjustable from front panel.
Sound carrier (4.5 MHz).

Power Requirements:
105-125 VAC, 50-60 Hz, 3 watts.

Size (HWD):
10⅜" × 10¾" × 5".

Weight:
6¼ pounds.

Price:
$159.50.

These are controlled by a rotary switch which gives a choice of guns to be left "on"—Normal, R + G, R + B, G, B, or R.

The second important new feature is the color display. This is now a keyed-rainbow, rather than the unkeyed-rainbow of the 660.

Fig. 6. New solid-state color generator.

A third feature which may be of interest is the fact that there is absolutely no similarity electrically between the two units. The GC 660 is solid-state and uses completely different circuits.

The block diagram is shown in Fig. 6. Note that the counting sequence starts at 378 kHz, has a number of buffers, and no stage divides by more than 7. These factors, and the use of unijunction transistors, insure that the GC 660 will maintain a high degree of stability under most any conditions.

The vertical and horizontal bars are developed by silicon switching transistors, which have inherently fast rise time. The lines and dots, therefore, are very narrow. ▲

For further information circle 48 of literature card

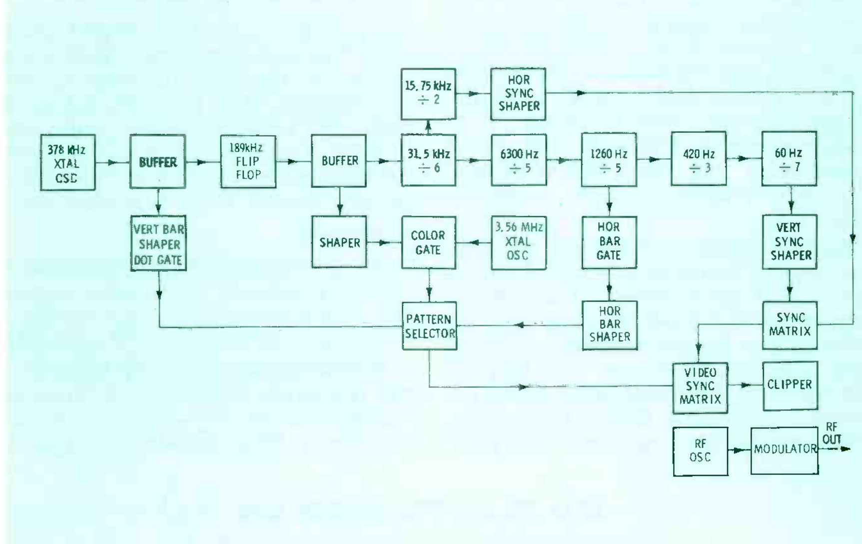
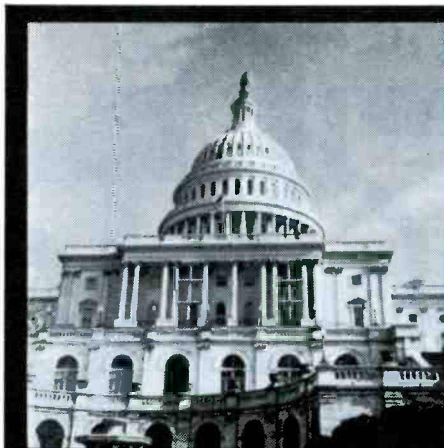


Fig. 7. Portions of GC 660 block diagram.


1.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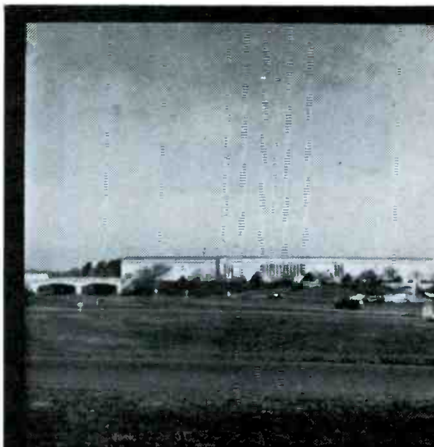
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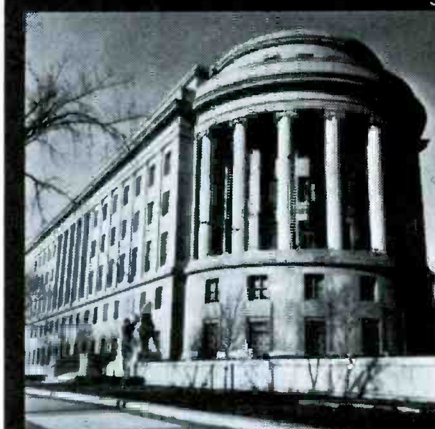
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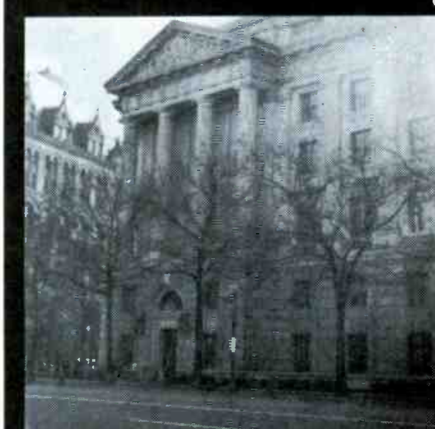
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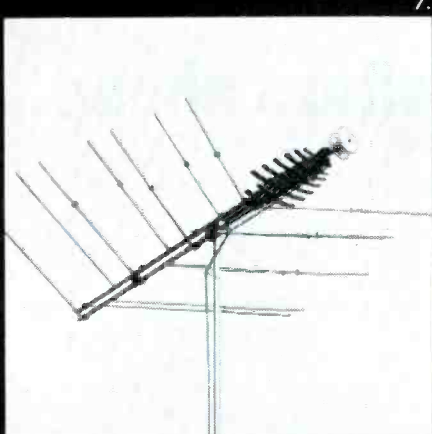
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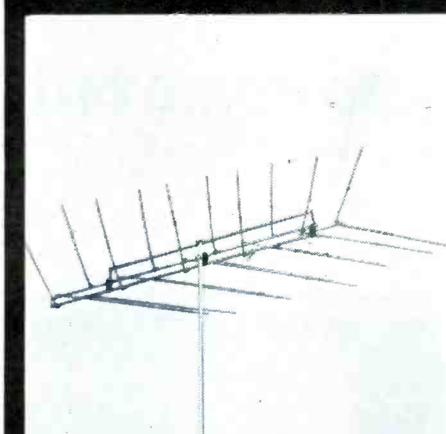
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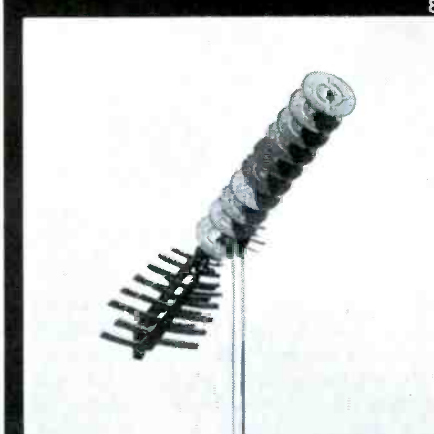
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 (Continued from page 26)

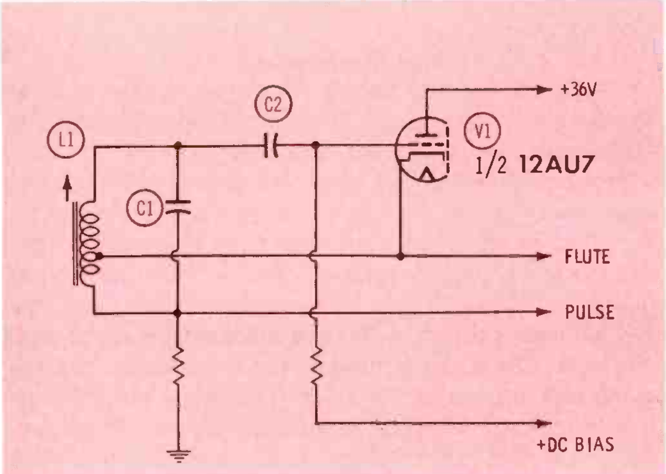


Fig. 4. Conn tone generator.

