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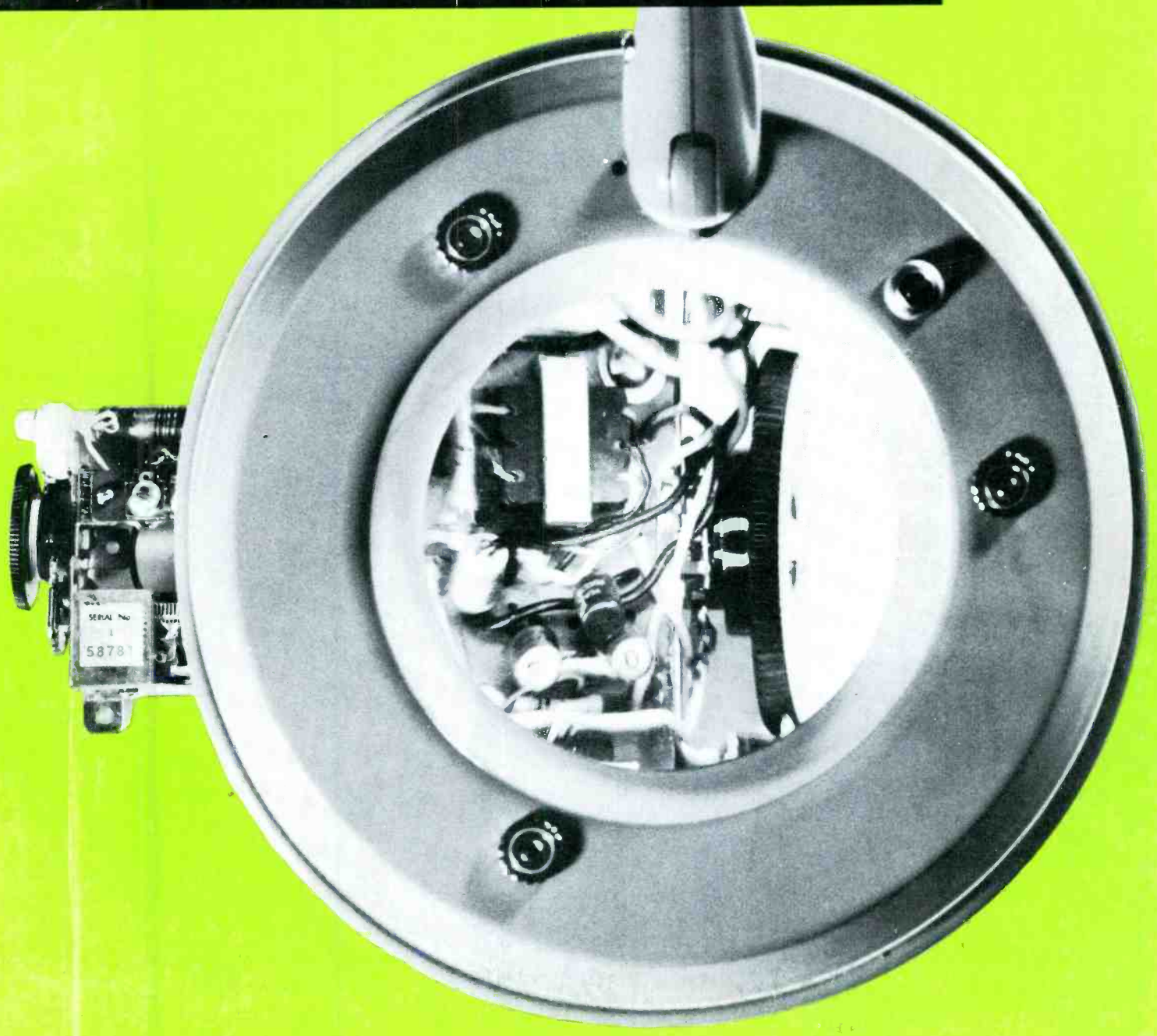

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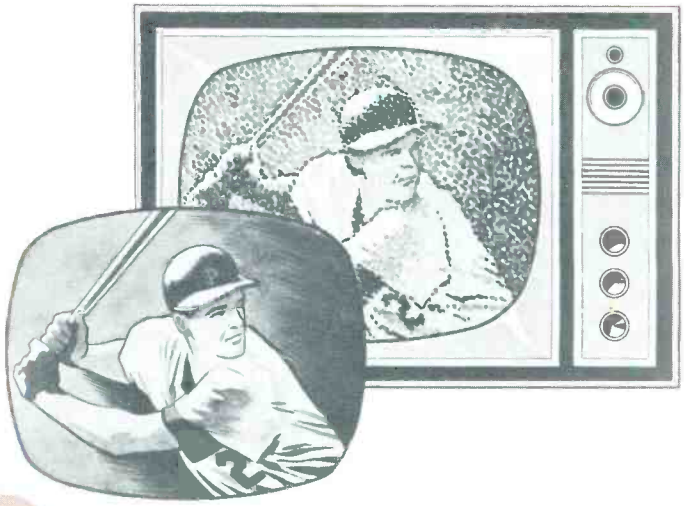

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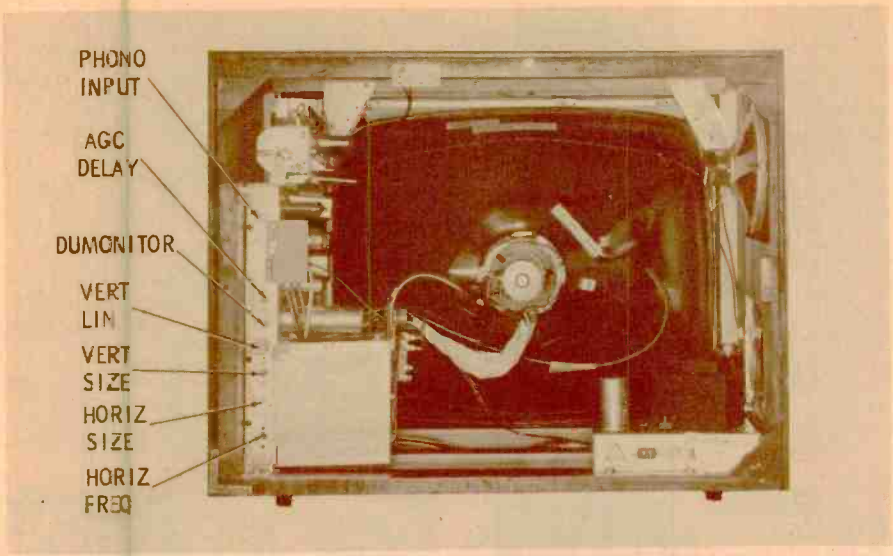
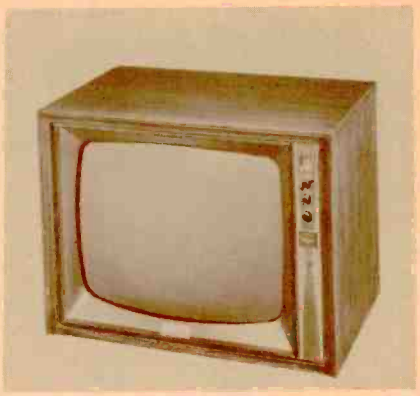




DuMont Dover Model RA700A-B50 Chassis 120602A

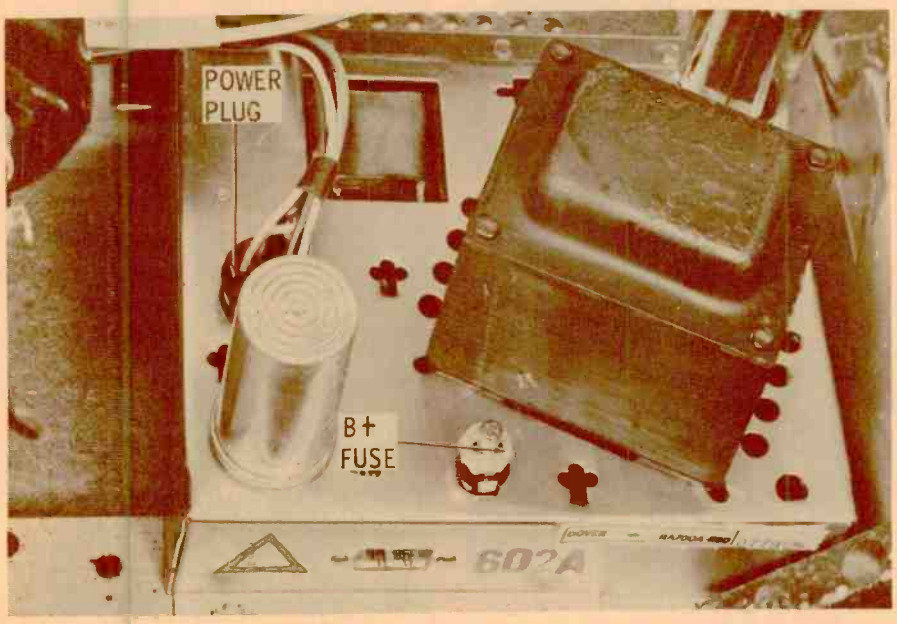
Models in the 1961 DuMont *700 Series* all use variations of the basic 120602A chassis. In every case, the picture tube is a 92° 23YP4 with a bonded safety shield. The channel selector, a do-it-yourself preset fine-tuning adjustment called *Perma-Tune*, and the volume control are grouped to the right of the CRT. The other operational controls are hidden behind a control-panel door. A TV-phono switch at the bottom of this panel disables the video output stage when set to the phono position.

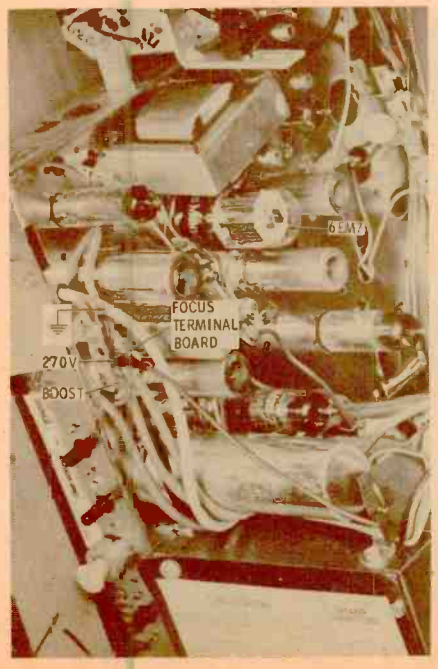
Setup controls are located on the rear apron, as is the phono-input jack. Three of the controls are associated with the 6BU8 AGC-keyer and sync-separator circuits. The *fringe lock* (an operational control located behind the front-panel door) is a sync-stability adjustment which regulates the bias on control grid No. 1 of the 6BU8, while the *DuMonitor* control regulates the bias on control grid No. 2. The *AGC delay* control governs the bias voltage applied to the RF-AGC line.

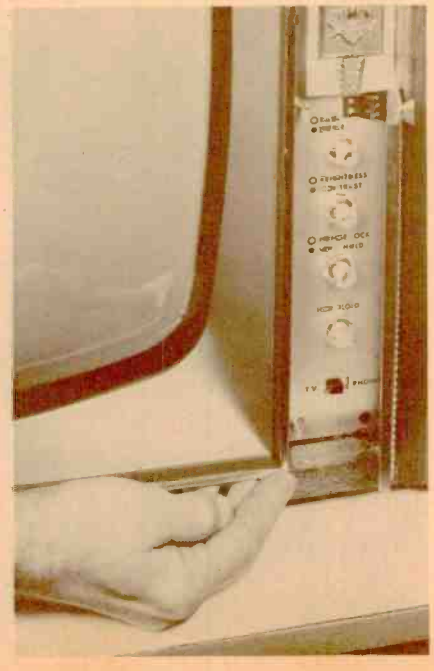
The 18-tube, hand-wired chassis is divided into two sections. Only the power supply is located on the smaller chassis. The power transformer has a 24-volt AC secondary to power the tuning motor in models equipped with remote control; filament voltage for the TV tubes is obtained from a 6.3-volt tap on this winding. The filament circuit is protected by a length of #26 fuse wire. Supply voltages are fed to the main TV chassis via a plug immediately behind the 5U4.

