JULY, 1962 35 CENTS

PF REPORTER

PHOTOFACT

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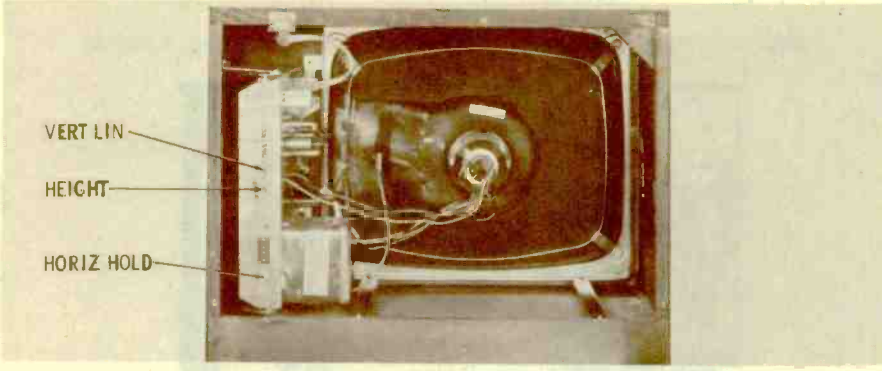
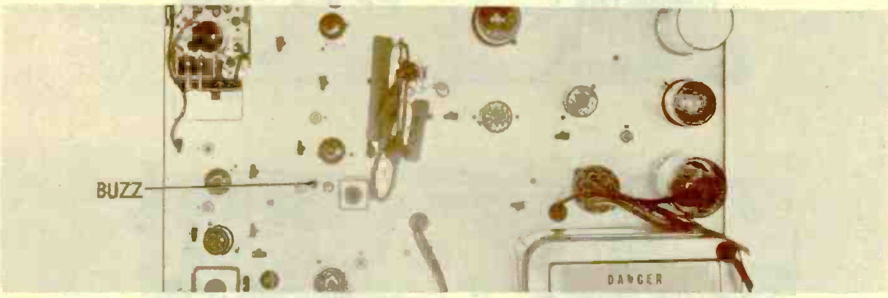
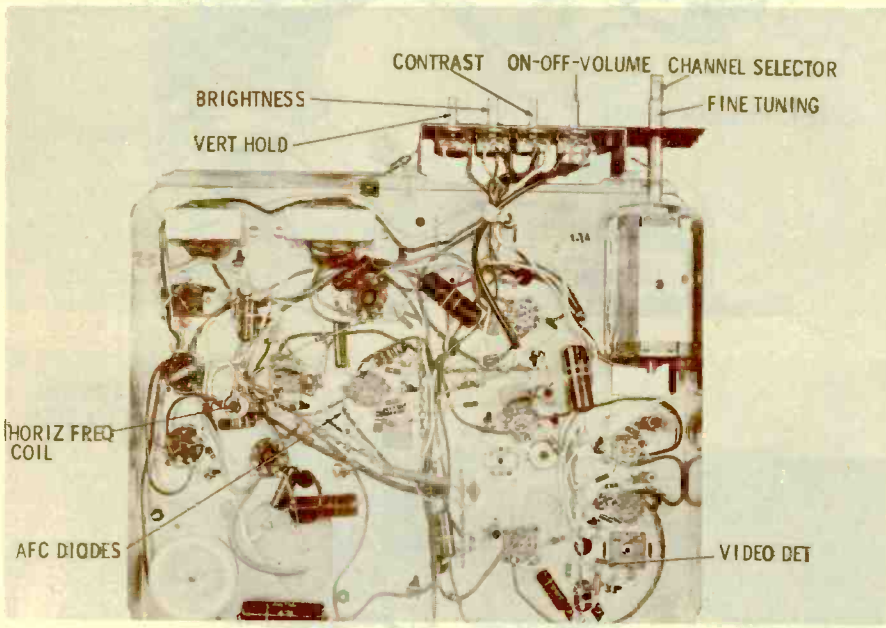
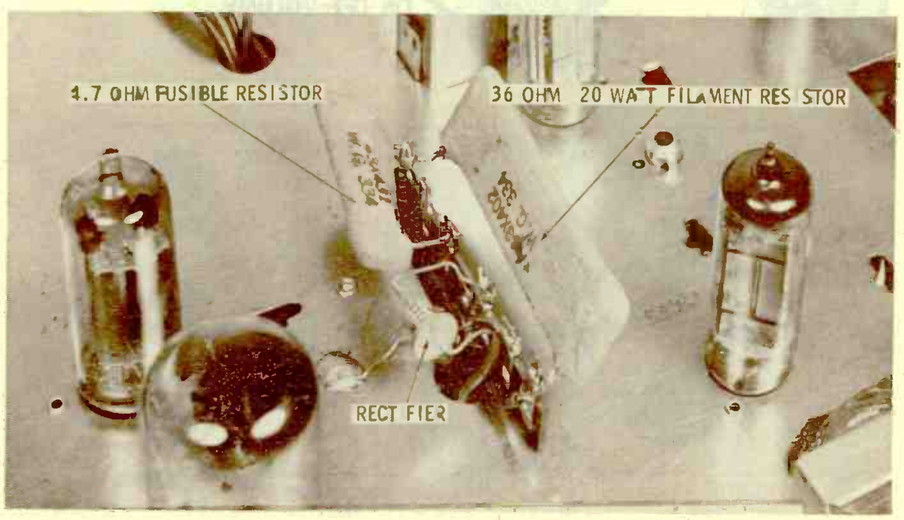








Airline Model WG-5277A Chassis 23S15SG

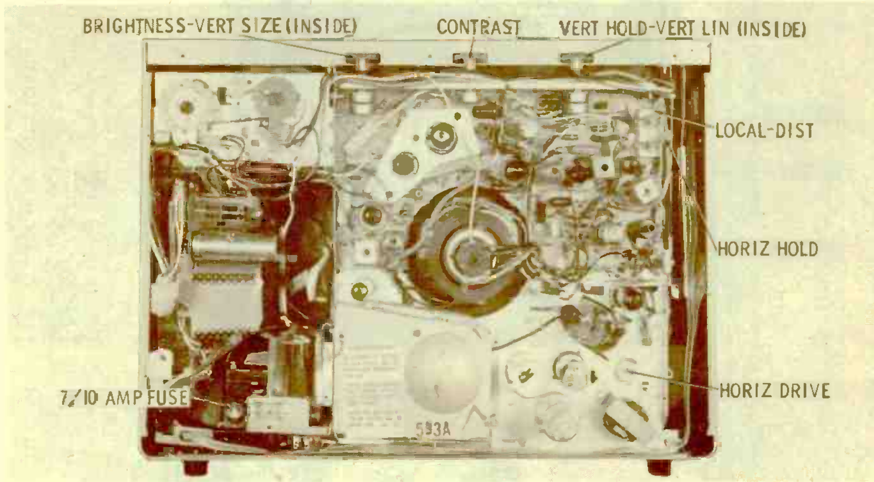
Here is one of the latest Airline 23" console television sets. The chassis contains a total of 14 tubes, including a 23AHP4, 92° picture tube. The VHF tuner is a turret type, with individual-channel oscillator slugs that can be adjusted after removing the channel-selector and fine-tuning knobs.

Channel-selector, fine-tuning, on-off-volume, brightness, and vertical-hold controls are located on the front-panel escutcheon. Directly above these controls is the channel-indicator window. The controls for vertical linearity, height, and horizontal hold are mounted on the chassis rear apron and extend through the rear cover. The buzz control (wire-wound pot in the gated-beam detector cathode) and the horizontal frequency coil can be adjusted after the rear cover has been removed.

Although many earlier Airline models had a *Synchroguide* horizontal circuit, this chassis uses a multivibrator. The procedure for adjusting the horizontal frequency (ringing) coil is as follows: Short the plate of the sync separator (pin 1 of the 6CG7) to chassis or the 135-volt B+ line. Short out the ringing coil and adjust the horizontal hold control until the blanking bar drifts slowly across the face of the picture tube. Remove the short from the coil, and adjust the slug until the blanking bar slowly drifts again. When the short is disconnected from the sync-separator plate, the picture should remain in horizontal sync without further adjustment.

Chassis removal in this receiver is fairly simple: Remove the front knobs, the rear cover (held by nine screws), two metal bolts located on the bottom of the cabinet, and one bolt which holds the top support bracket; unplug the yoke and the picture-tube socket; remove the speaker and anode leads and the CRT grounding strap; then you can pull the chassis.

Two 3BZ6's provide IF amplification, and a CK-706A crystal is used as the video detector. The low-voltage supply, a half-wave circuit using one silicon rectifier, is protected by a 4.7-ohm fusible resistor located on the exposed side of the chassis. Focusing-anode voltage can be selected with the shorting bar located on the CRT base. This bar can connect the focus grid (pin 6) to either pin 2 or pin 10 of the picture tube.



Emerson Model R-1818 TV Chassis 120593-A

Shown here is Emerson's 19" metal-cabinet portable, equipped with a two-function remote control and a built-in rabbit-ear antenna. A 19XP4 picture tube is used, and the first and second IF amplifiers are high-gain 6GM6's.

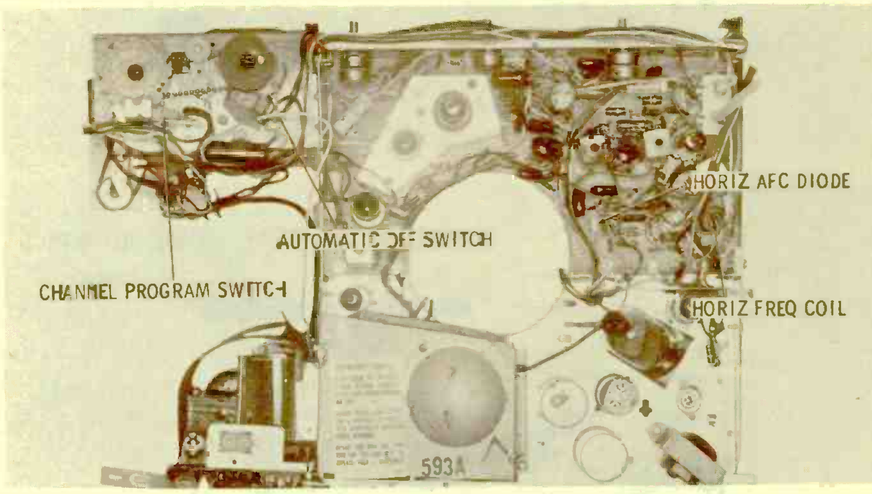
To pull the vertical chassis, first remove the three front knobs, the rear cover (secured by six metal screws), and the safety-glass assembly—which is held by three screws at the bottom of the cabinet. Next, take out the remote-receiver chassis by removing two screws and disconnecting the power plug. Following this step, remove the eight screws around the chassis edges, and another screw which holds the tuner assembly to the front of the cabinet. After removing the REMOTE-MANUAL selector switch, the CRT socket, and the yoke clamp, you can unplug the anode and speaker leads and remove the TV chassis.

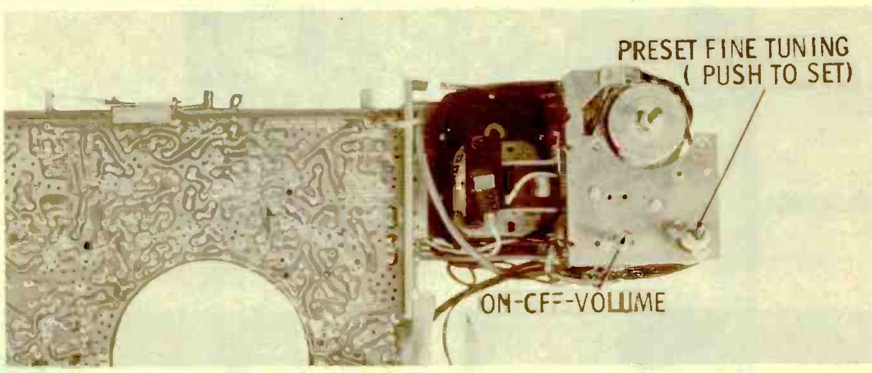
The brightness (inner shaft — vertical size), the contrast, and the vertical hold (inner shaft — vertical linearity) controls are all mounted on the rear apron and use "thumb wheel" knobs to facilitate adjustments. The LOCAL-DISTANCE and horizontal hold controls have plastic extension shafts so they can be adjusted without removing the rear cover. The manual push-type on-off switch, attached to the volume control, also actuates the remote-control receiver. The power-operated channel selector can be rotated manually, even when the REMOTE-MANUAL switch is set for remote operation.

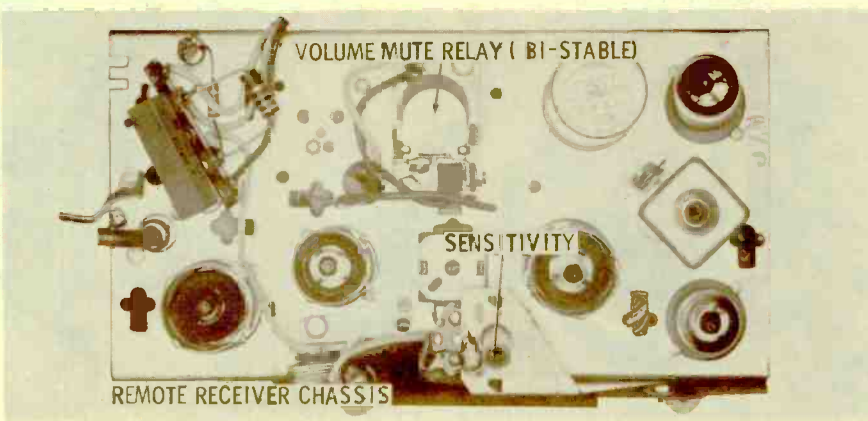
The TV chassis contains one large printed-circuit board upon which the majority of the components are mounted. The printed wiring and solder connections on the underside of this board are easily reached, once the chassis is removed from the cabinet.

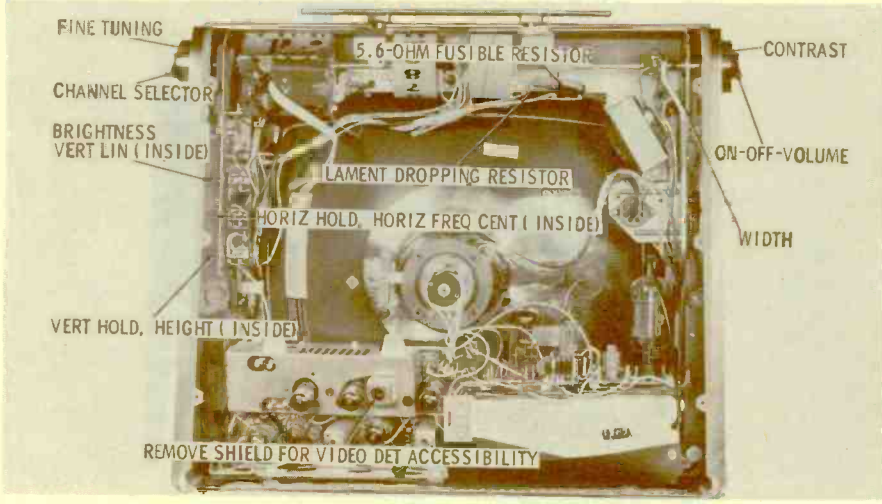
B+ is derived from a power transformer and a 5U4GB rectifier. A 7/10-amp fuse protects the low-voltage supply, and the 6.3-volt filament source uses a wire-link fuse for overload protection.

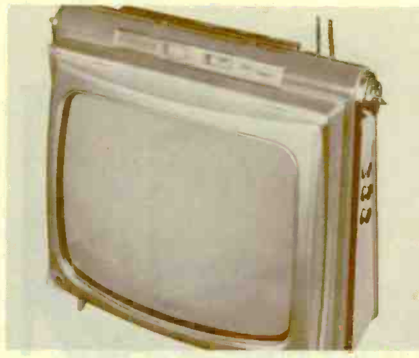
The horizontal AFC diode is soldered on the printed-wiring side of the chassis. The horizontal frequency coil (hex-type core) is located on the component side of the PC board, near the right edge. A wire-wound horizontal drive control is connected in the cathode circuit of the 6DQ6B, and can be adjusted from the rear of the chassis.











Philco Model K-3244SA Chassis 12J28A

You're looking at Philco's new *Black Beauty* 19" portable television. The cabinet is similar in shape to earlier *Briefcase* models except for the tapered cabinet, which gives a streamlined appearance. The plastic safety window is easily released for cleaning (with mild soap and water) by removing two bottom screws which hold the front panel, as shown in the photograph. Two rotating drums indicate channel and volume settings through front-panel windows.

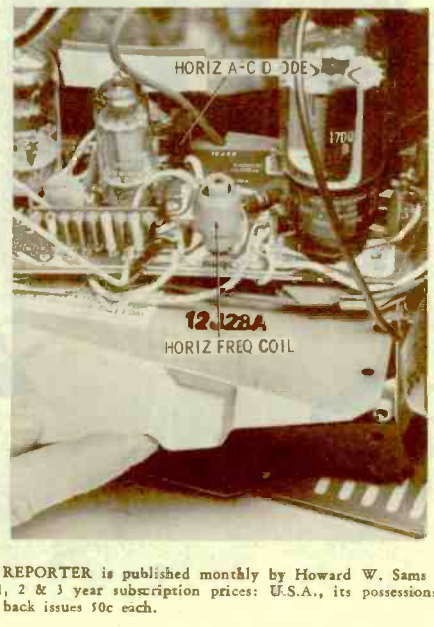
Channel and on-off control knobs are located at the ends of the top panel; the brightness, horizontal hold, and vertical hold controls are in the middle of the right side. Vertical linearity, height, and horizontal adjustments are located inside the shafts of the aforementioned controls. You can adjust the width control after first removing the volume and contrast knobs.

When the rear cover is off, all tubes (except the high-voltage rectifier) can be changed with ease. The high-voltage cage has a hinged door which can be snapped open after one retaining screw is removed. The silicon rectifiers, used in a "hot-chassis" voltage-doubler circuit, can be unsoldered and replaced without further chassis disassembly. A 5.6-ohm plug-in fusible resistor provides overload protection for this circuit. Located directly behind this component is the filament-dropping resistor.

The IF, video, and sound circuits are incorporated in one printed-circuit board. To service the video detector, it is necessary to remove the IF circuit shield and a small snap-off can which covers the detector assembly.

Three new tube types appear in this chassis. Two 11JE8's are used—one as the video output and sync separator, the other as the AGC keying and audio output tube. A 4EH7 frame-grid pentode, which has become popular in the last year or so, is used in the IF stages. The damper is a 17D4(dot) tube, with a newly developed "copper-core" plate for better heat dissipation. Philco cautions against use of the plain 17D4 tube in this chassis, as premature burnout may result. The suggested replacements are Philco's 17D4(dot) or the 17D4A offered by other manufacturers.

Use of DC coupling to the picture-tube cathode is the most significant circuit change in the 12J28 chassis line. This circuit maintains the picture-tube bias at a constant level for all settings of the contrast control.



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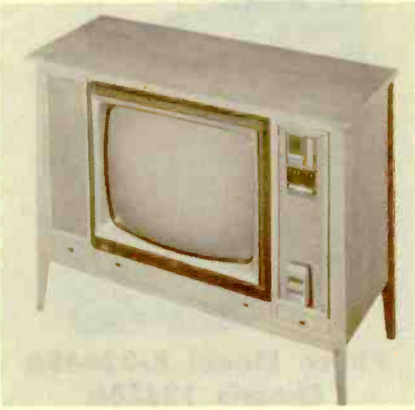


Zenith Model J3350L Chassis 16J22QS

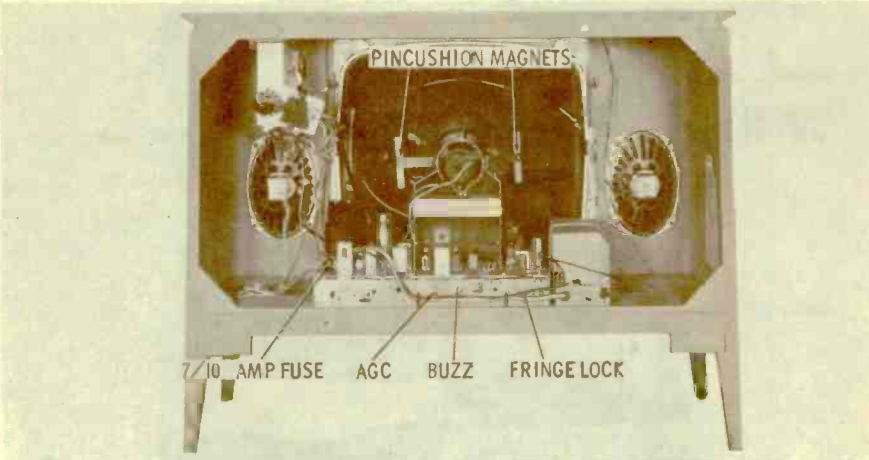
This 23" console television comes equipped with Zenith's new all-transistor remote control and a 23ANP4 (bonded) picture tube. The *Gold Video Guard* tuner has gold-filled contacts and preset fine tuning.

High-gain tubes (two 6EH7/EF183 and one 6EJ7/EF184) are found in the IF strip, while a 6GN8 serves as the video output tube. Not too familiar, as yet, is the 6HS8 (an improvement on the 6BU8 type) used for AGC keying, sync separating and noise limiting. The low-voltage rectifier is a 3DG4, and protection is provided by a 7/10-amp fuse (bayonet type). The filament source is fused with a 1½" strip of #24 wire, while a 5-amp fuse is used in the power transformer primary.

All operating controls, and most service controls, can be adjusted from the front of the cabinet. The AGC, FRINGE LOCK, and buzz controls are accessible from the rear.

To pull the chassis for servicing, remove the rear cover (held by eight screws), six screws around the inside of the CRT mask assembly, and four metal bolts located on the bottom of the cabinet; disconnect all leads to the tuner and remove the tuner (held by three screws); detach the speaker leads and the remote-receiver power plug from the main chassis. The complete chassis and mask assembly can be removed through the front of the cabinet.

A new feature in Zenith's "J" line is the all-transistor remote-control receiver chassis. In physical shape and size, it resembles previous types, with a snap-on dust cover to protect the coils and relays from damage. The eight plug-in PNP transistors can be removed easily for checking or substitution. The four-position volume-stepper relay (similar to that used in previous remotes) also performs the on-off operation. A sound-muting relay, a new function added to the remote chassis, permits complete cutoff of the sound, regardless of the volume-level setting. Two other relay circuits control tuner rotation; channel selection can be either clockwise or counterclockwise. The remote transmitter is a mechanical tone generator. Four push buttons provide *channel-higher, channel-lower, on-off-volume*, and *mute* functions. Overload protection for the power transformer in the remote chassis is provided by a .15-amp fuse, located on top of the chassis—see photo.



See PHOTOFACT Set 508, Folder 2

See PHOTOFACT Set 508, Folder 2

Mfr: Olympic **Chassis No. JRW**

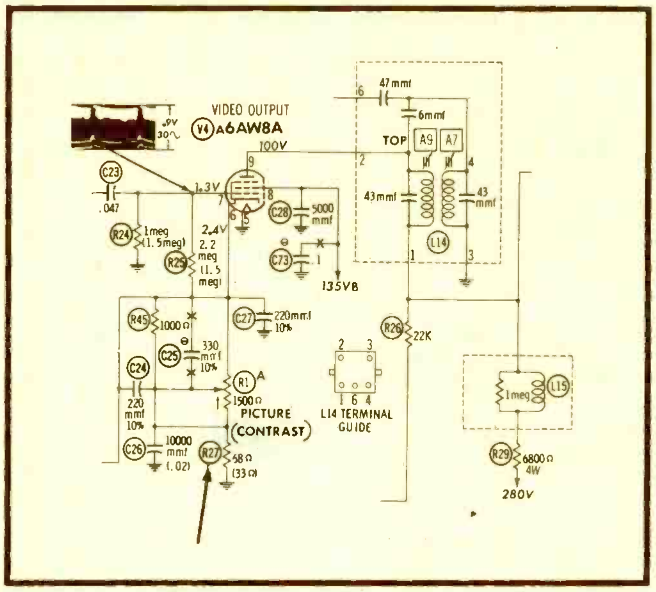
Card No: OL JRW-1

Section Affected: Pix.

Symptoms: No picture. Voltage at cathode (pin 6) of V4A (6AW8A) is too high.

Cause: Open cathode resistor in video output stage.

What To Do: Replace R27 (68 ohms).



Mfr: Olympic **Chassis No. JRW**

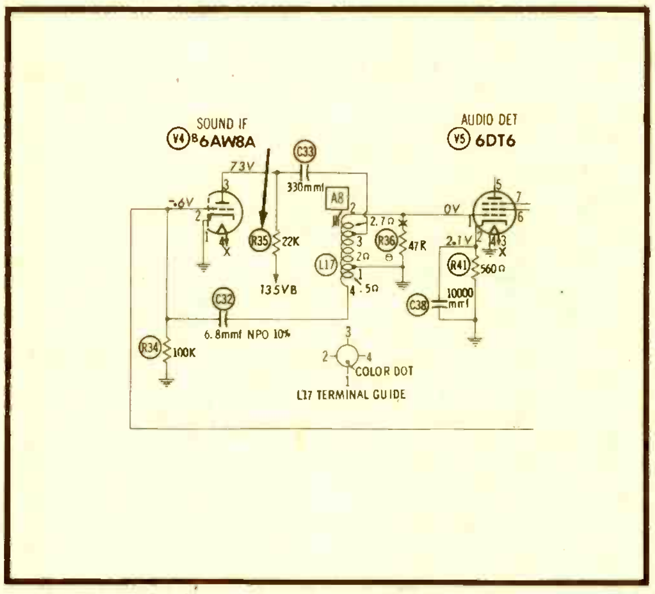
Card No: OL JRW-2

Section Affected: Sound.

Symptoms: Weak sound; voltage at plate (pin 3) is too high.

Cause: Plate-load resistor in sound-IF stage has decreased in value.

What To Do: Replace R35 (22K).



Mfr: Olympic **Chassis No. JRW**

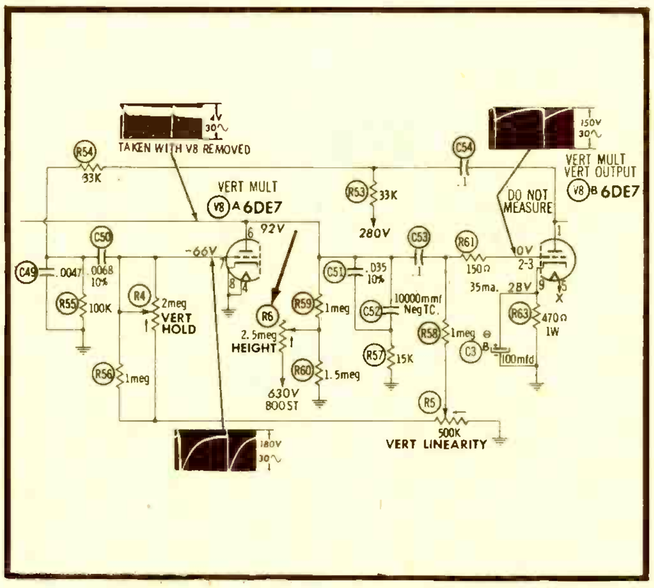
Card No: OL JRW-3

Section Affected: Raster.

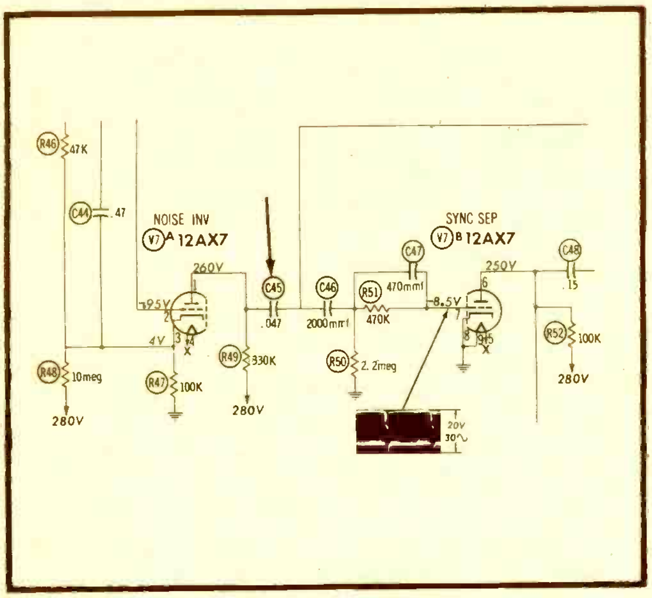
Symptoms: Streaks and flashes across CRT screen. Large fluctuation of voltage at plate (pin 6) of V8A (6DE7).

Cause: Internal arcing in height control.

What To Do: Replace R6 (2.5 meg).



See PHOTOFACT Set 508, Folder 2



See PHOTOFACT Set 508, Folder 2

Mfr: Olympic **Chassis No. JRW**

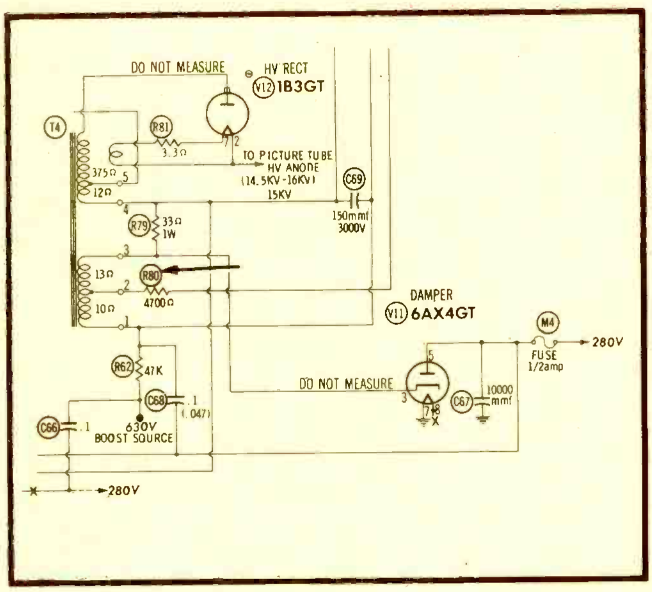
Card No: OL JRW-4

Section Affected: Sync.