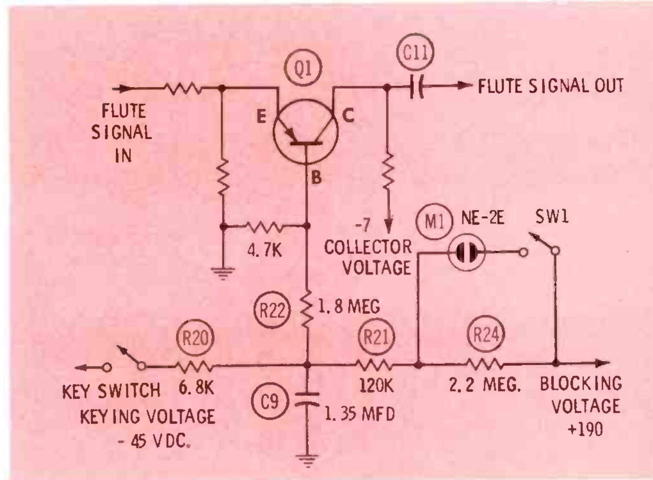


Fig. 5. Transistor keying switch.

cally a Hartley oscillator, as in Fig. 4. The pulse output, which is richer in harmonics than the flute output, is used for the reed and string stops. When a key is depressed, its note is allowed to pass from the generator, on through the organ, to the speakers. Sometimes the note is switched directly through a set of contacts below the key. More often though, the note is switched by an electronic keyer.

A typical transistor keyer is shown in Fig. 5. The incoming signal is applied to the emitter of Q1, which is biased to cutoff by the *blocking voltage applied* through R24, R21, and R22. If the key for this note is depressed, a negative *keying voltage* is applied to the base of Q1 through R20 and R22. This negative voltage forward biases Q1, allowing it to conduct and pass the signal on to the preamplifier. The decay characteristics of the note are determined by C9 and the amount of blocking voltage. When the key switch is released, C9 starts to discharge through R22 and R23 and tends to maintain the forward bias on Q1 for a longer period of time, producing a gradual decay of the signal, rather than a sharp cutoff. The amount of blocking voltage, and therefore the length of the note, is selected by stops, such as SW1. There are other stops elsewhere in the circuitry.

A typical preamplifier and associated stops is shown in Fig. 6. This is a straightforward common base configuration and needs no discussion. However, the stops are interesting. Note that with all switches closed (*stops off*) the output of the amplifier is grounded

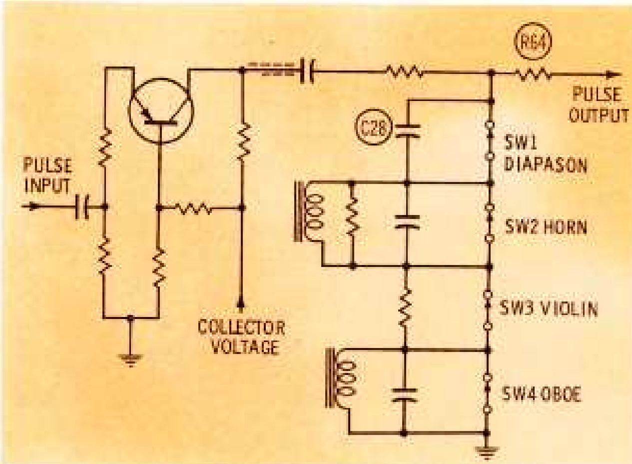


Fig. 6. Preamp with stops.

and no note will sound. Adding the diapason effectively makes a simple integrator circuit of R62 and C28. A large portion of the waveform is shaped and passed by this integrator. Adding other stops produces more complex wave shaping.

From the preamplifier on to the speakers, the organ may be treated as a typical Hi-Fi amplifier. There are often separate preamplifiers for pedal notes and the various stops, and these must be adjusted so that their relative gain is about equal. This is done to insure that one group of notes will not over-power the others. These adjustments will be found in the manufacturer's service information.

Troubleshooting

The basic test instrument for organ repairing is a VOM or VTVM. About 90% of all troubles can be found with this instrument alone. A good AC VTVM with scales down to .03 volts will also prove valuable since many of the signals to be measured in organs are small in amplitude. Another must is an audio signal tracer. (Some models of AC VTVM have this built-in.) With a tracer you can make sure that the AC voltages you are measuring are actually signal and not hum. The tracer is used in much the same manner as an oscilloscope in TV work. The scope, by the way is seldom used in organ servicing. The waveforms are quite complex, and in many cases, so similar that they become meaningless. For this reason, the tracer and an experienced ear are used to determine what signal is present at any given point in the organ.

Since most manufacturers are changing to solid-state organs, it follows that a good in-circuit transistor tester will be helpful in organ repair. Though there may be several hundred transistors in the organ, only a few need be tested on any one job. There will be only a dozen or so in the direct line from key to speaker, and often it is easy to narrow the trouble down to one particular stage, even before removing the back from the organ.

A study of Fig. 3. will show how this is possible. The many different signals merge at different places along the line from keys to speakers. For instance, if both the pedals and flutes work, the serviceman need only listen at the pulse speaker to determine if the pulse is lost before, or after, the pulse post preamplifier. If the pedal note is present in the pulse speaker, the pulse post preamplifier and pulse power amplifier must be functioning normally. The principle is exactly the same as troubleshooting an AM-FM-MPX radio/phonograph combination.

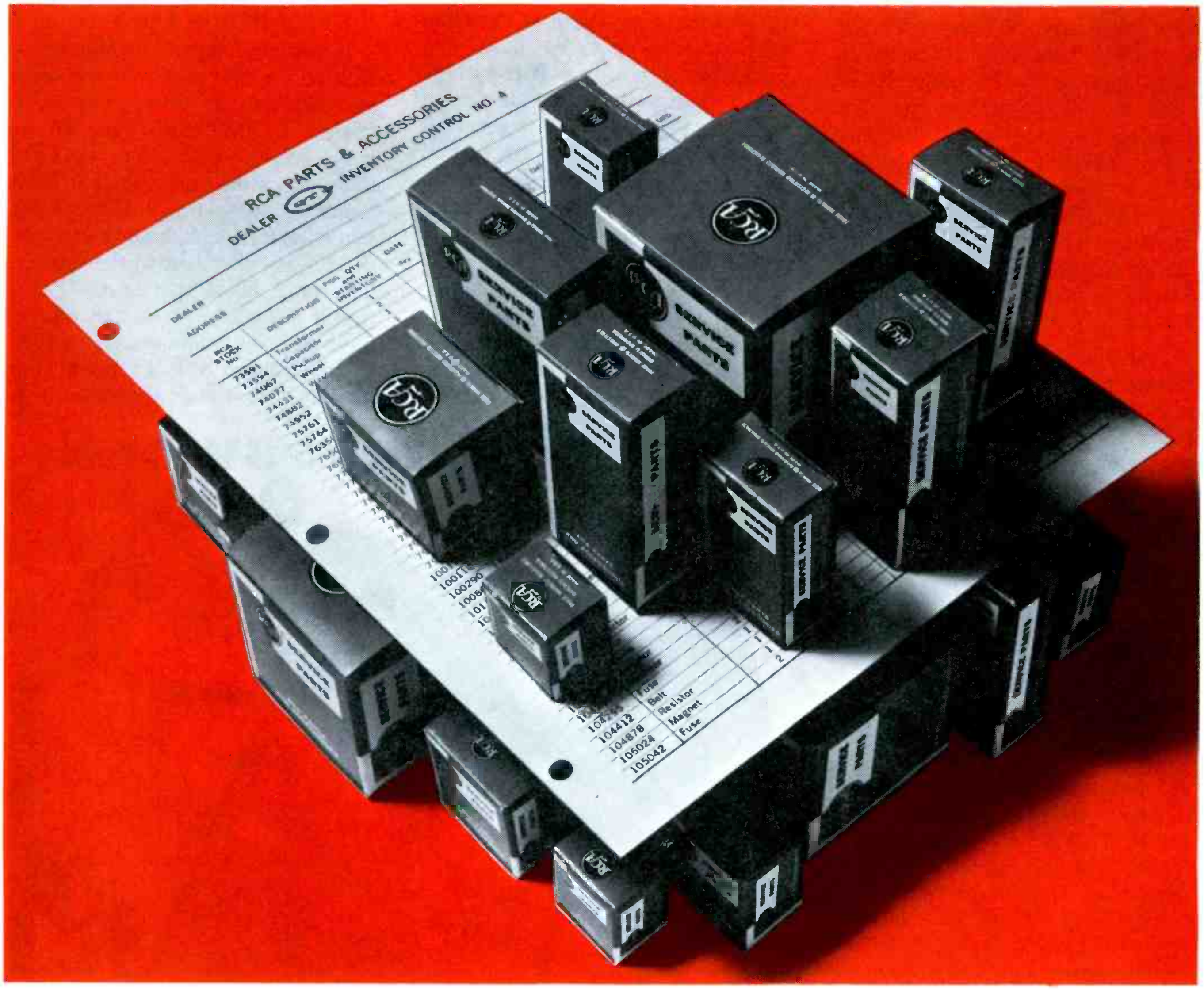
The biggest difference in organ service work, compared to TV work, is that all repairs must be done in the home. The organ is a large instrument, with most sub-chassis dependent on each other. Because of this, you can't remove it to the shop as a whole unit, nor in pieces. However, as we have pointed out previously, little test equipment is needed, and furthermore, most organs are designed for easy "on-site" troubleshooting.