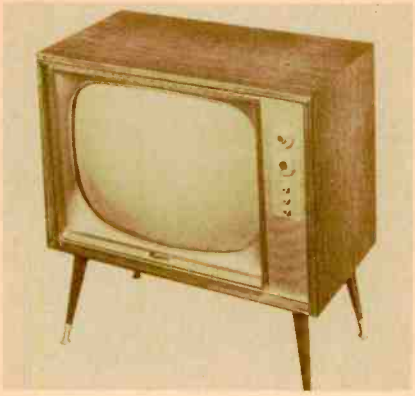
The main chassis contains all the other circuits. Familiar tubes are used in all stages except the combined vertical multivibrator and output circuit, which uses the relatively new 6EM7 dual triode. Some of the tubes are hidden from view by the high-voltage cage; however, the tube-location chart glued to the back of the cage shows the keyway positions as an aid to installation. The focus terminal board provides connections to ground, B+, and boost voltage sources to provide various potentials for the focus anode of the CRT.

The chassis is easily removed for servicing. One thing should be pointed out, however—the picture tube comes out the front. By grasping the mask at the lower right-hand corner with your fingertips, a brisk tug will cause the mask to snap out of the cabinet. The picture-tube mounting bolts are then accessible for removal.









Magnavox Model 1MU401M Chassis U35-02-00

Here is one of the few 27" sets in current production. It's a 90° model using a Magnavox *35 Series* chassis and a 27XP4 CRT. Some of the other models equipped with this chassis use a 23ASP4. Since neither CRT has a bonded safety shield, all models have a removable safety glass. Operational controls for contrast, tone and volume are front-mounted, whereas the horizontal hold, vertical hold, and brightness controls (all operated by thumbwheel knobs) are along the top of the back.

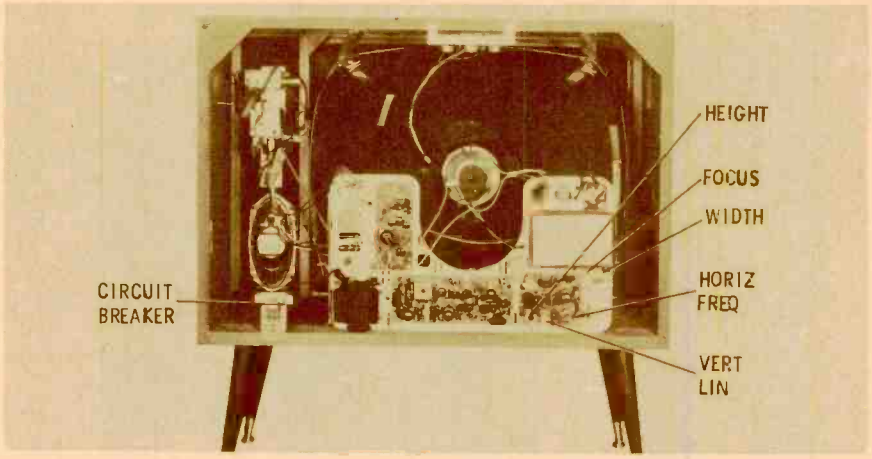
Your first glance at this 17-tube vertical chassis (16 tubes in VHF versions) will show that Magnavox has turned to printed-wiring construction. The three printed boards contain all of the circuitry except that of the power supply and horizontal deflection stages. White-dotted areas on the exposed side of the boards depict the foil-conductor pattern on the other side; if you ever take out the chassis, you'll also find component symbols printed on the foil side of the boards.

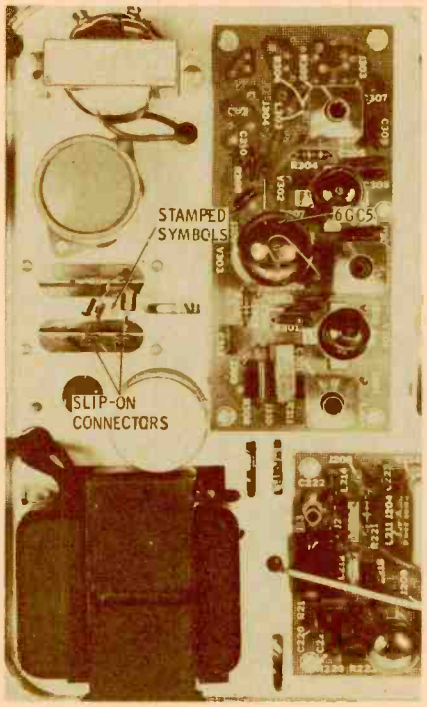
Three *Guided Grid* tuners are used with this series of chassis. Two of them have a new 6GK5 RF amplifier, while the third uses a 6FH5.

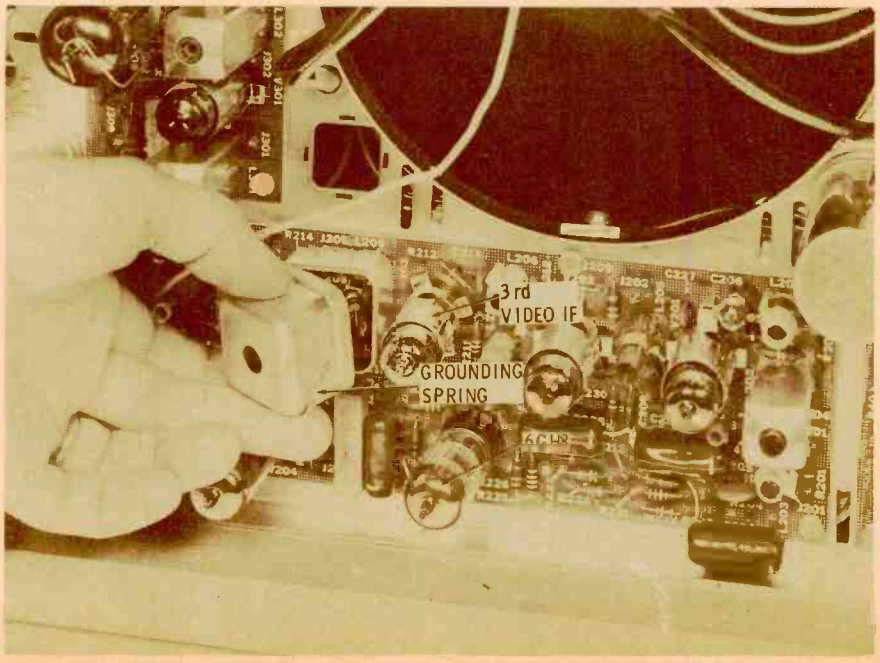
The chassis is tranformer-powered, and uses a pair of silicon rectifiers connected in a full-wave voltage doubler circuit which provides a 280-volt B+ source. Although the recitfiers are the conventional solder-in type, slip-on connectors are used to permit easy removal. Stampings on the chassis show the proper polarity for the rectifiers—a big help when you have to reinstall or replace them. Just to the right of the rectifiers you'll find an exceptionally large nine-pin tube. It's a new 6GC5 which doubles as an audio output amplifier and a B+ voltage divider.

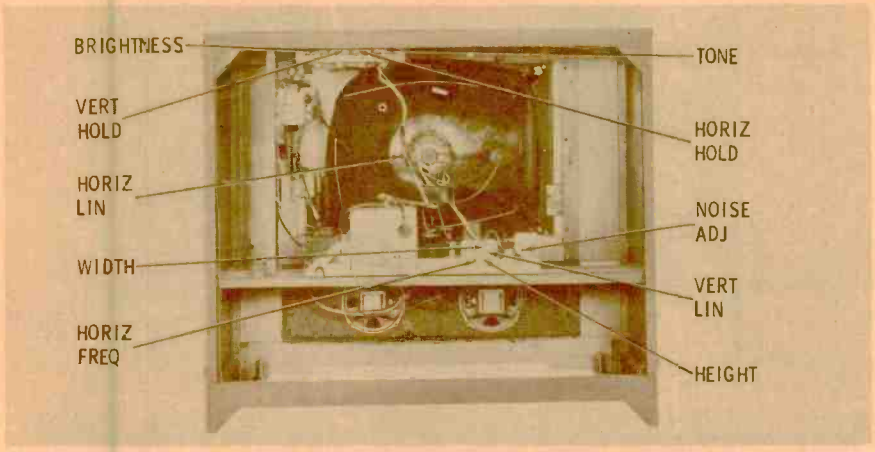
Another new tube type (a 6CG7/6FQ7) appears on the right-hand board and serves as the horizontal multivibrator. The vertical circuit, also on this board, is unusual in that the 6CM7 is wired as a blocking oscillator and independent output stage (rather than the more conventional combined multivibrator and output circuit).

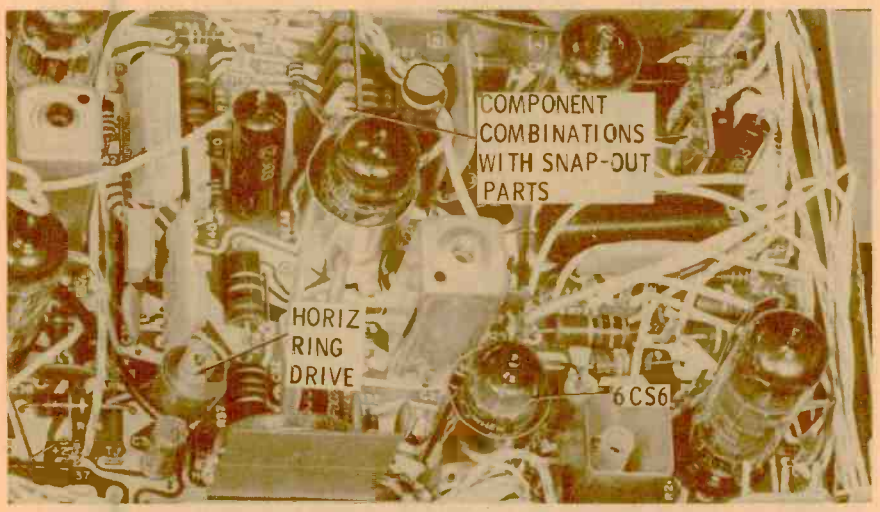
Still another new tube (a 6GH8) is used as an AGC keyer and sync phase inverter. It is located on the center board along with the IF and video circuits. Notice that the removable cap covering the 1N60 video detector has a grounding spring that's designed to contact the shield for the third video IF tube—make sure you put the cap on right

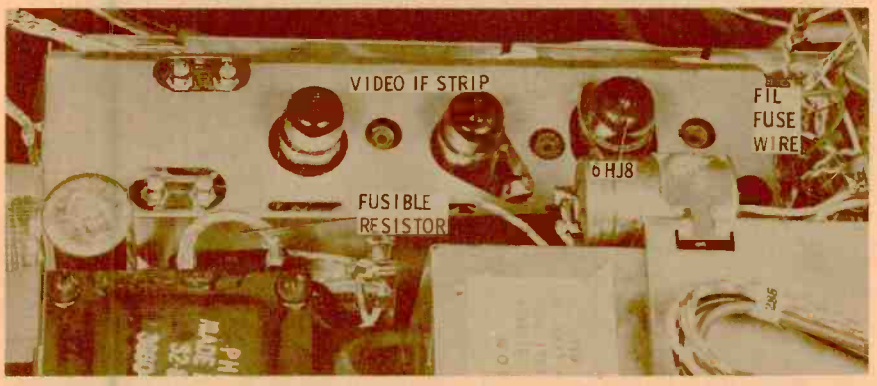


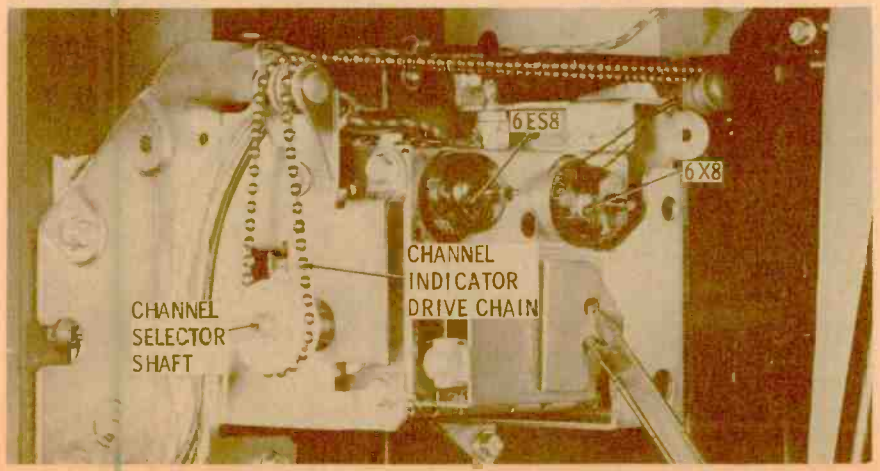


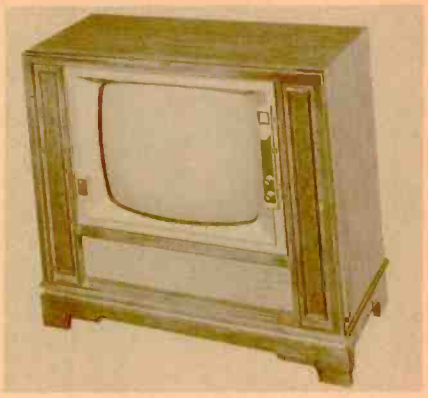












Philco Model J-4818 Chassis 11N53

This 110°, 23" model is one of the later additions to the 1961 Philco *J-Line* series. While the earlier versions were 19" and 21" sets, all later models use a 23CP4 with a bonded safety shield. Several operational controls in these models are front-mounted; in addition, thumbwheel adjustments for vertical and horizontal hold, brightness, and tone are located just under the rear edge of the cabinet top.