Symptoms: Critical horizontal and vertical hold. Voltage at grid (pin 7) of sync separator is almost zero, even with signal applied.

Cause: Leaky coupling capacitor between noise inverter and sync separator.

What To Do: Replace C45 (.047 mfd).



Mfr: Olympic **Chassis No. JRW**

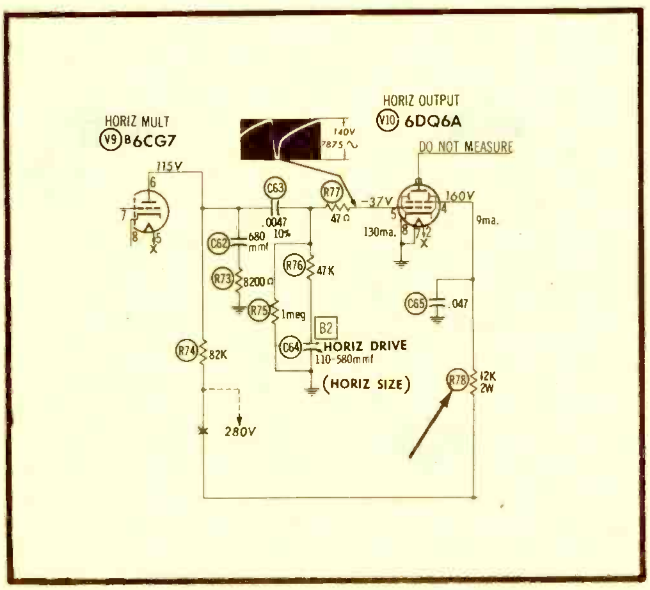
Card No: OL JRW-5

Section Affected: Raster.

Symptoms: White vertical lines in raster.

Cause: Open resistor in horizontal yoke circuit.

What To Do: Replace R80 (4700 ohms).



Mfr: Olympic **Chassis No. JRW**

Card No: OL JRW-6

Section Affected: Raster.

Symptoms: Horizontal sweep collapses; then raster disappears. Voltage at screen (pin 4) of V10 (6DQ6A) is much too high. 6DQ6A may burn out.

Cause: Screen-grid resistor in horizontal output stage has decreased in value.

What To Do: Replace R78 (12K—2W).

See PHOTOFACT Set 487, Folder 2

See PHOTOFACT Set 487, Folder 2

Mfr: Westinghouse **Chassis No. V-2378-1**

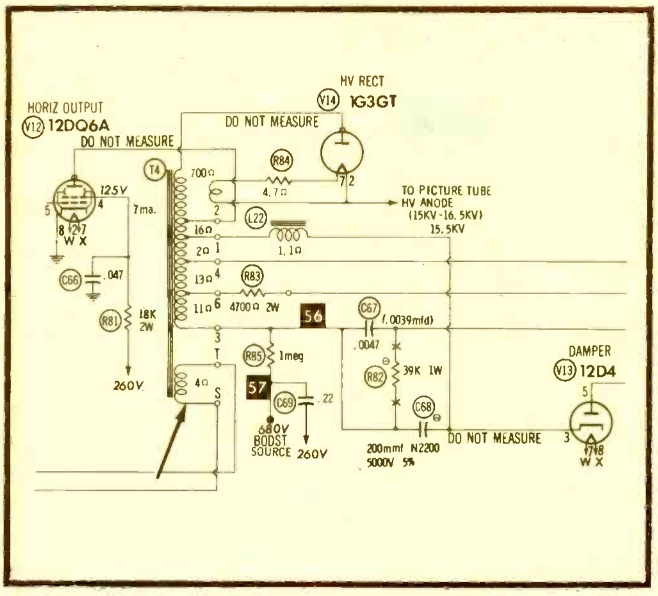
Card No: WE 2378-1-7

Section Affected: Pix and sound.

Symptoms: No video; weak sound with buzz.

Cause: Open AGC winding on horizontal output transformer.

What To Do: Repair or resolder leads on winding T-S, or replace T4.



Mfr: Westinghouse **Chassis No. V-2378-1**

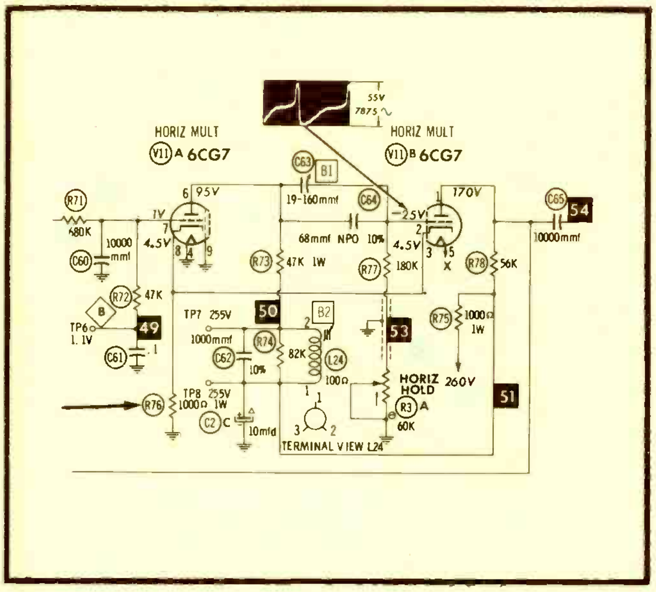
Card No: WE 2378-1-8

Section Affected: Sync.

Symptoms: Horizontal - oscillator frequency drifts out of hold-in range. Voltage at both cathodes (pins 8 and 3) of V11 (6CG7) higher than normal.

Cause: Cathode resistor of horizontal multivibrator increases in value.

What To Do: Replace R76 (1000 ohms).



Mfr: Westinghouse **Chassis No. V-2378-1**

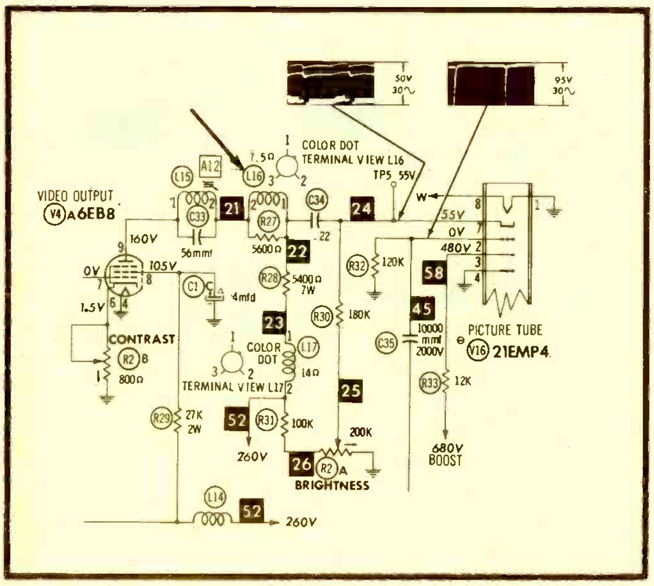
Card No: WE 2378-1-9

Section Affected: Pix.

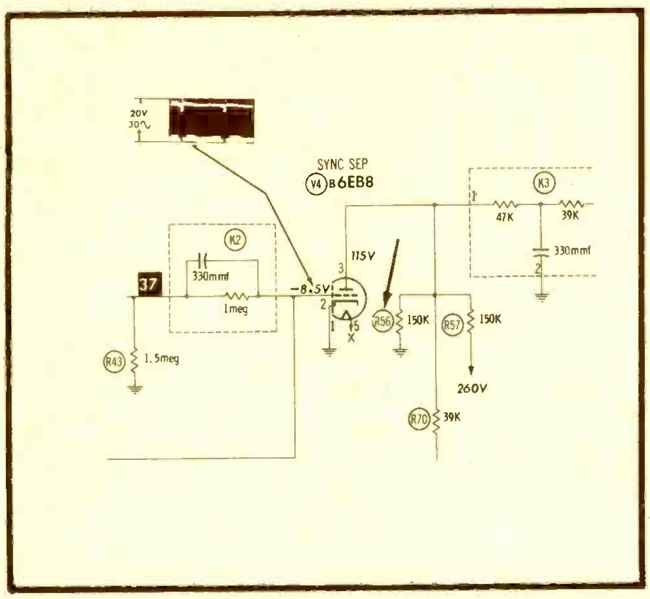
Symptoms: Picture smeared and weak; R27 burned. Low voltage on plate (pin 9) of V4A (6EB8).

Cause: Open peaking coil in plate circuit of video output stage.

What To Do: Replace L16, or resolder open pigtails.



See PHOTOFACT Set 487, Folder 2



See PHOTOFACT Set 487, Folder 2

Mfr: Westinghouse **Chassis No. V-2378-1**

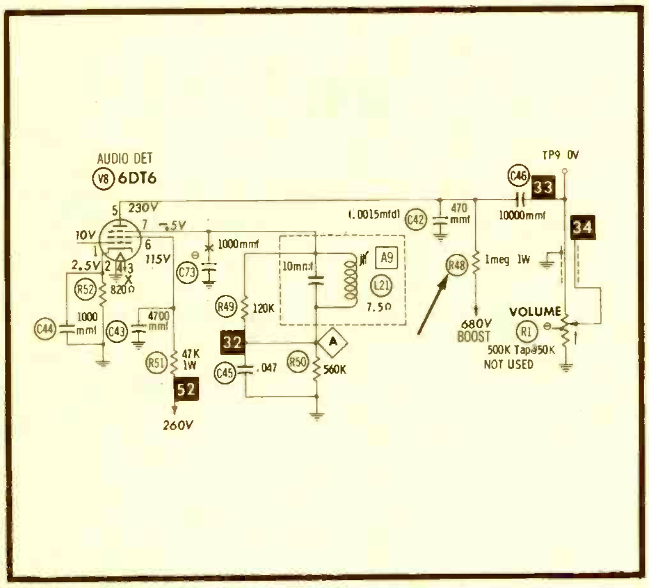
Card No: WE 2378-1-10

Section Affected: Sync.

Symptoms: Poor horizontal and vertical hold. Abnormally high voltage on plate (pin 3) of V4B (6EB8).

Cause: Open voltage-divider resistor in plate circuit of sync separator.

What To Do: Replace R56 (150K).



Mfr: Westinghouse **Chassis No. V-2378-1**

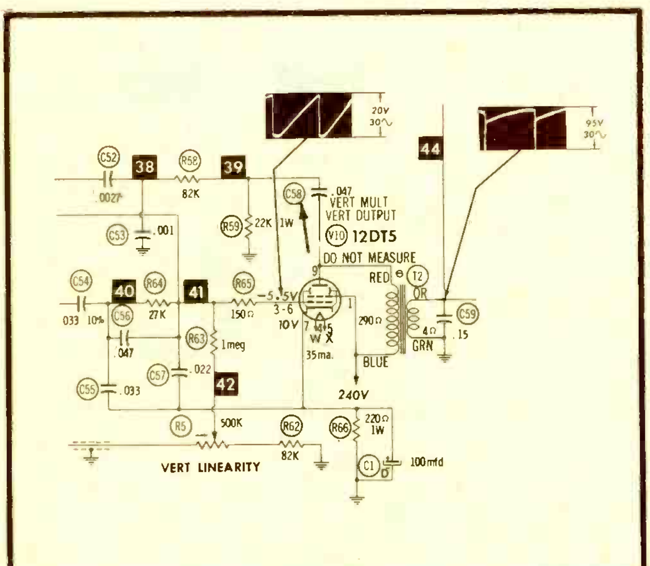
Card No: WE 2378-1-11

Section Affected: Sound.

Symptoms: Weak sound. Low voltage on plate (pin 5) of V8 (6DT6).

Cause: Plate resistor of audio detector has increased in value.

What To Do: Replace R48 (1 meg—1W).



Mfr: Westinghouse **Chassis No. V-2378-1**

Card No: WE 2378-1-12

Section Affected: Raster.

Symptoms: Vertical sweep collapses intermittently.

Cause: Shorted feedback capacitor in vertical multivibrator.

What To Do: Replace C58 (.047 mfd).

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PF REPORTER

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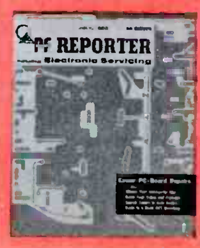
VOLUME 12, No. 7 *JULY, 1962*

CONTENTS

ABOUT THE COVER

When printed-circuit boards first appeared in radio and TV sets, many new repair techniques were born of necessity. Those which have stood the test of several years' field experience, and are becoming second nature to progressive servicemen, are pictured on pages 26 and 27.



LETTERS TO THE EDITOR

Dear Editor:

After a few hours of frustration looking for the cause of the "bends" in a chassis recently, I happened across the article "Recovering from the Bends" in your March, 1961 issue. I tried your suggestions and eliminated my trouble. As many times before, I found PF REPORTER to be a most valuable tool.

MICHAEL D. TOBIN

Astro TV
San Diego, Calif.

Glad we helped you get your head above water, Mike. The bends can really cramp a guy's style!—Ed.

Dear Editor:

I can understand why anyone trying to *earn* his livelihood in the servicing game might be found standing on his head—or butting it against the wall, for that matter—but why must everyone sit on the floor while listening to hi-fi or stero?

Seriously, I'm glad your magazine is dedicated to common everyday servicing.

ROBERT M. KING

Community Radio Service
Asheville, N.C.

It's obvious to us, Bob—so they won't have so far to fall!—Ed.

Dear Editor:

Have just read Tom Lesh's "Report on the New York UHF Test" in the May issue. Congratulations on a well-written and objective report on the ills of UHF. However, I believe you omitted one important contributing fact.

If the FCC's proposed coverage areas coincided with the Retail Trading Zones set by the U.S. Dept. of Commerce, the UHF problem would be largely nonexistent. What UHF needs, then, is a sort of "Monroe Doctrine" based on the Retail Trading Zone concept.

RICHARD W. LONG

General Manager
WFAM TV, Channel 18
Lafayette, Ind.

Dear Editor:

An expert TV serviceman,
I am most-times glad to be;
Sometimes I wish I were a dog
—and irate customers, a tree.

FRANK HESTER

Taylorville, Ill.

And just how much service business do you think you'd get from a tree?—Ed.

Dear Editor:

Every month I read PF REPORTER from cover to cover, and I find it to be the best publication of all. I've noticed a time or two where someone wanted you to donate space to gadget building. In my opinion, I don't think your magazine should waste valuable space in that way. I'd like to see more articles on commercial equipment and transistors.

V. S. STANLEY

Palestine, Texas

Dear Editor:

From time to time, I've seen letters in your column suggesting that you include construction articles on various electronic gadgets, such as garage-door openers, etc. Please register my vote in complete opposition to such suggestions. Two-transistor radios which will fit into an earmuff are fine for Cub Scouts, but I believe your magazine is aimed at adult service people. Let's keep it that way!

M. A. SYVERUD

Enumclaw, Wash.

Gee, Mr. Syverud, what do you have against earmuff-wearing Cub Scouts? Seriously, we have given a lot of consideration to both sides of this question, and feel we can best serve our readers by continuing to concentrate on the very best articles available about troubleshooting, operating a service business, and on the latest developments in the field of electronic servicing.—Ed.

Dear Editor:

I have an idea which might benefit servicemen all over the country. Why can't you develop a trouble-report form which servicemen could fill out telling of some trouble they have repeatedly found in similar sets. If these were mailed to you, you could publish the most interesting ones in your magazine every month. That way, we could all benefit from each other's experiences.

IRVING PUMETA

West Palm Beach, Fla.

Sounds like a good idea, Irv, provided enough readers would be interested in taking part in such a program.—Ed.

Dear Editor:

In the article "Cost of Doing Business" by Forest H. Belt, almost everything was covered except service literature. Would you please advise me how this is taken care of—by depreciation?

GEORGE W. RICHARD

Craig, Colo.

For tax purposes, service literature normally can be deducted as an expense item—as purchased. Or, if an unusually large expenditure is involved at one time (such as the purchase of a complete PHOTOFACT *Library), the cost can be taken care of by depreciating them over a period of time—say, five years. Your tax consultant can offer you specific suggestions as to the best method in your particular circumstances.—Ed.*

GE ELECTRONICS

G-E SEPT TUNE-UP SPECTAC

*

Hugh Downs

Joe Garagiola

Mel Allen

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Full Lineup of 155 Local Stations Covers 95% of U. S. Audience

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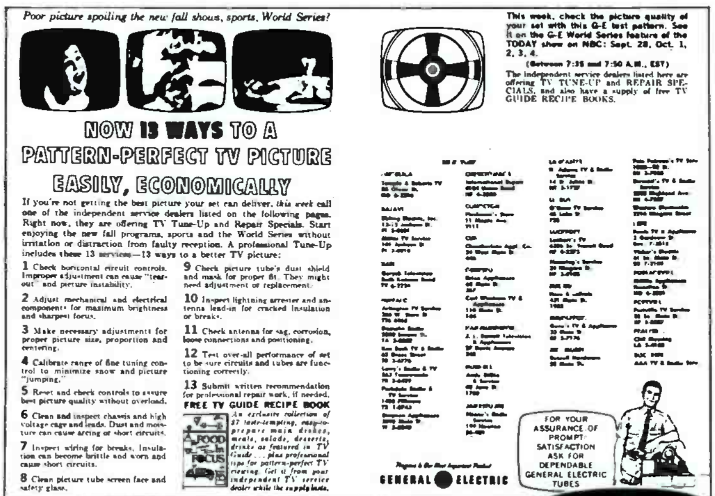

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1 Check horizontal circuit controls. Improper adjustment can cause "tear-out" and picture instability.

2 Adjust mechanical and electrical components for maximum brightness and sharpest focus.

3 Make necessary adjustments for proper picture size, proportion and centering.

4 Calibrate range of fine tuning control to minimize snow and picture "jumping."

5 Reset and check controls to assure best picture quality without overload.

6 Clean and inspect chassis and high voltage cage and leads. Dust and moisture can cause arcing or short circuits.

7 Inspect wiring for breaks. Insulation can become brittle and worn and cause short circuits.

8 Clean picture tube screen face and safety glass.

9 Check picture tube's dust shield and mask for proper fit. They might need adjustment or replacement.

10 Inspect lightning arrester and antenna lead-in for cracked insulation or breaks.

11 Check antenna for sag, corrosion, loose connections and positioning.

12 Test over-all performance of set to be sure circuits and tubes are functioning correctly.

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3-part program sells immediate need for your service before & during World Series*

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G-E reporter, Roland Kempton, tells how September Tune-Up Spectacular

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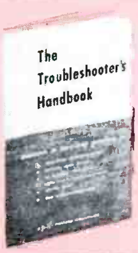
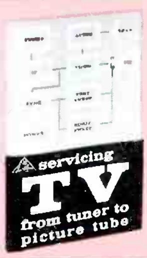
Ironing Out Vertical Sweep Distortion

Horizontal Oscillator Running Wild

NOTES ON TEST EQUIPMENT

Covering Anchor T475 Reacto Tester, Mercury 1000 Tube Tester, Paco G-32 Sweep Generator





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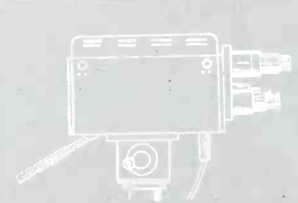
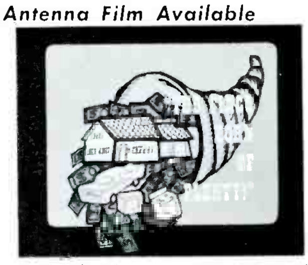


The Electronic Scanner

"I Couldn't Help Overhearing . . ."

For the second straight year, the **Electro-Voice** Model 643 microphone attracted crowds at the May Parts Show. Seven feet in length, "The Shotgun" is used regularly in President Kennedy's televised press conferences. Its ultra-directional characteristics permit hearing of questions from reporters located even in the rear of the room.

Antenna Film Available



A 25-minute color sound film has been completed by the **Finney Co.** and is available to distributors and service dealer groups. Designed to be of assistance to the dealer by pointing out various ways to increase sales of TV antennas "The Finco Horn of Plenty" is done in semi-humorous style and can be obtained upon request to the Finney Co., Bedford, Ohio, at least two weeks in advance of a scheduled showing.

To Manufacture Color Tubes

Zenith announced recently that its subsidiary, **Rauland,** will shortly begin making color TV picture tubes for Zenith and others. A 50,000-square-foot addition is in the works for the plant in Chicago. When the final phase of the expansion program is completed, Rauland's manufacturing and research facilities will be nearly doubled.

Tuner Replacement Parts Offered

Exact-replacement antenna coils will be the first items offered in **Sarkes Tarzian's** tuner replacement parts program. The coils are individually packaged in polyethylene containers which the service dealer can reuse for storing parts. Also available to distributors are window decals and counter cards for use as sales boosters.

New Hi-Fi Line Introduced

According to Harold A. Goldsmith, president of **Bogen-Presto** Division of the **Siegler Corporation,** Bogen's 1963 line of hi-fi equipment will represent a return to the policy pioneered by the company of offering quality components at moderate prices. The line includes five all-new components: two FM stereo receivers, two stereo amplifiers, and an FM tuner.

Resumes Color-Tube Manufacture

Sylvania has recently decided to resume production of color-TV picture tubes. The company previously produced and marketed color tubes from 1953 through 1957. Tubes will be manufactured at Seneca Falls, N. Y., headquarters of the company's picture-tube operations. A 21", shadow-mask, round glass tube will be available sometime in 1963. Sylvania president, Gene K. Beare stated, "Engineering and marketing studies we have conducted over the past several months show the color television market is now expanding and this is the time for us to re-enter the field."

Mallory To Make Silicon Controlled Rectifiers

P. R. Mallory & Co. has acquired the silicon-controlled-rectifier business of the **Tyco Semiconductor Corp.,** a subsidiary of **Tyco Inc.** Manufacture of the devices will continue at Waltham, Massachusetts. The addition of these rectifiers will expand the Mallory semiconductor produce line, which presently includes zener diodes, several types of silicon rectifiers, and other solid-state devices.

Quicker Servicing
by Wayne Lemons

...what to do when the FUSE BLOWS!

If you've been in the service business very long, you've probably encountered hundreds of TV sets with blown fuses. As often as not, a new fuse is all that's needed to get the set going again. Should you merely charge the customer for the call and the fuse, and hope for the best, or is there something you can do to increase the odds against a callback?

First, you need to know if there is much chance the fuse could have blown of its own accord. This happens on some occasions, but not often—perhaps in less than 10% of TV-fuse failures. According to fuse manufacturers, spontaneous blowing of simple fuses is usually due to *cyclic fatigue* caused by expansion and contraction of the fuse element. Slow-blow types are much less susceptible to this condition.

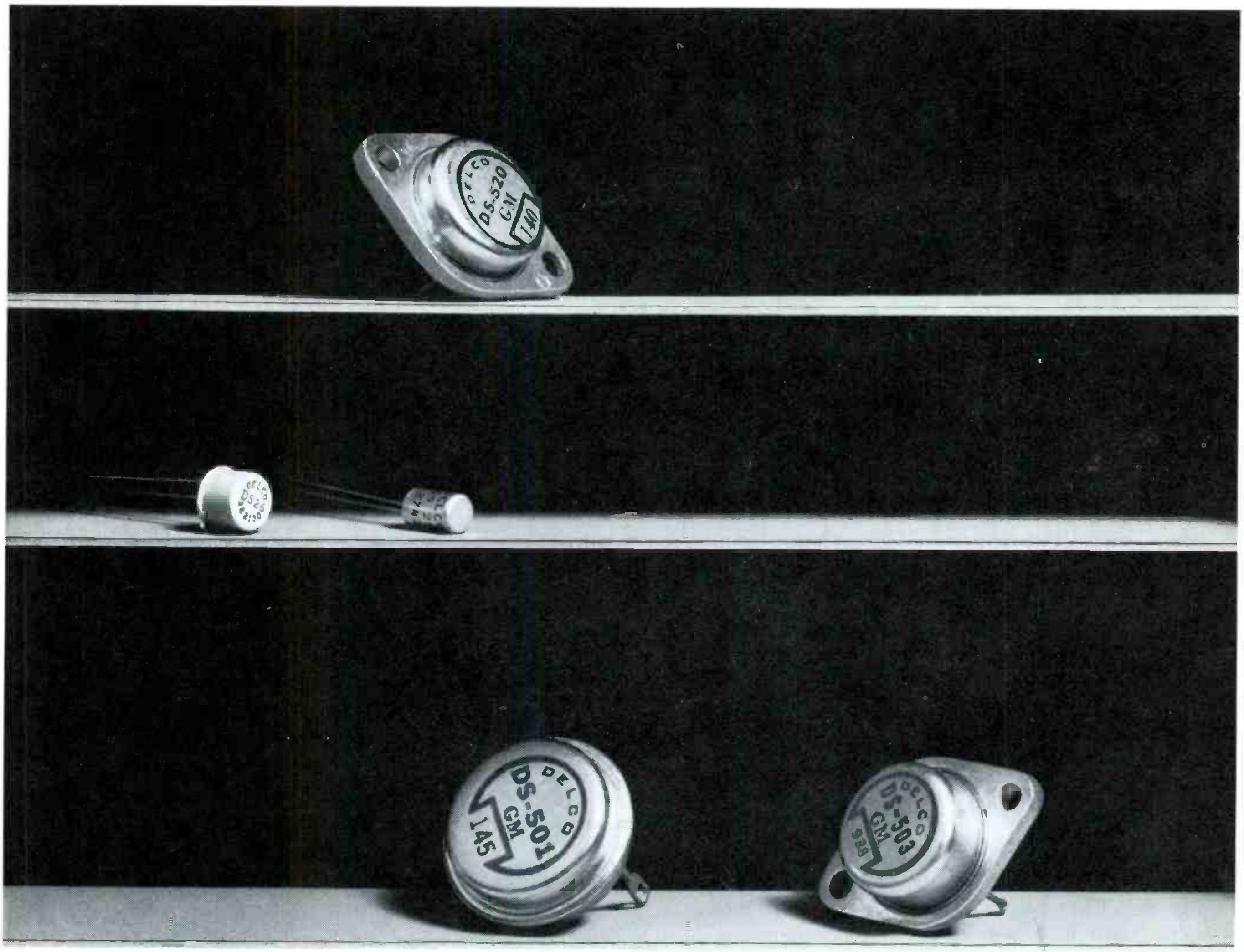
The 10% estimate just mentioned does not take into account the fusible resistors used in transformerless power supplies, which are notorious self-destroyers.

Fuse to Blame?

When a new fuse doesn't blow immediately, you can be reasonably sure that no short or unusually heavy leakage is present in the protected circuits; but you still need to check the circuit carefully for some intermittent fault that could explain why the original fuse blew. The following procedure won't *always* turn up the cause of fuse failure, but it doesn't often miss:

1. When a set comes in with a blown fuse, don't immediately put in a new one and turn the set on; first inspect the chassis carefully for evidence of burned wires or components. Look for frayed wires that could come in contact with other wires or the chassis. Check for discoloration on the chassis at points where arcing might have occurred. Especially check all wires which carry pulse voltages, such as the plate lead of the horizontal output tube, and the leads to the damper tube and deflection yoke.
2. Pull out the horizontal output and damper tubes. Make a careful inspection of the socket and also the tube base. Look for any burned or discolored areas that would indicate arcing. If the set uses a horizontal output tube with no plate cap, such as an 'AV5 or 'AU5, be especially watchful for arcing at the socket. Also check yoke connectors and plugs for any sign of trouble.
3. Now install a new fuse. To prevent frequent fuse failure while you're troubleshooting, you may want to "overfuse," or employ a current rating higher than the specified value. A *slight* increase is all right if you remember *not* to leave the substitute fuse in the set after you have found the trouble.
4. Turn on the set. As it warms up, watch for obvious arcing in and around the high-voltage section, and particularly in the horizontal output and damper tubes.
5. *Gently* tap the damper and horizontal output tubes with a pencil or rubber mallet. Watch very closely—if you see the slightest arc in either of the tubes, it should be replaced. Sometimes you cannot see arcing inside tubes. To detect it, watch the raster for streaking or tearing when the tubes are tapped. White flecks, especially inside a damper tube, are a good indication that the tube has been arcing and should be replaced.
6. *Gently* tap the tube and components in the horizontal oscillator stage, while you watch the raster. If it disappears or streaks violently, you should find out why. An intermittent loss of raster means an interruption of drive to the horizontal output tube. With no drive, current in the output tube increases considerably. Even though the intermittent surges of current may not be great enough to blow the fuse (except in critically designed circuits), they nevertheless can overload the fuse and sometimes cause early cyclic fatigue.
7. *Gently* tap the rectifier tube (or semiconductor rectifiers). Arcing here can burn out a fuse in the primary of the power transformer (Fig. 1A), a B+ fuse (Fig. 1B),

• *Please turn to page 67*



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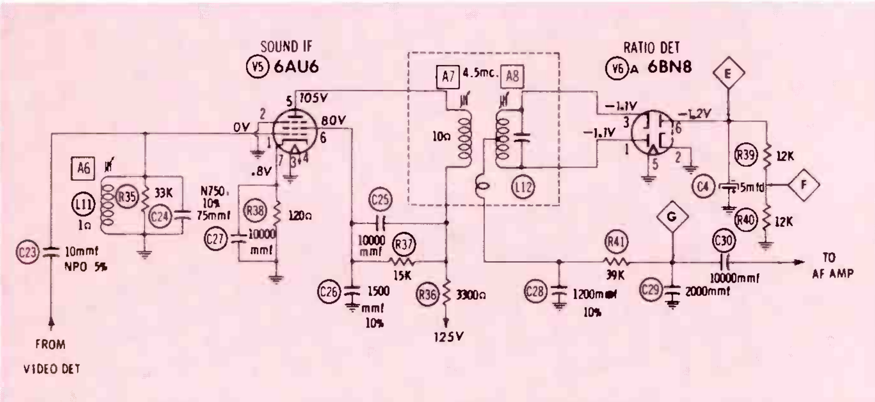

Fig. 1. Electrolytic capacitor in ratio detector filters out buzz.