In spite of the fact that there are many, many components in an organ, the parts needed to repair any one manufacturer's line may be carried in a case no bigger than a tube caddy. This is because so many of the circuits are repeated over and over. The 73 tone generators in a Conn Organ all use the same tube type— a 12AU7. Although the frequency determining components are different, many are shared, so that the total required is nearly halved. Also, most parts are not critical and may be freely substituted, so the number of spare parts carried is further reduced. However, the tone generator parts (L1, C1, and C2 in Fig. 4) **are** critical. C1 and C2 are special temperature-compensated capacitors and should always be replaced with the manufacturer's parts. If exact replacements are not used, the note is almost sure to drift out of tune, resulting in a call-back. Also, for intermittent or drifting notes, it is advisable to replace all of these components at the same time. The component cost is small compared to the cost of a callback.

Once you have repaired a tone generator, the note must be tuned. The tuning adjustments vary widely from one make of organ to the next. Some use a potentiometer or trimmer capacitor, while some use a coil adjustment. The procedure for tuning one note is simple. Play the note one octave below or above at the same time as the note to be tuned, and adjust for a zero beat. If the whole organ needs tuning, a standard must be used. This may be a tuning fork or a strobotuner. The instruction manual supplied with the strobotuner tells how to use this instrument. Instructions on the tuning fork method may be found in Howard W. Sams books ORG-1 (page 171) and EOA-1 (page 229). These books also contain a wealth of other information on organs, including specific service information on many models.

How to Begin

If you are living in a smaller town, with only a few organs to take care of, make contacts with nearby organ dealers. In most cases, they will be happy to learn that you're willing to take care of the organs in your community. They will be able to furnish you with service manuals and parts, or at least refer you to the factory. The same holds true in the larger towns; in many cases, the dealers have a problem taking care of their customers and will welcome your assistance in sharing the load. ▲



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Great Blobs of Color

(Continued from page 24)

electrolytic in the contrast control circuitry will give you a picture that is similar but not identical. It will be very pale looking, and the colors will go reddish, as you can see in Fig. 5. This one is easy: The contrast control won't have any effect at all on the picture. (Incidentally, while I'm thinking of it, watch out for this control on some of the older sets, back around the CTC9 or so. If the contrast control in these is turned all the way up, you'll have more troubles than you can shake a stick at! Misconvergence, oversaturation of color, and on and on all due to too much contrast. The proper operating position for this control in these chassis is all the way off! Try it and see.)

For a set with an assortment of symptoms, and one that called for some really scratchy diagnoses, this one took the cake. This was a Sylvania DO-5 table model color set. The screen was a mess; colors in great blobs, unstable sync, and a few other odd things. Fig. 6 shows this better than I could ever describe it. While sitting there scratching my head, I tuned the set back and forth across several channels. I happened to go by a station with an old-fashioned, black-and-white picture. Luckily, I stopped long enough to look at it. It was black and white, all right, but the black was where the white ought to be! In other words, I had a very nice negative picture! Oh, ho! Now I began to see the light. Even I can figure out that color signals with the Y component reversed are going to look funny, and they does!

Well, only one thing causes this: a reversal of polarity. This set seems to have a two-stage video amplifier, like the DO-3; a 5MB8 on the video IF board, and a 10JT8 video output. Now, let's see. . . . whoa! Look at the schematic (Figure 7). Looky there! A little transistor amplifier in between the two tube amplifier stages. Well, well.

There's only one way to find out. "Up scope!" The video signal looks good on the 5MB8 grid. Sync going negative, just as it should. 5MB8 plate, sync going positive; still OK. Transistor base signal about what it should be. Going to the grid of the 10JT8 output tube, about the same. Hmm. No gain. Hmm, no inversion either! Sync still going positive; this won't do. When we invert in the 10JT8 tube, we'll wind up with negative going sync, and a negative picture. Well, that's what we've got, isn't it?

So, I counted the number of signal inversions on my fingers, and then checked the polarity of the video detector crystal on the schematic, to make sure that the transistor wasn't connected as an emitter follower or something, which it wasn't. The transistor wasn't amplifying the signal, and it wasn't inverting it, either.

Well, everybody knows what causes this! A base-collector short in the transistor. So, I hooked up my new in-circuit transistor checker, pushed the red button and . . . Hmm. What d'you mean GOOD? Look, stupid, I can see that transistor's shorted! No inversion, no gain and look here—my ohmmeter says that there's a 120-ohm short directly across the thing from base to collector! And you sit there and beam your little red eye at me and say 'GOOD'? Well, all right, you smart-alec transistor tester, we'll see. I'll take your word for it, and leave the transistor in there until the last thing. Now let's find that short.

There are only eight resistors, a wee capacitor, and one tiny peaking coil in the whole circuit. So, let's unhook 'em and see. I clipped the ohmmeter across the circuit from the transistor base to the delay-line output, and every time I pulled something loose, I checked the meter to see if that killed the short. Seven resistors and one peaking coil later, the short was still there. One resistor left. I disconnected it, and the short disappeared! Ah, ha! Rechecked the transistor; still good. Hmm. Now, I replaced the last resistor I unhooked. (All of these parts checked good, of course). Hmm. No short now. I put all the parts back, watching the ohmmeter. Oh goody! No short. Take the ohmmeter off and turn the set on and let's see. Fine! Perfect picture; nice color, plenty of contrast, everything you'd want.

Now, what's we do? We cleared the short, obviously, but where the heck was it to begin with? Well, you can sit there long enough and you begin to think, even if it does make your head hurt. When I disconnected the last resistor, I'd noticed this little lance through the PC board wobble just a bit. Evidently, there had been a solder blob somewhere on the other side that had been shorting to something else. When I melted the joint, the solder blob had retracted, and so had the color blobs. A close examination of the whole thing with a magnifying glass failed to show it up, but the short had been there, and I'd cleared it (more or less accidentally). Anyhow, I'd learned one thing; the transistor checker worked.