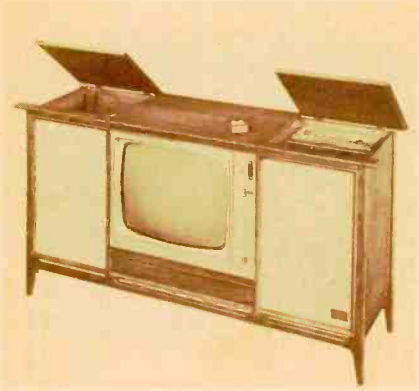
Most of the setup adjustments are mounted on the rear apron of the horizontal chassis and are well identified. One of these controls (horizontal frequency) is a "coarse hold" potentiometer instead of the usual slug adjustment for the ringing coil. (The latter is mounted on the larger of two printed boards and requires a hex alignment tool for adjustment.) Another rear-apron control (noise inverter) regulates the cathode bias of a noise inverter circuit and functions as a sync-stability control.

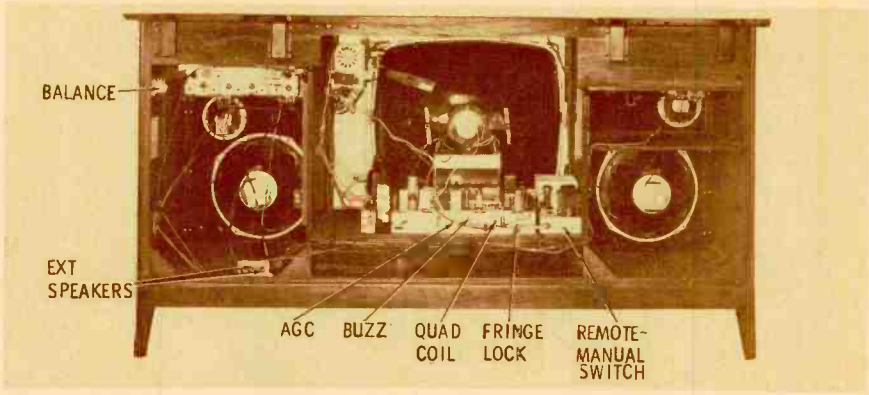
The 16-tube chassis for 1961, designated as the *Mark II Cool Chassis*, has the same layout as an earlier version. There have been many circuit revisions, however, so you'll want to be sure you have the correct data when you're called on to service one of these sets.

Many production changes were made in the 6CS6 quadrature detector circuit to improve the sound. Other modifications were made to protect components from damage in case arcing should occur in the CRT. Although we've mentioned the snap-in component-combination units in past *Previews* coverages, they deserve to be pointed out again. If one of the components in the pack needs to be replaced, it can be pried out of its spring clips and a conventional unit soldered into its place.

The transformer-powered chassis has a full-wave doubler B+ supply which incorporates a pair of silicon rectifiers (hidden in front of the large electrolytic). These are protected by a flexible, 5.6-ohm fusible resistor, while a length of #26 fuse wire safeguards all tube filaments.

The tuners used with this chassis have a rearward extension of the channel-selector shaft so they can be fitted with a power-tuning assembly for remote control. A complete wireless remote system is available for field installation if desired. Most of the tuners used in this series have a 6ES8 or 6EV5 RF amplifier and a 6CG8A mixer-oscillator, although a few (like the one pictured) use a 6X8 for the latter function.





Zenith Model F3388W Chassis 16F23Q

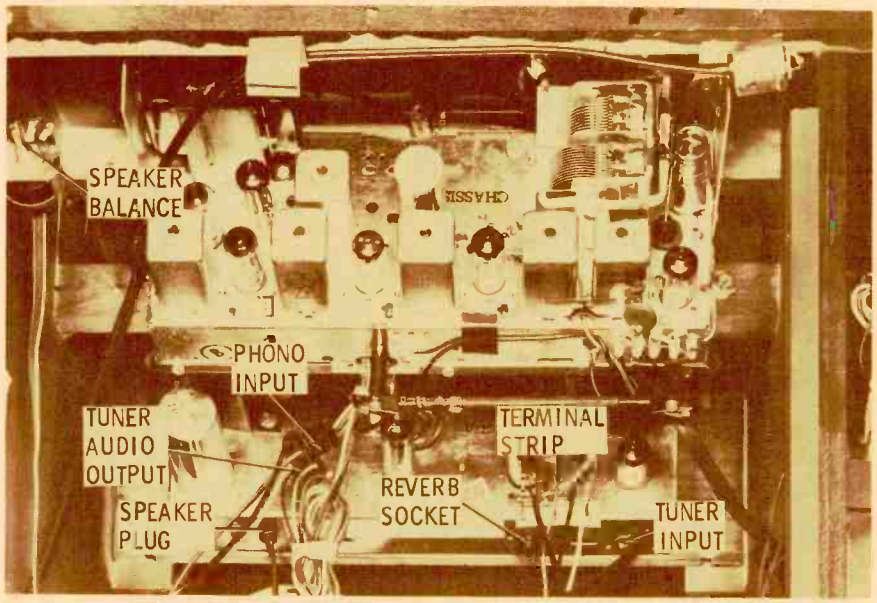
The 16F23-series TV chassis in this top-of-the-line combination is used in more models of the 1961 Zenith line than any other chassis. All models use a 90° 23ANP4 picture tube with an anti-reflection bonded safety shield. Practically all of the controls (both operational and setup) are located behind a door below the CRT. (Exceptions are the off-on-volume, AGC, buzz, and *fringe lock* controls.)

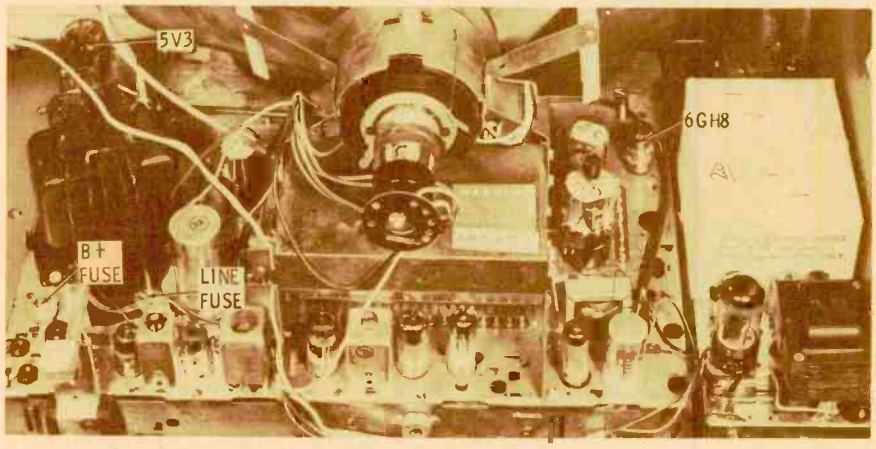
Another adjustment is accessible from the rear apron. It tunes the quadrature coil, which is mounted on the bottom side of the chassis. All controls are well marked for easy identification. In this combination model, the area beneath the stereo record changer is divided into two compartments housing the left-channel speakers; on the right side, both speakers are mounted in a single compartment which also contains the AM-FM tuner and stereo amplifier. The control mounted next to the radio tuner balances the speakers.

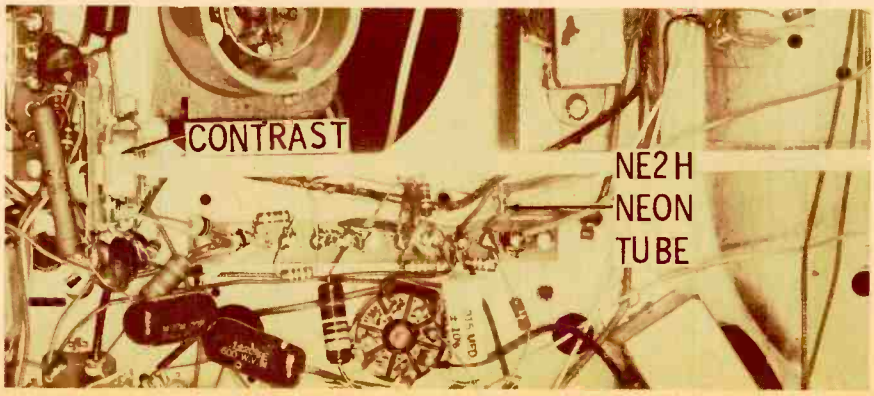
The tuner hides the 5-tube stereo amplifier; however, by squatting down low, you can see it fastened to the front of the cabinet. TV sound is connected to a well-labeled terminal strip on this chassis for distribution to both sets of speakers, although it does not actually pass through the stereo-amplifier circuits. Both the amplifier and AM-FM tuner have their own power supplies and operate independently of the TV.

The 16-tube, hand-wired chassis follows a layout pattern that has become "typically Zenith." A 5V3-equipped power supply is protected by a 5-amp, type-N line fuse. Other protective devices include a 7/10-amp, type-N fuse for B+, and a 1½" length of #24 copper wire in series with the filaments. Two relatively new tube types are used in the chassis; one is a 6GH8 horizontal AFC and oscillator, and the other is a 6GN8 which may be used in place of the 6EB8 video output and sound IF.

A neon lamp (NE2H) is mounted below chassis in series with the horizontal blanking circuit. It permits the blanking signal to pass through to the control grid of the CRT, but blocks weaker transients which could cause picture interference if not suppressed. The chassis also contains two spark gaps in the CRT circuit; one protects the filament, and the other limits the amplitude of the vertical blanking pulse.







See PHOTOFACT Set 463, Folder 1; PCB 239

Mfr: Airline **Chassis No. WG-5081A**

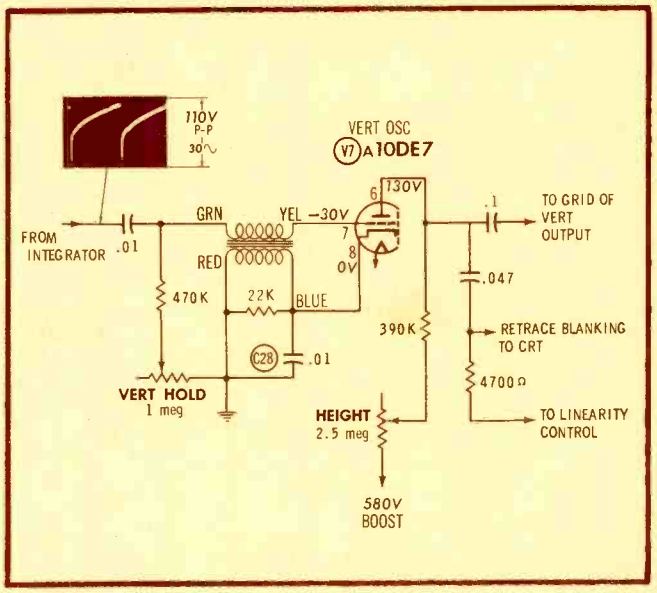
Card No: AI 5081A-1

Section Affected: Raster.

Symptoms: No vertical sweep.

Cause: Open capacitor across cathode winding of vertical-oscillator transformer.

What To Do: Replace C28 (.01 mfd).