In the infant years of commercial TV, a "conventional" sound circuit meant a *split-sound* system. A short distance past the output of the tuner, the FM sound signal was shunted into its own special IF strip, where it was free from interaction with the picture signal.

A number of set designers soon adopted a simpler *intercarrier* system, which took advantage of the heterodyning action that takes place between the picture and sound carriers in a normal video detector. The 4.5-mc beat frequency produced in this stage contains the same FM audio modulation as the sound carrier, and was found to be usable as a sound-IF signal.

Both types of sound circuits had their strong and weak features. In the intercarrier system, the 4.5-mc output signal picked up some of the amplitude modulation from the video carrier, as well as the FM from the sound carrier. The 60-cps vertical sync pulses were particularly likely to enter the sound circuits; to make the problem worse, they caused an irritating buzz from the speaker. Very careful design of the video-IF, 4.5-mc sound IF, and sound-detector circuits was necessary for suppression of these pulses.

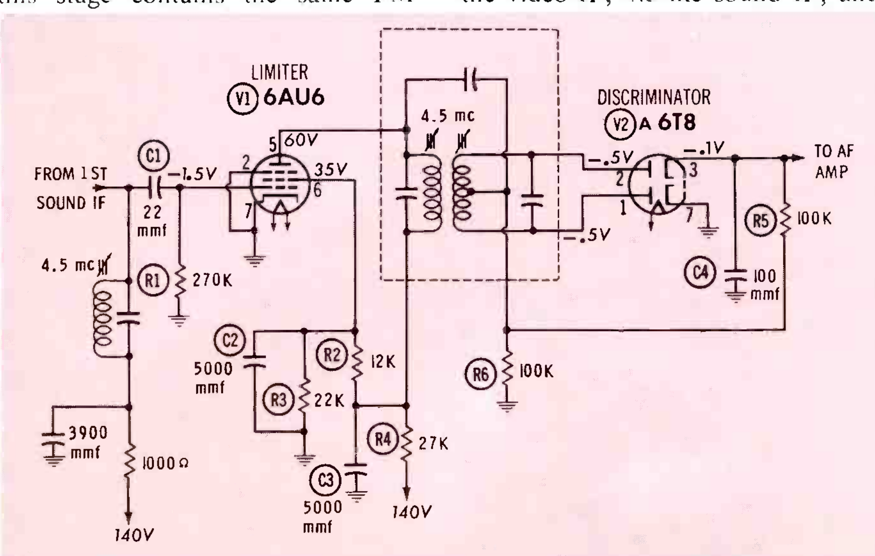

Fig. 2. Discriminator depends on limiter to suppress buzz in input signal.

In the split-sound circuit, the trace of AM interference that managed to sneak into the audio strip was much easier to eliminate. However, it was impossible to obtain clear sound unless the frequency of the sound-carrier output from the tuner was very close to the resonant frequency of the narrow-band sound-IF circuit. If the local oscillator were detuned, or if the RF alignment were incorrect, the sound signal would be weakened or lost. Intercarrier receivers did not have this problem, because the 4.5-mc output of the video detector has a constant frequency under all conditions.

TV designers apparently concluded that intercarrier buzz was a less difficult problem than oscillator drift and critical fine tuning in split-sound receivers, because the 4.5-mc system became almost universal by 1952. Continual refinement of the intercarrier circuit has resulted in virtually buzz-free performance in normally operating receivers. However, buzz is always lying in wait, ready to sound off as an early indication of slight defects or misadjustments in the tuner, video IF, sound IF, or FM detector. Let's examine the circuits that can cause this common trouble, see how and why it develops, and find out what we can do about it.

Suspect Circuits

The circuits which have the most to do with eliminating buzz are located between the sound take-off point (video detector or output stage) and the FM sound detector. These stages are the first to be investigated during a seizure.

Other possible troublemakers are the circuits between the RF input and the sound take-off point, plus

silence that intercarrier BUZZ

First of all, find out if the trouble is in the sound circuit or in the RF-IF section . . . *by Art Margolis*

the AGC and sync circuits. Faults in these stages can produce buzz by distortion of the RF-IF signal, or by spurious coupling of sync pulses into the sound section. A similar symptom (not a true intercarrier buzz) is sometimes produced when a stray signal finds its way from the vertical sweep section into the sound channel. This type of buzz is readily isolated by turning the vertical hold control; if the pitch of the buzz changes, the trouble is originating in the sweep circuit.

Chart I summarizes a basic procedure for isolating buzz trouble. It is normal to expect some of these operations to reduce the buzz, but not eliminate it completely; in other words, more than one remedy may be needed. Extensive tube replacement and touch-up alignment is sometimes the best solution to a buzz problem, because the condition may have multiple causes—particularly in older sets. The aging of RF-IF-AGC components tends to increase the type of signal distortion which produces buzz, while at the same time, the sound IF and detector circuits tend to lose their ability to reject buzz and other AM interference.

Sound IF and Detector Circuits

You'll find three general types of TV sound demodulators in use—the ratio detector, limiter-discriminator, and quadrature (6BN6 or 6DT6) detector. Each has its own specific way of eliminating buzz from the incoming signal.

Ratio Detector

Millions of TV sets use a circuit of the same general type as shown in Fig. 1, composed of one sound-IF stage followed by a ratio detector. In this particular circuit, the input signal is picked off at the video detector; some other sets utilize a sound take-off coil at the plate of the video-output stage. In either case, the sound-input circuit usually contains two features that help minimize buzz pickup from the picture signal. The take-off coil or a sound-IF grid coil (L11 in Fig. 1) is tuned rather sharply to 4.5 mc; also, the signal is coupled through a small-value capacitor (C23), which easily passes the sound signal but tends to block the lower-frequency video and sync signals.

Some AM interference (especially vertical sync) usually manages to reach the sound IF stage, where it is amplified along with the FM; however, the ratio detector is able to suppress most of this amplitude modulation. The key to its noise-rejecting ability is an electrolytic capacitor (C4 in Fig. 1), which is connected across the two diode sections of the ratio detector so that it governs the total voltage across both diodes in series. The voltage is allowed to adjust itself gradually to changes in over-all signal strength, but momentary fluctuations due to AM interference are filtered out.

Frequency fluctuations in the input signal affect the relative conduction of each diode section, without changing the sum of the voltage drops across both diodes. On one half-cycle of frequency modulation, the conduction of the upper diode section increases, while that of the lower section decreases; on the next half-cycle, the situation is reversed. The result is an audio-frequency fluctuation in the voltage at the center tap of the detector-transformer secondary. This signal is developed across C28, and is coupled through C30 to the audio-amplifier section.

Buzz problems in ratio detectors can usually be traced to a defective electrolytic capacitor, or to a fault which causes detuning or insufficient peaking of the sound IF or detector. To mention one fairly frequent defect, one diode section of the detector tube may be weaker than the other. In addition, transformers and coils can develop several different

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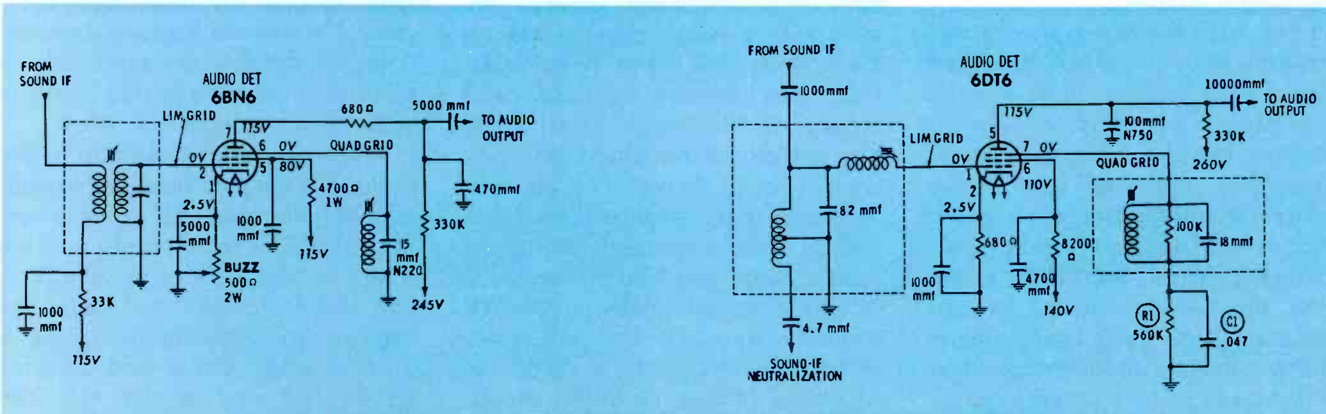
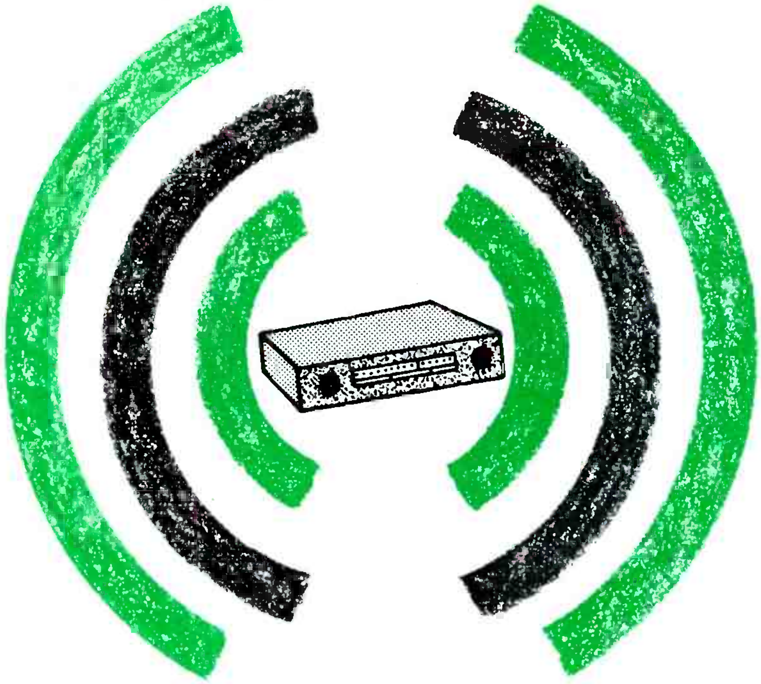


Fig. 3. Tube structure is main difference between 6BN6 and 6DT6 detectors.



Good electronic—mechanical coordination makes for smooth automatic tuning . . . George F. Corne, Jr.

SEARCH TUNERS in AUTO RADIOS

What's the big secret to success in repairing search tuners in automobile radios? Familiarity! Service shops which specialize in auto-radio work are well acquainted with search systems through frequent contact with them, and have few major problems in performing quick repairs. But servicemen who seldom work on search tuners often run into trouble because they don't understand the electrical and mechanical functions of these units.

Without this knowledge, search-tuner repairs can be frustrating—especially for servicemen whose first experience is with the tuning system used in older-model Cadillac radios. These receivers have no provision for manual tuning, and if the search system is giving trouble, there's no convenient way to tune in a station for operational checks of the RF, IF, and search circuits.

Later models do not present this problem, since they can be tuned manually as well as automatically. This feature not only aids bench servicing, but also takes some of the pressure of "hurry-up" jobs off the serviceman's shoulders. If a search tuner breaks down at a time when the owner doesn't want to leave his radio for shop servicing, he can temporarily use the manual tuning, and wait to have the automatic system serviced at his convenience.

Search-tuning systems have not been drastically changed since they first appeared in the mid-1950's. All systems have the same basic requirements: a method of moving the RF tuning elements, and a method of stopping this motion as soon as a usable signal is tuned in.

Sequence of Electrical Operation

Four tasks are carried out by the electrical portion of a search-tuning system. It must start the search cycle, provide a holding action to sustain the cycle, detect an incoming station signal, and stop the search cycle when this wanted signal arrives.

Fig. 1 shows a representative circuit, used in the 1962 line of auto radios manufactured by Delco Radio for General Motors cars. To initiate the searching action, one side of *tuner relay* M1 is grounded by pressing the *wonder bar*. With a current path thus completed through the coil, M1 is energized. An arm on the relay is lifted out of the *governor gear train*, allowing the mechanical section of the search tuner to go into motion; at the same time, relay contact set S1 is pulled down. The A section of S1 grounds the volume control to mute the sound during the search cycle, and also reroutes the cathode-to-ground path of the RF amplifier through the sensitivity switch. Meanwhile, the B section of S1 closes, placing 12.6 volts on the *space-charge* grid (pin 3) of the relay-control tube. (Although this grid is between the cathode and control grid, it serves practically the same function as a screen grid.) The control tube begins to conduct through the relay, keeping it energized so that the tuner can continue seeking. Thus, the path through S1B initiates the action of the *search holding* circuit.

Leaving the relay circuit in the "on" state, let's deal with the trigger-detector circuit. Section B of S1, being in the closed position, supplies source voltage via R5 to the plate of the detector. The tube is biased below cutoff, so no plate current is flowing; but coupling capacitor C1 charges through R1 and R5. The charge is positive on the plate side, negative on the grid side.

Remember, the relay-control tube is conducting rather heavily all this time, keeping the tuner relay energized. To stop the tuner at a specific point on the dial, we need only to drive the control tube into cutoff in order to de-energize the relay.

When a signal is picked up by the radio, it is coupled from the secondary of the last IF transformer through C2 to the control grid (pin 8) of the trigger detector. The positive peaks of this signal cause the detector to conduct, producing a drop in plate voltage and allowing C1 to discharge through R1. The negative voltage developed across

R1 by this action is sufficient to cut off the control tube—releasing M1 and stopping the search cycle.

The setting of the sensitivity switch determines the cathode bias of the RF amplifier during the search cycle only. If this switch is set to the position shown in Fig. 1, only the strongest stations in the area will produce an IF signal of sufficient amplitude to key the trigger tube. To receive more stations, the switch position is changed to increase the amplification of weaker radio signals in the RF stage.

If a strong local station is received, the IF-output signal may have enough amplitude to key the trigger circuit before the tuner reaches the center frequency of the station. To offset this undesirable situation, a negative AVC voltage is fed via R4 to the grid of the trigger detector. This bucking voltage automatically varies with signal amplitude, and is just enough to keep the trigger tube cut off until the tuner approaches center frequency.

A unique feature of the Delco system is the carriage-return solenoid (M2 on the schematic), the action of which will be described in detail, presently. This unit requires close to 17 amperes for its periodic pull-in-action—a heavy intermittent load on the power source. Under some conditions, operation of M2 can overload the power supply, and this solenoid will be unable to complete its normal action. When this happens, the tuner stalls at the high end of the band, and M2 continuously draws heavy current—possibly enough to blow the radio fuse.

Other models of search tuners use circuits practically the same as those in Fig. 1, except for the carriage solenoid and the hold-in feature. Instead of the solenoid, some tuners use a small motor to operate the mechanical components. For hold-in action, a few tuners depend on a change in the cathode bias of the relay-control tube. Of course, a number of older radios equipped with search tuners are vibrator-powered, and have a plate-supply voltage of more than 200 volts instead of the 12.6 volts indicated in Fig. 1. No matter what the details of the circuit, however, the general operation of the system is similar in all models.

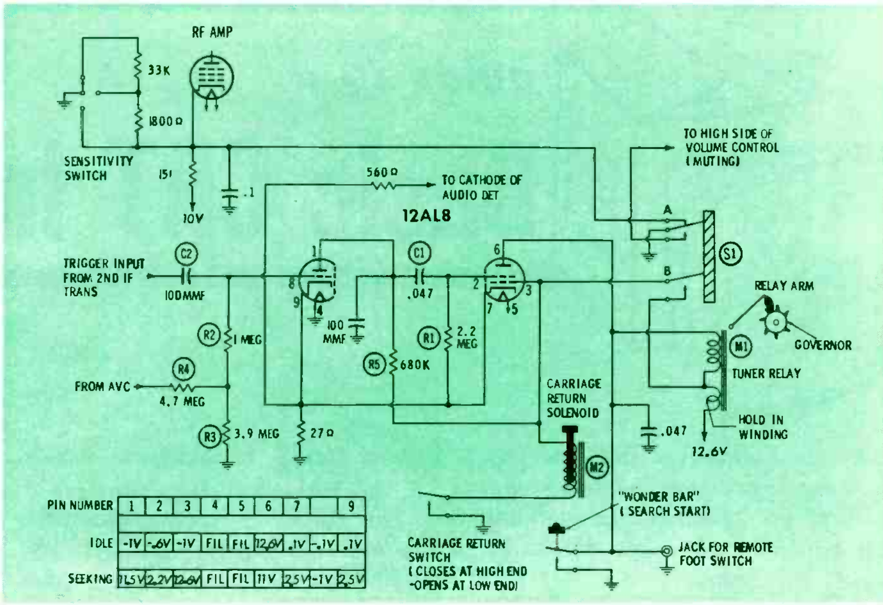


Fig. 1. Schematic of typical search-tuning system using solenoid return.

Circuit Troubleshooting

An inoperative search system is most frequently caused by a comparatively simple defect such as a dead relay-control tube, an open M1, or faulty relay contacts. It is usually harder to pin down the type of trouble which allows the search mechanism to run normally, but makes it unable to stop on stations. Since the search-stopping signal must pass through the RF-IF section of the radio to reach the grid of the trigger detector tube, continuous searching can result from a loss of this signal in any front-end stage as well as in the trigger circuit itself. To speed up troubleshooting, you need to employ some quick method of determining which section (front-end or trigger circuit) is at fault. One way to make this test is to use an external voltage supply (bias box). Using the circuit in Fig. 1 as an example, set the bias voltage to 1.5 volts; remove the IF tube; then press the *wonder bar* to start the tuner searching. With the negative lead of the bias supply connected to chassis, touch the positive

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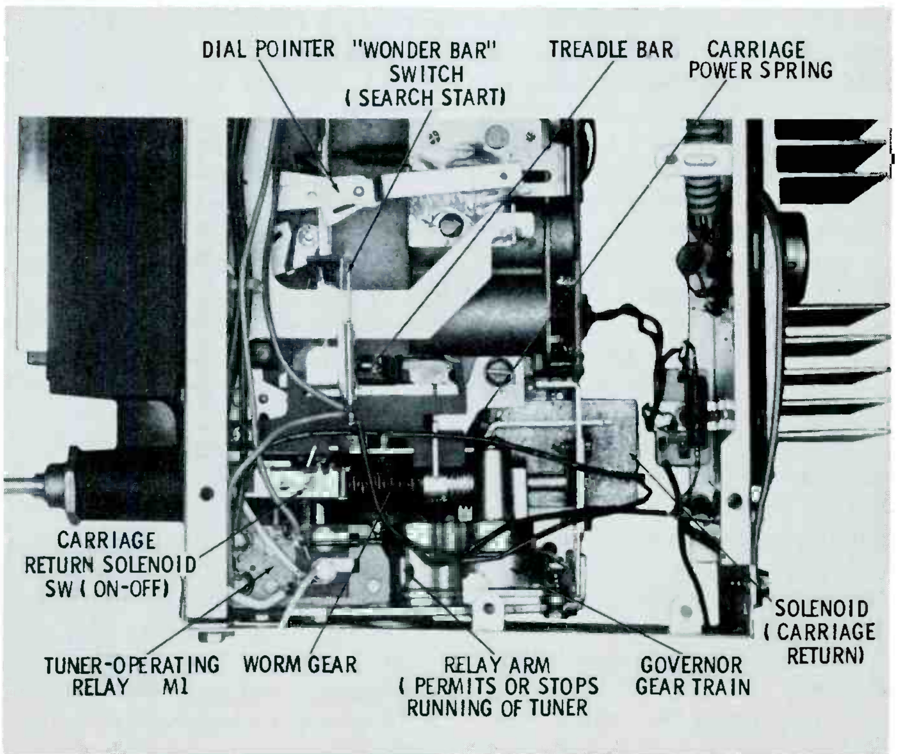
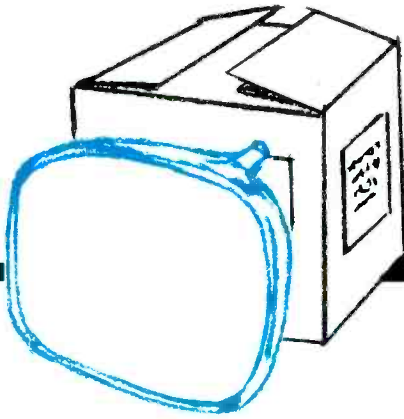


Fig. 2. Principal mechanical components of Delco F4-series search tuners.



guide to a Basic CRT Inventory

As the number of different picture-tube types steadily grows, the problem of maintaining adequate replacement stocks weighs more heavily on manufacturers, distributors, and dealers. This year, several major manufacturers are seeking to provide some relief by consolidating their CRT lines. In numerous cases where very similar tubes have previously been made available under several different type numbers, only one of these related types is now being recommended as a replacement for all others in the group.

Naturally, CRT's that have different type numbers are not *completely* identical, or the additional types would not have been registered. However, many new types originated as minor modifications of some existing design to meet a specific requirement — for instance, to shorten the neck length or increase the maximum anode-voltage rating. The basic characteristics of such tubes, including the bulb shape and electrical ratings of gun elements, are unchanged from the prototypes. There are many instances where the modifications are so slight that substitute CRT types can be installed without altering the set in any way. Dozens of other substitutions are made possible by such simple changes as discarding an ion trap or changing the anode connector.

Easily - installed substitutes for 162 types of picture tubes were listed in "Selecting a CRT Replacement" on page 22 of the May, 1961 PF REPORTER. The expressed purpose of that article was to suggest a course of action in case an exact-replacement type was unobtainable. Since then, however, the idea of substitution has been carried even further; it now is being applied to weeding many slow-moving types out of CRT replacement stocks.

Replacement Information

The following section describes the more important CRT's in the new "universal" replacement lines recently announced by various tube companies. Other manufacturers also supply these same types, but are not specifically recommending them as substitutes for tubes having different type numbers.

The replacements are listed in large type. Sometimes two CRT numbers appear together, indicating that both tubes are being recommended (by different manufacturers) for basically the same application. These pairs of tubes can be substituted for each other and for the additional types given under the same heading. For each of the latter, a short notation indicates if the suggested substitute type is normally a direct replacement, or if there are any points which require special attention by the installer. Relatively minor differences, which ordinarily do not prohibit substitution, are not itemized. Some of these excluded characteristics, accounting for most of the differences between closely related CRT types, are as follows:

1. Aluminized screen (used on nearly all replacement types and on most older types bearing the suffix "A").
2. Rated value of filter capacitance provided by inner and outer aquadag coatings on picture tube (not too critical for replacement purposes).
3. Slight variations in cutoff-bias voltage on grid no. 1 (can be counteracted by readjusting brightness and contrast).
4. Difference in anode-voltage rating between original and replacement (generally 2 kv or less).

Many of the "universal" types have a straight electron gun and require no ion-trap magnet. In fact, one manufacturer (General Electric) has changed a number of older CRT types from bent-gun to straight-gun design. The modified versions are readily substituted for bent-gun tubes, simply by discarding the ion trap originally used.

The replacement types have the same faceplate contour and bell shape as the other types listed in the same group; therefore, they can be installed without changing the mask, cabinet, or yoke-support bracket. In many cases, the new tube has a shorter neck than the original, but this difference almost never poses a problem of physical clearance.

Most replacement types have an outer aquadag coating on the bell of the tube. To prevent RF-interference and shock-hazard problems, the installer should take extra care to make certain this coating is properly grounded. If the type being replaced had no outer coating, a grounding spring must be mounted on the chassis and positioned so that it will press against the aquadag surface of the new tube. If a spring is already present, check to see if it is making proper contact. Sometimes it fails to touch the new tube's coating, which may not cover the same area as on the tube being replaced.

Other substitutions besides those listed here can easily be made. To obtain the necessary information, check with your distributor, or consult a cross-reference guide. The Howard W. Sams book, "Tube Substitution Guide, Vol. 4," includes CRT-substitution data; also, tube manufacturers provide specification charts to help you select a proper replacement.

21CBP4A (RCA, Sylvania)

21FLP4 (G-E, West'hse.)

These 21″ tubes—by far the most popular types in their respective lines—can replace many other electrostatically-focused 90° CRT's. Major specifications include: aluminized screen; straight electron gun; over-all length 18″; neck length 5½″ (2″ shorter than most types they replace); inner and outer aquadag coating used as high-voltage filter capacitor.

Can replace following types:

21ALP4,-A,-B Discard ion trap.
21ANP4,-A Discard ion trap; add aquadag-grounding spring.
21ATP4,-A,-B Discard ion trap.
21BAP4 Direct replacement.
21BNP4 Direct replacement.
21BTP4 Discard ion trap.
21CMP4 Discard ion trap.
21CVP4 Recommended by all except Sylvania. Direct replacement.
21CWP4 Recommended by all except Sylvania. Direct replacement.
21DNP4 Recommended by RCA and G-E only. Discard ion trap.

21ACP4A (G-E)

21AMP4A (RCA)

Electromagnetically-focused, these near-equivalent 90° tubes have a nominal over-all length of 20″, neck length of 7½″, aluminized screen, and an external aquadag coating. The RCA type (but not the G-E) requires a single ion trap.

Can replace following types:

21AQP4,-A Add aquadag-grounding spring.
21BSP4 Direct replacement.
21CUP4 Direct replacement.

24AEP4 (G-E, RCA, Sylvania)

This "short-neck" 90° tube has the same specifications as the 21CBP4A and 21FLP4, except for the 24″ screen size and 19⅛″ over-all length.

Can replace following types:

24ANP4 Discard ion trap.
24DP4,-A Discard ion trap.
24YP4 Discard ion trap.
24ZP4 Discard ion trap.

24CP4A (G-E, RCA)

A 24″ counterpart of the magnetically-focused 21ACP4A and 21AMP4A, this tube measures 21⅛″ in over-all length. Discard the ion trap when a G-E replacement is installed, but not if the new tube is an RCA.

Can replace following types:

24ADP4 Direct replacement.
24CP4 Direct replacement.
24QP4 Direct replacement.
24TP4 Direct replacement.
24VP4,-A Direct replacement.
24XP4 Add aquadag-grounding spring.

27RP4 (G-E, RCA)

The largest member of the magnetically-focused 90° group, this 27″ tube is basically the same as the 24CP4A except for size. Over-all length is 23″. The RCA version requires a single ion trap, but the G-E does not.

Can replace following types:

27EP4 Add aquadag-grounding spring.
27GP4 Direct replacement.
27NP4 Direct replacement.

17BJP4 (G-E, RCA)

Here's a 90° tube for portables and small table models. Like its larger brothers in the electrostatically-focused series, it has a short (5½″) neck and needs no ion trap. Total length is 14⅝″, averaging an inch shorter than the other types it replaces.

Can replace following types:

17ATP4,-A Discard ion trap.
17AVP4,-A Discard ion trap.
17BUP4 Discard ion trap.
17CBP4 Discard ion trap.
17CLP4 Discard ion trap.

17DKP4 (RCA, Sylvania)

This 110° tube is designed for late-model slim-line portables, being only 10-11/16″ long with a 3-9/16″ neck.

Can replace following types:

17DTP4 Direct replacement.
17DLP4 Recommended by Sylvania only. If trouble is encountered with substitution, change grid no. 1 connection from pin 6 to pin 2 of socket.

17BWP4 (G-E)

17CSP4 (RCA)

Of somewhat older design than the 17DKP4, these two 110° tubes have a greater length (12 5/16″) and require a deeper cabinet.

Can replace following type:

17BVP4 Direct replacement.

14CP4A (G-E)

14EP4 (RCA)

Quite a few "universal" replacement CRT's are being made available to keep older-model TV sets operating—for example, these aluminized 14″ tubes with 70° deflection and magnetic focus. Measuring 16¾″ in length, these types have a 7½″ neck.

In this and all following categories, the RCA replacement tube needs a single-magnet ion trap, whereas the G-E tube has been modified from the original specifications so that the ion trap is no longer needed.

Can replace following types:

14CP4 Direct replacement.
14BP4,-A Direct replacement.
14DP4 Change from double to single ion trap, if replacing with 14EP4. Add aquadag-grounding spring.

16KP4A (G-E)

16RP4A (RCA)

A "step-up" in size from the 14″ tubes just discussed, these 16″ rectangular types are 18¾″ long and have a 2-kv higher anode-voltage rating. Other specifications are similar to those of the 14CP4A and 14EP4.

Can replace following types:

16QP4 Replace double ion-trap magnet with single type, if replacing with 16RP4A.
16UP4 Check physical clearances; original tube has ⅝″ shorter neck than replacement.
16XP4A Direct replacement.
16TP4 Recommended by G-E only. Check physical clearances, as indicated for 16UP4.

20CP4D (G-E)

20DP4C (RCA)

Moving up one more notch to the 20″ rectangular size, we find these two slightly different 70° types capable of replacing each other. Several older versions of these same types, bearing different letter suffixes, can also be replaced; however, careful attention should be paid to the following notes to insure a correct substitution.

Can replace following types:

20CP4, -B, -C Add aquadag-grounding spring.
20CP4A Direct replacement. Original not aluminized.
20DP4,-B Add aquadag-grounding spring.
20DP4A Direct replacement. Original not aluminized.