We're going to run into more and more transistor circuitry. Zenith is using almost the same thing in the 23XC36 series chassis, and others. A small transistor amplifier between two tube amplifier stages. The arrangement is different, as the video detector delivers a positive going video signal, the 1st video stage is a cathode follower, the transistor stage is a common emitter type, and the last stage is the high-gain 12HL7 tube, with a positive-going-sync picture coming out on the cathodes of the color CRT at about 130 volts p-p.

In the Sylvania circuit, the color signals take off from the emitter of the transistor stage; so, it acts as an emitter-follower for color, and as a common-emitter for the video signals. As you can see from the picture in Fig. 6, the shorted stage upset the colors pretty badly, and at the same time it inverted the video signal polarity. In other transistor amplifier circuits you will probably find different symptoms, depending on just what kind of defect has developed. Here, as in any kind of transistor amplifier stage, we're going to have to watch out for those tiny bias voltages.

The scope is still the most effective weapon for testing Y circuits. It will show you the signal levels at input and output of the stage, and if these levels are within tolerance, the stage is pretty apt to be all right. When you find a stage with input and no output, then stop and hunt for troubles. Or, as you can see, if we find one with input right side up and output still right side up, when it ought to be upside down, then we've found the trouble. Voltage readings won't tell you anything about signal polarity, but the scope will. ▲

THE TROUBLE-SHOOTER

answers your servicing problems

Video Detector

We had a General Electric Chassis AY (PHOTOFACT Folder 725-2) with no video and poor sound. On examining the set, we discovered that the video detector diode had been brought from its original location to a bracket on the rear of the set. It was connected into the circuit with a section of 300-ohm lead-in. We replaced the diode, and the picture and sound returned to normal.

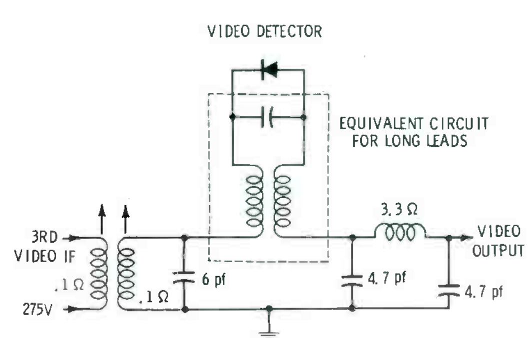
Three months later, the diode went bad again. All circuits around the diode check within tolerance. Any clues?

DONALD D. TEAGLE

Barberton, Ohio

This looks like another good argument for keeping the shielding and lead dress intact. With the diode connected at the end of long leads, there is a good possibility that the leads are picking up energy radiated from the sweep circuits. This energy can be great enough to exceed the peak ratings of the diode and cause it to burn out.

When the diode was taken from its original location, the tuning of L7 may have been changed. After you put the diode back where it belongs, check to see if the detector circuit needs to be aligned. As "insurance" against more trouble, insert a 750-ohm resistor between the detector output and the video amplifier grid.



No Vertical Output

I have an Admiral Chassis 21B1 (PHOTOFACT Folder 118-2) with intermittent vertical sweep. The sweep returns occasionally, sometimes with compression at top and bottom. Even when I have a full raster, the retrace lines are visible and the top few of them appear to "dance" and have white spots on them.

With no vertical sweep, the only unusual voltage reading is at the grid of the 6S4 vertical output tube. This voltage should be zero, and although the VTVM "hovers" around the zero mark, the needele jitters as though an alternating voltage were present

All components in the vertical section have been changed, but still no sweep. I would appreciate any help you can offer. Incidentally, if this set is from another production run, perhapts some components have been added which I don't know about.

Thirteen days later — A new 6S4 socket was installed and the vertical sweep returned. I still had the retrace lines with the "dancing white spots," but replacing the vertical output transformer eliminated this problem. The voltage readings are now normal with no jitter at the grid of the vertical output tube.

H. HAVENER

Ardsley, N. Y.

Your two letters seem to cover the subject adequately. It is so easy to ignore the passive components, and when one of them goes "sour," finding it can be a big problem. The use of a scope will often speed troubleshooting these "dogs."

Hum Before Raster

A Zenith 15L22 chassis (PHOTOFACT Folder 715-4) has a very loud hum until the raster appears, then it has a good picture with very little hum. At times it has a slight horizontal pull. All waveforms are normal. I have replaced all filters and rectifiers. Do you have any ideas on possible causes of hum associated with this receiver?

EUGENE N. SPETTER

Rossville, Kansas

From all indications your set is operating normally. The choke-type filter *used in this chassis not fully effective until an appreciable amount of current is passing through it. Since this current is from the sweep circuits, a certain amount of hum is normal until the set develops a full raster. The horizontal pull indicates the set needs horizontal alignment, as outlined in the* PHOTOFACT *folder for this set.*

Open CRT Filament

I am having trouble with a Motorola Chassis 534D-13 (PHOTOFACT Folder 312-8) and I would appreciate any advice you can give. The original CRT was replaced with a type 21-FLP4, but after a few months, the set was brought back with an open CRT filament.

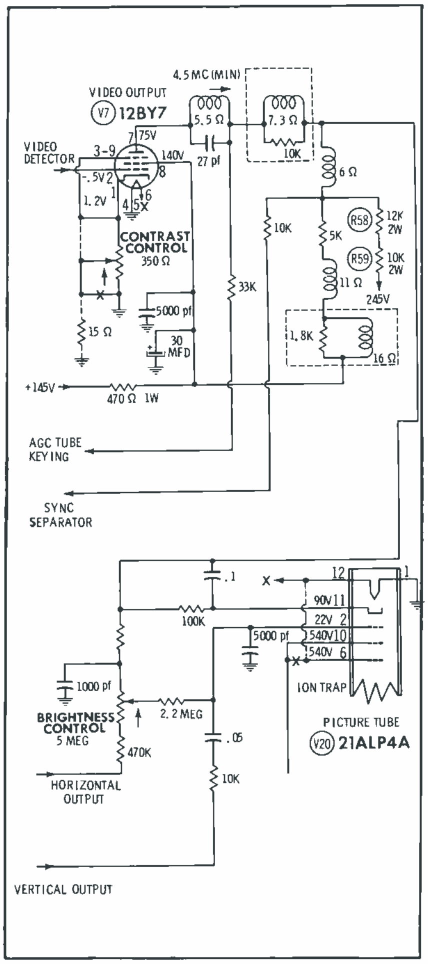
Another new CRT was installed, and after two days, it also developed an open filament. The owner reported that he saw "flashes" before the raster disappeared. I have installed another new CRT and there is arcing in this tube.

I have taken the following measurements with a 20,000 ohms-per-volt meter with no signal applied: CRT filament, 6 volts AC; CRT cathode, 160 volts; CRT control grid, 540 volts; video amplifier plate, 150 volts; and video amplifier screen grid, 125 volts.

STANLEY GENDELMAN

New Hyde Park, N. Y.

The reason for the repeated CRT filament burnouts is the high potential being applied to the CRT cathode and the video amplifier plate. This is causing arcing between the CRT cathode and filament. The CRT cathode potential is determined by the drop across R58 and R59, and you will probably find that one of these resistors has changed to a low value. ▲



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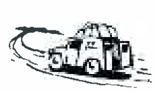

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BOOK REVIEW

Electricity One through **Electricity Seven:** Edited by Harry Mileaf; Hayden Book Company, Inc., New York, 1966; seven volumes, 940 pages, 6" × 9", soft cover; $18.75.

Designed specifically to teach electricity, this seven-volume series begins with atomic theory and proceeds through the basics of electricity and electrical circuits to power sources and motors. Although each volume covers a given segment of electricity, the logical sequence of presentation assures continuity throughout the series.

The material covered in each volume is arranged so that only one new topic is discussed on each page. To reinforce the text, color illustrations that summarize important points are also included on each page. A summary of facts and a set of review questions are provided at the end of each lesson to increase retention and aid the reader in determining how well he is learning. Retention is also improved through the use of italicized key words in each topic and repetition of major points introduced in earlier topics.