Mfr: Airline **Chassis No. WG-5081A**

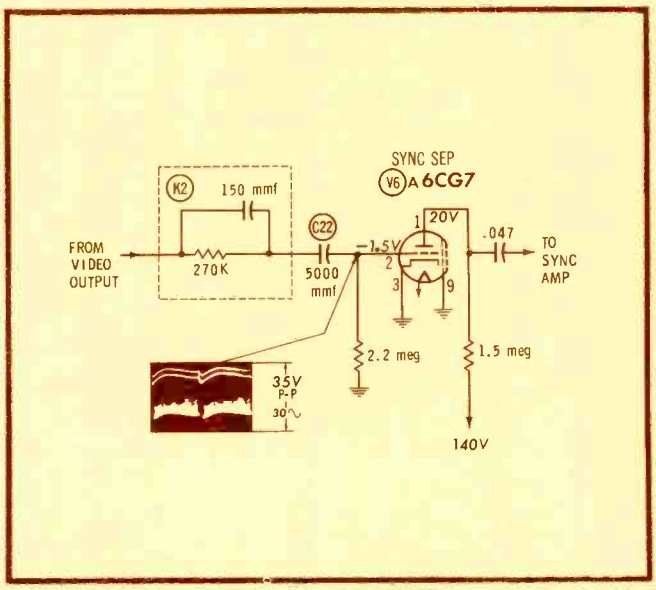
Card No: AI 5081A-2

Section Affected: Sync.

Symptoms: Unstable horizontal and vertical hold.

Cause: Leaky capacitor in grid circuit of sync separator.

What To Do: Replace C22 (5000 mmf).



Mfr: Airline **Chassis No. WG-5081A**

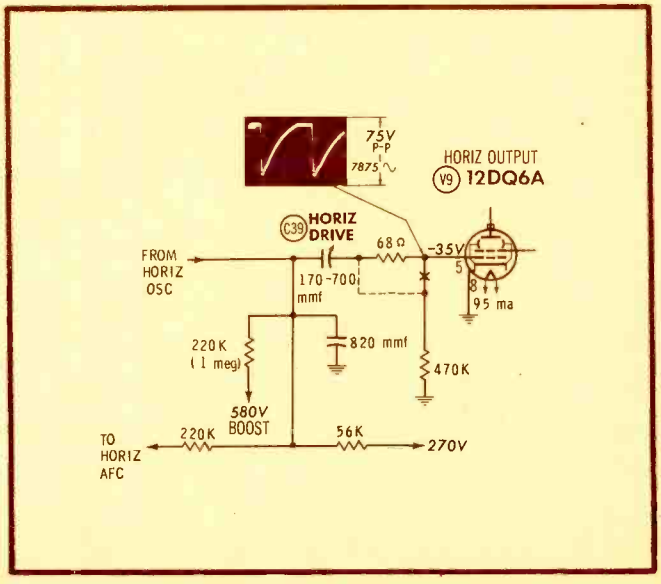
Card No: AI 5081A-3

Section Affected: Raster.

Symptoms: Intermittent loss of raster and high voltage.

Cause: Intermittent short in horizontal drive trimmer.

What To Do: Replace C39 (170-700 mmf).



See PHOTOFACT Set 463, Folder 1; PCB 239

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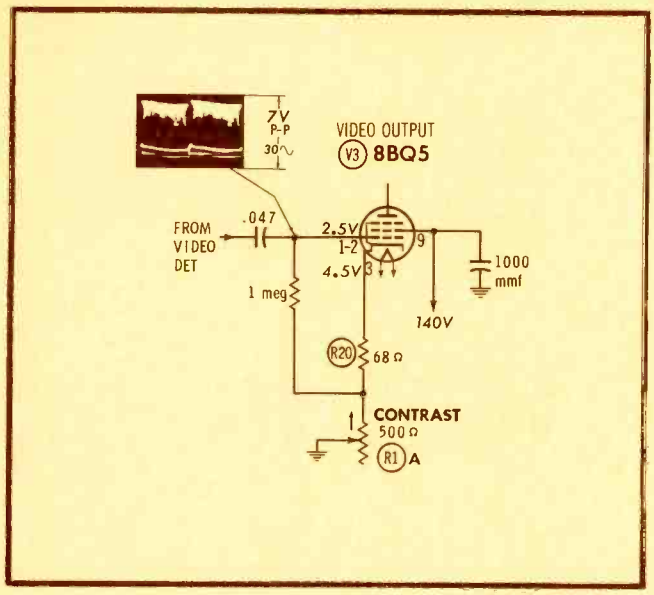
See PHOTOFACT Set 463, Folder 1; PCB 239



See PHOTOFACT Set 463, Folder 1; PCB 239

Mfr: Airline **Chassis No. WG-5081A**

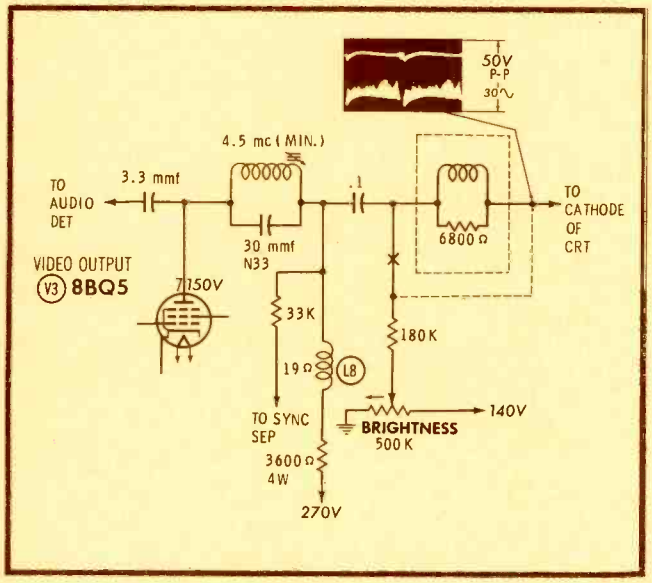
Card No: AI 5081A-4

Section Affected: Pix.

Symptoms: No picture. High positive voltage on cathode of V3.

Cause: Open cathode resistor in video output stage.

What To Do: Replace R20 (68 ohms); check contrast control R1A (500 ohms) and V3 (8BQ5).



Mfr: Airline **Chassis No. WG-5081A**

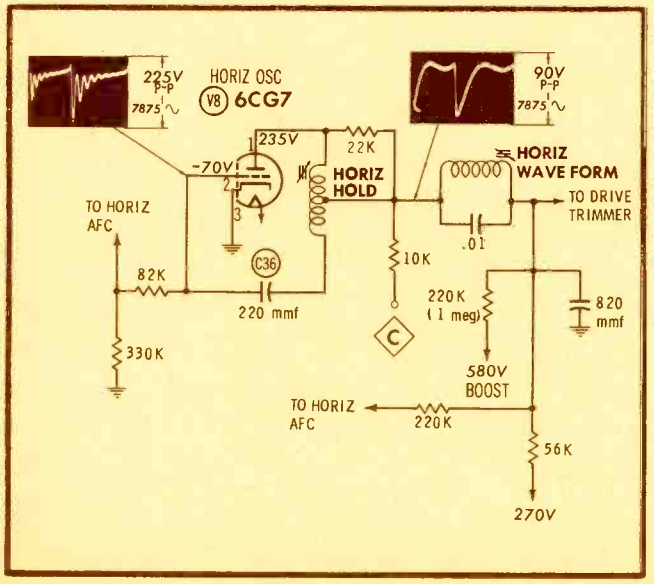
Card No: AI 5081A-5

Section Affected: Pix.

Symptoms: Picture disappears about a half hour after set is turned on.

Cause: Plate voltage is removed from video output tube as a result of open peaking coil in plate circuit.

What To Do: Replace L8.



Mfr: Airline **Chassis No. WG-5081A**

Card No: AI 5081A-6

Section Affected: Sync.

Symptoms: Horizontal oscillator far off frequency.

Cause: Leaky capacitor in horizontal oscillator circuit.

What To Do: Replace C36 (220 mmf).

See PHOTOFACT Set 504, Folder 2

See PHOTOFACT Set 504, Folder 2

Mfr: Motorola **Chassis No. RTS-433**

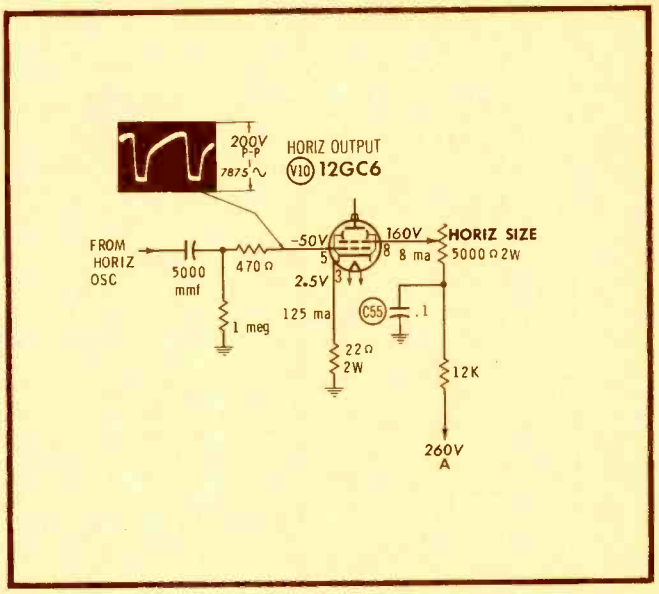
Card No: MO 433-1

Section Affected: Raster.

Symptoms: Raster disappears after short period of operation. Low screen voltage on V10 after trouble occurs.

Cause: Leaky screen-bypass capacitor in horizontal output circuit.

What To Do: Replace C55 (.1 mfd).



Mfr: Motorola **Chassis No. RTS-433**

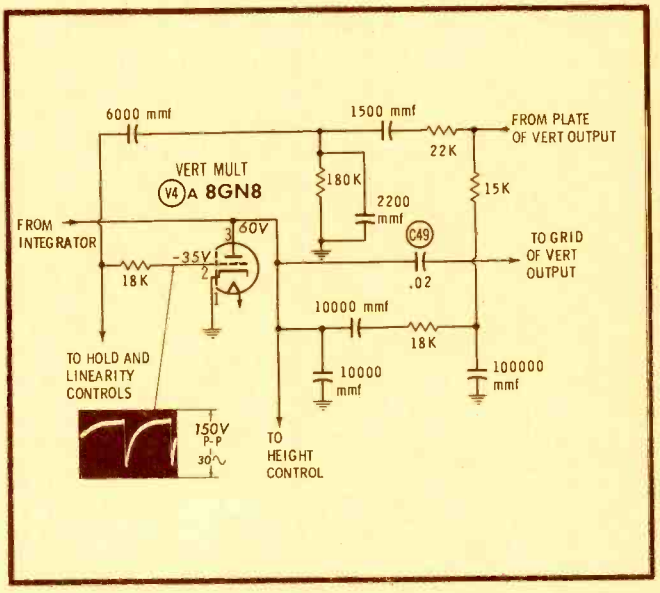
Card No: MO 433-2

Section Affected: Raster.

Symptoms: Vertical foldover at bottom.

Cause: Leaky coupling capacitor between sections of vertical multivibrator.

What To Do: Replace C49 (.02 mfd).



Mfr: Motorola **Chassis No. RTS-433**

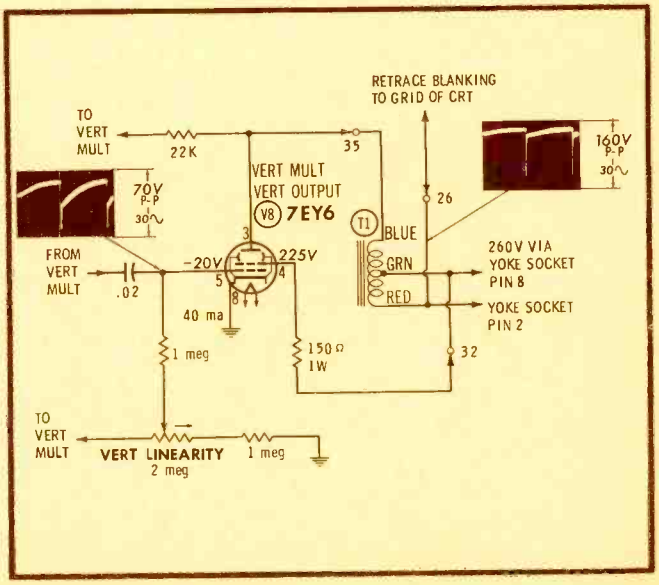
Card No: MO 433-3

Section Affected: Raster.