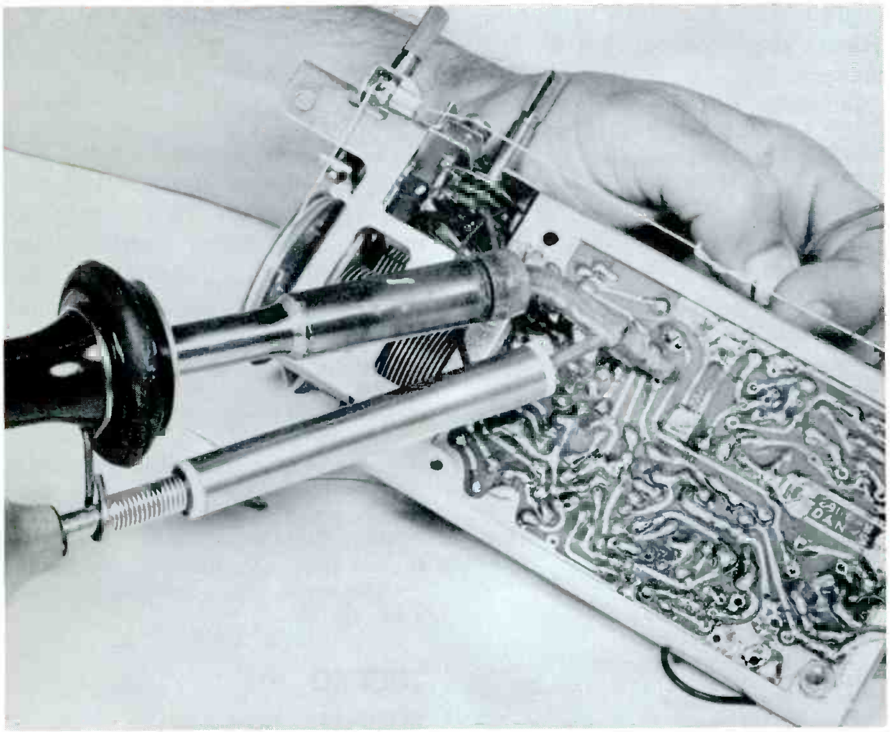
20HP4D (G-E, RCA)

This tube is the same size as those just mentioned, and has the same electrical specifications except that it is electrostatically focused.

Can replace following types:

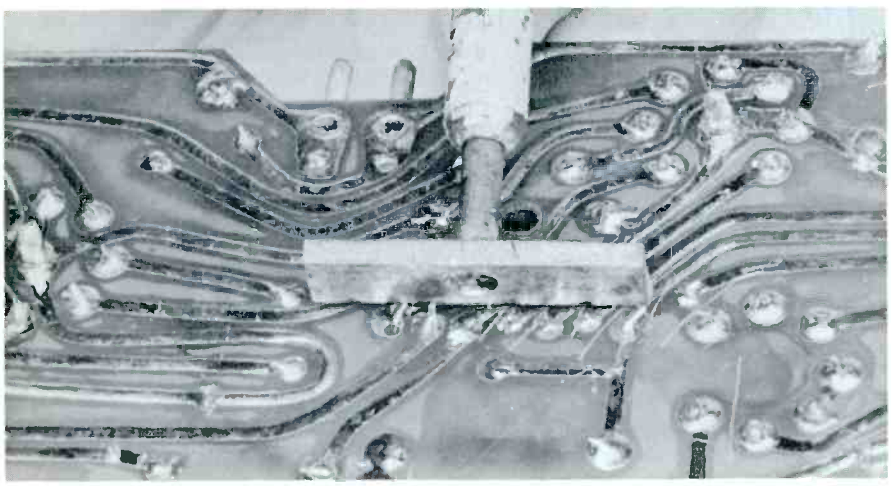
20HP4, -B, -C Add aquadag-grounding spring.
20HP4A Direct replacement. Original not aluminized.
20LP4 Direct replacement.
20MP4 Direct replacement.

easier PC board



This photo shows one of the methods you might try for easier removal of multiple-lead components, such as the miniature transformers found in transistor radios, or IF cans in television sets. This job requires a bit of caution. Some technicians run into trouble because they apply too much heat to a small area of the board, unbonding the foil; others damage components by pulling too hard in trying to rock them loose.

A new vacuum-type soldering iron removes the solder from the contact area, by first melting the solder and then drawing it into a cylinder which is a part of the iron. After this is done, the component will usually drop free from the board. Notice the already-cleared area around several transformer pins.

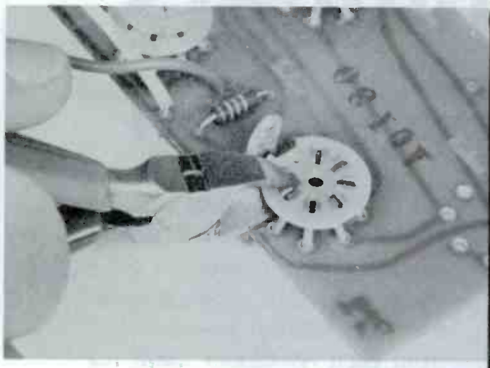


Some types of electronic equipment, in addition to using printed-circuit boards, also incorporate one or more printed-component units, such as shown here. These units can be removed easily with the special solder tip shown. This rectangular tip will cover and heat all the leads at once. When the solder becomes molten, the component is easily lifted from the board. This attachment can also be used to unsolder other components by merely turning it sideways and using the small end, or by using the tip to apply heat to the connection on the board.

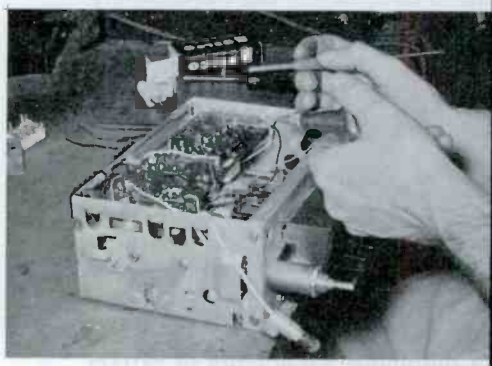
Many soldering attachments especially intended for PC-board work are being introduced every year. One such desoldering kit, with special tips shaped for quickly unsoldering tube sockets and different types of IF transformers, is shown here. With the appropriate attachment installed on the gun, all the connecting points are heated at the same time; the component may then be removed from the board, intact. The attachments can be installed as easily as replacing the tip.

repairs

Problems which can be encountered during the repair of printed-circuit boards are many—broken boards, blistered foil, hairline cracks, and intermittent contacts, to mention only a few. Haphazardly performed repair work contributes to these problems. To make printed-board servicing as foolproof as possible, the service industry has developed special tools and techniques, several of which are shown on these pages.

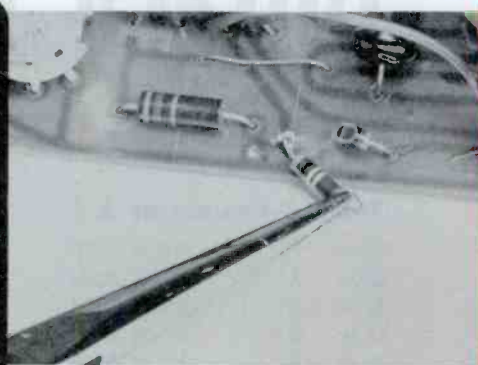


A relatively simple method of removing a defective tube socket without special adapters is shown here. After crushing the socket's phenolic wafer material, heat the individual pins and remove them with long-nose pliers.



After using a soldering iron to heat the contacts until the solder melts, this technician uses an air gun to clear the solder away from the component contacts. A fine wire brush finishes the job.

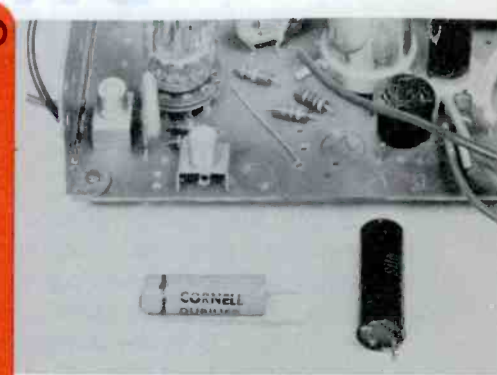
Pictured here is a proper technique for repairing a crack or open circuit. Place a piece of bare wire across the open circuit; then apply enough solder to cover the foil and the wire. The result is a neat, electrically secure repair.



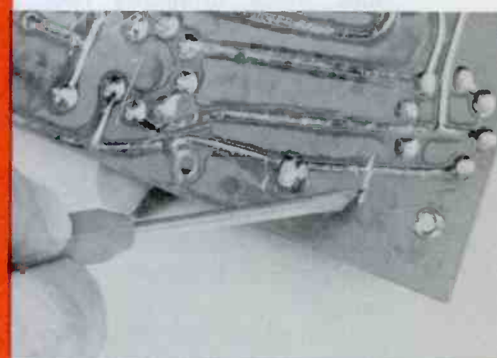
Shown here is the "hook" technique of replecing a resistor. Cut and crush the body of the old component to expose the full length of the leads. Form the old and new leads into hooks, clamp them together, and solder them carefully.

To prevent damage to an IF can, use the s otted end of a soldering aid to first straighten the ground tabs on the outer shield. With these tabs loose, the entire job of removal is made easier.

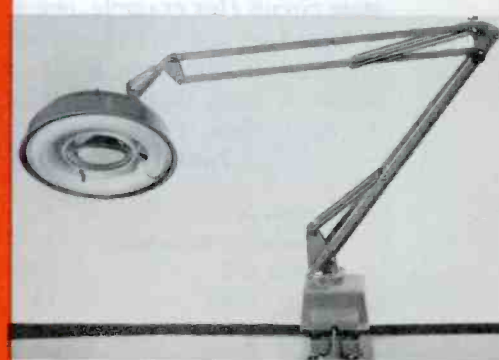
External connections for applying power or for testing purposes are easily provided by soldering one or more short wires to the printed board. Form them into a fish-hook pattern and clip on your leads, using miniature test clips.



"Single-ended" components, such as the capacitor shown, can be replaced by the familiar "double-end" types, if you dress the leads on the new component in the manner shown here. Tape the wire close to the body of the unit.



To isolate an individual component for testing, without dismounting it from the board, try cutting the printed foil with either a razor blade or the special tool shown. The cut is easily repaired later.



The adjustable light pictured here supplies shadowless lighting for printed-board work. It also has a built-in magnifying glass—a useful service aid for use with the miniature equipment now requiring the serviceman's attention.

Servicing Industrial Electronics
by Jim Galloway

10110
10101
01110

binary numbers
are not complicated!

If you have had experience with computers, you are undoubtedly familiar with the binary numbering system, and understand how to convert numbers from the decimal system to binary (and vice versa). But do you really understand how binary numbers are added, subtracted, multiplied, and divided? In this article, we intend to point out not only the rules for conversions, but also how to perform the manipulaions which ordinarily take place within the computer. Although these mechanical and electronic actions are somewhat different from those operations which can be shown on paper, a better understanding of the basic principles of these mathematical manipulations will be very helpful to the technician who must analyze and troubleshoot computer circuits.

The reason for using a two-digit (binary) numbering system instead of the universal ten-digit (decimal) system is because of its simplicity. Since there are only two digits (1 and 0) in the system, it is possible to use a very simple two-state circuit (for example, one which is turned on and off) to indicate the digits in the computer. If the on-off circuit is used, the circuit indicates 1 (one) when it is on; when it is off, it represents the digit 0 (oh). This simplicity makes the binary system very useful for computer work, enabling operations to take place rapidly.

Table I—Powers of 2

$2^0 = 1$	$2^{-1} = .5000$
$2^1 = 2$	$2^{-2} = .2500$
$2^2 = 4$	$2^{-3} = .1250$
$2^3 = 8$	$2^{-4} = .0625$
$2^4 = 16$	$2^{-5} = .0313$
$2^5 = 32$	$2^{-6} = .0156$
$2^6 = 64$	$2^{-7} = .0078$
$2^7 = 128$	$2^{-8} = .0039$

Conversion

Converting ordinary numbers to computer language is an operation easily understood, but also easily forgotten. As with many other mathematical subjects, there are certain rules which are best memorized; with these rules at hand, problems suddenly become less complicated.

The best way to learn a procedure is to *use* it. Therefore, we are going to include examples of the use of each rule—some with the procedure carefully explained, and others merely showing the operations. Try them yourself; you'll find they are easy!

Decimal to Binary

Rule 1: *To convert a decimal number to a binary number, extract the largest power of 2 that is contained in the number. Continue extracting each consecutive descending power of 2 from each remainder, until the least power (2^0) is extracted.*

Table II—Conversion from Decimal to Binary

Example A							
Number or Remainder	39	7	7	7	3	1	
Power of 2	2^5	2^4	2^3	2^2	2^1	2^0	
Binary Digit	1	0	0	1	1	1	
Example B							
Number or Remainder	90	26	26	10	2	2	0
Binary Digit	1	0	0	1	0	1	0
Power of 2	2^6	2^5	2^4	2^3	2^2	2^1	2^0

To illustrate, let's convert 39 to a binary number, using Tables I and II as a reference. (Table I shows the numerical equivalents for powers of 2, and Table II gives the results of each step in the conversion.)

The largest power of 2 which is contained in 39 is, of course, 32—or 2^5. This establishes the first binary digit (which is always 1) and leaves a remainder of 7. We now know that there will be six digits in the complete binary number, since we are going to extract the other descending powers of 2 from the remainder—the fourth, third, second, first, and least.

Continuing, we attempt to extract the fourth power of 2 (16) from the remainder (7). Since 16 cannot be taken from 7, we indicate that the fourth power is not contained in the remainder, by making the next binary digit 0 (oh).

Since the same circumstances apply to the third power of 2, another 0 is written as the third binary digit, and the remainder is still 7.

The second power of 2, which is 4, *can* be extracted from 7—making the next binary digit 1, and leaving a remainder of 3. The first power of 2, which is 2 itself, can be extracted from this remainder, supplying another 1 and leaving a remainder of 1.

The least power of 2 (2^0, or 1) is now extracted, resulting in 1 as the final digit of the binary number;

there is no remainder. Thus, we have converted the decimal number 39 into its binary form, 100111. This is read, "one-oh-oh-one-one-one."

Now, for practice, let's convert the decimal 90 to a binary number. Table II shows each step, along with the resultant binary digit and the remainder after each power is extracted. Note that the last remainder shown is zero; since the least power of 2 (1) cannot be taken from zero, the final binary digit is 0 (oh). If your conversion has been correct, you will find that the binary equivalent of 90 is 1011010, or "one-oh-one-one-oh-one-oh."

Binary to Decimal

Rule 2: *To convert a binary number to a decimal number, begin with the power of 2 represented by the right-hand digit and add each succeeding power of 2 until the left digit is reached. If any binary digit is 0, do not include that power of 2 in the decimal number.*

Using Table I as a guide, and following the steps in Table III, convert the binary number 110101 to a decimal number. Here's how it works: The first (right-hand) digit is 1, indicating that 2^0 *is* contained in the decimal number; therefore, you have a decimal quantity of 1 to start with.

The next digit is 0, meaning that 2^1 is *not* in the decimal number, so you add nothing. The third digit is a 1, indicating that 2^2 (4) is to be added to the decimal quantity already derived, making a total—so far—of 5.

The fourth binary digit is 0, so this step is skipped again. The final two digits are 11, and mean that 2^4 and 2^5 (16 and 32) must both be added to the 5 already obtained. Adding 16, 32, and 5 results in a total of 53; therefore, the binary number 110101 is equivalent to the decimal number 53.

For practice, try converting the binary number 101111 to its decimal equivalent. If your conversion is correct, you will find that 101111 is the same as 47.

Binary Fractions

Binary numbers which are less than 1 are expressed in a manner similar to decimal fractions—by the use of a *binary point.* For example, consider the binary number 1101.01. The digits to the right of the point represent negative powers of 2 (for decimal equivalents, see Table I).

Rule 3: *To convert a decimal fraction to binary form, extract negative powers of 2 from the numbers to the right of the decimal point, beginning with 2^{-1}.*

As an exercise, let's convert the decimal number 22.57 to a binary number. The whole number 22 converts by Rule 1 to 10110. In like manner, we can convert the fractional portion .57. The first negative power of 2 (.5000) can be extracted from .57, giving a binary digit of 1 and leaving a remainder of .07—see Table IV. Neither the second nor the third negative power of 2 are contained in .07; therefore, the next two binary digits are both 0's.

The fourth negative power of 2 (.0625) *is* contained in .07; therefore the fourth digit is a 1, and the remainder is .0075. The process continues for the fifth and sixth digits, both of which are 0's.

The seventh negative power of 2 (.0078) is slightly more than the .0075 remainder, but since most fractions need be carried only to a few digits past the decimal point, we can round off the final binary digit to 1. Thus, the fractional binary portion of the original decimal number is .1001001; the entire 22.57 converts to 10110.1001001.

Converting a binary fraction back to a decimal should now be fairly simple. Table IV shows how the binary fraction .1101101 converts to the decimal fraction .8516, or approximately .85.

Table III—Conversion from Binary to Decimal

Binary Digit	**1**	**1**	**0**	**1**	**0**	**1**	
Power of 2	2^5	2^4	2^3	2^2	2^1	2^0	
Decimal Number	**32**	**+16**	**+0**	**+4**	**+0**	**+1**	**Total 53**

Binary Manipulations

Binary numbers can be added, subtracted, multiplied, and divided just as decimal numbers can. In each operation, however, there are certain rules to remember which can keep the procedure from becoming unnecessarily complicated.

Addition

Rule 4: *To add binary numbers, the following facts must be used:*

$1 + 1 = 10 \qquad 1 + 0 = 1$

$0 + 0 = 0 \qquad 0 + 1 = 1$

In Rule 4, the statement that $1 + 1 = 10$ is read, "one plus one equals one-oh." This is the binary number 10 and *not* the decimal quantity *ten*.

Let's say that we have to add 110 and 101—see Table V. As in regular addition, we start in the right-hand column and add 1 + 0, which totals 1. The next column is 0 + 1, which is also equal to 1. The final step is to add the left-hand column; 1 + 1 = 10.

The figures to the right of each example in Table V are the decimal equivalents, and are included for checking purposes. The additional examples are for practice.

In example C, it is necessary to carry digits. In the right-hand column, 1 + 1 = 10. The 0 is written and the 1 is carried to the next column, where it is added to the 1 + 0 already in that column; so, 1 + 1 + 0 = 10. Again the 1 must be carried to the next column, where the result is again 1 + 1 +0 = 10. And once more the 1 is carried, this time to the left-hand column — where it is added to the 1 + 1 already there.

To add three 1's, it is easiest to add two of them—which equals 10

• *Please turn to page 62*

Table IV—Converting Binary Fractions

Example A								
Number or remainder	**.57**	**.07**	**.07**	**.07**	**.0075**	**.0075**	**.0075**	
Power of 2	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	
Binary Digit	**1**	**0**	**0**	**1**	**0**	**0**	**1**	
Example B								
Binary Digit	**1**	**1**	**0**	**1**	**1**	**0**	**1**	
Power of 2	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	
Decimal Number	**.5**	**.25**	**0**	**.0625**	**.0313**	**0**	**.0078**	**Total .8516**

by Forest H. Belt

summer service promotions

Summertime is a naturally trying time for most service shops, since there is a tendency for business activity to slow down. At this time of year, stimulating the service business is likely to be your greatest challenge. The business is there, but it seems unusually slow in presenting itself. So it is up to you to go after it.

The solution to this problem is *promotion,* or advertising. It may seem a bit paradoxical to be spending *more* money when business is ordinarily scarce, but this is the time when advertising is most needed. In addition to building summer business, a series of well-planned, aggressive promotions (coupled with good service) can result in satisfied customers who will be needing your services during the remainder of the year, too. Thus, summer promotions can be a double-barreled solution which will aid in keeping business booming the year around.

Budgeting and Planning

Budgeting for summertime promotions is much the same as for any other time of the year, with one exception: A bit more of the shop budget must be allotted for advertising during this season, because of the need to reach a larger portion of the market. Advertising is considerably less effective during difficult periods; therefore, you must allow for a more extensive campaign than usual.

Once you've set your budget, you must plan other details of the promotion. The method of reaching the potential customer is essential to the success of the promotion, and requires much careful thought. In most instances, the direct approach seems to be highly effective during this season. A promotional bulletin sent by direct mail, or perhaps a hand-delivered message, is likely to gain the immediate attention of the prospect. Promotional pieces distributed by the last two methods can be directed into carefully chosen localities, to selected groups of desired customers.

The promotion itself deserves careful planning, too. It should contain some extra "punch" to convince the customer that he should have his electronic service work done, *here* and *now*. The theme should be geared to the customer's needs—for example, what item of home entertainment equipment will he be using most during this season?

Other considerations which may enter into your planning of a summer promotion are: Should some special offer be included, such as a price cut or a free "extra" of some sort? Will the customer likely be spending more of his time outdoors at home, or does his income bracket enable him to spend considerable time boating, picnicking, touring by automobile, or other away-from-home activities? What are the various items of electronic entertainment equipment he is most likely to own—portable radio, tape recorder, television set, auto radio? You must analyze all these considerations as you try to decide on an effective, dynamic promotion.

Furthermore, you must plan the timing of the promotion to have the greatest impact on the potential customer. It must reach him at a time when he is most likely to look it over and say, "Yes, I had better get this done right away." If he puts the repair job off for any length of time, he is apt to let it go altogether. Therefore, the promotional item should stir the customer to *immediate* action, if at all possible.

Promotional Ideas

Themes for summer promotions can come from several sources. For example, the theme could be *seasonal,* pointing out the added importance of certain devices during the summer months—such as portable radios, record changers, or auto radios. The promotion could point out the advantages of getting service work done during the summertime, when speedier service is available, or perhaps while a small price concession is in effect. Or it could call the customer's attention to the effects of heat and humidity, advising him to have entertainment devices checked or repaired before more drastic repairs become necessary. The summer heat, vacation periods, or any other seasonal theme usually can be worked into an effective promotion. "Summer is a good time to have the old TV completely overhauled" or "Have *all* your radios, television sets, and record changers checked over while you're away on vacation" suggest definite advantages to the customer.

A *product* can be the subject of a promotion. Special items such as batteries for portable radios may entice the customer into the shop and serve as a springboard for obtaining service jobs. The promotion could suggest that when the customer stops by for batteries, he also bring in other radios that need repairs.

Again B&K Makes Servicing Easier... More Profitable!

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Model 625

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1 **TUBE TESTER SECTION** is fast and accurate. Tests the *newest* tube types as well as all of the *old* commonly used tubes in TV and radio sets. Tests the Nuvistors and Novars, the new 10-pin tubes and 12-pin Compactrons. Tests voltage regulators, thyratrons, auto radio hybrid tubes, European hi-fi tubes, and most industrial types. Checks for *all* shorts, grid emission, leakage and gas. Provides *adjustable* grid emission check with exceptional sensitivity to over 100 megohms. *Checks each section* of multi-section tubes separately. Checks tube quality and capability of cathode emission under current loads simulating actual operating conditions.

2 **VOM SECTION** provides the 7 most-used ranges for convenient TV testing:

3 DC Ranges: 0-10, 100, 1000 volts
3 AC Ranges: 0-10, 100, 1000 volts
1 Resistance Range: 3 k center scale

3 **CRT SECTION** spots picture tube trouble and corrects it in a few minutes right in the home, without removing tube from set. Tests and rejuvenates picture tubes at correct filament voltage from 1 to 50 volts. Checks for leakage, shorts, and emission. Removes inter-element shorts and leakage. Restores emission and brightness. (Checks and repairs color picture tubes with B&K Accessory C40 Adapter.)

Model 625 Dyna-Tester complete in handsome, lightweight, leatherette-covered carry-case.
Size: 11¾" x 15" x 4½". Net, $139.95

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Time-Saving, Money-Making Instruments Used by Professional Servicemen Everywhere

Model 960 Transistor Radio Analyst

Model 360 V O Matic Automatic VOM

Model 375 Dynamatic Automatic VTVM

Model 1076 Television Analyst

Model 440 CRT Rejuvenator Tester

See Your B&K Distributor or Write for Catalog AP20-R

B & K MANUFACTURING CO.
Division of DYNASCAN CORPORATION
1801 W. BELLE PLAINE AVE. • CHICAGO 13, ILL.
Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

Other effective sales items are needles and cartridges for the portable record changers which provide entertainment on the outdoor patio or porch. Replacement auto antennas and rear-seat speakers attract the interest of the family who drives a lot in the summertime. Other product themes will suggest themselves to the imaginative shop owner.

A promotion can be *customer-slanted*—that is, intended to attract a certain class of customers. For instance, the advertising might be intended for boating enthusiasts only, offering special attention to the service needs of the "summertime skipper"—depth sounders, portable direction finders or transistor radios, and marine or CB two-way radios. On the other hand, perhaps the shop caters to customers in a particular income bracket; the promotion could be designed to create special interest among this group. Almost any promotion theme will lend itself to a treatment slanted for a particular type of customer.

Gimmick Promotions

The *gimmick* promotion often draws the greatest response from all types of customers. In this type of advertising, something out of the ordinary is offered—a free item, a free service, a special price, or perhaps an unusual service. The possibilities in this category are limited only by the imagination of the planner.

The word *gimmick* sometimes leaves the impression of quackery, or faking; this need not be the case. A *gimmick* also refers to "an ingenious device for attaining an end." The end to be attained by the promotional campaign is the attracting of new (and old) customers.

A typical promotion of this sort might make an offer such as: "Free pickup and delivery — when you have three or more radios repaired at the same time." This offers the customer a genuine service in return for having his servicing needs taken care of at a time which is more convenient for you. The promotional piece can point out that the special offer makes it easier than usual for him to take advantage of the reputable service which is always available from your shop.

Special flat-rate charges might serve as the basis for a gimmick pro-

Find it and Fix it in 1/2 the time!

EASILY SOLVES "TOUGH DOGS"... INTERMITTENTS ... ANY TV TROUBLE

B&K **MODEL 1076** **TELEVISION** **ANALYST**
BLACK & WHITE AND COLOR

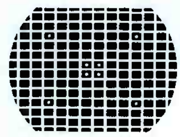
By Easy Point-to-Point Signal Injection, You see the Trouble on the TV Screen and Correct it—Twice as Fast and Easy!

Simplified technique stops lost hours never recovered on **"tough dogs", intermittents,** and **general TV trouble-shooting.** This one instrument, with its complete, accurate diagnosis, enables any serviceman to cut servicing time in half . . . service more TV sets in less time . . . satisfy more customers . . . and make more money.

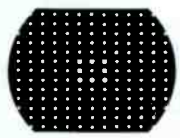
With the Analyst, you inject your own TV signals at any time, at any point, while you watch the generated test pattern on the picture tube of the television set itself. This makes it quick and easy to *isolate, pinpoint, and correct* TV trouble *in any stage throughout the video, audio, r.f., i.f., sync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

Available on Budget Terms. As low as $30.00 down. Net, $299.95

SIMPLIFIES COLOR TV SERVICING, TOO



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



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

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

Time-Saving, Money-Making Instruments Used by Professional Servicemen Everywhere

Model 960 Transistor Radio Analyst

Model 360 V O Matic Automatic VOM

Model 375 Dynamatic Automatic VTVM

Model 700 Dyna-Quik Tube Tester

Model 440 CRT Rejuvenator Tester

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motion. If the price represents a genuine saving, the thrift-conscious customer will be prodded into going ahead and authorizing repairs which he normally would delay until he wanted to use the item more regularly.

Free service is a useful gimmick, but only if wisely applied. The ethical shop owner will guard carefully against misleading statements, and the promotion will very clearly state *exactly* what the offer includes, and the *conditions* of the offer. For example, "Free needle replacement on record changers" might be misleading; it would be better to say, "Any needle purchased here will be installed free." This keeps the customer from feeling that the offer should include a free needle.

One successful method of applying the "free-service" gimmick is by adapting the "one-cent sale" device used for many years by soap advertisers: You might offer to repair any radio at the usual price and, in addition, service another similar radio for $1 additional (plus parts). A similar gimmick is an offer to repair any AC/DC radio free when the customer has a TV overhaul job (at the usual price, of course).

Offers of this nature must be carefully planned beforehand, since it is easy to give away enough free labor to offset any profit which might be obtained from the added volume of work. However, if costs are analyzed thoroughly, the offer can be priced so as to represent a genuine saving to the customer, and still leave a reasonable margin of profit for you. And it's better to have a small margin of profit on several repair jobs than to have no work and ring up no profit at all.

Putting Promotions to Work

Some shop owners don't feel qualified to develop and carry out their own advertising campaigns. If you are a successful businessman, you have undoubtedly advertised before, and your advertising expert may well have a number of worthwhile suggestions on how to beat the summer business slump. A number of specially-prepared campaigns are available—usually at a nominal cost—from companies which specialize in business promotions. Some manufacturers of electronic components make promotional material available to the service-shop owner at very low prices.

As in other advertising campaigns, *consistency* is one of the keys to successful summer promotions. It is of little value to make one "flash-in-the-pan" offering, and then sit back and hope the momentum will take care of the rest — it won't. A continuing series of promotions is necessary to keep the business in your service shop at an even keel throughout the lazy summer months. ▲

Moving to a New Location?

If so, notify us by the 15th of the month to assure uninterrupted delivery of PF REPORTER.

Please be sure to give us both your old and new address, including your postal zone number. (Or better yet, enclose a current mailing label with your new address.) Send to:

PF REPORTER
Circulation Dept.
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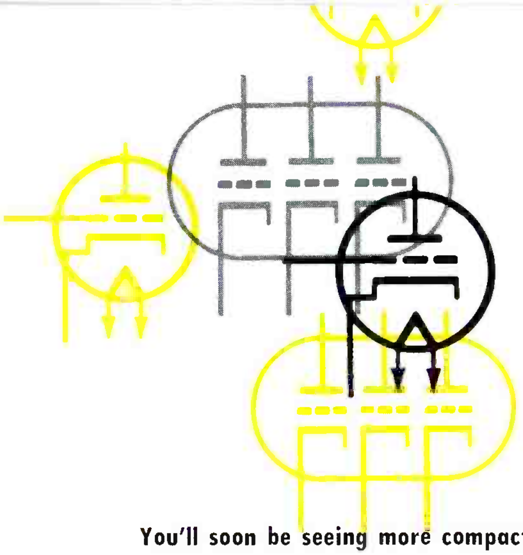
Indianapolis 6, Ind.