The series begins with a discussion on atomic theory, electrical charges, electron theory, and the production of electricity. Electric current, the effects of electricity, magnetism, and electromagnetism are also included in volume one. Direct current, Ohm's law, Kirchhof's law, superposition, and circuit types are covered in volume two. Volume three introduces alternating current and related subjects such as waveforms, AC circuits, inductors and inductive circuits, transformers, and capacitors and capacitive circuits. AC theory is continued in volume four, including LCR, RL, LC, and RC circuits; series-parallel and resonant circuits; vectors; and filters. Volume five discusses test equipment circuits and applications. Power sources such as batteries; photo, thermo, and solar cells; DC and AC generators; motor generators and dynamotors are presented in volume six. Volume seven covers motors.

Although the subject matter of this series is basic in nature, the method of presentation makes it useful as a review source for readers with a more advanced knowledge of electricity. ▲

PHOTOFACT™ BULLETIN

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis. This is another way PF REPORTER brings you the very latest facts you need to keep fully informed between regular issues of PHOTOFACT Index Supplements issued in May and September.

Admiral Chassis	1H1256-1, 1H1258-2, 1H1260-1, 1H1298-2, H12	876-1
	G7, 4J4, 4JM	877-1
Airline	GEN-1367A, 63-1367	876-2
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AMC	P923	867-3
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Dumont Chassis	59P01 (Ch. 120814A)	877-2
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Motorola Chassis	A22TS-/20TS-/22TS-/23TS-918A	880-2
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RCA Chassis	CTC21A/AC/AD/B/C/D	881-3
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Toshiba	719M1	880-3

The following TV sets are given schematic coverage in the Extra Contents.

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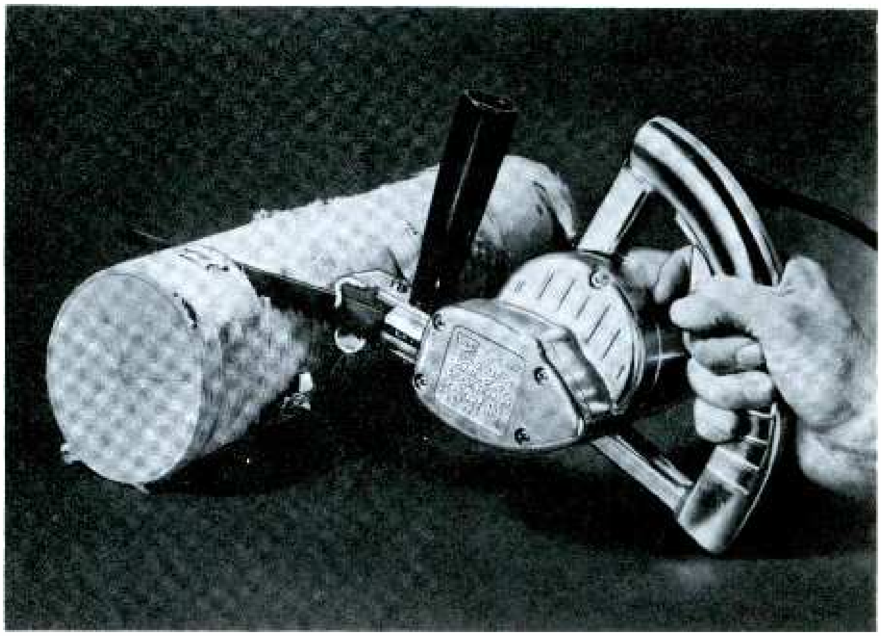
Hitachi	CNA-1900T	879-10-S
Philco	17H22, 17J25	867-11-S
	17J28, 17JT41	877-10-S
Sharp	CN-32T	880-9-S

PRODUCT REPORT

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



Portable Power Saw

(50)

This new, industrially rated, two-speed, electric, free-hand cutting saw, permits the operator to select the correct speed for any cutting job (metal or wood). An electronic speed control, conveniently located in the handle of this **Wen** Model 920 Zipp saw, enables the user to select the correct speed selection without any loss of power. Wood, metals (including sheet and pipe to 2" in diameter), masonite board, plastics, ceramic tile, wallboard, and other materials can be cut with this saw.

The saw is designed so that its curved foot plate enables it to start its own inside cut. No adjustments are needed. Plunge cuts can be made rapidly without a starting hole. It can be used for cutting openings into wallboard, installing extra outlets, ductwork installation, and cutting conduit. Intricate scrollwork and fine patterns can be cut with a fine toothed blade (one of seven furnished with the saw). The 4¼ ampere, ⅓ H.P., 115–volt AC/DC motor and handle are offset so that the pattern line is visible when cross-cutting, ripping, or working in any position.

A finger tip control safety switch, built within the saw grip handle, releases and shuts off the power of the saw. A tapered, upright grip that can be attached for extra-heavy work is also provided. The saw weighs 5½ lbs. and measures 7" in length by 7½" wide by 7" high. The heavy duty aluminum saw housing has a Ball Brite finish. Other features include heavy-duty oilite and roller bearings, heavy–duty hardened gears, and a three-wire, 6' cord with grounding adapter. Price is $44.95.

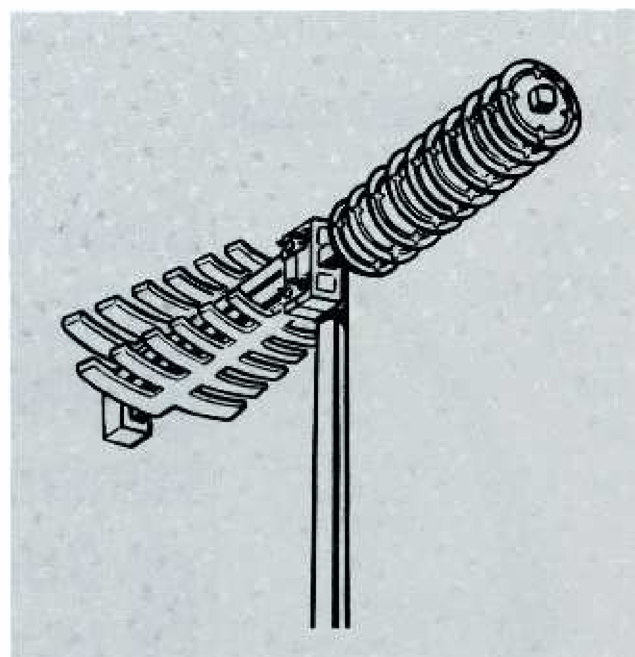
Solid-State Volt-Ohmmeter
(51)

The new, lightweight, transistorized volt-ohmmeter shown here combines the portability of a VOM with the high input impedance of a VTVM. Designed to measure DC voltages, resistance, and AC RMS values, the **Triplett** Model 600 has an accuracy of ±3% of full scale on both AC and DC at 77°F.

The transistorized amplifier incorporated in this instrument uses a special Field Effect Transistor (FET) circuit to provide an input impedance of 11 megohms on all DC ranges except the 0.4-volt and 0.8-volt ranges, which have 2.75- and 3.5- megohm input impedances, respectively. The AC ranges have a minimum of 0.75 megohms. Frequency range is 15 Hz to 2 MHz. DC voltage ranges are .4, .8, 1.6, 4, 8, 16, 40, 160, 400, and 1600 volts. AC voltage ranges are 0, 4, 8, 16, 40, 160, 400, and 800. Ohms ranges are 1000, 10K, 100K, 1 Meg, 10 Meg, and 100 Meg.

A single selector switch knob is used to select all ranges and functions. One small, compact probe is used for all functions. A built-in sliding switch in the probe places a resistor in series with the instrument on DC voltage readings. The meter is a 5" type with a 4.125" scale length. The DC-AC RMS and zero center scales are black on white, while the ohms scale is red on white. Other features include a direct reading for FM discriminator measurements and a DC polarity reversing switch.

The outside dimensions of the instrument are 3 3/16" x 5⅛" x 6½". Weight is approximately 2½ lbs. The unit, complete with full battery complement, is $78.00. A leather carrying case is available for $14.00.