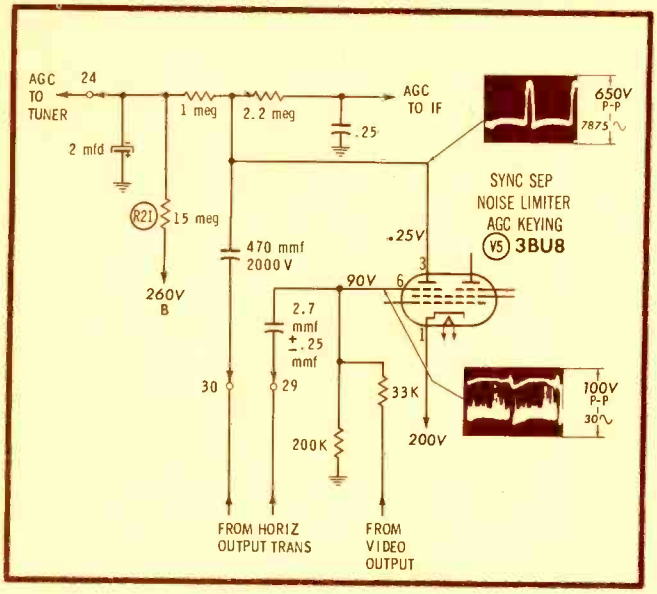
Symptoms: No raster; no high voltage; lowered voltage at 260V B+ source.

Cause: Vertical output transformer shorted to ground.

What To Do: Replace T1.



See PHOTOFACT Set 504, Folder 2



See PHOTOFACT Set 504, Folder 2

Mfr: Motorola **Chassis No. RTS-433**

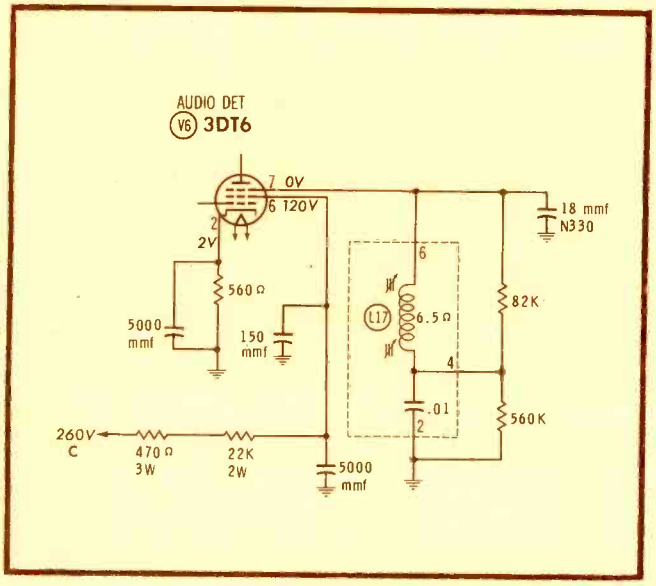
Card No: MO 433-4

Section Affected: Pix.

Symptoms: Snowy picture.

Cause: Increase in value of AGC delay resistor.

What To Do: Replace R21 (15 meg).



Mfr: Motorola **Chassis No. RTS-433**

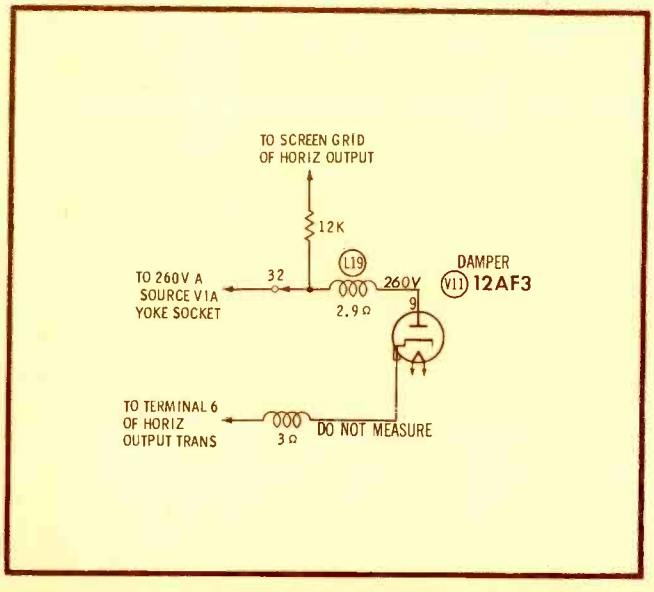
Card No: MO 433-5

Section Affected: Sound.

Symptoms: Buzz in sound.

Cause: Open quadrature coil in audio detector circuit.

What To Do: Replace L17.



Mfr: Motorola **Chassis No. RTS-433**

Card No: MO 433-6

Section Affected: Raster.

Symptoms: Raster disappears intermittently.

Cause: Intermittently open RF choke in plate circuit of damper.

What To Do: Replace L19.

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See your distributor, or use this address for fast, factory repair service

It just makes sense that a manufacturer of tuners should be better-qualified, better-equipped to offer the most dependable tuner repair and overhaul service.

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Tarzian-made tuners are identified by this stamping. When inquiring about service on other tuners, always give tube complement . . . shaft length . . . filament . . . voltage . . . series or shunt heater . . . IF frequency . . . chassis identification. All tuners repaired on approved, open accounts. Check with your local distributor for Sarkes Tarzian replacement tuners, replacement parts, or repair service.

SERVICE MANAGER • TUNER DIVISION • DEPT. 3A

SARKES TARZIAN INC

east hillside drive • bloomington, indiana
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MANUFACTURERS OF TUNERS . . . SEMICONDUCTORS . . . AIR TRIMMERS . . . FM RADIOS . . . AM-FM RADIOS . . . AUDIO TAPE . . . BROADCAST EQUIPMENT and SHISH-KABOB GRILLES

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PF REPORTER

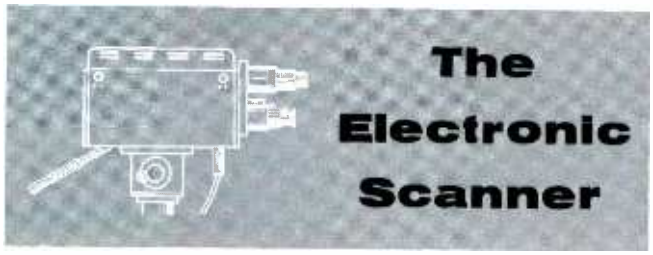
including Electronic Servicing

VOLUME 11, No. 7 JULY, 1961

CONTENTS

ABOUT THE COVER

The paradox of transistor-radio servicing is that you can reduce your troubles by magnifying them. A careful inspection may reveal a visible defect, or furnish clues to the identity of an unfamiliar radio. Even when the brand name is totally unknown to you, the chassis can usually be related to a reasonably similar model for which service data is easy to find. The problem of servicing imported "orphans" comes in for close scrutiny in the article beginning on page 24.



CBS Quits Receiving Tube Business

Effective June 30th, **CBS Electronics** discontinued manufacturing receiving tubes at Danvers and Newburyport, Mass. The announcement was made June 1st by Clarence H. Hopper, who stated, "We believe that the technological requirements of the space age clearly indicate that our particular talents and skills should be directed to products other than receiving tubes." The company's headquarters will be centered in the new Lowell, markedly strengthen **Raytheon's** position in the tube business.

The **Raytheon Company** has arranged to purchase a major portion of the **CBS** tube inventory, and plans to sell and service many **CBS** tube distributors and dealers—a move expected to markedly strengthen **Raytheon's** position in the receiving tube business.

Transistor Servicing, Summa Cum Laude

Service men who successfully complete the **Channel Master** Transistor Radio Servicing Clinic are eligible for a "Certificate of Proficiency." The servicing course, initiated in June 1960, has been attracting interested dealers throughout the country by the thousands. Further details about the course and the Diploma are available from **Channel Master** distributors.

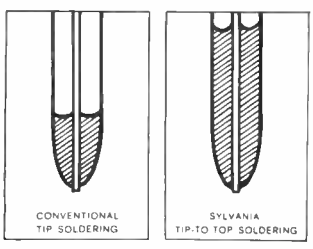
Facts on the New Stereocasting System

A 16-page Facts Book entitled 'Factual Questions to Your Answers About Stereo/FM Broadcasting" has just been published by **Zenith Radio Corp.** Beginning with an explanation of how stereo broadcasting came into being, the book contains 27 questions and answers designed to provide dealers with information that will help them render better service to their customers.

Blackboard Display Helps Sell Records

Surveys indicate that displays listing the current best sellers helps boost record sales. An all-metal blackboard display, on which phono record dealers can list the "Top Ten" recordings, is available through **Walco Electronics Co., Inc.** distributors with the purchase of a modest supply of sapphire needles.

New Soldering Technique for CRT Base Pins



"Tip-to-top" soldering is what **Sylvania** calls their newest improvement in picture tube manufacturing. It involves use of tapered socket pins with solder entended throughout the entire length. The new technique will result in more firmly seated sockets, and will minimize service callbacks for cracked picture tube bases and open or intermittent base pin connections.

Marketing Aids Promote Outdoor Hi-Fi

Point - of - sale promotional aids featuring the **Electro-Voice** "Musicaster" are now available to **E-V** dealers. Included in the package are reprints of full-page consumer ads, 3-color folders entitled, "How to Enjoy High Fidelity Outdoors," and a 4-color display piece which fits on top of the "Musicaster." A merchandising guide with numerous suggestions is included.

TESTS All TV and Radio Tubes—Old and New

TESTS the Nuvistors

TESTS the New 12-Pin Compactrons

TESTS the New 10-Pin Tubes

TESTS for True Dynamic Mutual Conductance (Gm)

TESTS European Hi-Fi Tubes, Voltage Regulators, and Most Industrial Types

OBSOLESCENCE PROOF Designed for Maximum Use Today and Tomorrow

NEWEST *FINEST* MONEY-MAKER *for Professional Servicemen*

Multiple-Socket Speed with Gm Accuracy PLUS OBSOLESCENCE PROTECTION

Model 700
DYNA-QUIK

Fastest, Most Complete Most Up-to-Date

DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

See your B&K Distributor, or Write for Catalog AP18 -R

TESTS BOTH OLD AND NEW TUBE TYPES—SELLS MORE TUBES PER CALL

Again you benefit from proved B&K techniques! This up-to-date, obsolescence-proof, professional instrument is designed for maximum use *today and tomorrow.* Provides multiple-socket section to quick-check most of the TV and radio tube types the *true dynamic mutual conductance way—plus* simplified switch section to check new tube types in Dyna-Quik emission circuit. Also includes provision for future new sockets.

Makes test under set-operating conditions. Checks each section of multi-section tubes separately. Checks for *all* shorts, grid emission, leakage and gas. Makes quick "life" test. Exclusive adjustable grid emission test provides sensitivity to over 100 megohms.

Makes complete tube test in seconds. Checks average set in a few minutes. Discovers weak tubes that need replacement. *Satisfies more customers. Sells more tubes. Saves call-backs. Insures your reputation.*

Patented automatic compensation for line voltage variation. Large 4½" plastic meter with easy-to-read "Replace-Good" scale. Lists most commonly used tube types with settings directly on socket panel for fastest operation. Complete listing in reference chart in cover. Phosphor-bronze contacts for long life. 7, 9, and 10-pin straighteners on panel. Operates on 117 volts 50-60 cycle a.c. Handsome leatherette-covered carrying case.
Size: 16⅛" x 15¾" x 5⅞" deep. Net wt: 15½ lbs.

Net, **$169.95**

NEW TUBE INFORMATION SERVICE
Available every 3 months, on subscription, for all B&K Dyna-Quik Tube Testers

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LETTERS TO THE EDITOR

Dear Editor:

Of all the publications in the TV, radio, and electronics field, yours gives *all* we want to know, and *not* a lot of things unconnected with our field. However, I would like more information (in condensed form) on new tubes as they come out.

Keep up the good work, as we need your excellent magazine.

HENRY L. MARPLE

Buckhannon, W. Va.

Keep a close watch on our "Product Report" and "Free Catalog & Literature Service," Hank. They carry frequent announcements on new tubes, and are keyed to the free literature card to make it easy for you to obtain additional information from the manufacturer.—Ed.

Dear Editor:

I started getting PF REPORTER about three months ago, and I think it's a great magazine. I'll make that "*the* greatest." I like the way you write your articles.

P. J. JONES

Charleston, Tenn.

Dear Editor:

PF REPORTER is the greatest buy I have made since I became an independent radio and TV serviceman.

LLOYD S. MCKEITHAN

Freeland, N. C.

We're working hard to make it an even better buy, fellas, so if you have any comments or suggestions, let us hear from you.—Ed.

Dear Editor:

In recent issues of PF REPORTER, I have noticed an increase in advertising and a decrease in electronic servicing articles. Why this is so I do not know; however, I would like to suggest that if you lack material to write about, you start a new series of articles dealing with fundamental radio-TV theory and servicing. I, for one, would be very interested, and I'm sure many others feel the same. Also, I would like to see an article written about the various ways capacitors can be checked for *leakage*.