TV TUBE TRENDS

You'll soon be seeing more compactrons, novars, and other advanced types . . . by Thomas A. Lesh

Been waiting for your first chance to test or replace a compactron, novar, or other unusual new tube type? You won't have long to wait, because quite a few of these special tubes are being incorporated in late '62 and early '63 TV models.

Compactrons

These 12-pin devices began to appear in large quantities early this spring. About that time, the General Electric MW chassis (originally introduced in mid-1961 with all conventional tubes) was modified to use five compactrons, and Muntz announced an all-new "19 Met" model—a 19" set with six compactrons out of a total complement of nine tubes plus CRT. Somewhat later, G-E introduced a 1963 line consisting of the small LX chassis and the larger MX chassis, each using a different selection of six compactrons. Admiral, which made use of one triple triode in the 1962 models, has also "compactronized" the horizontal-output and damper circuits in some of the '63's. In addition, certain 19" models in the 1963 Zenith line have compactrons in the horizontal and vertical output stages. Many more of the new 12-pin tubes are expected to appear in other '63 models now being readied for the market; these types will be

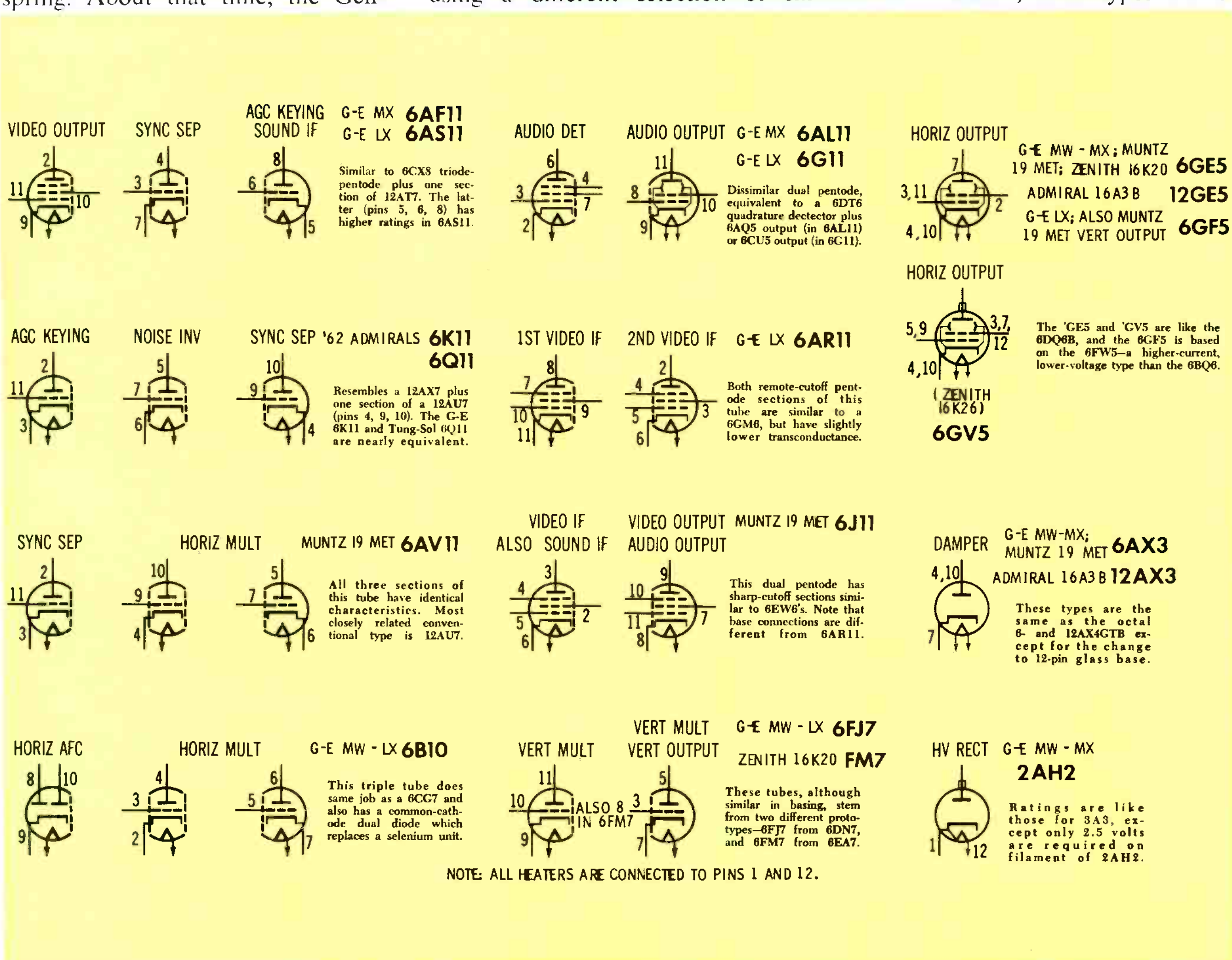


Fig. 1. Base connections and circuit applications for 19 compactrons now in use.

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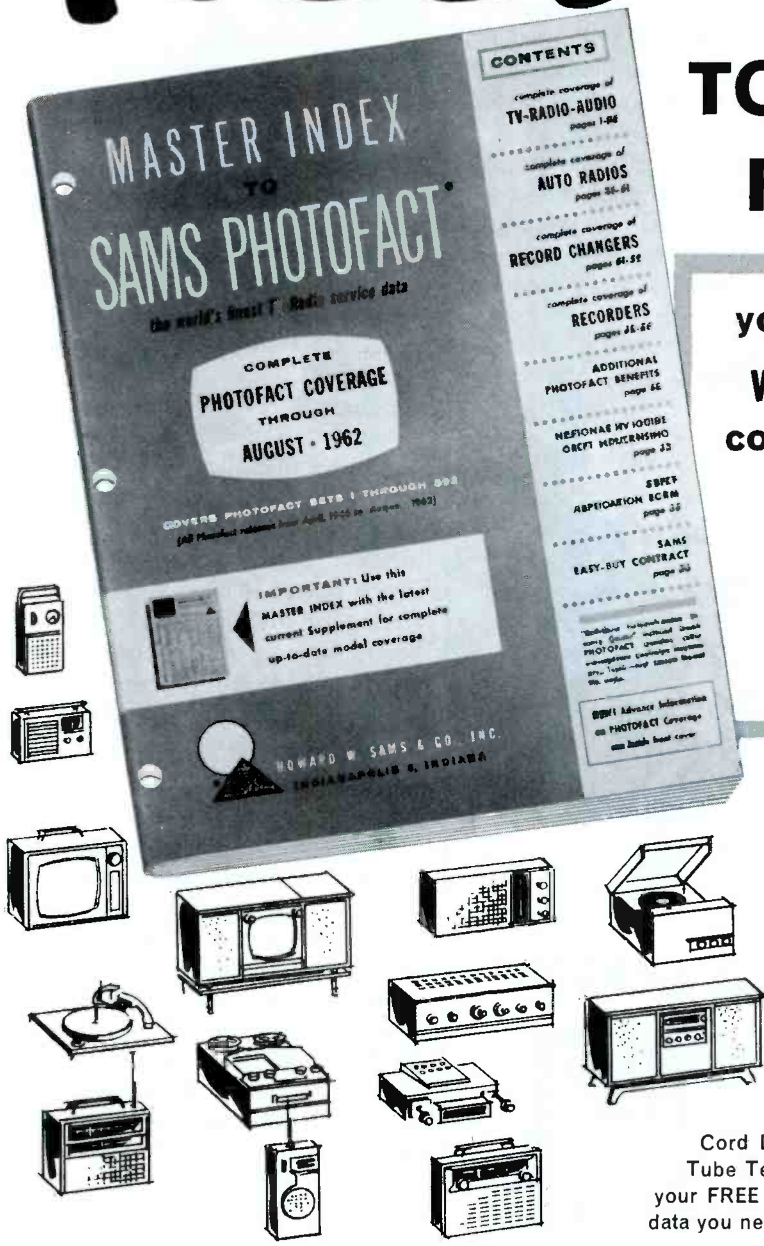

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world's finest service data

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CITIZENS BAND RADIOS

Here is your invaluable 60-page guide covering virtually every model of home-entertainment electronic equipment produced since 1946! Helps you locate the proper PHOTOFACT Folder to quickly solve any service problem in any model. PHOTOFACT provides *everything* you need in complete, uniform style for quick, effective repairs: Famous Standard Notation Schematics packed with the service details you need; Full Photo Coverage of all chassis views; Complete Replacement Parts Lists; Tube Placement Diagrams; Alignment Instructions; CircuiTrace® for printed boards; Disassembly Instructions; Dial Cord Diagrams; Changer and Recorder "Exploded Views"; Tube Test data—plus dozens of other great features. Send for your FREE copy of the latest PHOTOFACT Index to the service data you need!

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covered in the October PF REPORTER.

Fig. 1 gives basing diagrams for the first 19 compactron types in actual use, indicates the chassis in which each tube is found, and names the stages in which the various tube sections are employed. In all these types, each section is electrically very similar to some conventional tube found in earlier TV models. These "forerunner" types are mentioned in Fig. 1 to help you become acquainted with the compactron circuits, as well as to furnish valuable information for use in tube testing.

When you know the correct base connections and nearest equivalent types, you can figure out how to set up your tube tester and compactron adapter to obtain a usable check of new compactrons not listed on your tester's roll chart. More information on this technique was presented in "Develop Your Own Tube Test Data" on page 82 of the April, 1962 issue.

Notice that the last nine types in Fig. 1 have no more elements than ordinary single- or dual-section tubes. For these tubes, compactron design was employed to permit

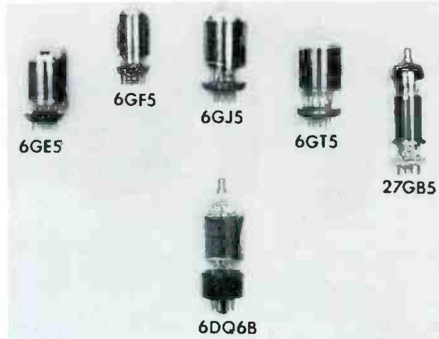


Fig. 2. Compactron and novar horizontal output tubes compared to a 6DQ6B.

changing over from an octal base to a miniature-style glass base, while retaining a large-diameter tube envelope for rapid dissipation of heat.

Horizontal - output compactrons are made in two different sizes, both pictured in Fig. 2. The larger 6GE5, capable of operating in 114° circuits with high CRT-anode voltage, has the same bulb size as a 6DQ6. The smaller 6GF5, used where less sweep power is needed, is about as large as a 6BQ6. The tubes shown here have the plate connection made through base pin 7, but another available type (the 6GV5) has a top-cap connection.

Novars

Two other "super - miniature" horizontal output tubes, shown at the right of the 6GF5 in Fig. 2, are novar types with nine widely-spaced base pins supporting a T-12 bulb (same size as a 6DQ6). The 6GJ5 first appeared in RCA's Chassis KCS140 and –141, and the 6GT5 in the Magnavox 38 series chassis. The only difference between these tubes is that the 6GJ5 has a top cap, while the 6GT5 does not. Except for basing (Fig. 3), the novar tubes are like the octal 6GW6 that was used in RCA's KCS136 chassis last year. This tube differs from the 6DQ6B in having slightly lower peak cathode-current and plate-dissipation ratings.

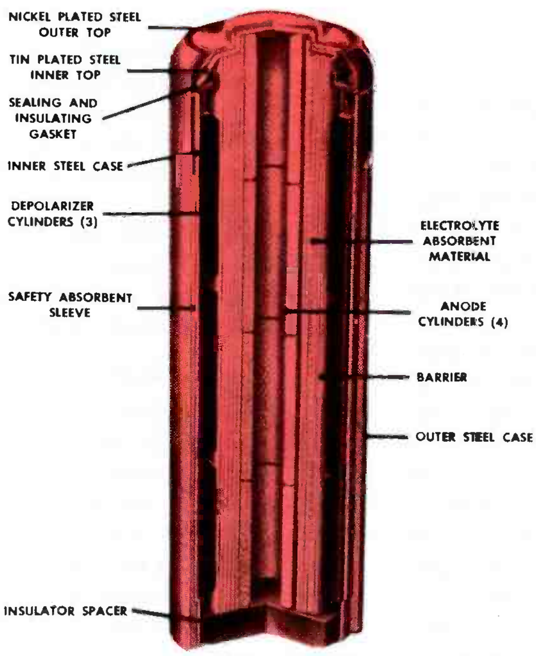
A novar damper, the 6- or 17AY3, is used in all the latest RCA sets—including revised versions of the KCS130, –37, and –38 series —and is also found in Zenith Chassis 16K20 and –26. (See Fig. 3 for base diagram.) Electrical ratings, the same as for the 6- and 17DM4 used in the '62 RCA line, are among the highest available in any type of damper tube.

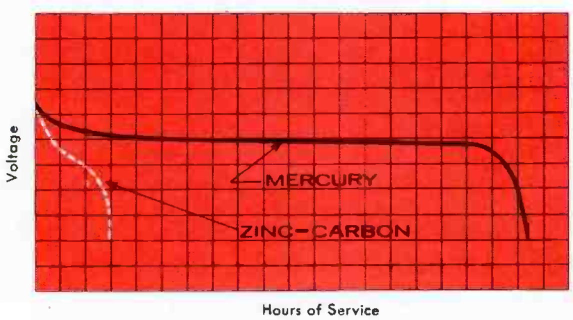
MALLORY
P. R. MALLORY & CO. Inc.

Tips for Technicians

Distributor Division, P. R. Mallory & Co. Inc.
P. O. Box 1558, Indianapolis 6, Indiana

The new generation of batteries ...how to use them





You may not realize it, but dry batteries used in modern electronic circuits are as different from old style dry cells as 1962 autos are from the Model T.

Of primary interest to you as a technician is the mercury battery. Instead of the ordinary combination of zinc, carbon, and electrolytic compounds, Mercury batteries use mercuric oxide and a zinc amalgam in combination with an alkaline electrolyte. This chemical system produces a dry battery uniquely matched to solid-state electronic circuits. For example, Mercury batteries have about four times the milliampere-hour capacity of ordinary batteries of the same physical size.

Not only do mercury batteries contain more actual power, they hold this power for long periods of time. Ordinary batteries start to lose power from the instant they are assembled *whether used or not.* On the other hand the storage life of a mercury battery is amazing. We've had some on storage test for more than nine years . . . AND THEY'RE STILL ALIVE.

Perhaps the best thing about mercury batteries is their steady output voltage. It stays nearly constant throughout the entire life of the battery (see chart). Ordinary battery voltage drops steadily. Constant voltage is important in solid state circuits . . . it means constant gain and linearity.

Terminal voltage on a mercury cell is 1.35 volts $\pm \frac{1}{2}\%$! This is so accurate there's a special multi-voltage reference battery (Pt. No. 303113) that's widely used as a secondary voltage standard. It's excellent for setting scopes, meters, etc., and all sorts of lab work. We'll be happy to send complete information. Just ask.

Mercury batteries are a Mallory development. We like to think we're experts on them. But we know there are jobs a mercury battery shouldn't do. Jobs where very high surge drains or continuous heavy drains are required . . . flash cameras, flashlights, movie cameras, etc. So we developed the Mallory Manganese Battery. It's the king of heavy drain batteries . . . with excellent storage life and moderate price.

There are literally dozens of other battery systems available from Mallory. We simply don't have space to go into them here. But if you're interested in rechargeable batteries, or ultra low temperature types, or extreme low or high voltage types, or other exotic types, write to Dept. 762. We'll send the information.

Meanwhile, when you need a battery for a grid bias circuit, or a portable instrument, or a transistor radio, use a Mallory Mercury Battery. For flashlights and similiar applications use Mallory Manganese Batteries. You can get them from your Mallory Distributor. He's the man to see for Mallory capacitors, controls, switches, semiconductors, and vibrators . . . and for all your electronic requirements.

The 19" Zenith sets which contain a 6AY3 are also equipped with a novar low-voltage rectifier, the 5BC3 — equivalent to a 5U4GB with a miniaturized base.

European Imports

The novar tube at the far right in Fig. 2 is a 27GB5/PL500, made in Holland—one of five imported tube types in the Motorola Chassis TS-449 (19" sets) and TS-578 (23" sets). The other four types are conventional 9-pin miniatures. Although several of these tubes are commonly used in European TV receivers, this is the first time they have appeared in an American-made set. However, replacements are readily obtained in this country; all five types are in the Amperex and Mullard lines. Also three of the tubes are related to other types previously used by Motorola, and this fact simplifies the testing problem.

The 16AQ3/XY88 damper is identical (except for filament) to the 6AL3/EY88, and is also similar to the 6AF3; both of the latter types are found in many recent Motorola models. Incidentally, specific suggestions for testing the 16AQ3 by referring to the 6AF3 setup information are on page 92 of the April issue.

Three 9A8/PCF80 triode-pentodes are used as sound IF-vertical multivibrator, keyed AGC-noise inverter, and sync separator-horizontal oscillator tubes. This type is a series-filament version of the 6BL8/ECF80, which has been extensively used by Motorola for the past couple of years, and has also appeared in some Zenith models. In basing and specifications, the 6BL8 is most nearly similar to the 6GH8 or 6EA8.

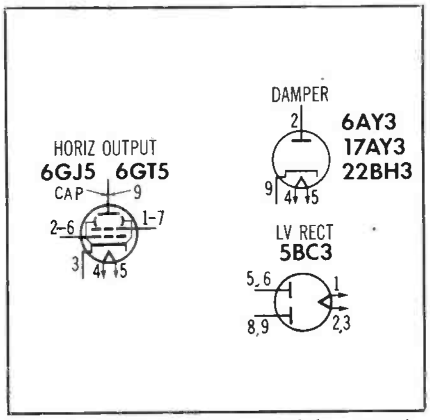


Fig. 3. Several 1963 models contain one or more of these novar tube types.

The audio-output and vertical-output stages use 15CW5/PL84 power pentodes, which are series-string counterparts of the 6CW5/EL86 type found in many hi-fi amplifiers.

Newer on the scene is the 7HG8/PCF86 oscillator-mixer, a triode-pentode with a frame-grid pentode section.

These Motorola sets also contain a new American-made tube, the 15HB6 video amplifier. Although basically similar to a 6GK6, this type has higher electrical ratings and a filament designed for operation in a series string drawing only 300 ma. The TS-449 and -578 have a series-parallel filament circuit with only the damper and the picture tube common to both branches.

Only a Beginning

Besides the many unusual tubes discussed in this article, quite a few other types have made their bow in the last several months. In fact, more new tubes are being introduced this season than in any other recent year. So, before you begin to receive service calls on the new models, now's the time to check your tube stock and test facilities. ▲

know your YOKES and FLYBACKS

Replacements don't have to be a problem.

by George F. Corne, Jr.

Flyback and yoke circuits in TV sets have for years presented a big service headache. But nowadays, they have become much less of a problem.

Many of the older TV's, with their complex flyback and yoke circuits, gave you the impression, "Here is a dog"—and many of them were! Just picking up the service information for one of these "oldies" and seeing the multitude of connections to the flyback transformer alone (to say nothing of the many "cousin" components) was cause for concern. You got the feeling that it wasn't going to be easy to pin down the particular part responsible for a trouble, or even to locate the faulty section of the horizontal circuit (oscillator, output, flyback, yoke, or boost).

However, complicated designs are fading from the scene. Compare the flyback circuitry of a 1952-model receiver with that of a 1961 model made by the same company (Fig. 1). Doesn't the newer circuit look simple when compared with the older one?

For further comparison, pick out the service information on several TV sets (of any brand) introduced in the last few years. You will almost always find an autoformer in the flyback slot. This type of transformer not only gives the high efficiency needed for the modern 90° to 114° sweep, but also makes the circuit much less complicated than the isolated-secondary and direct-drive types used previously. The eventual retirement of older sets will chop off two-thirds of the circuit designs confronting service shops; that's quite a relief in itself! As horizontal output and yoke circuits become more standardized from one set to the next, they will look more familiar to the serviceman, and he will save much time in choosing a suitable repair technique.

Better Replacements

Had any trouble obtaining a replacement for a yoke or flyback lately? It's not likely, for the units now available can almost always be installed with few or no changes,

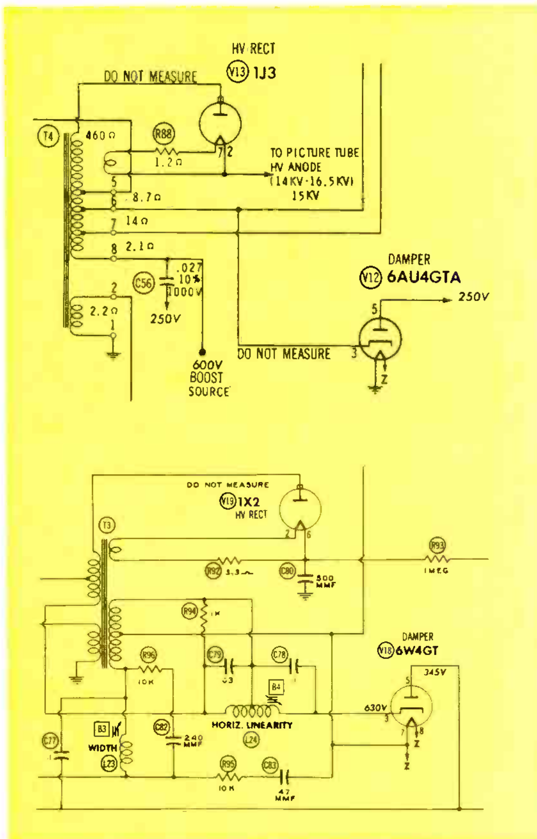


Fig. 1. Modern flyback circuits are simpler than designs of ten years ago.

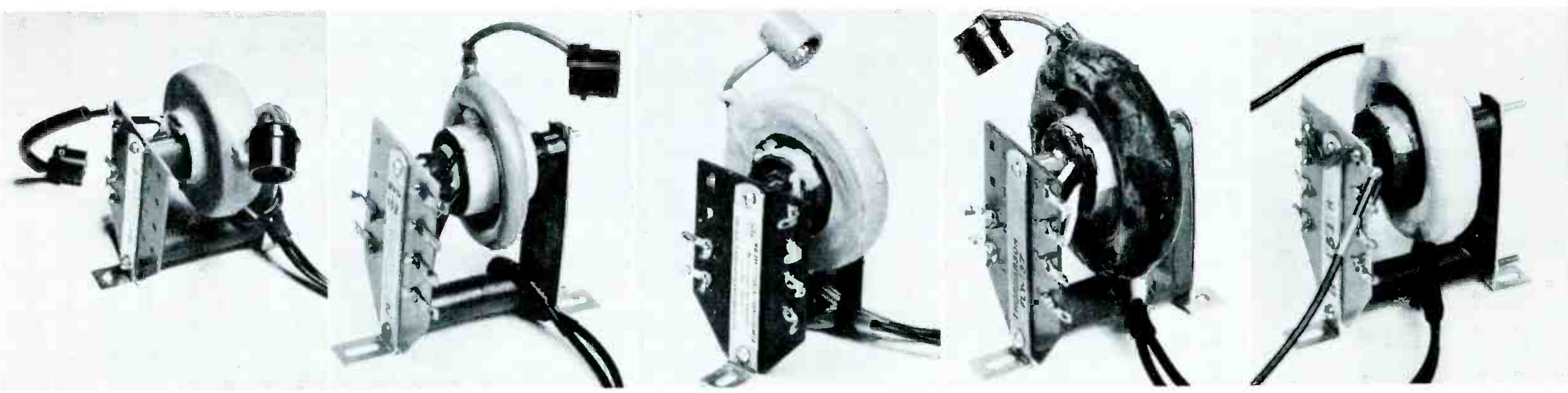


Fig. 2. Note similarity between original flyback (at left) and four different brands of replacements.

Wake Up

A new day is dawning in electronics.

Transistors are here to stay . . . they are now being used everywhere; in radio, television, Hi-Fi, intercom, and in nearly all new electronic equipment . . .

Why put off transistor circuit servicing any longer . . . there's gold in them thar hills. But you must be equipped to do the job fast and efficiently. Here are the tools that you will need.

NEW SENCORE TRANSI-MASTER

This Tester will analyze the entire circuit in minutes and test transistors in-circuit or out of circuit. Here is how you can pin point troubles step by step with the TR110.

First, check the batteries with the 0 to 12 volt meter. If the batteries are O.K., check the current drain with the 0 to 50 milliamp meter. A special probe is provided so that you do not need to break the circuit. Excessive current indicates a short; low current indicates an open stage or cracked board. All PF schematics indicate average current.

If trouble is not located by now, isolate the trouble to a specific stage by touching the output of the harmonic generator to the base of each transistor and note spot where sound from speaker (or scope where no speaker is used) stops or becomes weak. The generator becomes a sine wave generator for audio stages to help find distortion.

If trouble points to a transistor, check it in a jiffy with the exclusive in-circuit power oscillator check provided by the TR110. A special probe is also provided for this.

If the transistor checks bad in-circuit, remove it and give it an out of circuit check with the oscillator check or the more accurate DC check.

The DC check is provided for comparison reasons, experimental or engineering work and to match transistors in audio output stages. Beta (current gain) is read direct or on a good-bad scale for service work.

DEALER NET. ONLY $59.50

Tests all transistors in-circuit or out-of-circuit

Model TR110

***It's a* COMPLETE TRANSISTOR TESTER**

- **SIGNAL TRACER** • **VOLTMETER**
- **BATTERY TESTER** • **MILLIAMMETER**

NEW SENCORE TRANSISTOR AND DIODE CHECKER

Here is a low cost tester that has become America's favorite. The TR115 provides the same DC out of circuit checks as the TR110; leakage and current gain. Beta (circuit gain) can also be read direct or as good or bad. Opens or shorts in the transistor are spotted in a minute. The TR115 checks them all from power transistors to the small hearing aid type. Japanese equivalents are listed also. This famous tester is used by such companies as Sears Roebuck, Bell Telephone and Commonwealth Edison. New circuits enable you to make service checks without set-up charts even though charts are provided for critical checks.

Model TR115
Dealer Net
Wired
$24.95
Kit........$15.95

SENCORE BATTERY ELIMINATOR AND TROUBLE SHOOTER

For replacing batteries during repair.

Many servicemen say that they wouldn't service transistor circuits without this power supply. The tried and proven PS103 is a sure fire answer. It can be used to charge the nickel cadmium batteries as well. Dial the desired output from 0 to 24 volts DC and read on meter. Low ripple insures no hum or feedback. Total current drawn can also be read on the PS103 by merely flicking the function switch to milliamps. The PS103 is the only supply that will operate radios with tapped battery supplies such as Philco, Sylvania and Motorola. No other supply has a third lead.

Model PS103
Dealer Net
$24.95

Now in stock at your Authorized Sencore Distributor

ALL PARTS SENCORE ® MADE IN AMERICA

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either electrical or physical. The "universal" flyback required for many repair jobs in past years is outdated, and (except in rare cases) is now seldom needed by service technicians.

In Fig. 2, a flyback used as original equipment in one make of receiver is compared with four different brands of replacements. Notice the similar appearance of all five flybacks. The electrical characteristics are also very similar from one to another. Any of the four replacements may be used to replace the original flyback without drilling new holes for mounting, and only two of the four require that you connect leads to terminal numbers different from those of the original. This ease of replacement will save the service shop time and money when a new flyback must be installed.

Replacement yokes, like flybacks, are easy to obtain. Installation is not much of a chore, requiring little more than plugging in the new unit or soldering a few lead connections. The few problems encountered in yoke replacement have more to do with certain accessories than with the yoke itself.

For instance, a newly-installed yoke occasionally requires the addition of *pincushion magnets* to compensate for slightly nonlinear operation which causes bending of one or more raster edges.

One yoke which actually had caused this problem is shown in Fig. 3. Note the slightly offset position of the two horizontal windings, which distorted the magnetic field enough to cause curved sides in the raster. The necessary correction could be made by inserting small magnets in the slots at the edges of the yoke assembly.

When you need pincushion magnets, you can't always count on obtaining them from the defective yoke you are replacing, because they are not used in all cases. Therefore, it's a good idea to save a few magnets from discarded yokes for possible future use.

To position the magnets in a new yoke, insert them in the slots, and slide them around until the edges of the raster are fairly straight. (To see the edges, decrease the width of the raster, if possible, or slightly decenter the CRT beam.) Since the

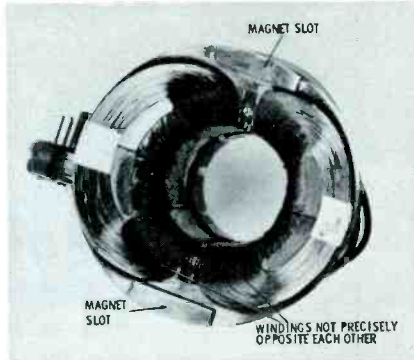


Fig. 3. Magnets can be installed in slots to counteract pincushion effect.

magnets have north and south poles, you may have to turn them over to check the effect of both polarities. After finding the best position, apply a drop of glue to secure the magnets in place.

Other yoke accessories that often need attention are the external capacitors and resistors in the antiringing and damping networks. In many instances, these are included with a new yoke when it is purchased; however, there are exceptions to this rule. For instance, one manufacturer supplies the networks separately and recommends using a new network whenever a yoke is replaced. In cases like this, be sure to use network components which have the same values and characteristics as those in the original network.

Servicing Techniques

"Pinpointing Yoke and Flyback Troubles," in the May, 1961 issue, described a general troubleshooting procedure for autoformer-type flyback circuits and the theory of their operation. Here are further particulars on some aspects of flyback-yoke servicing which seem to give technicians considerable trouble.