UHF Color Antennas

(52)

Because UHF signals are more susceptible to buildings, trees, and other obstructions, signal loss on this spectrum can become significant. UHF is more limited to line-of-sight distances than VHF, and its signals attenuate more swiftly. To help offset these factors, two new features have been incorporated in the new LPV-UCL series of Color Laser antennas announced by **JFD Electronics Co.**

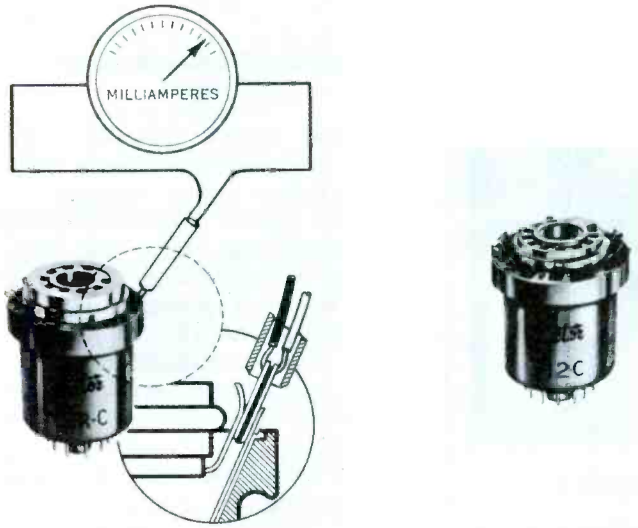
The first feature is the new disc-on-rod director system. Adapted from the high-gain antennas used for NASA, Apollo, and military radar, the disc shape increases the capture area to bring in much higher gain than thin-linear director elements. It also broadens the bandwidth and pulls in sharper color reception on all UHF channels. Its narrow beam width rejects ghosts, interference, and other undesirable signals. The disc-on-rod system is omni-polarized to intercept UHF signals that often depart from horizontal polarization. The other feature is the new, wideband "zoned" trapezoid driver. This section of the antenna uses wide, log-periodic dipoles and delivers high gain and flat frequency response. It reinforces the performance of the disc-on-rod directors on the low end of the UHF spectrum.

The antennas are gold alodized for protection against corrosion and weather conditions. Four different models are available with ranges from 40 to 100 miles and priced from $12.95 to $27.50.

Regulated Power Supply

(53)

Variable, regulated DC plate voltages, bias voltages, and AC filament voltages are provided by a new compact power supply recently introduced by **Precision Apparatus.** Called the Model B-12 Regulated Power Supply, it provides service bench and circuit development users with regulated DC voltages from 0 to 400 volts and a bias supply from 0 to −150 volts. A 12.6-volt AC supply is also included. The front panel display includes variable range voltage controls and two double-jeweled D'Arsonval meters. Price is $99.95.



Current Test Adapters

(54)

The availability of two more Current Test Adapters is announced by **Vector Electronic Company.** These new models permit current measurements on any pin position of Novar and Compactron tubes from the tube side of the chassis without cutting any leads. In the past, lack of a simple method to make current measurements, particularly in the high-voltage section of color television sets, has resulted in excessive tube failures because of improper current adjustment.

The Novar and Compactron Current Test Adapters, like their earlier counterparts for the 7-, 8-, and 9-pin tubes, have two spring test tab elements for each pin that break the circuit when a dual-sided probe is inserted in the test position. Probes are gripped by the test tabs and need not be held in position. Current is read on the meter connected to the two test leads. The same test adapters and probe also permit voltage and waveform readings on any pin position by merely connecting the leads jointly to the meter. Both adapters have mica-filled shells and keyways, and may be used in a horizontal or vertical position.

The new test adapters, designated Model T9RC and T12C, are priced at \$3.65 and \$3.85, respectively. P-2 Probes are 79c each when purchased with the adapters.

Marker Generators
(55)

Two new marker generators for superimposing crystal-controlled AC or DC marks upon an oscilloscope display of response curves are available from **Jerrold Electronics Corporation.** The Model CM-6 marker generator can be programmed to provide any desired fundamental frequency between 2 and 100 MHz. The rack-mounted Model CM-10 has a frequency range of 100 kHz to 100 MHz. Harmonics up to the 20th are visible in the higher frequencies (20 to 100 MHz), and harmonics up to the 10th are visible in the lower frequencies (100 kHz to 20 MHz). Proper choice and proper mixing will provide harmonic and sideband markers across a wide bandwidth.

The preamplifiers used in both generators have a gain of 40 dB minimum, and a maximum undistorted output of 5 volts into 100K ohms, or higher. Flatness is ±2 dB from 20Hz to 20 kHz for the Model CM-6 and ±2 dB from 20Hz to 50K Hz for the Model CM-10. Price of the Model CM-6 is \$365.00.

Battery Eliminator and Charger
(56)

A new battery eliminator and charger incorporating a unique "low-ripple" output circuit designed to meet the special requirements of transistorized car radios and other electronic equipment of 6- and 12-volt ratings has been developed by **Precision Apparatus**. The Model B-10 Battery Eliminator and Charger provides a continuously variable output from 0 to 8 volts DC and 0 to 16 volts DC at both the low-ripple and standard output terminals. The standard output capacity at the 6-volt setting is 10 amps DC continuous and 20 amps DC intermittent. The output capacity of the 12-volt range is 6 amps DC continuous and 12 amps DC intermittent.

RCA Transistors Rectifiers Integrated Circuits

For EXPERIMENTERS HOBBYISTS HAMS and TECHNICIANS

LOOK FOR THIS DISPLAY AT YOUR RCA DISTRIBUTOR

Here displayed on the RCA Solid-State Center is the RCA SK-Series Transistors, Rectifiers, and Integrated Circuits; the new RCA 3N128 MOS Field-Effect Transistor; RCA's 40214 Silicon Stud Rectifier; and three RCA Experimenter's Kits. This new Solid-State Center, in addition to its host of devices, also includes technical literature to support the devices right on the rack. It's the "one-stop" answer to the solid-state needs of experimenter, hobbyist, ham, or the replacement requirements of the service technician.

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

RCA Solid-State Center Includes:

- RCA Experimenter's Kits. Three kits enable you to build a light dimmer or any one of 14 different circuits for dozens of applications around the house.
- RCA SK-Series "Top-of-the-Line" Devices: 17 Transistors, 2 Rectifiers, and 2 Integrated Circuits, for experimenter or replacement use.
- RCA Technical Manuals. Four manuals include: RCA Experimenter's Manual, RCA Transistor Manual, RCA Linear Integrated Circuits Fundamentals Manual, and RCA Tunnel Diode Manual.
- RCA Solid-State Replacement Guide. Lists all RCA SK-Series "Top-of-the-Line" Transistors, Rectifiers, and Integrated Circuits and the more than 7,300 types which they replace.

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

RCA Electronic Components and Devices, Harrison, N.J

RCA®

The Most Trusted Name in Electronics

CB Antenna Mount
(57)

A big problem for CB operators who don't relish drilling holes for their mobile antenna has been solved with a new type of trunk mount developed by **The Antenna Specialists Co.** The "Quick-Grip" device requires no holes for either cable or fasteners, and looks like a conventional permanent communications antenna installation, with neither cable nor fasteners visible.

The mount consists of a specially designed clamp that slips over the edge of the trunk lid. It is fastened and locked permanently in place by two sharply pointed, self-tapping Allen screws which lock into the underside of the lid. The assembly also supports the cable connector. The entire mount is then encased in a chrome-plated housing shaped like a section of a small inverted cone. This housing is positioned to slightly overlap the edge of the trunk lid, permitting the cable to be "snaked" through to the trunk interior without showing. A rubber grommet prevents surface marring and also bars surface water from entering.