J. A. SPURCHISE

East Syracuse, N. Y.

Please recheck your figures, J. A. If anything, we have been providing MORE editorial pages in recent issues. Our problem is not a lack of ideas, but rather selecting those of most benefit to over 75,000 subscribers. We try to include something for everyone in every issue, including fundamental and advanced servicing techniques. The capacitor article will be in the next issue.—Ed.

Dear Editor:

Just finished reading Anthony Annelli's letter to you (May issue), and after considering the two or three thousand words I could write on this subject, I finally came up with these few simple lines.

Mr. Annelli sounds to me like the type of man who goes hunting without a gun and goes fishing to sleep in the sun.

I would like to thank you very much for the personal service PF REPORTER has rendered me. Please don't ever change the greatest magazine ever published, even though I never intend to be an engineer.

ROBERT RALSTON

Westernport, Md.

Dear Editor:

Tony [Annelli], I'm with you 100%. I also feel too much time is spent telling us how some engineer (?) finally found, after hours of searching with scope and low-impedance (or high) probe, plus his marker and Lord knows what else, that C88 in the grid circuit of the sync separator was leaky. About 10 minutes spent with a good capacitor checker would have told him the same thing.

My troubleshooting procedure is quite simple—i.e., look and listen. This observation will tell a lot. Then go after the section that seems to be giving trouble. Sure, you're wrong once in a while, but voltage and resistance checks will confirm your observations. I do a complete tube and capacitor check after everything seems OK. This job, which takes only a few minutes, eliminates a lot of potential troubles and cuts down on callbacks.

As Tony said, if a serviceman followed the procedures in most of your troubleshooting articles, he'd never get any sets off the bench. I read the articles in this manner: Find the complaint, go to the end and find out the final solution, study the schematic, and then decide how I would have arrived at the answer.

Let's have a servicing article called "Troubleshooting Without a Scope," or "How I Fixed a Set Using My Head."

Thank you for listening to me; I'll continue to take your magazine because I think it's the best on the market.

JOHN J. ZEDER

Williamsville, N. Y.

Dear Editor:

I am afraid you stuck your neck out in your answer to Anthony Annelli, for I agree with him—in part, anyway. I have been a subscriber to PF REPORTER for a long time and don't think it is improving any, though I hate to say so. There's not enough down-to-earth material for the serviceman. I dare you to ask your readers to comment on this.

GLEN MASON

Portland, Ore.

Consider them asked!—Ed.

Dear Editor:

It is seldom I write the editor of any magazine, especially PF REPORTER; but the April issue "did it." This was your best.

I have only one request to put forth. Your coverage on TV has been tops; but since I've drifted away from servicing small radios and TV sets, I find some of

• *Please turn to page 20*

TO ALL INDEPENDENT

PHILCO OFFERS YOU FREE BUSINESS AIDS with your purchases of Philco receiving tubes

Here's a GALAXY of ALL-STAR OFFERS that you can get with your purchases of Philco receiving tubes you use every day. Offers end July 31, 1961.

- Alphabetically indexed folders included
- Storage compartment with lock and key
- 30" high, 12½" wide, 15" deep

FREE with your purchase of **250** PHILCO RECEIVING TUBES

COMBINATION KING SIZE CABINET FILE AND COMPACT COLLAPSIBLE DESK

The perfect unit for filing and storage of office supplies combined with a fold-a-way desk that opens up to a full 40-inch-wide work surface.

LUXO

Magnifier Lamp for Difficult Service Jobs

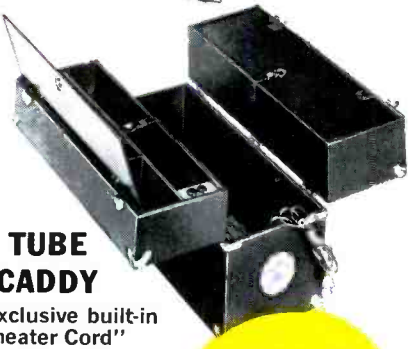
It both illuminates and magnifies—leaves both hands free for the job • Circuline Fluorescent Tube surrounds precision ground lens • Precision Spring-Balanced Action puts light where you want it.

FREE with your purchase of **500** PHILCO TUBES

FREE with your purchase of **250** PHILCO TUBES

2-DRAWER FILE

Heavy gauge steel—grey baked enamel finish! Drawers operate on Ball Bearing Rollers! Dimensions: 30½" high, 15" wide, 14" deep.



TUBE CADDY

with exclusive built-in "Cheater Cord" and Pin Straightener

The most useful Tube Caddy yet. "Cheater Cord" and Pin Straighteners are built-in, so they are always available when needed.

FREE with your purchase of **175** PHILCO TUBES

Available in Solid Blue or two-toned Blue and Yellow.

DOUBLE 99er OFFERS

FREE with your purchase of just **99** PHILCO RECEIVING TUBES

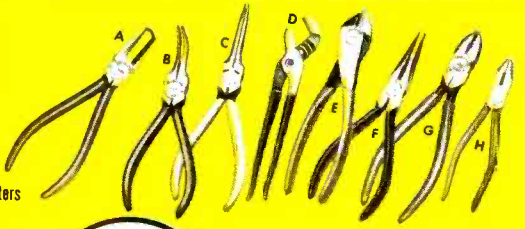
Handsome, Rugged ALL-PURPOSE CASE

Perfect as an extra tube caddy or for personal travel. Richly-styled with the luxury look and feel of finest leather.

- Designed to resist rough handling and still keep its new look!
- Saddle-type stitching adds luxury
- Dimensions: 16" long, 12" deep, 7" wide
- Four brass feet protect base from scuffing

FAMOUS KRAEUTER TOOLS

Finest Quality! All With Cushion Grips On Handles!



A End-Cutting Pliers
B. Curved Snip-Nose Pliers
C Snipe Nose Pliers
D Jaw Grip Pliers
E Heavy Duty Diagonal Cutters
F Needle Nose Cutting Pliers
G Diagonal "Oblique" Cutters
H Flat Nose Side Cutters

ANY 3 **FREE** with your purchase of **99** PHILCO TUBES

Available individually, your choice **FREE** with purchase of **39 PHILCO** receiving tubes

SERVICE TECHNICIANS

PHILCO INVITES YOU TO JOIN PFSS

PHILCO Factory-Supervised Service ®

YOU'LL GET UNEQUALLED BUSINESS-BUILDING BENEFITS

if you qualify for PFSS membership

As a PFSS electronics servicing member, Philco recommends your service business to all Philco owners, and helps you get increased business every day of the year. You belong, if you service Philco products. It's the only association of its kind in the industry.

ONLY PFSS GIVES YOU COMPLETE UP-TO-DATE PHILCO SERVICING DATA

You get *complete* information, including circuit analysis, base views, production run changes, and servicing procedures. Most important of all, service data is issued at the time new products are introduced.

PLUS ALL THESE EXCLUSIVE EXTRAS

FREE SUBSCRIPTION to Philco Service Businessman magazine—the only publication of its type in our industry. It's packed with business-building ideas every month.

STORE IDENTIFICATION KIT

Complete store-front display printed in 3 colors on clear acetate.

BUMPER SAFETY STRIP

for your vehicle — serves as a safety warning as well as a sales message!

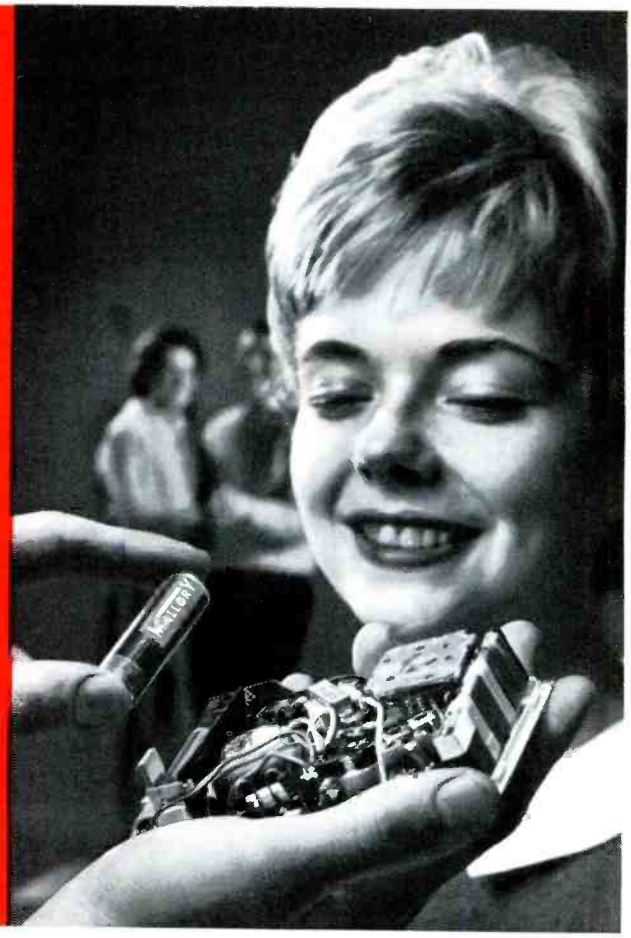
SPECIAL OFFER NOW!

THERE ARE MANY OTHER PFSS BENEFITS, such as Accident Insurance Protection at low group rates, advertising material, and training programs. If you qualify, you can join now on a special offer never before available. DETAILS ARE FREE!

SEE YOUR PHILCO DISTRIBUTOR

New Mallory Mercury Battery kit

COMPACT . . . AND STOCKED RIGHT!
Only 2" x 5" x 7", this handsome kit comes stocked with popular, fast-moving Mallory Mercury Batteries. You can refill it with the selection that best fits your service needs.



SILICON RECTIFIERS
Top quality, moisture-proof. 5-packs, in re-usable jewel boxes, on handy file cards. 50 volt to 600 volt ratings.

VIBRATORS
Sure-start Gold Label® and every other type for auto or mobile communications.

PVC CAPACITORS
Premium quality Mylar* Capacitors in handy zip-lip package.

*Reg. Trademark E. I. du Pont de Nemours, Inc.

STA-LOC® CONTROLS**
30 second delivery on every imaginable control.

**U.S. Patent 2,958,838

puts extra cash into service calls

Here's a profit-building sales tool to help you cash in on the booming transistor radio battery business by turning service calls into *added* profits. It's the BM-11 Mallory Mercury Battery Service Kit . . . a compact unit that fits easily in a corner of your tube or tool caddy.

On a home TV service call, ask if there's a transistor radio in the house. Six out of ten times there will be. And with your BM-11 Kit, you can sell your customer the guaranteed Mallory Mercury Battery he needs . . . right on the spot. He'll get extra satisfaction, because Mallory Mercury Batteries give up to seven times more ***sound power***Ⓣ. You'll get a profitable sale, and a good chance of getting his *repeat* battery business.

NEW EYE-APPEALING PACKAGING!

Mallory Mercury Batteries for popular transistor radios are now available in handsome, reusable jewel boxes . . . pre-priced for your convenience. Guarantee certificate in each package.

THE ONLY RADIO BATTERY GUARANTEED AGAINST LEAKAGE!

NEW MERCHANDISER FOR YOUR STORE

Attractive metal merchandiser No. BM-10 feeds new Mallory Mercury Battery packages one at a time. Guarantee against leakage is prominently displayed.

ADVERTISED IN LIFE

DISCAPS®

The standard of the ceramic capacitor field.

®Trademark Radio Materials Company, a Mallory Division

ELECTROLYTIC CAPACITORS

Famous FP-WP metal can types, reliable TC tubulars, and tiny TT tubulars.

Distributor Division, Indianapolis 6, Indiana

P.R. MALLORY & CO. Inc.

MALLORY

In Canada: A. C. Simmonds & Sons, Ltd., Toronto 7, Ontario

Letters

(Continued from page 14)

the material in your magazine less valuable than formerly. Therefore, I would like to see more articles on other electronic equipment, such as your series on industrial electronics. One other subject that would be interesting is communications (Citizens, mobile, aviation, and maritime).

RAYMOND J. WENSMAN
Phoenix, Ariz.

How about "Two-Way Radio Antennas" and "Photoelectric Control Devices" in this issue? More on the way.—Ed.

Dear Editor:

I don't recall seeing a "Believe It or Not" column in your magazine, but the following situation belongs in that category. Even though it sounds unbelievable, I can vouch for its factual accuracy.