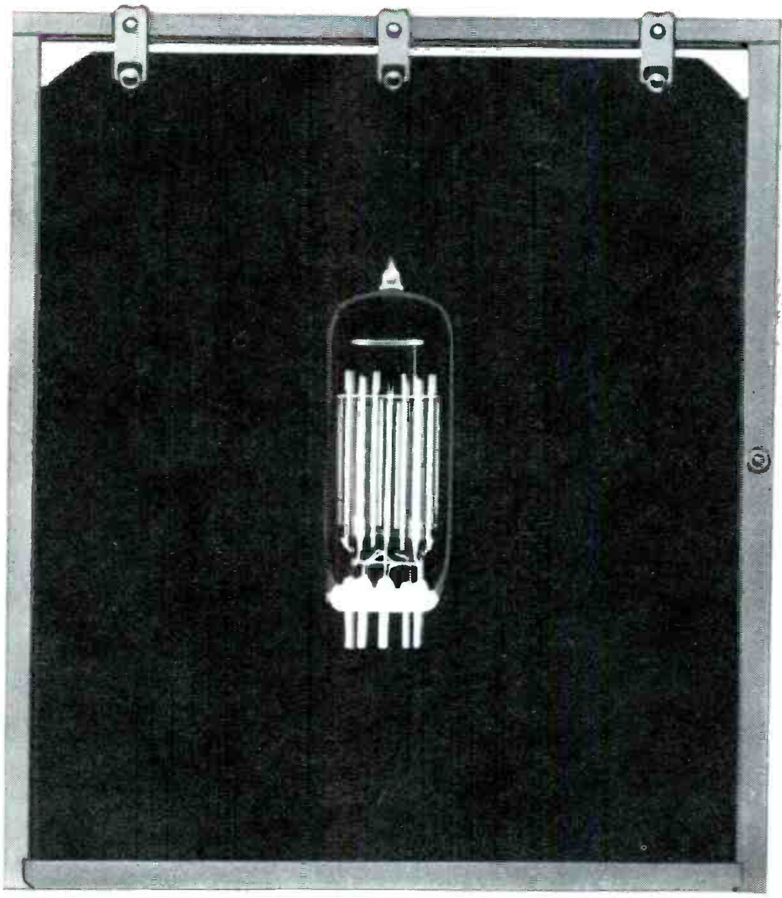
Resistance Measurements

Ordinarily, the only thing you can learn from a resistance reading of a yoke or flyback is whether or not a winding is open. A few shorted turns, which may disturb circuit operation enough to eliminate the raster, cannot usually be detected by this test. Even if an ohmmeter *could* spot this defect in a "cold" circuit, it would miss many intermittent cases which appear only when the set is in operation. Therefore, resistance readings won't always tell you whether or not a yoke or fly-

ANATOMY CLASS FOR DOCTORS OF RADIO AND TV SERVICE

Controlled heater explains greater life expectancy of Tung-Sol series-string tubes

Prognosis—*excellent!* Examination of Tung-Sol series-string TV tubes reveals advanced design of heater and cathode structure, making possible *controlled warm-up time.* This explains the good health and longevity of Tung-Sol series-string tubes. Tung-Sol was a pioneer producer of 600 ma series-string tubes. But, not content merely to be among the first, Tung-Sol expanded this group to cover many applications and then added 450 and 300 ma series-string tubes for sets of more sophisticated circuitry. Time has proved Tung-Sol's diagnosis to be correct; the series-string principle radically improves tube life expectancy while retaining youthful vigor. Consultants on TV service agree that the family of Tung-Sol series-string tubes are far more immune to malfunctions of all kinds. Sets equipped with Tung-Sol series-string tubes require fewer visits and less hospitalization than sets with ordinary tubes.



℞ FOR A HEALTHY TV SERVICE BUSINESS

To avoid sluggish customer attitude, low profit levels and other complications symptomatic of poor components selection, always rely on Tung-Sol. Choose from more than 100 Tung-Sol series-string tubes to fill your prescriptions.

the first name | to ask for when ordering

TUNG-SOL®

SERIES-STRING TUBES

TUNG-SOL ELECTRIC INC., NEWARK 4, N. J.

back is in good condition.

They are helpful, however, in locating certain types of troubles which sometimes develop. When a winding has many shorted turns, its resistance will be much lower than the value normally called for. Also, an ohmmeter can detect leakage or a short from a coil winding to the core, a mounting bracket, or another winding.

One case which comes to mind *was* solved by resistance checking. The flyback circuit for the set involved (a Sylvania) is shown in Fig. 4. The original trouble in this receiver was a lack of high voltage. Checking the set on the bench, the technician found the flyback defective; a short, detected with an ohmmeter, had developed between the AGC/AFC winding and the main winding. After a new flyback was installed, the set was fired up for a checkout. No arcing or burning of any kind was observed, but now a problem of weak high voltage existed.

Since this particular flyback is not difficult to install, and since the technician had sketched a connection diagram prior to unsoldering the bad unit, he postponed checking for wiring errors and focused his attention on the new flyback itself. He found no continuity between terminals 1 and 2, but discovered an apparent short from terminal 1 to 3, which should be isolated from each other. Was this transformer shorted, like the old one? Looking at the rear of the terminal board for a possible lead short, the technician found a wiring error which had been made during manufacture of the flyback. The leads which should have been connected to terminals 2 and 3 were reversed. Unsoldering these leads,

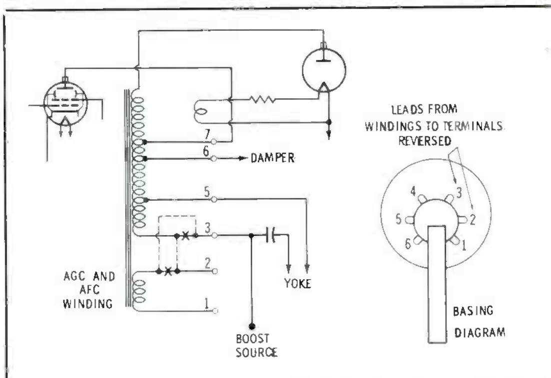
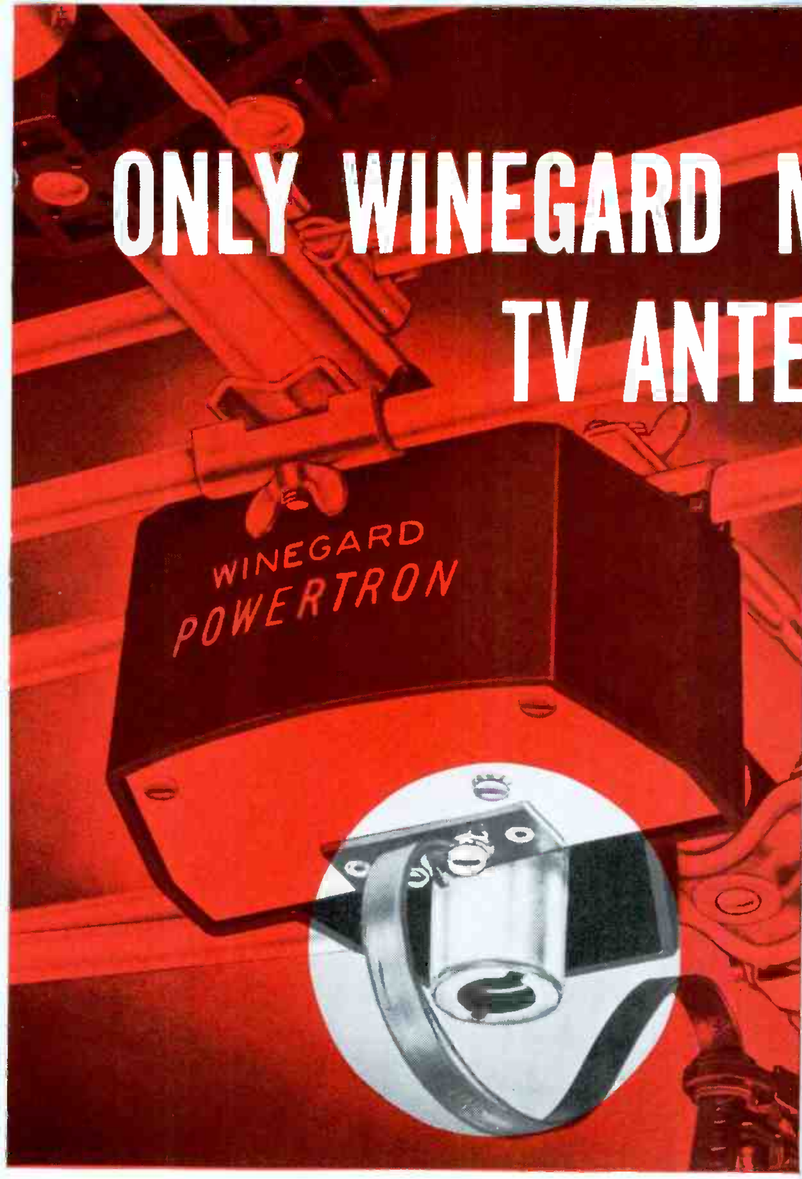


Fig. 4. Wrong connection in this flyback was located by ohmmeter check.

ONLY WINEGARD MAKES ELECTRONIC TV ANTENNAS WITH TUBES!



Work Perfectly in Areas Where Transistors Fail!

Why Winegard Makes BOTH Tube and Transistor Electronic TV Antennas!

In December, 1960, Winegard introduced the first electronic TV antenna—the Powertron—a tube model that created an immediate reaction in the industry. Winegard had a transistor model ready for introduction within a few months. Later, competitive antenna amplifiers appeared, all of which were transistorized. But Winegard continues to make tube type Powertrons as well as transistor models, for very important reasons. *In fact,* more Winegard Powertrons have been sold than all *competitive* antenna amplifiers and so-called electronic antennas combined!

There are two types of signal area where electronic antennas can do wonders in improving TV and FM:

1. **Fringe areas:** where the nearest TV or FM stations are a considerable distance from the set.
2. **Mixed signal areas:** where some TV or FM stations are far away and weak, but other stations are strong because of being located fairly close.

The type of signal area is *extremely* important in determining your selection of tube versus transistor.

Transistors currently available, while they are very satisfactory for weak signals, often cause cross modulation interference when signal input is in excess of 20,000 microvolts. (It is possible to design a circuit that will prevent overloading transistors, but at too great a sacrifice in gain and noise figure.)

Because tube type electronic antennas will take many times more signal input than transistors without overloading, *there are areas where only Winegard tube type Powertrons can be used successfully.*

Both transistors and tubes have individual advantages. Transistors, for example, are small, use little power, and have a very long expected life. Tubes have the high gain and low noise characteristics of transistors, but do not normally overload.

Only Winegard gives you both! Get the facts, write for technical bulletin today or ask your distributor.

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- **POWERTRON CAPTURES MORE SIGNAL** than any other all-channel antenna ever made. Patented design, electro-lens director system, dual "TAPERED T" driven elements.
- **POWERTRON'S THE ONLY TRUE ELECTRONIC ANTENNA.** Only the Winegard Powertron is built with the amplifier as part of the driven element—not an "add-on" attachment.
- **POWERTRON ELIMINATES ALL SIGNAL LOSS** that normally occurs between the driven element and the amplifier due to transmission and coupling mismatch.
- **POWERTRON BOOSTS WEAK SIGNALS UP OUT OF THE SNOW** far better than any other antenna or antenna-amplifier combination made.
- **FOR VIVID COLOR, HIGH DEFINITION BLACK AND WHITE AND LONG DISTANCE RECEPTION,** nothing can compare to the Powertron.

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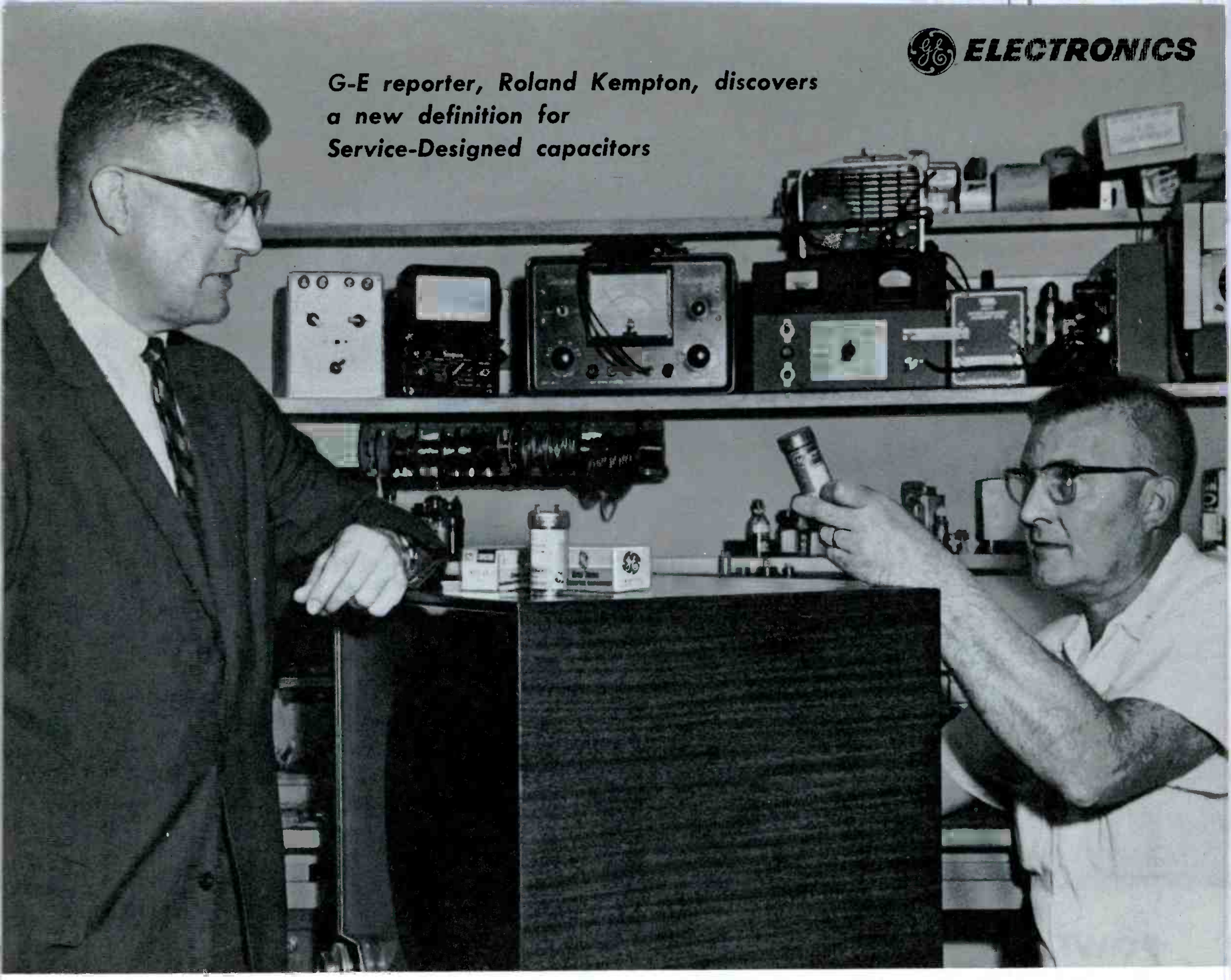

"Gas Savers"... that's what John Crocker calls G-E *SERVICE-DESIGNED* capacitors, because he can fill 70% of his replacement needs with just 20 types

Here's how John Crocker, owner of CROCKER TELEVISION AND RADIO SERVICE, Fort Wayne, Ind., figures the day-to-day advantages of G-E Service-Designed capacitors:

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It pays to stock G-E Service-Designed capacitors. Save gas. Save time. Reduce costs and inventory requirements. Speed customer service.

Get all of the facts, including the most complete capacitor catalog and replacement guide ever published, from your G-E capacitor distributor. Ask for ETR-2600, or write to: General Electric Company, Distributor Sales, Electronic Components Division, Room 1754A, Owensboro, Kentucky.

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and connecting them to the proper terminals, restored normal operation of the high-voltage circuit. Wiring errors in new flybacks and yokes are very seldom encountered, but they *can* happen!

Final Checkouts

Premature failures of replacement flybacks are due to two major causes —other troubles still present in the circuit, and incorrectly-set adjustments. An operating check of a newly-repaired horizontal circuit is in order unless you want the set back in a short time.

If the receiver has logged a large number of operating hours, look for value changes in resistors that handle fairly heavy current. A great percentage of early flyback failures can be traced to excessive screen current in the horizontal output tube, frequently resulting from resistor defects. So, check the value of every screen resistor, and inspect it with a keen eye for physical signs of overheating or cracks.

Measure the B+ feeding the output stage; excessive voltage may cause the current through the flyback to rise to a ruinous level. Check for faulty capacitors, too, and don't overlook troubles in the horizontal-oscillator and boost circuits. If you let yourself be lax about making this final checkout, you're asking for a callback.

Even though all horizontal-sweep components may be good, operating conditions in this circuit may change slightly when a new flyback or yoke is installed. Therefore, it's advisable to check all possible adjustments, including drive, width, and linearity. These are not variable in all makes and models of receivers, but you'll encounter each of the three types of adjustments from time to time.

Generally speaking, the object of any adjustment is to obtain a normal raster without causing the flyback circuit to draw any more current than necessary. Since the most convenient indicator of flyback current is the cathode current of the horizontal output tube, connect a milliammeter into the cathode circuit before proceeding with adjustments. The reading will normally fall in the range between approximately 100 and 130 ma in most sets built during the last several years; but most older receivers, except those using a 'CD6 or 'BG6 horizontal output tube, should use substantially less than 100 ma.

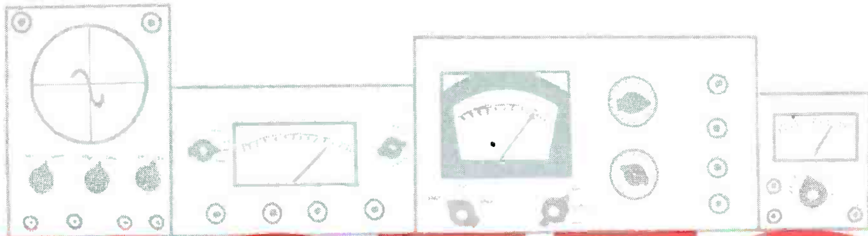
If the output stage has a cathode resistor, you can measure the voltage drop across it and compute the current; but direct measurement with a milliammeter is a more dependable procedure. The meter should be left in place while you monitor the various adjustments. By noting the effect the controls have on output-tube current, you can more easily locate the cause of any condition which produces too much current in the flyback.

The *drive* control, usually located in the grid circuit of the output stage, should be set just below the point where a drive line (narrow vertical white stripe near midscreen) appears in the raster. If no line appears, set the control for minimum cathode current, making sure the reading is within safe limits. If it is not, check to see if the drive signal supplied by the horizontal oscillator has sufficient amplitude.

On sets equipped with a *width* adjustment (tunable coil, potentiometer, or yoke sleeve), use this— *not* the drive control—to obtain proper horizontal size. Getting enough width should be no problem if the circuit is operating normally, and if the correct flyback or yoke replacement has been installed.

Linearity coils should always be set to obtain minimum current through the output tube. Most circuits are designed so that best linearity occurs at this point. Even a moderate misadjustment of the coil can cause a great enough rise in current to burn out a flyback in a matter of minutes. Even slight overcurrent can cause very short life for the output tube. You can prove this statement for youself by keeping an eye on the cathode-current meter as you turn the linearity adjustment.

As a final test after all other checks and adjustments have been made, recheck the screen current of the output tube. The reading should be about 10 ma in late-model receivers, and proportionally less in older sets. When you've taken all possible precautions to keep the cathode and screen currents down to a normal level, the flyback and yoke can be expected to operate well within their ratings and last a long time. ▲



NOTES ON TEST EQUIPMENT

by Forest H. Belt

Testing, Testing!

The *Model 700 Dynamic Mutual Conductance Tube Tester*—see Fig. 1—is built by B & K Mfg. Co. Containing two independent testing circuits, it can evaluate practically all receiving-type tubes available today.

Specifications are:

1. *Power Requirements—117 volts AC; 60 cps.*
2. *Tube Tests—emission; mutual conductance (in prewired section); leakage, sensitivity over 100 megohms; shorts, less than 1 megohm causes neon lamp to glow; gas or grid emission, sensitive to as little as 2 or 3 ua; special "life" test.*
3. *Tubes Tested — standard receiving types, novar, compactron, 10-pin noval, and 5-pin nuvistors; separate tests for multisection tubes.*
4. *Panel Meter—face size 4½";* GOOD-?-REPLACE, *numerical value comparison, and shorts-and-grid-emission reject scales.*
5. *Controls and Terminals — rotary heater-voltage switch;* SENSITIVITY *potentiometer; five push-button switches (shorts, grid emission, test 1, test 2, and test-circuit transfer); four rotary switches (A, B, C, and D) for emission tests; on-off slide switch; "life" test slide switch; two neon test-circuit indicators; neon shorts indicator; jeweled pilot lamp.*
6. *Size, Weight, Price—16" x 16¼" x 5¾"; 15 lbs; $169.95.*

Fig. 1. Model 700 can test tubes for both emission and mutual conductance.

The Model 700 utilizes 34 prewired tube sockets to test several hundred of the most popular receiving types, using a transconductance bridge circuit. Of course, diodes are tested by a simple emission test, even in the prewired section of the tester. For the remaining types, the *Dyna-Quik* emission circuit is used to evaluate tube performance.

The prewired section of the instrument tests the tubes by applying a fixed bias to the grid of the tube under test, injecting a known amount of 60-cps signal voltage, and rectifying and measuring the resulting signal voltage in the plate circuit. A 6BN8 tube does triple duty as a bias rectifier, a metering rectifier, and a bridge tube; a type 83 mercury-vapor tube is the main rectifier in the unit.

For tubes which cannot be tested in the prewired mutual-conductance section, eight sockets are provided which will accept all the other available receiving types — including novars, compactrons, 10-pin novals, and 5-pin nuvistors. A push button takes care of transferring the connections from one section of the tester to the other.

The "switching" section utilizes four switches to interconnect all elements except the cathode and heater. Voltage is applied to the tube under test by grounding all these elements; the cathode is then connected to the negative side of the rectifier supply via the metering circuit, which measures the current flowing from the cathode.

The grid-emission test uses the circuit shown in the simplified schematic of Fig. 2. The negative bias is normally applied to the grid of the 6BN8, keeping it cut off. If the grid of the tube being tested does emit electrons, the more positive plate will attract these electrons. Current will flow, creating a drop (with polarity as shown) across the 5.6-meg resistor. The positive voltage overcomes the cutoff bias of the 6BN8, allowing it to conduct, and thus causing the meter to deflect—indicating grid emission. The sensitivity of the circuit is variable, and can be adjusted by setting R1 (which determines the point of 6BN8 conduction).

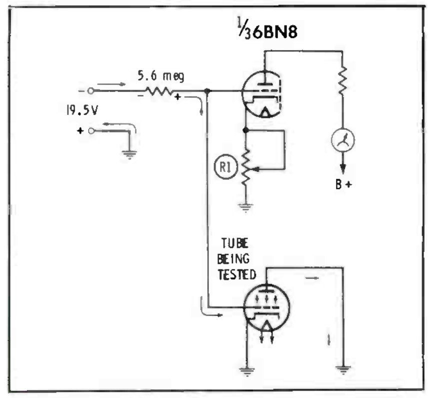


Fig. 2. Simplified schematic shows how grid-emission test is accomplished.

Testing for shorts is accomplished in the prewired section by interconnecting all the tube elements except the cathode, applying a voltage between the cathode and the other elements, and checking for current flow between the elements. This is a very sensitive test; leakage measuring less than 1 megohm will cause the neon lamp to glow, while the meter will indicate leakage up to several megohms.

We put the Model 700 to work in the lab testing a number of our known-defective tubes. Aside from a tendency to read some weak tubes at a higher-than-usual value, the instrument located a majority of the faulty specimens.

Here's a pointer which will be of value to the technician who is testing tubes for gas and grid emission: in many cases, these effects become noticeable only after the tube becomes very hot. To speed up the test for these faults, increase the filament voltage (not over 50%) for a very short time—if gas is present, this will usually shake it loose! In one instance, a known gassy tube failed to show reverse grid current until it had been in the tester for some 10 minutes. The following day, after waiting a minute or so with no results, we "shot" the 12-volt filament with 16 volts for three or four seconds; the gas showed up and proved the tube was defective. Even after leaving the tube out of the tester for 15 minutes, we found that the gas showed up immediately upon retesting.

Another feature worth mentioning is the "life" test. This test takes advantage of the fact that reducing the filament voltage of a tube a very small amount will have little effect on the emission, provided the cathode is emitting enough electrons to maintain a substantial space charge. If it is not, an immediate decline in the value reading will become apparent. In the Model 700, the test is performed by merely lowering the heater voltage and noting the decrease (if any) in the quality reading. Thus, the ability of the cathode to build a space charge is checked and construed as an indication of the remaining useful life of the tube.

Volts and Ohms

EICO's new VTVM, the Model 222, is shown in Fig. 3. The instrument incorporates such features as better-than-usual accuracy on lower ranges, low ohmmeter voltage, and the EICO *Uniprobe* (which combines the functions of an AC-OHMS and a DC probe).

Specifications are:

1. *Power Required—105-125 volts AC; 50-60 cps; 5 watts.*
2. *DC Voltmeter—five ranges: from 0 to 3, 15, 75, 300, and 1500 volts DC; input resistance, 11 megohms; accuracy ±3% of full scale; polarity reversal in function switch.*
3. *AC Voltmeter—five ranges: from 0 to 3, 15, 75, 300, and 1500 volts rms; input resistance, 1 megohm; accuracy ±5% of full scale (sine wave only); frequency response, 30 cps to 3 mc.*
4. *Ohmmeter—five ranges: from 0 to R x 1, 10, 1000, 10K, and 1 megohm; center scale reading is 10; accuracy ±3% (battery, 1.5 volts).*
5. *Panel Meter—sensitivity 400 ua; face size 4½"; voltage scales: 0 to 3, 15, and 75; ohmmeter scale, 0 to infinity; zero-center voltage scale.*
6. *Controls and terminals* — ON-OFF-FUNCTION *switch;* RANGE *switch; zero-adjust and ohms adjust potentiometers; coaxial fitting for Uniprobe; banana jack for ground lead; neon pilot lamp.*
7. *Size, Weight, Price—8½" x 5¾" x 5⅛"; 5 lbs; $27.95 kit, $42.95 wired.*

The Model 222 is useful in the service shop as a general-purpose VTVM. The voltage ranges are chosen to provide for accurate low-voltage measurements in transistorized equipment, and to extend the high-voltage range to facilitate measurements in communications or industrial equipment.

Measurements are made with a straightforward vacuum-tube bridge circuit using a 12AU7 tube. The plate power for the bridge tube is developed by a transformer power supply, with one half of a 6AL5 serving as the rectifier. The other half of the 6AL5 is used in the AC-voltmeter function to rectify the measured AC.

Firing up the Model 222 in our lab,

Fig. 3. Model 222 VTVM features wider measurement range than earlier units.

we found that the unit required approximately five minutes to reach complete stability; after this warm-up period, the needle remained at zero. After the instrument was well "broken in" (having aged for a few days with the power on), we carefully calibrated each adjustment, taking special care with the AC-balance procedure. (By the way, the calibration potentiometers are accessible through holes in the side of the cabinet.) When calibration was completed, one characteristic of the instrument was readily apparent: We noted very little "needle shift" when switching from range to range or from function to function. When this "shift" exists, it can be very annoying to the VTVM user, since it necessitates rezeroing the meter each time a different range is used. The Model 222 is conspicuously free of this problem.

The AC-voltmeter function of the Model 222 is particularly useful to the audio technician because the frequency response is compensated to be flat from 30 cps to 3 mc. In fact, the instrument we tested in the lab exceeded this specification, demonstrating a flat response even beyond 3 mc.

The frequency response of a meter can decidedly affect its usefulness as an audio VTVM. Most AC voltmeters are calibrated to read accurately in the vicinity of 60 cps, and when higher frequencies are involved, their poor response leads to erroneous measurements.

One other point deserves mention in connection with audio measurements: The Model 222 responds to the *peak* value of whatever waveform is applied to its input. But all its scales are calibrated in rms values of a sine wave; therefore, the scales are accurate for sine waves only. For example, suppose a sine wave and a square wave—each having a *peak* value of 10 volts—are measured with the Model 222. The reading for both waveforms will be the same—slightly over 7 volts. For the sine wave, this is the true rms value, but in the case of the square wave, it is not—the rms value of a 10-volt square wave is 10 volts.

If these facts are kept in mind, the instrument can be used as a peak-reading voltmeter for most waves by multiplying the scale reading by 1.4 in each case. Furthermore, even though the Model 222 fails to include a decibel scale, it can be used as an output meter by referring to the instruction manual—which contains a conversion table for changing volts to decibels. Thus, the thoughtful service technician can find many additional uses for this instrument.

Multiplex Complex?

If servicing FM stereo equipment has been a problem for you, the new Model MX625 SG Signal Generator (Fig. 4) produced by Calbest Electronics of Los Angeles, California may be the answer. Specifications are:

1. *Power Required—117 volts AC; 60 cps; 42 watts.*
2. *Frequency Range—A single preset RF carrier between 88 mc and 90 mc.*
3. *Stereo Signal—consists of pilot carrier, double-sideband suppressed-carrier component, and L and R audio components (which must be provided externally); available as a 1-volt (peak to peak) composite stereo signal or as frequency modulation on 88-90 mc RF carrier.*
4. *Distortion—less than 2% on all functions.*
5. *Accuracy—pilot carrier and double-sideband signal, frequency ±.01%.*
6. *Panel Meter—face size 4½"; indicates modulation percentage of FM carrier; scale 0-100 (100 equals ±75-kc deviation).*
7. *Controls and Terminals—toggle power switch; two* AUDIO MODE *switches; pilot signal* ON-OFF *switch; stereo-signal level control; "BN"-type RF output connector; banana jacks for composite-stereo output, SCA-signal input, and L and R audio-signal inputs; pilot lamp.*
8. *Size, Weight, Price—11½" x 15" x 7"; 18 lbs; $495.00.*

At present, the most common problem with FM stereo servicing seems to be that many stations provide stereo programming only occasionally. When an accurate signal is needed to align the critical circuits in the multiplex receiver,

Fig. 4. Calbest stereo FM generator.

the station doesn't happen to be broadcasting in stereo. This can cause considerable inconvenience to the serviceman, and some delay to the customer who is waiting for his set to be repaired.