The new Model M-161 "Quick-Grip" mount will accept any existing antenna with a 3/8" hole requirement. Adapters are available to accommodate other antenna hole sizes. In addition, many of the company's standard mobile CB and professional antennas may be purchased complete with the new "Quick-Grip" mount. Model M-176, shown here, comprises a complete coil, shock spring, whip, and "Quick-Grip" mount. Prices include $7.50 for the mount alone and $23.75 for the Model M-176 antenna. ▲

INDEX TO ADVERTISERS

May, 1967

$ FREE $ CATALOG AND LITERATURE SERVICES

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

ANTENNAS

75. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of Tenna-Rotors.
76. *ANTENNACRAFT* — 12-page catalog listing complete Antennacraft line of UHF, VHF & FM antennas for all types of installations.
77. *BLONDER-TONGUE* — Compact brochure detailing a line of all-channel products expressly designed to improve reception in the home and small MATV systems.
78. *COLORMAGIC*—Form FR-28-C describes a complete line of antennas and accessories.
79. *CORNELL-DUBILIER* — 16-page booklet illustrates color, black-and-white TV, and FM-stereo reception problems that are eliminated by the installation of a CDE antenna rotor system.
80. *DELHI*—Twelve-page catalog introducting a complete new line of home TV towers, ham towers, citizen's band towers, masts and telescoping masts.
81. *FINNEY* — Forms 20-338, 20,356, and 20-357 describing distribution amplifiers and antenna amplifiers for 300-Ohm and 75-Ohm TV and FM systems.*
82. *JERROLD* — New 4-page full-color catalog describes the new Paralog Plus antennas.*
83. *JFD* — Color Laser and LPV antenna brochures. New 1967 dealer catalog covering complete line of log-periodic out-door antennas, rotators, and accessories.
84. *MOSLEY* — Information on new Mosley MATV system for up to 8 TV/FM sets. Includes TV antenna, distribution system and outlets.
85. *PARKER*—Flyer sheet about a new tunable indoor antenna.
86. *WINEGARD* — 8-page color brochure on new Super-Colortron antennas: 5 VHF-UHF-FM, 4 VHF-FM, 3 UHF. Includes information on 6 new solid-state preamplifiers and 82-channel booster-couplers.*

AUDIO

87. *ATLAS SOUND* — Catalog 556-67 illustrates and describes many new models of public address loudspeakers, microphone stands, and accessories for commercial sound applications.*
88. *DOBBS/STANFORD*—Flyer sheets on a line of tape recorders and microphones.
89. *ELECTRO-VOICE* — A comprehensive guide to microphones and microphone accessories is offered in pocket-sized brochure form.*
90. *JENSEN*—New electronic musical instrument louspeakers brochure, NY-2, containing newest additions to the line.
91. *3M* — Literature describing flat cable jumper systems.
92. *NUTONE* — 16-page full color booklet illusrating built-in stereo music, intercom, and radio systems.
93. *OXFORD TRANSDUCER* — Catalog sheets featuring speaker systems for automobiles.
94. *RACON* — Full line horn loudspeakers, sound columns and microphone stands are described in a new catalog.
95. *SWITCHCRAFT*—Bulletin 168 describes a new hi-fi/stereo speaker switching system. Models 641 and 642 sound control centers will control up to 8 complete stereo speaker systems.
96. *VIKING*—Brochures about Viking Model 230 and Magnecord Models 1028-1048.

COMMUNICATIONS

97. *AMPHENOL* — 2-color spec sheets on new Model 650 CB transceiver and Model C-75 hand-held transceiver.
98. *COMO*—Flyer describing a line of business-band and public-service-band communications equipment.
99. *MOTOROLA* — New brochure tells how to reach people on-the-move through use of personal two-way radio.*
100. *PEARCE-SIMPSON* — Brochures and flyers on the complete line of CB transceivers.

COMPONENTS

101. *BUSSMANN*—New 1967 16-page car and truck fuse list. Shows what fuse protects —proper fuse to use and where fuse is located. Also shows what BUSS fuse to use in servicing foreign cars and trucks. Ask for BUSS Form AWC.*
102. *CENTRALAB* — Catalogs offered on electrolytic capacitors, PEC's, and auto radio shafts and bushings.*
103. *G.C.*—Phono drive wall chart and supplement.
104. *LITTEL FUSE* — Pocket-sized TV circuit breaker cross-reference gives the following information at a glance. Manufacturer's part number, corresponding Littelfuse part number, price, color or b/w designation. A second glance gives trip ratings and acquaints you with a line of caddies. Ask for CBCRP.*
105. *QUAM-NICHOLS* — Quam-auto radio speaker replacement guide. Complete replacement information on front and rear-seat speakers for automobile radio models from 1955-1966.
106. *SONOTONE*—Data reference catalog on a line of nickel-cadmium batteries.
107. *SPRAGUE*—C617, a complete catalog of the Sprague line.*
108. *SWITCHCRAFT* — Distributor bulletin D-816 describes Switchcraft's new "traffic-tailored" audio dealer and distributor accessory merchandiser program.
109. *WORKMAN*—New coil catalog lists general and exact replacements for radio and TV schematic drawings and illustrations of all coils.*

SERVICE AIDS

110. *CASTLE TUNER* — How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included.*
111. *CHEMICAL ELECTRONIC ENGR.* — Brochure of contact cleaners for TV tuners and controls.
112. *ELECTRONIC CHEMICAL* — Catalog sheet on aerosol sprays for servicemen.
113. *MIDSTATE TUNER*—24-hour service on any make tuner is described in a colorful brochure.
114. *POMONA*—36-page catalog of the complete line of molded electronic accessories.
115. *QUALITY TUNER SERVICE* — Introductory letter describing costs and service on all makes of TV tuners. Repair tags and shipping labels included.
116. *RAWN*—Bulletins on repair ideas using Plas-T-Pair knob and plastic repair kits. Also, bulletins on tuner cleaners and circuit coolers. Includes price sheets.
117. *WILCO*—Flyer sheet on anti-static plastic cleaners.

SPECIAL EQUIPMENT

118. *ELECTRONIC ALARMS* — Installation guide for burglar alarms.
119. *PERMA POWER* — Catalog sheet in Model G-670 solid-state garage opener.
120. *STACO* — New 6-page product guide contains information on a complete line of variable autotransformers and isolated variable transformers.

TECHNICAL PUBLICATIONS

121. *CLEVELAND INSTITUTE OF ELECTRONICS*—Free illustrated brochure describing electronics slide rule and four lesson instruction course and grading service.*
122. *MALLORY*—Free 32-page booklet "Tips for Technicians."*
123. *PHILCO*—Information about Tech Data & Business Management service. Also, free parts catalog.*
124. *RCA INSTITUTES* — New 1967 career book describes home study programs and courses in television (monochrome and color), communications, transistors, industrial, and automation electronics.*
125. *SAMS, HOWARD W.*—Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1967 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

126. *B & K*—New 1967 catalog featuring test equipment for color TV, auto radio, and transistor radio servicing, including tube testers designed for testing latest receiving tube types.*
127. *EICO*—New long-form catalog of the complete Eico line.*
128. *HICKOK*—Short form catalog plus specification sheets on the Models GC 660 color generator, CR-35 CRT analyzer/rejuvenator, and 860 Injecto-Tracer.
129. *JACKSON*—New line folder or "Service Engineeed, test equipment includes push-button-operated color-dot/bar generator.
130. *LECTROTECH*—Two-color catalog sheet on new Model V6-B color bar generator, the latest improved model of the V6. Gives all specs and is fully illustrated.*
131. *MERCURY*—All-new-low-price color dot bar generator and Model 2000 conductance tube checker all for under $100.
132. *PRECISION APPARATUS* — Illustrated catalog describing signal generators, oscilloscopes, and meters.
133. *SECO*—Operating manual for Seco's new Model 107C tube tester with constant voltage transformer and eye tube indicator for the grid circuit test.
134. *SEMITRONICS*—Brochure on the new Model 1000 transistor tester.
135. *SENCORE*—8-page full color catalog plus a new 4-page supplement catalog.*
136. *SIMPSON*—New 1967 16-page test equipment brochure featuring a palm-sized VOM, Model 160.
137. *SINGER*—Catalog GD-1 describing frequency meters and standards receivers for the two-way radio communications service.
138. *TRIPLETT*—All test equipment catalog #50-T featuring VOM's, VTVM's, transistor analyzers, tube testers and accessories.*