A public utility employee, walking around a house to check a meter, passed by an open living-room window. Inside, he noticed the head of the family working on a TV chassis, and was astounded to see the neck of the picture tube sporting what appeared to be a black goiter! The entire family was gathered around the chassis, and the man of the house was energetically working a tire pump.

His curiosity getting the better of him, the utility employee leaned through the window and politely inquired what they were doing. They explained that the owner's wife, in sweeping the floor around the chassis, had accidentally swung the broom against the neck of the picture tube. The result was described as a "psssst" sound, like escaping air.

The husband had remarked, "Don't worry—we can fix that easy." He had taped up the fractured neck of the tube, and the wife was holding the nozzle of the tire pump up against the high-voltage anode button while the husband was pumping away with all his might.

"We's puttin' the air back in," he explained. "I think the tape will hold."

LEE CLOUGH
Galveston, Texas

If we ever do run a regular "Believe It or Not" column, we'll call it "Do-It-Yourself Dillies"; your story certainly qualifies for that category!—Ed.

Dear Editor:

I thought you might be interested in this photo I took last year on a trip through Europe. The modern TV antennas make a striking contrast to the ancient rooftops of Florence, Italy.

MAURICE W. DAVIS
Shasta College
Redding, Calif.

Judging from the contrast between the rundown appearance of the buildings and the excellent condition of the antennas, TV programming in Italy must be a heck of a lot better than it is in the U. S.!—Ed.

Dear Editor:

I see more good than bad in the fact that so many tube types are being offered to the television industry. True, there have been some offbeat types, but there have also been many improvements in circuitry which could not have been made without introducing new tube types.

The supermarkets, drug stores, and variety stores simply will not be able to keep their tube checkers and tube stocks up to date. These operators are not technically-minded and don't understand the tube business. It will become unprofitable for them, even without offering discounts up to 50%. Such price-cutting was easy to do in the days of many 6AU6's, 6CB6's, etc.

Personally, I welcome the new tube types. The industry can introduce more of them twice a year and not hurt my feelings. The service industry stands to gain far more than it will lose.

I have been in the service business over 25 years, and I know a man must love servicing to stay in it. So, whenever necessary, I will buy another tube caddy and thank God for small favors.

CARL F. PEDERSEN
Seattle, Wash.

You may change your mind when you look over the latest "Stock Guide for TV Tubes" when it comes out.—Ed.

Dear Editor:

In the January *Letters* column, Mr. H. W. Hill questioned the advisability of operating a television receiver with the speaker disconnected. I believe it should be pointed out that this should not be done unless the volume control is set to minimum.

Aside from risking damage to components by operating with no speaker, other problems will be encountered if the receiver utilizes the audio output tube as a voltage divider. The low B+ source, frequently including a portion of the brightness-control circuit, is often derived from the cathode circuit of the audio output tube. With the output-transformer secondary open, the transformer presents a very high impedance to the output tube. Then, if the tube is driven with a substantial signal, it ceases to operate Class A and causes a wide swing of the low B+ voltage in step with audio modulation. This results in fluctuations of brightness and/or video level, depending upon what circuits are returned to the audio-output cathode. In some cases, this problem can prove most puzzling if the cause is not recognized.

R. C. HANNUM
Supervisor—Technical Service
General Electric Co.
Syracuse, N. Y.

In short, the possibility of damage may not be the main objection to operating a TV set with no speaker connected. Clipping in a dummy load is cheap insurance.—Ed.

NEW...Home TV Signal Amplifier

TRANSISTORIZED WINEGARD "BOOSTER-PACK"

Clears up snow, improves contrast, adds miles to reception distance!

Here's the most unusual (and most useful) home TV-FM signal amplifier you've ever seen! Winegard "Booster-Pack" utilizes new low noise, high gain transistor* to give you a flat gain of 16 db on the low band and FM . . . a flat gain of 14 db on the high band.

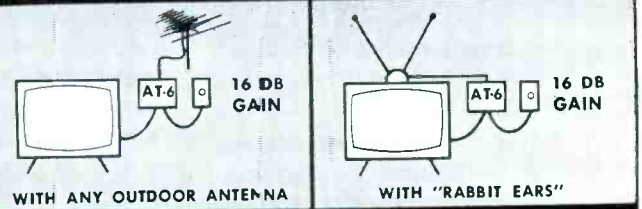
Shock-proof . . . full AC chassis with AC isolation transformer (not AC-DC). Draws only 1.2 watts . . . cost only 27c per year to operate if left on continuously. No heat radiation. Can be mounted on back of TV set, on baseboard, in basement, attic, etc. Use "Booster-Pack" as a single set booster or as a home system amplifier for up to 6 or 7 sets. (See right)

*Special transistor so new that this amplifier could not have been produced until now.

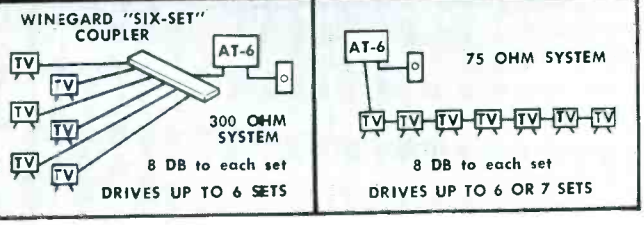
No other amplifier under $80.00 has all these features!

- Drives from 1 to 7 TV/FM sets
- Ideal for color
- Power Consumption: 1.2 watts
- Gain: Low and FM: 16 db
  High: 14 db
- Input: 300 ohm
- Output: 300 ohm and 75 ohm
- Transistor*: Low noise, high gain type
- Power Transformer: AC isolation type
- Gain Control: 3-position switch
- AC Outlet: To receive TV set power plug
- Precision Wiring . . . finest quality throughout

1 USE IT AS A "SINGLE SET" AMPLIFIER



2 USE IT AS A "HOME SYSTEM" AMPLIFIER



New! Winegard "Six-Set" SIX SET TV COUPLER

For connecting up to 6 TV sets to "Booster-Pack" or to Winegard Powertron antenna. 300 ohm input and outputs. Low insertion loss, positive isolation between sets.

Mod. LT-63
$7.95 List

ASK YOUR DISTRIBUTOR OR WRITE TO:

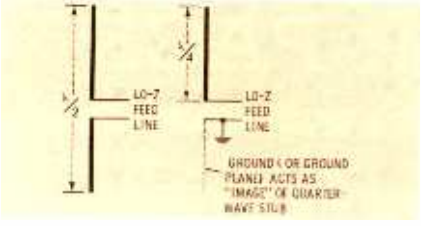
Winegard ANTENNA SYSTEMS

WINEGARD CO., 3009-7 Kirkwood Ave., Burlington, Iowa

TWO-WAY RADIO ANTENNAS

Characteristics and capabilities of the different types . . . by Edward M. Noll

The antenna makes an important contribution to the effective and efficient operation of any two-way radio communications system. There are several practical limitations on the power output of a communications transmitter—for example, battery drain (in mobile equipment), cost, size, and FCC restrictions. Therefore, the proper type of antenna must be used to obtain peak performance from every installation. Most types stem from the basic half-wave (Hertz) and quarter-wave (Marconi) designs.



This drawing shows similarities between half-wave dipole (Hertz) and quarter-wave (Marconi) antennas.

The physical length of an antenna element depends upon the two-way radio band used. The most popular bands are given in Table I, together with a free-space quarter-wavelength measurement for the center frequency of each range. Notice the great difference in this dimension for the various bands. The high-frequency region, which includes the Class D Citizens band at 27 mc, seems most popular at present.

The receiver and transmitter operate at peak efficiency when the antenna is brought into exact resonance. Most antennas, as supplied, are of the full length required to resonate at the low-frequency end of a given communications band. To optimize operation of the antenna at some other frequency, it is necessary to reduce the length of the whip antenna. Many communications technicians prefer to cut the antenna to exact length rather than become involved with the possible variables of a telescoping arrangement.

Table I — Quarter-Wave Dimensions

	BAND (MC)	CENTER FREQUENCY (MC)	DIMENSIONS IN INCHES (2952/INCHES)
HF	25-50	37.5	78.7
VHF1	72-76	74	39.9
VHF2	150-174	162	18.2
UHF	450-470	460	6.41

Mobile Installations

Practically all two-way radio services involving mobile units employ vertical antenna polarization. This provides more reliable communications when the antenna height is limited, as in the case of land and marine vehicles. Vertical antenna systems are more suited to obtaining the omnidirectional horizontal-radiation pattern usually required for mobile systems. Furthermore, the vertical antenna directs the bulk of its radiated energy at right angles to the antenna element instead of wastefully sending it upward into the atmosphere.

Quarter-Wave Whip

The quarter-wave or shortened quarter-wave whip antenna is by far the most popular antenna style for mounting on moving vehicles. The vehicle body itself serves as a ground, thus permitting quarter-wave operation. The long antennas for the 25-50 mc band are usually mounted on the bumper or along the side of the vehicle, whereas the most popular mounting position for the shorter VHF and UHF antennas is at the center of the roof.

Many designs include a swivel mount so that the whip can be positioned straight up and down, even when the base is attached to a sloping surface. In addition, the longer, heavier antennas used in HF systems are generally connected to the base through a spring, mainly to prevent damage to the mount from brushing against obstacles.

Mobile installations normally use quarter-wave whip. For low-frequency operation, loading coil (in series with antenna or wound over it) extends electrical length. Swivel and spring mounts simplify attaching large antenna to vehicle.

Loading Coil

To make large mobile HF antennas more manageable, they are sometimes cut shorter than an exact quarter wavelength. If so, they display a capacitive reactance to the source of signal. The more the whip antenna is shortened, the higher its capacitive reactance becomes; as a result, its radiation resistance is lowered. This effect prevents proper resistive loading of the transmitter, so the efficiency and output drop off. However, it is possible to present a reasonable load to a transmitter if the capacitive reactance is balanced out by adding inductance. This is usually done by mounting a coil at the base of the antenna.

The use of a loading coil permits efficient operation with an antenna substantially shorter than a quarter wavelength. However, it should be stressed that the total amount of

Please turn to page 66

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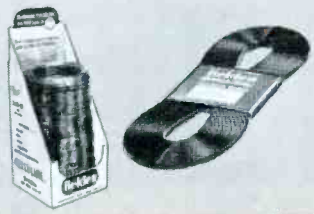

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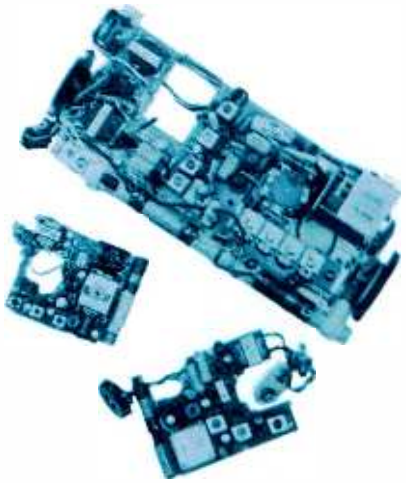

SERVICING IMPORTED TRANSISTOR PORTABLES

A helping hand for working on "orphan" models . . . by Joe A. Groves

One of the biggest problems facing the radio-TV servicing industry today involves imported transistor radios. These sets have poured into the American market by the millions; thus, most service shops have already come into contact with them. What complicates matters most is the lack of service data for many of these units. They appear under literally dozens of trade names, and many are sold in such limited areas and in such small numbers that it's impossible to keep track of them all. In the face of these odds, it's amazing to learn that service data is available for quite a few of these private-label sets.

Those shops which are facing up to the imported-portable problem have fortunately set a precedent of getting paid for their trouble. It isn't hard to convince customers that these miniature radios are difficult to service (but not impossible), and that the special handling they require makes them even more costly to service than a TV. In fact, talk to some men who are real "pros" at this type of service, and you'll find they charge anywhere from $4.50 to $6.50 for labor alone. When you stop to think that they can service 10 sets or so a day, that makes $65 a day for their labor. Thus, a day spent in the shop repairing transistor radios can be as profitable as a day spent traveling all over town to fix TV sets!

How can you tap this source of revenue? Simple—just become familiar with imported portable radios. Printed boards, miniaturized components, and questions about obtaining replacement parts present an unfortunate psychological block to many. Actually, the only real problem stems from lack of service data. The solution to this problem is so obvious that it's often overlooked:

Most of these radios are very similar. Stop a minute and think about a five-tube AC-DC set. There are dozens of these makes, too. Yet, each one is enough like the others that you seldom need any data to track down a trouble. The same thing can apply to imported portables if you get to know them as well as the five-tube AC-DC models.