The Model MX625 SG generator provides an FM stereo signal whenever it is needed by the technician. The instrument has one outstanding feature which few other stereo signal generators boast—its signal can be connected to the RF input of the FM stereo receiver. Of course, the composite stereo signal is also available to be fed directly into a multiplex adapter (or at any point following the FM demodulator) if this is more desirable. However, we found in our lab that using the frequency-modulated RF output was the quickest way to couple the signal into the receiver, and provided very satisfactory results.

As can be seen in the simplified block diagram in Fig. 5, the right-channel audio and the left-channel audio are mixed in two matrix circuits—one which subtracts the right from the left and one which adds the two together. The L − R signal is mixed (in a balanced modulator) with an internally generated 38-kc signal. The balanced modulator is centered at 38 kc; therefore, its output contains the products of the mixing—in other words, the sidebands of the L − R signal. These sidebands are amplified and fed to a cathode follower. The L + R signal and the sideband signal are combined and coupled through another cathode follower.

We now have a composite signal consisting of an L + R signal (which is direct audio) and a sideband component which contains the L − R modulation. In order that the L − R sideband signals will bear an exact phase relationship to the L + R signals when they are recovered at the receiver, the generator provides a 19-kc pilot signal on which the receiver multiplex circuitry can "lock in."

The 19-kc pilot signal is generated by

erratum

The prices of Sencore's Model RC121 Substitutor given in last month's column were Canadian prices. Correct U.S. prices: $39.95 wired, $27.95 kit.

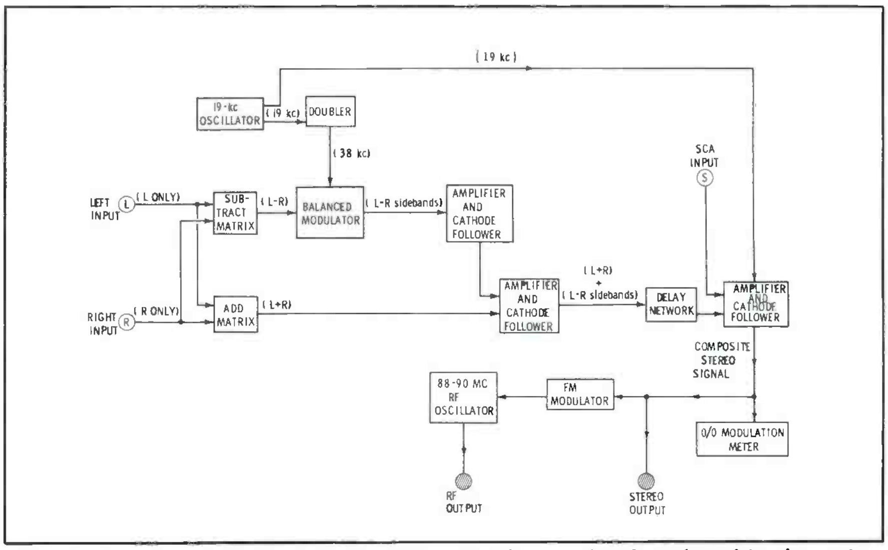


Fig. 5. Functional diagram shows how signals are developed within the unit.

a crystal-controlled oscillator, which maintains the frequency of the signal within ±.01% of 19 kc. The L – R sidebands bear a direct relationship to the 19-kc oscillations, since the 38-kc signal in the balanced modulator is derived from this source. In order that the L – R sidebands will be exactly in phase with the 19-kc pilot signal (when they are transmitted together on the carrier), a factory-adjusted delay network is located between the L – R/L + R mixing circuit and the composite-signal mixing circuit. This is to assure balanced recovery of the audio signal in a properly-operating receiver.

Now, let's re-examine the stereo signal (see Fig. 6). Frequency-modulated on the 88-mc signal is a group of signals including the L + R components, a double set of sidebands which contain the L – R information, and a 19-kc pilot signal to assure the proper phase of the 38-kc carrier-reinsertion oscillator (or amplifier) in the receiver.

The 67-kc signal indicated in the diagram is used by only a small number of FM stations, and is known as the SCA (Subsidiary Communications Authorization) subcarrier. It is authorized by the FCC for use by the station to carry any subsidiary program information, such as background music or a similar service. The MX625 makes provision for inserting this signal to permit checking the FM stereo receiver for a trouble known as *SCA interference*. Interaction between the 67-kc subcarrier and the regular stereo program can become objectionable; so, in many receivers, circuits are provided to suppress this unwanted carrier. With the MX625, a 67-kc signal can be injected to aid in adjusting these suppression networks.

The Model MX625 does not contain its own right- and left-channel audio signals. For channel-separation measurements, therefore, the unit must be used in conjunction with an audio generator and a tunable audio VTVM. A simple

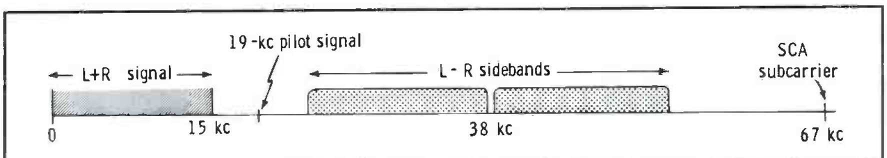


Fig. 6. The composite stereo signal is made up of several different signals.

VTVM can be used during these measurements, provided a set of filters are inserted at the output of the amplifier (or adapter) to cause the VTVM to respond to the test frequencies.

For these measurements, the audio generator is connected to the left-channel input jacks of the MX625, and the stereo-generator signal is fed into the multiplex receiver (or adapter). The audio signal frequency is set at 2 kc, and the audio voltage is adjusted for 50% on the modulation meter of the MX625.

If the multiplex receiver is operating properly, and its circuits are aligned correctly, a tone should be present at the output of only the left channel—since no R component is present in the composite stereo signal. Therefore, this signal is composed of one L signal directly modulated on the FM carrier, and another L signal (a portion of the same one, actually) appearing as sidebands of the 38-kc subcarrier. In the receiver, these should combine to give only a left-channel audio signal.

Now, the output from the left channel is measured, and the reading is recorded. In one lab test, we found an L output of .6 volts rms at the measuring point (in this instance, the input of the loudness control), so let's use this as an example. Measuring the output of the right channel during this test, we found .03 volts rms of the 2-kc signal. This represents a voltage ratio of 20 to 1, or slightly more than 25 db; the channel separation of the unit under test, therefore, was approximately 25 db.

Since the measured separation was less than the separation specified by the manufacturer of the particular stereo receiver we were testing, we used the MX625 to carefully align the multiplex circuits of the set—following the stereo manufacturer's recommended procedures. When this step was completed, we remeasured the separation, finding .8 volts rms at the left-channel output and only .006 volts at the output of the right channel. The separation ratio was now 133 to 1—over 40 db—and was now well in excess of the set manufacturer's specification.

The Model MX625 SG Stereo Signal Generator can provide almost any signal which the technician needs to service a stereo receiver. It requires only that he use at least one audio generator, a tuned audio VTVM, and perhaps a stereo program source (such as a stereo phonograph or tape recorder) in addition to the MX625 SG. Using this test setup, accurate adjustments can be made to the receiver in question.

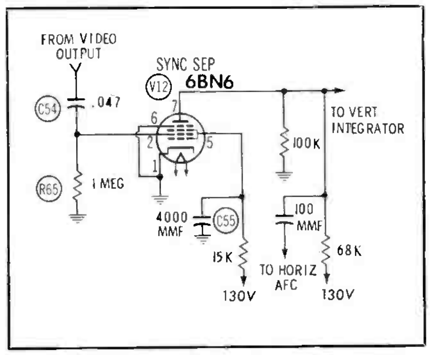
now in our lab . . .

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

Anchor Model T475 Reacto Tester
Hickok Model 656XC Color Generator
Mercury Model 1000 Tube Tester
Paco Model G-32 Sweep Generator
RCA Model WO-91A Oscilloscope

THE TROUBLESHOOTER

answers your service problems



More "Pulling Power"

What's the best method of connecting a small outside antenna to ferrite rod and loop antennas of transistor radios? Some of these little sets don't have sufficient pickup to bring in some stations, and I'd like to improve their range.

Ray S. Hanson
Galt, Calif.

Using an outside antenna with a transistor radio is not often practical. However, a 10-15 ft. wire can sometimes be inductively coupled to a radio's antenna by merely winding a couple of turns around the ferrite rod. No direct solder connections should be made to the radio circuit because the existing antenna coil is designed to match the input circuit exactly; in many instances, the "loopstick" is part of the RF tuning circuit. We have heard of instances where signal pickup was increased by placing the receiver near a telephone lead or a lamp cord.

Suspended Sync

In a Zenith Chassis 24H20 (covered in Photofact Folder 120-13), I have a curious sort of sync trouble. The set will play perfectly well until I either change channels or momentarily switch off channel and back again; then it loses horizontal and vertical sync. Using the hold controls, I can momentarily stop the picture in order to inspect the vertical blanking signal on the face of the picture tube. The pattern is normal, with the sync bar darker than the blackest part of the picture.

The trouble centers around sync separator tube V12, which I have replaced twice with new 6BN6 tubes to no avail. The voltages at this tube when the sync is normal, as measured with a VTVM, are: pin 2, −16 volts; pin 5, +85 volts; pin 7, +95 volts; pins 6 and 1, zero volts. When the sync is lost, the voltage changes to 60 volts on pin 2, 50 volts on pin 5, and 45 volts on pin 7. If I momentarily ground pin 2, or remove and reinstall the 6BN6, the voltages go back to normal and the picture locks in.

Replacing C54 and C55 has made no difference. All resistors connected to V12 have been checked and are correct.

Charles Sankel
TV Instructor
Taft Youth & Adult Center
New York, N.Y.

If you can't find a short in the wiring associated with pin 2, I'll bet the socket of V12 has an intermittent leakage path between pin 2 and pin 5 or 7. Since the leakage is easily interrupted by grounding the grid or removing the tube, the trouble will be hard to spot. It would be a good idea to go ahead and change the socket as a conclusive test for this condition.

Another conceivable cause of the intermittent positive voltage on pin 2 is a poor ground connection at the cathode terminal (pin 1) of V12.

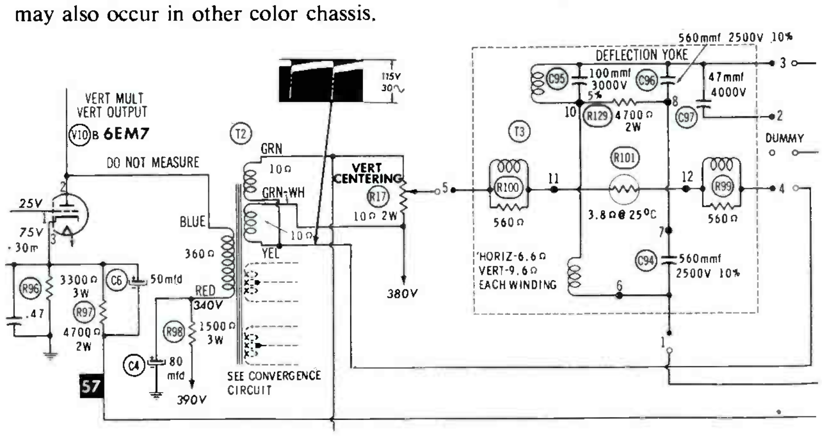
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: RCA CTC11

Symptoms: Raster will appear shrunken vertically, with black showing at the top or bottom of the screen.

Tip: Before looking for trouble in the vertical multivibrator and output circuit, try using the vertical hold control to roll the blanking bar down while checking for linear vertical sweep. If linearity looks good, rotate the vertical centering adjustment and watch for erratic operation. You'll probably find one-half of this pot open. This fault will cause the raster to be displaced up or down, depending on which half of the control has opened. The same trouble may also occur in other color chassis.



On-Off IF

A Zenith Chassis 15B20 (covered in Photofact Folder 426-3) has a normal raster, but intermittently loses both picture and sound. I can get a negative picture and garbled sound by adjusting the AGC control. Normal picture and sound can be brought back by pulling out and reinserting any one of the three IF tubes; the set then works perfectly for a length of time ranging from an hour to a month.

H. F. Hamilton
Lincoln Park, Mich.

The 470- and 220-mmf decoupling capacitors in the screen circuits of the IF stages are a very common cause of this trouble. Replace all three capacitors, and you should have your problem licked.

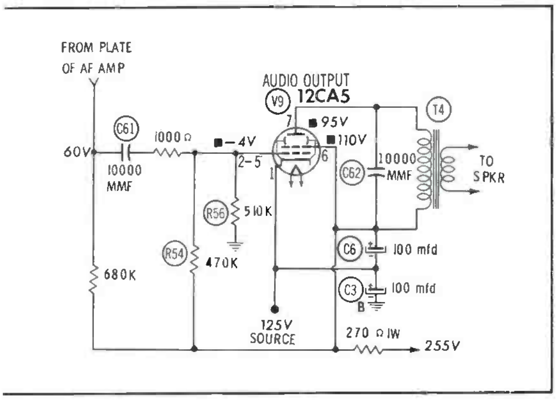
Whistle—Click—Silence

A dandy intermittent is present in a G-E Model 17TO26 portable TV (covered in Photofact Folder 342-7). When the set is turned on, it takes about 25 seconds for both the sound and the picture to come on. About 15 seconds later, a loud whistle and click are heard, and the sound disappears for about 45 seconds. Then it comes back again with another whistle and click. The picture remains good, even when the sound is missing.

I've taken numerous voltage readings, with the sound both present and absent. The most important changes are in the plate voltage of video output tube V6A (which goes down from 180 to 140 volts DC), and the cathode voltage of audio output tube V9 (which rises from 130 to 180 volts). The screen voltage of V6A also rises, since this element is tied directly to the cathode of V9 through the low-B+ line.

I have replaced electrolytic capacitors C3 and C6, plus resistors R54 and R56. Furthermore, I've disconnected every branch of the 125-volt low-B+ line (one at a time) in an effort to isolate the fault.

John Balko
Jackson Heights, N.Y.



You've been barking up the right tree; in fact, you've already checked on just about all the common causes for an abnormal rise in voltage on the low-B+ line. In continuing your search, I'd suggest that you concentrate on the audio output stage, since the audible symptoms are much stronger than the visible reactions to the trouble.

Your primary problem is to determine what could cause overconduction of V9, or otherwise lower the resistance between the 125- and 255-volt B+ lines. I assume you've replaced V9 to eliminate the possibility of intermittent shorts or gas in this tube. You probably don't need to look further in the grid circuit; you've already substituted new resistors, and leakage across C61 isn't a likely cause of your trouble because it would tend to lower the grid voltage and bias V9 into cutoff.

There might be an intermittent short or leakage in the audio-output tube socket, or between printed-wiring conductors in the area near this tube. Try pressing various points on the board to see if you can make the trouble appear. Also investigate to see if T4 or C62 is shorting intermittently.

Since you mention slow warm-up of the receiver as part of the trouble, there's a slight chance that a fault in the series filament circuit has something to do with your problem. Check the AC voltage across the 12CA5 (from pin 3 to pin 4) when the sound is cut off. If it's far above normal, find out why.

Grid Dip? Yes—But . . .

Can a grid-dip meter be used to align IF transformers in a TV set? If not—why?

R. W. UNGER
APO 39, New York, N.Y.

To answer your question: Yes, a grid-dip oscillator can be used to align TV IF transformers. However, there are some practical reasons why this is not done as a rule. In a television set, the proper response curve can be obtained in the video IF stages only when the coils are precisely on their intended frequency. The accuracy of the usual grid-dip oscillator is insufficient for this purpose. However, if the transformers have been drastically misaligned, you can use a GDO to "rough-align" the individual coils before proceeding to a more comprehensive alignment.

Definitions

I'd like to know the difference (if any) between an "audio generator" and an "audio oscillator."

NICK HARTMAN
New York, N.Y.

Usually, a generator produces an audio output by beating two oscillator signals together, while an oscillator produces the audio wave directly. Occasionally, the words are used interchangeably, since both types of units serve essentially the same purpose. Incidentally, a sine- and square-wave generator is simply a more versatile form of audio generator.

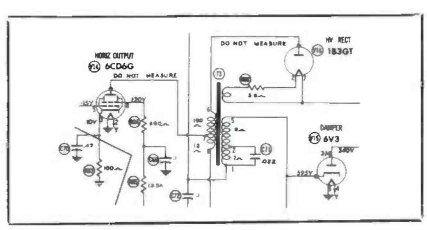
It Went *Zap!*

A 27" Muntz Chassis 17B8 (the version covered in PHOTOFACT Folder 208-7) was brought to me not long after someone else had replaced the flyback transformer. I can describe the symptom only by saying the screen went wild, and a grounding wire hanging alongside the picture tube actually went into motion—alternately jerking toward the CRT and dropping back down. The 1B3 high-voltage rectifier was lighted up as brightly as any six-volt tube you ever saw. I tried moving the filament lead of this tube to a new position on the flyback, where less voltage would be induced in it. This reduced the glow in the HV rectifier somewhat, and I was actually able to sync in a good picture; but I was still getting excessive high voltage. An arc nearly 2" long could be drawn from the chassis to the second-anode lead! After about 20 minutes, *pfft* went the high voltage.

I've combed the high-voltage circuit for trouble, and have even tried another new flyback on the chance that the first one might not have been a suitable replacement. However, the high voltage is still as overactive as before. Can you help me with this problem, or do you know anyone who is in the market for a junior cyclotron with probably a very short life expectancy?

LEO FRUIT
Macks Creek Mo.

In the sketch you sent with your letter, I notice the absence of a 5.6-ohm dropping resistor (R88) which should be in series with the 1B3 filament. Could this component have been left out when the flyback was replaced the first time, or could it have been wired incorrectly into the circuit? If some pin other than 2 and 7 on the 1B3 socket is used as a tie point for R88, make sure the tube being used has no internal connection which could short out this resistor. Proper connection of R88 should bring the high voltage down to a safe level.



Search Tuners

(Continued from page 23)

lead to pin 8 (the trigger-detector grid) of the 12AL8. Triggering should take place, and the tuner should stop. If this test fails, chances are the trouble lies in the search circuit. With positive results, you can generally assume the trouble is ahead of the trigger-signal take-off point, and normal RF-IF troubleshooting techniques should be applied.

To help locate an apparent trigger defect, use the voltage chart in Fig. 1. Two different sets of readings (one while seeking, one at idle) are shown; both were taken with a 12.6-volt input to the radio.

Solenoid-Operated Tuner

The electromechanical tuning system controlled by the circuit of Fig. 1 is representative of Delco's new F4-series unit (used in late-production '62 models) and of the preceding F3 type (which was first introduced in 1960). There are only minor differences between these two series.

The photos in Figs. 2 and 3 show the main working parts of the F4 tuner. To become familiar with these components, let's look at their separate and combined functions.

Tuner relay M1, when energized, removes the *relay arm* from the *governor train* and permits the search sequence to begin. When M1 is de-energized, the *arm* returns to the gear box and stops the tuner. In conjunction with the above movements, the relay also operates dual-contact unit S1. Remember that the three functions of this switch are to mute the sound, connect the sensitivity switch into the RF-amplifier cathode circuit, and start conduc-

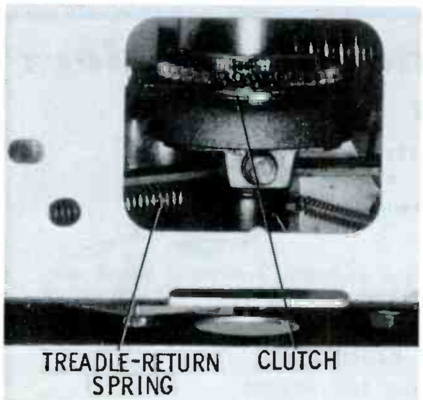


Fig. 3. Close-up of clutch and treadle.

tion through the relay-tube holding circuit.

The plunger-type *carriage-return solenoid* returns the movable tuning components from the high to the low end of the band, while rewinding the *power spring* at the same time. This heavy-duty spring supplies energy to sweep the carriage from the low- to the high-frequency end of the band—the searching portion of the cycle. A *worm gear* driven by the power spring turns the *flat gears* (not visible in photos). Via the *clutch*, these gears move the *treadle bar*, which pushes the tuning coils in and out of their forms and also moves the dial pointer.

Sequence of Mechanical Operations

To aid in understanding the mechanical service problems encountered in F3 and F4 tuners, let's review the order in which the different mechanical functions occur in a normally operating receiver. Pressing the *wonder bar* energizes the tuner relay; the arm is then pulled clear of the governor train, permitting the power spring to pull the worm gear at a speed determined by the governor train. This motion is coupled to a set of flat gears, and through these, via the clutch, to the treadle bar. The tuning coils begin to move towards the front of the tuner (out of their forms), while the dial pointer heads for the high-frequency end of the dial. If a station signal triggers the relay tube, the tuner will stop; otherwise, it will continue until it reaches the high end of the band. At this point, a metal tab trips the carriage-return switch to the closed position, activating the solenoid—which rewinds the power spring and returns the carriage to the low-band end. When it reaches the limit of its travel, the carriage-return switch is opened, deactivating the solenoid. This completes one full search cycle, and recycling automatically begins.

Bench-Servicing the Mechanical Section

When other than tube trouble is encountered in any auto radio, bench servicing is normally required. Most techniques used in repairing manual and push-button radios are also suitable for search-tuned types, but if the search circuit is the trouble spot, a few additional "musts" are in order.

The Delco search tuner, since it demands high current to pull in the solenoid, requires the use of a power supply capable of intermittently delivering at least 20 amperes at 12 volts. Actually, the voltage control may have to be set to 16 volts to insure proper tuner operation. If a power supply capable of handling this load is not available, connecting a 12-volt car battery in parallel with the eliminator will permit proper testing. As a final note on bench servicing the F3 and F4, *don't operate the radio upside down* —it may run erratically or fail to sweep the entire band.

As we stated before, other brands of search tuners employ a small motor to drive the tuning carriage, instead of periodically recocking a spring by means of a solenoid. The motor-control circuitry is very similar to M1 and its associated components in Fig. 1, except that the relay arm is replaced by an extra set of contacts on S1 to apply power to the motor widings. Separate

LOCAL and DISTANT buttons are frequently used to start the search cycle, while simultaneously choosing the wanted sensitivity setting. Parts associated with the motor usually include gears and clutch, plus limit switches to reverse the motor rotation at the high and low ends of the dial.

Summary

The following checkout procedure is effective for diagnosing trouble in any type of search-tuning system.

When you push a bar or button on the front of the radio, a relay should close, and the tuning mechanism should begin to move. If it does not, there may be mechanical trouble in the tuning-carriage assembly, or in the drive spring or motor; on the other hand, the operating relay or its control circuit may have some electrical fault. To help localize the trouble, look to see if the relay actually closes when the actuating bar is pressed.

When the bar is released, the relay should remain energized, and searching should continue at least until a station is tuned in. If the system stops, the most probable trouble is that the relay-control tube is not supplying hold-in current to the relay. The holding contacts on the relay could also be defective.

If the tuning carriage travels to the end of the dial and comes to a stop, check for a faulty motor-reversing switch, or (in Delco models) insufficient power to the solenoid.

In case the search cycle continues without stopping, the electronic control section is probably to blame—although a stuck relay contact is another possible cause. The most likely reasons for nonstop searching are a defective search-trigger circuit or insufficient station-signal input to the circuit.

Failure to tune in enough stations, or inaccurate tuning, usually means improper amplitude or waveshape of the input pulse to the search-trigger stage. The usual cause is low RF-IF sensitivity or a defect in the AVC circuit. Lack of precision in tuning could also be due to binding or slipping of the mechanical components.

Familiarize yourself with this procedure, and it will serve you well in finding the answers to your search-tuning problems. ▲

Binary Numbers

(Continued from page 29)

Table V—Binary Addition

A.	110	= 6
	101	= 5
	1011	= 11
C.	1001	= 9
	1111	= 15
	11000	= 24
B.	1101	= 13
	1010	= 10
	10111	= 23
D.	11011	= 27
	10111	= 23
	11001	= 22
	10110	= 22
	1100001	= 97

—and then add the remaining 1. The result is 11 (one-one) which is written in its proper place in the answer.

Example D of Table V shows how to use binary addition in a more difficult problem — adding 11011, 10111, 11001, and 10110.

In the right-hand column, the three 1's add to give 11, as in the example above. The left-hand one is carried to the next column, making it 1 + 1 + 1 + 1. The first two 1's are added to give 10, and the last two give the same result—10. These are combined by adding first the two 0's, writing the result (0) as the next term in the answer, and carrying the two 1's to the next column of the problem.

The third column now consists of four 1's. These are combined as before, and the process is continued, step by step. The final column ends up reading 1 + 1 + 1 + 1 + 1 + 1. The three pairs of 1's are combined, yielding an 0 as the sum, with three 1's to carry. The three 1's are then added in an imaginary column, resulting in a total of 11, which is written as the first two digits in the answer. As before, the decimal numbers to the right of the problem serve as a check of the work.

Subtraction

The best method of subtracting binary numbers and the one that will work in every case, involves *complementing* the subtrahend.

Rule 5: *To subtract binary numbers, first complement the subtrahend (extended with 0's to contain the same number of digits as the minuend) by changing the 0's to 1's, and adding 1. Change the sign and proceed as with addition. Finally, drop the first (left-hand) 1 in the answer.*

The process of *complementing* is described in that part of the rule which alters the number to be subtracted (subtrahend). For example, complementing the binary number −1011 (this is pronounced "one-oh-one-one") results in 0101, or simply 101. Taken step by step: Changing

Table VI—Binary Subtraction

A.	**1111 = 15**	
	−1011 = −11	
	Complementing and adding:	
	1111	
	101	
	10100	
	Dropping first 1:	
	0100 = 100 = 4 (Ans.)	
B.	**10111 = 23**	
	−1100 = −12	
	Changing subtrahend to same number of digits:	**10111** **−01100**
	Complementing, Exchange digits:	**10111** **−10011**
	Add 1:	**10111** **−10100**
	Change sign and add:	**10111** **10100** **101011**
	Drop first 1:	
	01011 = 1011 = 11 (eleven) (Ans.)	

Table VII—Binary Multiplication

```
A.      1011 = 11
         110 =  6
        0000
       1011
      1011
     1000010 = 66

B.     101.11 = 5.75
         1.01 = 1.25
        10111
       00000
      10111
     111.0011 = 7.1875
```

the 0's and 1's makes 1011 into 0100; adding 1 changes the number to 0101; changing the sign results in 0101; and since the left-hand 0 has no value it can be dropped, resulting in the binary number 101 as the *complement* to 1011.

Now, let's subtract 1011 from 1111, as shown in Table VI. Complementing and adding gives us an answer of 10100. Dropping the first 1 leaves 0100, which is equal to the decimal number 4 (the first 0 has no value).

Example B shows how to subtract the binary equivalent of 12 from the binary equivalent of 23. While you are learning the process, the use of decimal equivalents is handy to check your work. You will note that, in this example, the subtrahend contains fewer digits than the minuend; thus, before it can be complemented properly, the 0 on the left must be added.

Multiplication

Rule 6: *To multiply binary numbers, the following facts must be used:*

0 x 0 = 0   1 x 0 = 0
1 x 1 = 0   1 x 1 = 1

In all other respects, binary multiplication is much the same as decimal multiplication, as can be seen from the examples in Table VII. As in other practice problems with binary numbers, the decimal equivalents serve as a check on the work. Of course, once the procedures are understood, there is little need to include these checks.

Table VIII—Binary Division

```
Step A.                 Step B.
          1                         1
  111 | 1001101             111 | 1001101
        -111                      1001
                                  ~~1~~0010
Step C.                     (dropping first digit)
        101
  111 | 1001101         Step D.
        1001                         1011
          1010              111 | 1001101
          1001                    1001
          ~~1~~0011                 1010
                                    1001
                                     111
                                     111
```

Division

Binary division is likewise very similar to decimal division (see Table VIII). Remember to complement in the subtraction portions, and to drop the first 1 in each result. Let's follow this process, step by step.

We are dividing the binary number 1001101 by the binary 111. We see immediately that 111 will not go into 100, so we must use 1001 as our fiirst dividend. In binary numbers, there are only the two digits—0 and 1—so we determine only that the binary 111 will go into 1001 either not at all or one time. Therefore, the first digit in the quotient is 1.

Now, to subtract 111 from 1001 requires that we complement and add. Thus, step B shows the complement of 111, which is 1001; adding, we get 10 as the remainder.

Next, we bring down the next 1 from the dividend. Realizing that 111 will not go into 101, we put 0 as the next digit in the quotient and bring down the next digit from the dividend. Once again complementing the 111 to subtract from 1010, we add and find the remainder to be 11.

Carrying down the next digit from the dividend, we find that 111 is contained in 111 exactly one time. There is no remainder, so the answer requires no binary point. If there had been a remainder, the process could have been carried to the desired number of places to the right of the point, as in decimal division.

Summary

The rules given and processes described will enable the technician to understand the mechanics of any binary manipulation. The rules should be memorized; only if they are committed to memory and then used occasionally will they become effective tools. Work a few practice problems from time to time, and check your accuracy by using their decimal equivalents. Your reward will be a better understanding of binary numbers, their functions, and their relationships. ▲

Intercarrier Buzz

(Continued from page 21)

types of troubles that can increase the buzz level. The problem may be simply a drift in resonant frequency with age; if so, repeaking the slug adjustment is all that is necessary to strengthen the sound and reduce noise. On the other hand, a transformer may develop leakage between windings and have to be replaced. Sometimes a 4.5-mc coil or transformer cannot be tuned to a satisfactory peak because its powdered-iron tuning slug has been cracked. A good quick test for this condition is to insert the powdered-iron tip of a tuning wand into the troublesome transformer. If this improves the volume or AM rejection, install a new transformer (or a new slug).