TOOLS

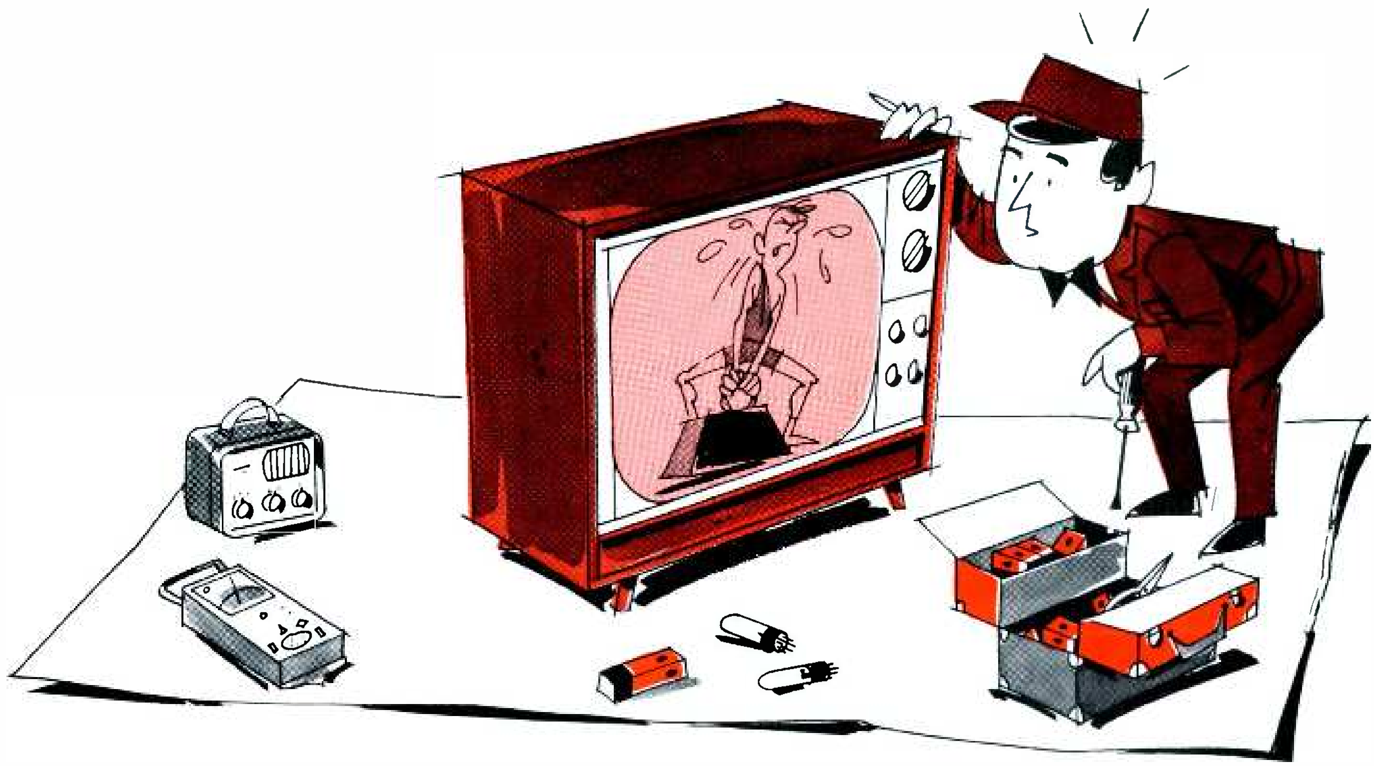
139. *ARROW*—Catalog sheet showing 3 staple gun tackers designed for fastening wires and cables up to ½" diameter.
140. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering methods for speeding and simplifying operations on PC boards.*
141. *LUXO* — Flyers on counterblanced and magnifying bench lamps.
134. *VACO PRODUCTS*—Catalog No. SD-123 on self-adjusting nut driver which selects right hex size from ¼" to 7/16" automatically.
143. *WEN*—Four-page, four-color catalog features full line of single-post soldering guns.

TUBES AND TRANSISTORS

144. *CALVERT*—Price lists on tubes and semiconductors and data sheets and catalogs on AEI semiconductors made in U. K.
145. *IR*—Transistor cross reference guide—22 pages of detailed specifications on universal silicon and germanium transistors and a complete listing of more than 5000 devices which they replace.
146. *RADIO CORP. OF AMERICA*—PIX 300, a 12-page product guide on RCA picture tubes covering both color and black-and-white. Includes characteristics chart, terminal diagrams, industry replacement, and interchangeability.*

RCA's COLOR TV FASTCHECK #7

WEAK COLOR?



Follow these steps to isolate the trouble area...

If colors lack full saturation, make sure that fine-tuning, brightness and color controls are set correctly. Then determine the receiver section in which signal is attenuated as follows:

1. Apply an rf color-bar signal at the antenna terminals.
2. Connect a scope at the video detector. Check amplitude of the color-bar pulses and sync pulses. They should be approximately the same. If color-bar pulses are attenuated, check for trouble, including poor bandpass, between the antenna terminals and the video detector.
3. If amplitudes are correct, look for trouble in the chroma section, as follows:

   a. Check bar-pulse amplitude at input and output of bandpass amplifier.

   b. Check bar signal at input and output of demodulators and color amplifiers. Note: Trouble in only one of these stages will produce a *shift* in colors, which will show up in the color-bar pattern. Loss of color saturation in the demodulators or color amplifiers, therefore, indicates trouble in a circuit common to the demodulators or color amplifiers.
4. Once the defective stage or section has been found, use voltage or resistance measurements to pinpoint the circuit defect.

This is another in RCA's continuing series of color TV service hints, to help make your job easier. Your RCA tube distributor can also make your job easier, because he's your best source for quality RCA receiving tubes for color TV, as well as for black-and-white TV, radio and hi-fi. You enjoy more customer confidence and satisfaction when you replace with RCA receiving tubes,

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

RCA®

The Most Trusted Name in Electronics

Give yourself a break you can depend on!

actual size
1¾"x13/16"x½"

#094077

CIRCUIT BREAKER CADDY

10 ratings, one each 2-1/4, 2-1/2, 2-3/4, 3, 3-1/4, 4, 4-1/2, 5, 6 and 7 amps.

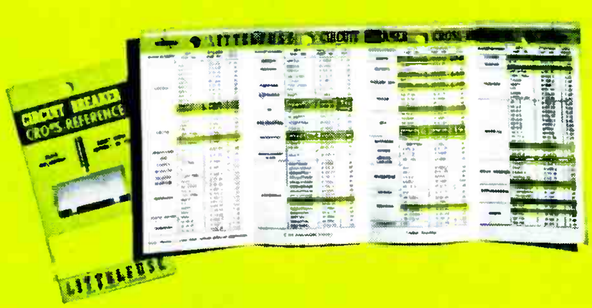
Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for all types of electronic and electrical control wiring such as model railroads and power operated toy transformers, hair dryers, small household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

#094076

SERVICE CADDY
Breakers and Fuses

One service call is all —8 breakers—one rating each 2-1/4, 2-3/4, 3, 3-1/4, 4, 4-1/2, 5 and 7 amps and 30 fuses—five each type C3/10, C1/2, C3-1/2, N3/10, N7/10 and N1.

Available individually packaged one breaker per display card; or 5 breakers of same rating per unit pack or as complete, versatile assortments for shop use or replacements in the field.



Included with each assortment:
Pocket size cross reference on color and black/white TV circuit breaker applications.
Form No. CBCRP-1266H

LITTELFUSE

DES PLAINES, ILLINOIS

Circle 47 on literature card