The rest of the components in the sound section seldom play much of a part in causing buzz, but they should not be ruled out as troublemakers. Stubborn cases of noisy sound can sometimes be solved by making voltage and resistance checks of the sound IF and detector.

Discriminator

Although seldom used in intercarrier TV sets, the discriminator type of sound detector (Fig. 2) deserves mention because it presents special problems in buzz elimination. Unlike a ratio detector, the discriminator has no built-in AM-rejecting feature comparable to C4 in Fig. 1. The pulses which cause buzz must therefore be removed from the signal before it enters the detector.

For this reason, two sound IF stages usually precede a discriminator. The first stage is a conventional amplifier, and the second is a *limiter* which is concerned more with clipping of signal peaks than with amplification. The limiter tube has low screen-grid and plate voltages, so that it can be driven easily into both cutoff and saturation. Positive voltage peaks in the input signal draw grid current, and grid-leak bias is developed by R1 and C1. This bias enables the negative peaks of the signal to cut off the tube, if the input signal is of sufficient strength. With one set of voltage peaks compressed, and the other set of peaks chopped off, the output signal of the limiter contains FM but practically no AM.

Obviously, trouble in the limiter can allow buzz to leak through to the discriminator. The operating voltages on the tube must also be close to normal.

Watch particularly for incorrect screen voltage. Many sets use bleeder resistors to obtain the required low voltage (R2 and R3 in Fig. 2), and since a fairly high IR drop is continuously present across these resistors, they may change value over a period of years.

Just as in ratio-detector circuits, any mistuning or unbalance of a discriminator can weaken or garble the audio, thus making buzz more noticeable. The detector-diode and interstage-transformer checks described in the last section also apply to discriminators; in addition, the load resistors—R5 and R6 in Fig. 2—should be checked to make sure their values are closely matched.

For a fast check to see if the detector is properly balanced, you can inject a 4.5-mc signal into the limiter grid, and check the voltage across the load resistors. (In the circuit of Fig. 2, measure from pin 3 of V2A to ground.) If the voltage *decreases* when the generator is tuned away from 4.5 mc in either direction, the detector needs alignment or repairs.

Quadrature Detectors

Most late-model sets use either of the two closely-related circuits shown in Fig. 3. The 6BN6 and 6DT6 pentodes, specially designed for use as sound detectors, produce a demodulated signal strong enough to be applied directly to the audio output tube. FM detection depends upon using two different sharp-cutoff grids in the detector tube (generally called the *limiter* and *quadrature* grids) to control the flow of plate current. Each grid circuit is tuned to 4.5 mc. When an input signal is fed to the limiter grid, a signal is induced in the quadrature-grid circuit by electron coupling through the tube. The frequency modulation in the input signal causes a constantly-changing phase difference between the applied and induced signals, and the average plate current increases or decreases in step with this phase shift.

Buzz suppression is accomplished mainly in the limiter-grid circuit. The 6BN6 *gated-beam* tube has a complex internal structure (not evident from the schematic) which

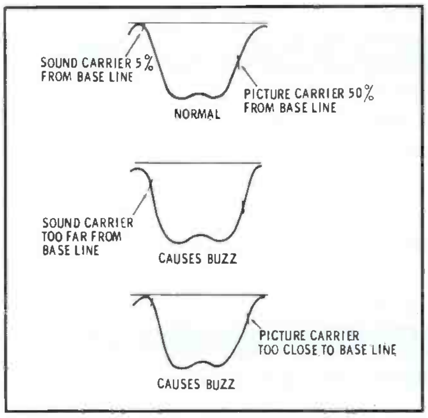


Fig. 4. Buzz may occur if sides of IF response curve have incorrect slope.

forms the plate current into a narrow beam, and makes it possible to drive the plate current from full saturation to cutoff with a change of two volts or less at the limiter grid. These sharply-defined grid-voltage limits make the bias critical, and necessitate the use of a variable cathode resistor (buzz control) to set the correct operating point for the limiter grid.

The 6DT6 is physically somewhat simpler than the 6BN6, and the saturation characteristic of its limiter grid is not critical enough to require use of a bias adjustment. However, the grid still has a much shorter operating range than the control grid in most tubes, and cathode- or grid-circuit troubles which affect the bias can easily cause buzzy or garbled sound.

Another difference between the 6DT6 and 6BN6 is that the former tube requires several volts of negative bias on the quadrature grid during reception of a signal. This voltage is developed by a grid-leak circuit (C1 and R1 in Fig. 3B). A defect here, or in the quadrature tank circuit, can lead to various symptoms—including buzz.

Coil troubles afflict quadrature circuits the same as diode-type detectors. It's important to note that buzz may not always be the most significant symptom, from the standpoint of troubleshooting; perhaps the main trouble is weak sound, which makes buzz more noticeable in the background. But since buzz is the most irritating sign of trouble, the set owner will probably complain of this first.

Trouble Outside Sound Section

Although the sound channel does an efficient job of buzz-blocking, it

Chart I—Troubleshooting Procedure for Intercarrier Buzz

ABOVE-CHASSIS TESTS

1. Check fine-tuning control for misadjustment.
2. Check contrast control; may be set too high.
3. Check AGC control; may be set too low.
4. If set has buzz control, check for misadjustment.
5. Replace sound-detector tube.
6. Replace sound IF or limiter tube.
7. Replace video output, video IF, and tuner tubes, in that order.
8. Replace audio amplifier tube or tubes.

BELOW-CHASSIS TESTS

1. If set has ratio detector, substitute electrolytic capacitor in this circuit.
2. Short out sync-separator input. If buzz ceases, look for stray coupling from sync to audio section.
3. Check output waveform of video detector. If sync pulses are compressed, look for AGC, RF, or IF defects resulting in overloading IF amplifier.
4. Touch up coil adjustments in sound section.
5. Touch up 4.5-mc trap adjustment in video output.
6. Make voltage and resistance checks in stages between sound take-off point and sound detector.
7. Observe over-all video-IF response curve; if incorrect, repair or align circuits.

can't perform miracles! Even when this section is operating perfectly well, it can compensate for only a certain amount of distortion in the signal that reaches the sound take-off point. Such distortion is extremely common, and this explains why eight of the 15 trouble-isolating hints in Chart I suggest looking outside the sound section for the fault.

In some cases of severe video-signal distortion, the sound-IF signal is attenuated or even killed during each vertical sync pulse. These breaks in the signal cause an extremely loud buzz, which the sound detector or limiter is helpless to remove. The only remedy is to find the source of the defective video. In general, you can obtain the best results by handling the buzz problem as an AGC trouble; however, there are several alternatives to be investigated if the fault does not appear to be related to AGC. For instance, careful adjustment of the fine-tuning control may convince you the IF strip is misaligned. An intercarrier receiver should be adjusted so that the sound-carrier marker falls only 5% to 10% away from the base line of the IF response curve, as shown in Fig. 4. If the sound-carrier level is too high, or of the picture carrier is much below its normal level (at the 50% point on the curve), the 4.5-mc beat-frequency output of the video detector will tend to pick up too much modulation from the video carrier—and you'll have a buzz problem.

Another possible trouble source mentioned in Chart I is spurious pickup of vertical sync pulses by the audio circuits. The most likely coupling path is through the B+ system in sets with defective power-supply filter capacitors. Pickup of radiated pulses due to poor lead dress—once a common problem—has largely been solved. Even so, you may run across this situation once in a while.

Summary

Intercarrier buzz is caused by incomplete suppression of AM interference (mainly vertical sync pulses) in the 4.5-mc difference frequency derived from the video detector and fed to the sound circuits. The AM-limiting features of the sound section may be ineffective because of some defect in this area, or a fault outside the sound circuitry may be exaggerating the AM interference so much that the sound circuits cannot cope with it.

By increasing your knowledge of the stages involved, and following the trouble-isolation procedure outlined in this article, you'll have a much easier time curing intercarrier buzz. There are few repairs your customers will appreciate *more*. ▲

Fuse Blows

(*Continued from page 18*)

or a fusible resistor.

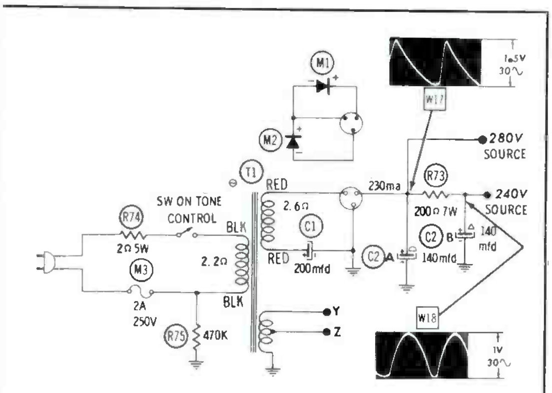
8. Make an operational check of the set before returning it to the customer. Using a variable-voltage transformer to increase the normal line voltage by about 10%, let the set run for an hour or more, preferably inside its cabinet. Watch for any signs of arcing in the raster. Also keep an eye out for raster pull-in or dimming; this indicates heavy B+ loading that could account for intermittent fuse blowing. Before concluding the test, again gently tap tubes and components, watching for any telltale signs of arcing or overload.

How Can I Re-Fuse?

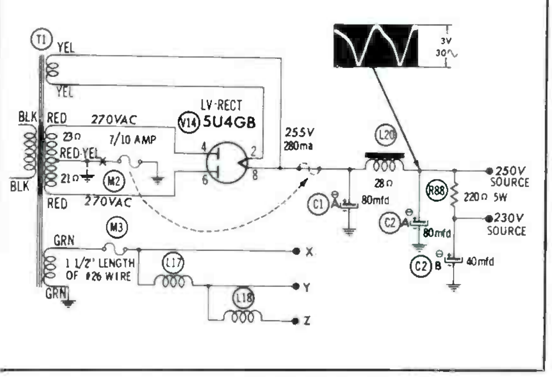
In recent years, TV set designers have made it more difficult to use the wrong fuse size. Special fuseholders are made in three different lengths, with bayonet-style locking tabs in seven different widths, and each size is designed to accommodate fuses in only a limited range of ratings. These special fuses are made in two series — the C type (regular) and the N type (slow-blow). Another fuse that uses the N-type holder is the slow-blow *chemical* fuse, a special low-resistance unit which is necessary to prevent intermittent fuse-blowing in several RCA chassis.

Regular fuseholders offer no safeguards against incorrect fusing, and these precautions must be observed:

1. Don't overfuse. Barring those rare cases where the designer flubbed, the fuse rating should not be increased. Incidentally, a fuse rating is the current that the fuse will carry *continuously* without blowing. For example, a fuse rated at one amp will pass this much current continuously and not blow; in fact, it may handle 1.1 amps (110% of rating). Even a regular fuse may take as long as two hours to blow on a 125% overload. Most equipment designers allow from 75 to 100% overload in addition to the fuse rating; that is, if a circuit normally passes a steady current of ½ amp, a fuse rated at around 1 amp will probably be installed. If you should overfuse for testing purposes, we repeat—be sure not to leave the oversize fuse in. You may have to buy (or be morally



(A) In primary of transformer.



(B) In B+ circuits.

Fig 1. Fuse arrangements for protection of power-supply circuits in set.

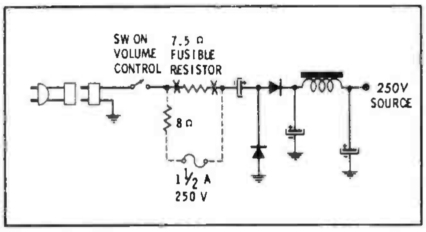


Fig. 2. Resistor protects against the surge inherent in metallic rectifiers.

responsible to buy) a flyback or power transformer for your customer!

2. On the other hand, *don't underfuse*. This mistake can be the source of a needless callback. If the exact rating is not available, you're better off if you slightly overfuse. For example, a 3/8-amp fuse can be used to replace a 3/10-amp, and a 3/10 can replace a 1/4 in emergencies. Going in the other direction will probably mean a blown fuse on the first line-voltage surge.
3. *Never replace a fusible resistor with a fuse alone*. The resistor also acts as a current limiter to prevent damage to the rectifier during warm-up. Therefore, if a fuse is installed as a replacement, a series resistor should be added, as shown in Fig. 2.

Weak-Link Fusing

Parallel heater circuits are often fused with a piece of wire, usually #26. The small wire is connected in series with the heaters to the heater winding on the power transformer. Should a short occur. the small wire functions as a "weak link" and burns open before the power transformer is damaged. The most common cause of heater-fuse burnouts is a short in the pilot-lamp socket or wiring, although a short within a tube or a defective filament bypass capacitor could also cause this link to "blow."

Precautionary Fusing

Many technicians insert a fuse in the primary circuit of anv power transformer they replace. This is a good practice. The fuse and fuseholder (Fig. 3) do not add much to the bill, and the customer is insured against another transformer burnout. The primary fuse simultaneously gives protection against heater, rectifier, and B+ shorts. Due to surge currents when the set is first turned on, the fuse should be a slow-blow type. A rating of 4 to 5 amps is adequate for most TV sets.

Fuse-Circuit Testing

Rather than replacing a fuse for testing purposes, you can make good use of an instrument which takes the place of a fuse. Some such instruments measure the AC or DC current flowing in the circuit, while others merely serve as an automatic overload protector.

The merit of either type of instrument is that you can determine when the current is excessive in the circuit, without sacrificing another fuse. If the instrument measures the current in the circuit, the current reading can be considered normal if it is less than ¾ of the specified fuse rating. Line voltage should be at least 120 volts during the tests.

In DC circuits, the milliampere scales of your VOM can be used to determine if the current is near normal or not. Caution must be used, however, since a heavily overloaded circuit could easily damage the meter.

Some causes of increased fuse current may be:

1. High power-line voltage.
2. Insufficient drive signal from the horizontal oscillator. Be sure the tubes are okay, the drive control is set for minimum fuse current (without a drive line), the oscillator plate-load resistor has not increased in value, and there is no leakage in the coupling capacitor.
3. Incorrect setting of the linearity coil. Set for minimum current consistent with good linearity.
4. Leaky electrolytic capacitors (not a verv common cause of fuse failure).
5. Decreased value of screen resistor

Fig. 3. Fuse and chassis-mounted fuse-holder for protecting new transformer.

in horizontal output circuit.

If the above precautions are observed when the fuse blows, you will have little trouble in determining the true cause, and in preventing callbacks due to repeated failures.

Detailed Desoldering

Removing components from printed-circuit boards is greatly facilitated by a new desoldering tool introduced by Enterprise Development Corp. of Indianapolis. Called the Model 100A *Endeco Desoldering Iron,* the unit uses a suction bulb to draw molten solder from the printed board through its hollow tip into a solder-collection tube.

A variety of tip styles are available for the iron. Tips can be changed by merely removing the old tip with a 5/16" nut driver and putting the new one in place. It is not even necessary to wait for the iron to cool if this procedure is followed.

The 5/16" nut driver also serves very well as a cleaning tool for the solder-collection tube. The tube is easily removed from the assembly so that the nut driver can be inserted into the tube, pushing out the residue which has gathered. A small piece of stiff wire will serve to clean the hollow tip.

The basis of this device is a Weller soldering iron which uses a magnetic type of thermostat to maintain an even temperature at the tip. The iron can be used for normal soldering operations with no trouble at all.

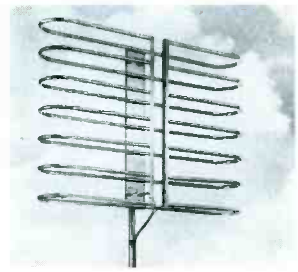
In operation, the unit is held in the hand with the rubber suction bulb between the thumb and two fingers. Before the tip is placed on the connection, the bulb is squeezed and held. When the solder melts, the bulb is released, and the molten solder is drawn away from the connection.

The unit is very handy for the technician who must work with printed circuits and the associated components. It is priced at $14.95

PRODUCT report

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

FM Antenna (40P)



A seven-element antenna designed by Mark Engineering is now available from **B & K Mfg.** The "Mark Stereo 7" is omnidirectional and horizontally polarized. Especially designed for stereo reception, the antenna measures 30" wide by 22" high by 5½" deep, and comes complete with mounting hardware. The unit can be used indoors as well as outside.

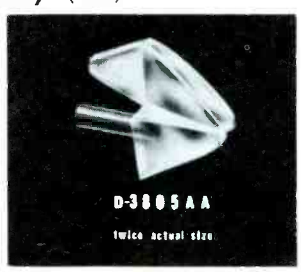
Soldering Aids (41P)

Five different soldering aids and a chuck handle are contained in a new kit by **X-acto.** The set consists of a fork for twisting component leads and wires, a knife/scraper for cutting and repairing printed circuits, a probe to check for loose connections, a reamer to clean out lug holes, and a brush for removing splattered solder and cleaning connections. Price of the complete kit is $3.00.

Microphones (42P)

Three new microphones are available from **Astatic.** Model 551 is for industrial use and is a dynamic type which lists for $69.50. Model 511 is a ceramic unit for mobile use, and has an EIA rating of 100K input impedance. Model 513H is also for mobile use, but is a dynamic type with an EIA rating of 40K input impedance. Model 511 lists for $19.95, while Model 513H is $34.50.

Stylus Assembly (43P)



The Model D-3805AA "V-Guard" stylus assembly for the Stanton Stereo Fluxvalve by **Pickering** is designed for use in lightweight arms having a low coefficient of friction. Using a stylus tip radius of .5 mil, the unit will allow Model 198 and 199 Unipoise arms to track with less than 1 gram of force. Audiophile net price is $21.00.

Hi-Fi Tuner/Amplifier (44P)

Background music and paging are two uses for **TEECO's** new Model 1105 tuner-amplifier (made by Trutone Electronics, Inc., Van Nuys, Calif.). Containing eight tubes, the unit has a power output of 7 watts at less than 2% distortion, and a frequency response from 40-20,000 cps. A self-contained relay system suspends FM reception when paging or intercom functions are being used.

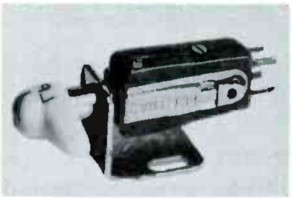
Antenna Splitter (45P)

A new antenna signal splitter from **Jerrold** (Model TX-FM) permits reception from a common antenna for both TV and FM receivers. The splitter comprises a bandpass filter that isolates FM signals from a TV set and feeds them to an FM receiver. The unit, which features low losses, lists for $5.95 and comes in an unbreakable housing.

High-Intensity Lamp (46P)

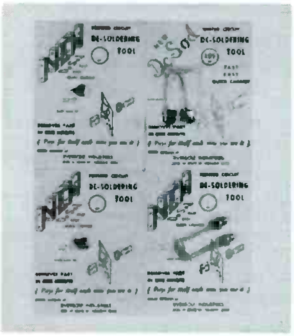
An automotive-type bulb is used in the "Hi-Lite," a new lamp manufactured by **Swing-O-Lite.** Measuring only 2½" in diameter, the miniature head allows the lamp to fit into small places for concentrating the light. Also available is a choice of 3-, 5-, or 7-power magnifiers for use in close inspection or working with blueprints or schematics. The unit is available in a choice of arm-lengths and colors.

Replacement Cartridge (47P)



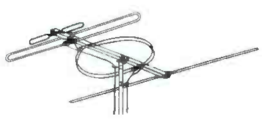
Designed to replace any crystal stereo cartridge now in use, the **Jensen** snap-in cartridge comes complete with two needles. Two models are available, the "S" has a high output level of 2 volts, and the "T" a lower level of .8 volts. The cartridges fit all Jensen snap-in brackets and use standard needles. List price for either model is $5.95.

Desoldering Tools (48P)



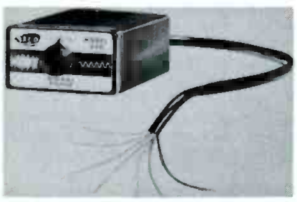
Twenty-three models in ten different styles are available in a new line of printed-circuit desoldering tools from **Eversole Industries.** Everything from small capacitors to IF cans can be removed and replaced by using the specially-formed plate of the tool to heat the component leads which protrude through the board. Net prices range from $1.49 to $1.95, and the tools are available to fit several different soldering irons and guns.

Combination Antennas (49P)



Three models of TV-FM antennas are available in the **Finco** "Combine Series." Illustrated is the Combine #1 for use in metropolitan areas. The television section is unidirectional, while the FM portion is omnidirectional. Two transmission lines are required for each model. Also available are the Combine #2 for suburban use and the Combine #3 for use in fringe areas. List prices vary from $12.95 to $37.50 depending on the model and whether the construction is of plain or gold-corodized aluminum.

Noise Eliminator (50P)



A dual high-mu triode and a dual diode are incorporated in an inverter circuit which clips noise impulses out of radio signals in **Seco's** Signal Filter. The unit reduces ignition interference, hash, and certain types of background noise. Adaptable to most tube-type Citizens-band receivers, the Signal Filter requires 6 or 12 volts and 150 volts DC. Net price is $16.88.

Soldering-Gun Attachment (51P)

Printed-circuit board terminals and lugs can be cleaned quickly and easily with **Oneida's** soldering-gun attachment. The hollow, tubular tip of the unit is pressed against the terminal and, after the trigger is pressed for a few seconds to heat the terminal, the suction bulb is squeezed and released to draw the molten solder into the porcelain bowl. A quick-disconnect fitting permits the bowl to be emptied after extensive use. The device attaches to a soldering gun in less than five minutes.

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INDEX TO ADVERTISERS

July, 1962

Latest Jackson Tube Test Data

Tube Type	MODEL 648 Fil.	D.	E.	Plate Test	MODEL 598 A.	B.	C.	Fil. Cent.	D.	E.	F.	G.
6DW4*	6.3	126	5	14 W								
12GT5*	12.6	A123	AB456	39 VW								
15CW5	15.	A123	B569	15 WZ	15.	4Y	168	5	7	2	9	21
19JN8	19.	A127	AC689	47 V	19.	4Y		5	6	9	7	47
	"	A123	AC45	42 V	"	4YZ			2	1		60
50HC6	50.	AC123	457	83 VW	50.	3YZ	6	4	7	2	5	35
	SUPPLEMENTS LATEST ROLL CHART 648-25				SUPPLEMENTS LATEST ROLL CHART 598-3							

MODEL 658

Tube Type	Sec.	Heater	Circuit H-K	P-G	Plate	Grid Test	Heater Current
6DW4*	D	6.4N	126	5	18U	V	
12GT5*	P	13.6K	123	ab456	22R	95VY•	A22.E Z600
15CW5	P	18.6F	123	b569	13Q	80VY•	
19JN8	P	18.6L	127	ac689	42R	10WY•	
	T	"	123	ac45	23R	10WY•	
50HC6	P	50.K	123	457	21S	15WY•	

SUPPLEMENTS LATEST ROLL CHART 658-5

"For further information, see Tube Test Data in PHOTOFACT Folder No 588."

CATALOG AND LITERATURE SERVICE

ANTENNAS & ACCESSORIES

1P. *JFD*—Descriptive and promotional literature plus sales aids for new *Transis-Tennas;* also complete set of specifications for outdoor and indoor TV antennas and accessories, including exact-replacement antenna data.

2P. *WINEGARD*—Brochure describing amplified and nonamplified FM antennas; also FM station-finder map and log. *See ad page 47.*

AUDIO & HI-FI

3P. *DUOTONE*—1962 phonograph needle replacement guide and accessories catalog, containing cross-reference charts and conversion data.

4P. *EICO*—New 32-page catalog of kits and wired equipment for stereo and monophonic hi-fi, test equipment, Citizens-band transceivers, ham gear, and transistor radios. Also "Stereo Hi-Fi Guide," and "Short Course for Novice License." *See ad page 46.*

5P. *QUAM-NICHOLS*—8-page general catalog listing all types of speakers: miniature, replacements, auto-radio, bulk-packed, public address, and hi-fi; also describes audio transformers. *See ad page 67.*

6P. *SONOTONE*—Sheet SAH-54 describing new ceramic stereo cartridge Model 916-TA. *See ad page 32.*

COMMUNICATIONS

7P. *COMCO*—Brochure describing *Fleetcom* series of mobile communications equipment; includes 25- and 75-watt high-band and 35- and 100-watt low-band units.

COMPONENTS

8P. *BUSSMANN*—24 page booklet SFB giving detailed information on complete line of BUSS and FUSETRON Small Dimension fuses and fuseholders; used for protecting electronic equipment. *See ad page 13.*

9P. *CENTRALAB*—Catalog sheet listing new stereo attenuators, expanded line of L and T pads, economy lever switches and associated hardware. *See ad page 53.*

10P. *EBY*—1962 catalog containing 34 pages of specifications and information on sockets, pin jacks, television accessories, and other products.

11P. *LITTELFUSE* — Illustrated catalog showing prices and specifications on complete line of fuses, holders, and merchandising aids. *See ad 4th cover.*

12P. *PHILCO*—94-page electronic-parts catalog listing 55,000 components; also contains a 64-page cross-reference section.

13P. *RCA*—Form TK310, "RCA Color Parts and Accessories for Installation and Service," listing replacement parts and service for all RCA color TV receivers. Also Form TK-292, 28-page "TV Knob Directory," listing part numbers for all knobs used on 1955 through 1962 RCA TV receivers.

14P. *SPRAGUE*—Chart C-457 (designed to hang on wall) showing all popular TV-radio-hi-fi replacement components. *See ad page 10.*

SERVICE AIDS

15P. *BERNS*—Data on 3-in-1 picture-tube repair tools, on *Audio Pin-Plug Crimper* that lets you make pin-plug and ground connections for shielded cable without soldering, and on *ION* adjustable beam bender. *See ad page 64.*

16P. *CASTLE*—Leaflet describing fast overhaul service on television tuners of all makes and models; also illustrated lists describing universal and original-equipment tuners. *See ad page 38.*

17P. *CHEMICAL ELECTRONIC ENG'G*—Leaflet on *Hush* TV-tuner cleaner, *Ever-Quiet* contact restorer, *Plastic Sealer* spray, *Ever-Kleen* glass cleaner, and Sure 'n' Easy wire connectors.

18P. *ELECTRONIC CHEMICAL CORP.*—Catalog sheet describing *No Noise* line of servicing chemicals; gives specifications and prices.

19P. *INJECTORALL*—Catalog of electronic chemicals, including new No. 20 *Lens Kleen* (for removing scratches from plastic TV safety windows) and No. 30WC *Renew Spray* (for polishing cabinets and removing scratches); also pocket-sized catalog, "Open the Door."

20P. *PRECISION TUNER*—Information on repair and alignment service available for any TV tuner. *See ad page 52.*

21P. *SARGENT-GERKE*—Catalog of service chemicals in aerosol spray cans; also spray-paint color cards. *See ad page 70.*

22P. *SWING-O-LITE* — Two-color catalog sheet giving details on *Hi Mag* inspection light with miniature shade.

23P. *TECHNI-PARTS CORP.*—Brochure describing *Makabelt Kit* and other products.

24P. *YEATS*—Literature describing the new Model 14 appliance dolly, featuring all-aluminum I-beam construction. *See ad page 71.*

SPECIAL EQUIPMENT & SERVICES

25P. *ACME*—Release giving information on new line of rack-mounted regulated magnetic power supplies. *See ad page 70.*

26P. *TERADO* — Catalog sheets describing complete line of converters, battery chargers, and relays. *See ad page 61.*

TECHNICAL PUBLICATIONS

27P. *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics, including 1962 Book Catalog and descriptive flyer on 1962 Test Equipment Annual. *See ads pages 37, 44, 54, 59.*

28P. *MOTOROLA TRAINING INSTITUTE*—Literature describing two-way radio correspondence course available to qualified electronics technicians.

29P. *RIDER*—1962 Spring-Summer catalog describing new publications.

TEST EQUIPMENT

30P. *B & K* — Catalog AP18-R, giving data and information on Model 960 *Transistor Radio Analyst*, Model 1076 *Television Analyst*, *Dynamatic 375 VTVM*, *V O Matic 360*, Models 600 and 700 *Dyna-Quik* tube testers. Models 440 and 420 CRT Tester-Reactivator.
1070 *Dyna-Sweep* Circuit Analyzer, and *B & K Service Shop. See ads pages 31 and 33.*

31P. *CBC*—Literature on Color Gun Killer Model CGK-1, used for checking purity of color TV screens.

32P. *DON BOSCO* — Literature describing seven new accessories for the *Stethotracer*, including microwave demodulator, vibration pickup, telephone pickup, etc.

33P. *MERCURY ELECTRONICS*—New catalog giving specifications on Model 1000, 1100, and 1200 Tube Testers, Model 201 Self-Service Tube Tester, Model 500 Component Substitutor, Model 300A Combination Tester, and Model 800 CRT Tester-Reactivator.

34P. *RCA*—Pocket catalog covering complete line of test equipment; includes all color-TV instruments. *See ad page 17.*

35P. *SECO*—Catalog sheet describing Model 250 transistor and tunnel-diode analyzer; checks all types of transistors. *See ad page 57.*

36P. *SENCORE*—New booklet, "How to Use the SS117 Sweep Circuit Troubleshooter," plus brochure on complete line of *Time-saver* instruments. *See ads pages 41 and 43.*

TOOLS

37P. *ENTERPRISE DEVELOPMENT CORP.*—Literature from Endeco on improved desoldering and resoldering techniques for use on PC boards. *See ad page 69.*

38P. *EVERSOLE INDUSTRIES*—Sheets describing and listing prices on *DeSod* desoldering tools for removing and replacing parts on printed-circuit boards.

39P. *XCELITE*—Folder S462 describing line of pocket tools for electronics servicing.


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LC FUSES 250V TYPE C
LC FUSES 125V TYPE C
LC SLO-BLO 125V TYPE N
8AG INSTRUMENT FUSES
8AG U/L FUSES
4AG AIRCRAFT FUSES
4AG SLO-BLO
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