Take a good look at the schematic shown in Fig. 1. Study it carefully, because the circuitry in this radio is typical of most imported

• *Please turn to page 58*

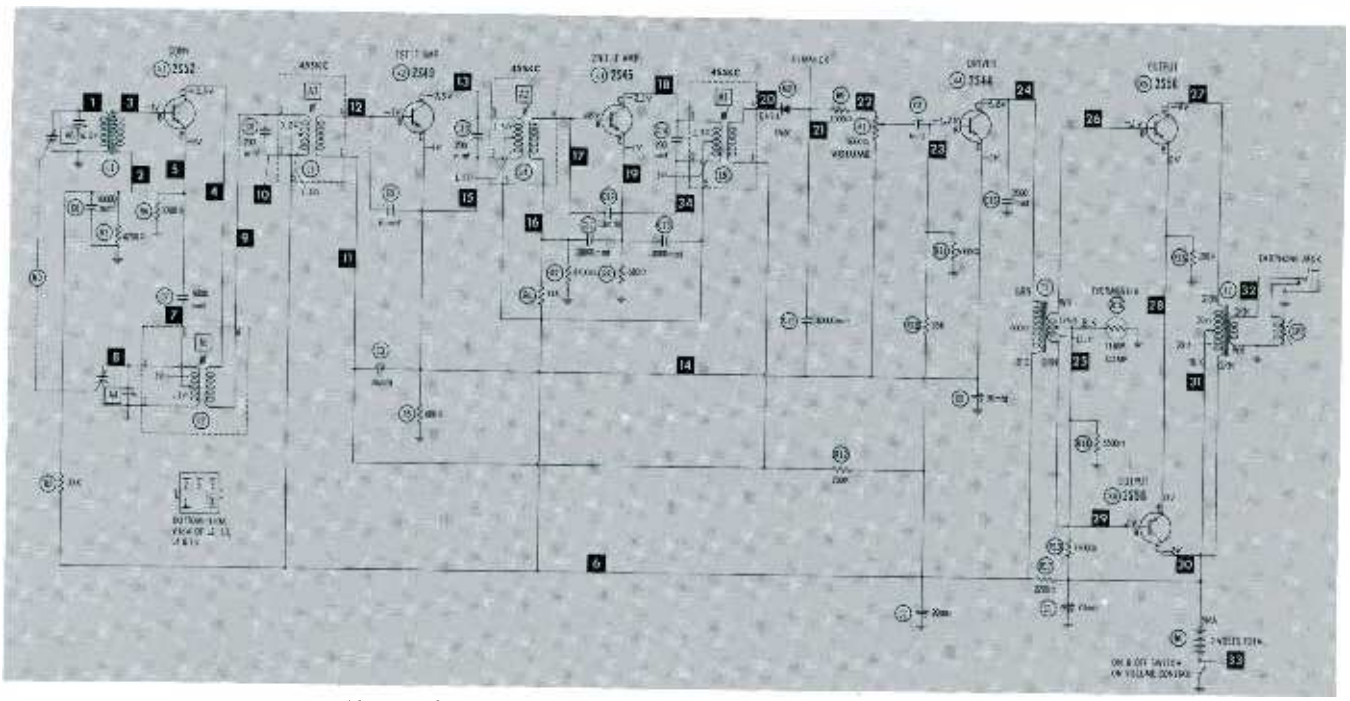

Fig. 1. The circuits in most imported portables are very similar to these.

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TYPE NUMBER	JOB DESCRIPTION	REPLACEMENT FOR
SYL 101	NPN, conv., mixer, osc.	18 types
SYL 102	NPN, if-amplifier	24 types
SYL 103	NPN, af-amplifier driver	21 types
SYL 104	NPN, af-power amplifier	12 types
SYL 105	PNP, conv., mixer, osc.	30 types
SYL 106	PNP, if-amplifier	40 types
SYL 107	PNP, af-amplifier driver	60 types
SYL 108	PNP, af-amplifier output	65 types
SYL 109	PNP, af-amplifier pwr output (popular auto radio type)	54 types

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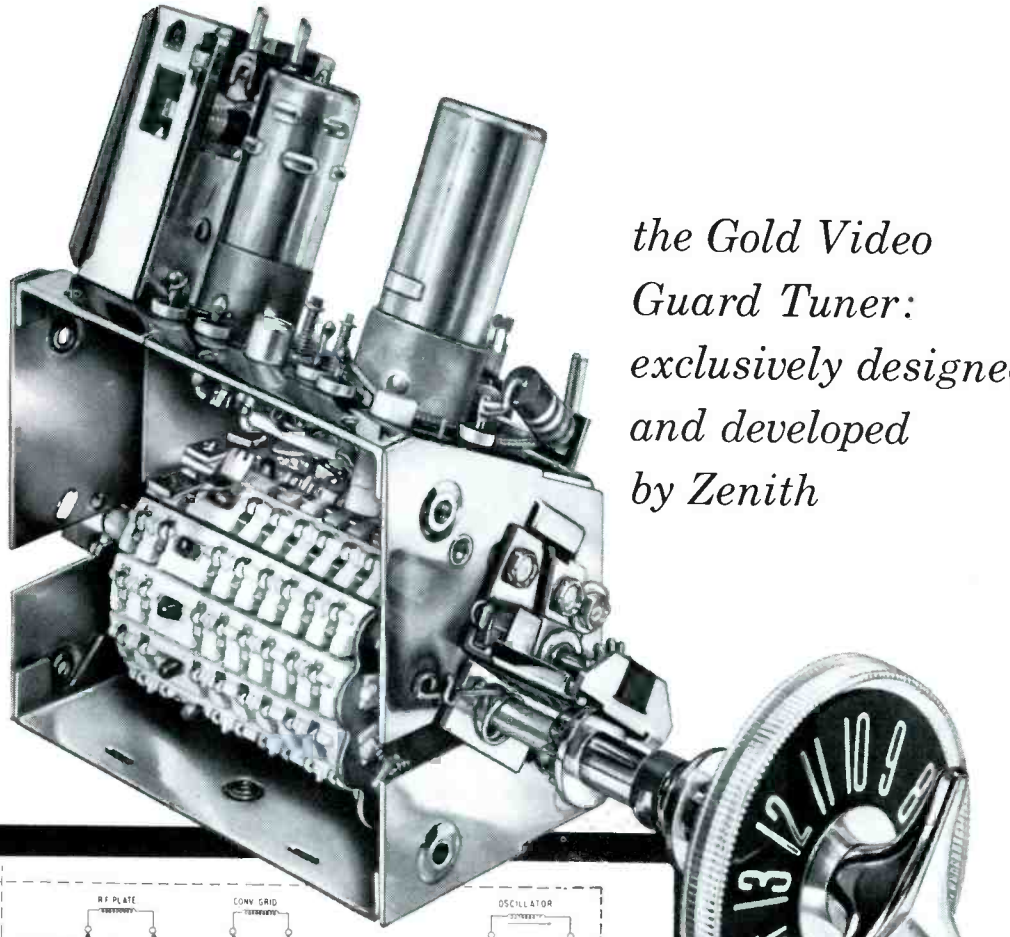
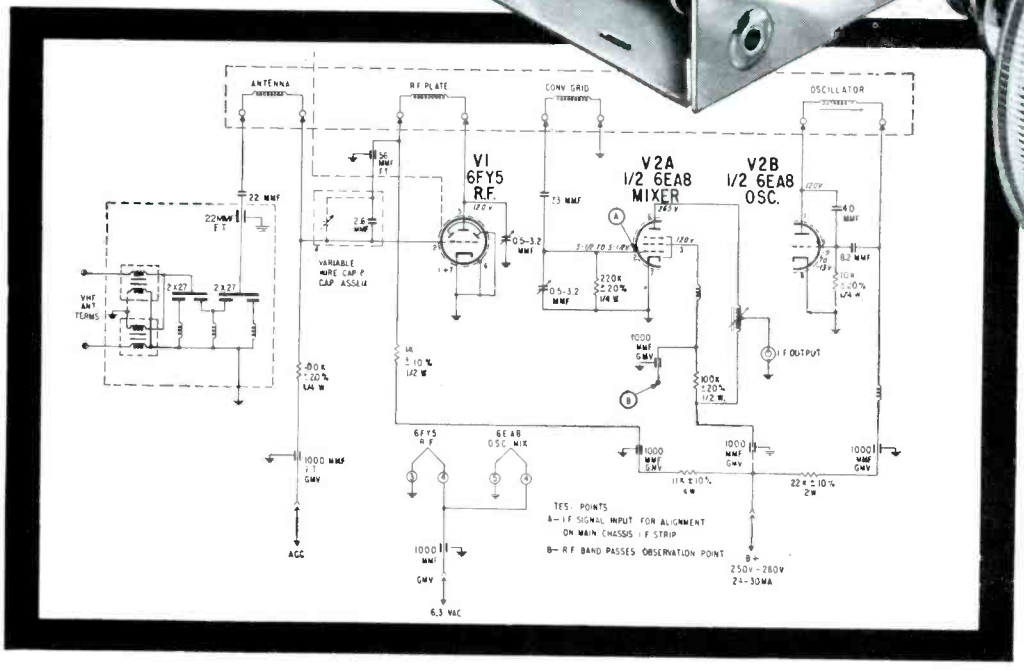
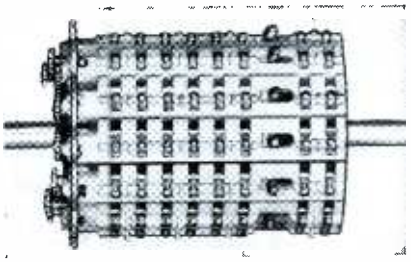


the Gold Video Guard Tuner: exclusively designed and developed by Zenith



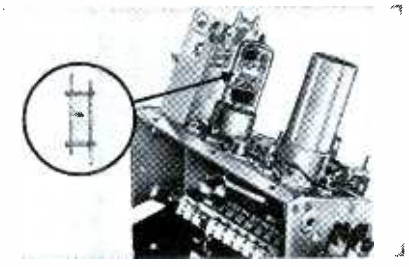
10 great Zenith features now eliminate troublesome tuner problems—simplify service, deliver stronger pictures in any signal area, assure better performance for the lifetime of the set.



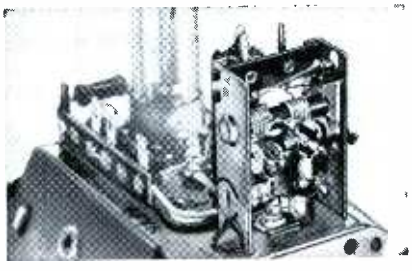
1. New 16-k. gold contact points can't oxidize or wear out. Gold-filled, not just plated. Can't lose signal like corrodible silver points, rarely need cleaning—won't wear out like gold plating.

2. New out-front Perma-Set control custom-tunes each channel. Zenith eliminates fine-tuning circuits and drift. Single control makes *all* tuning adjustments—*assures maximum frequency stability.*

3. New channel strips 10 times more resistant to moisture. Remarkable new glasskyd insulation material virtually ends moisture-caused drift—ends one of the major causes of lost picture quality.



4. New frame-grid type tube provides TV's best signal-to-noise ratio. Zenith-pioneered micro-precision tube gives unsurpassed fringe-area or prime-area reception.



5. New filter cuts police and ham radio interference. Exclusive Zenith high-pass filter improves rejection efficiency—gives purer signal for still finer picture.

6. Tuner designed for quick, easy UHF conversion on the spot. You can convert tuner to take up to 4 UHF stations, *switch strips without disassembling tuner or drum.*

7. Handcrafted construction—no printed circuits anywhere. Famous Zenith handcrafted quality means more dependable operation, longer life, quicker servicing.

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PHOTOELECTRIC

To what extent is a radio and television technician qualified for industrial electronics servicing? Would the training period for entering industrial electronics be long or short? Many radio and TV servicemen are asking themselves these two intriguing questions, since the demand for industrial electronics service is growing all the time —creating many new opportunities for profitable servicing. These opportunities exist primarily for the skilled technician who can go into a plant and do the job. Is such skill hard to come by? Not if you have a chance to examine a variety of industrial equipment from a *service* standpoint.

This new series of articles will analyze many classes of equipment. For each class, a general discussion of over-all operating and servicing principles will be followed by a description of specific units, together with more detailed service instructions. All this will be written against a backdrop of radio and television service experience, with industrial units related to home electronic equipment insofar as possible. With this help, you will discover that a good radio and TV technician can readily become an equally good industrial electronics technician.

Let's begin with photoelectrically-operated devices — perhaps the simplest types of industrial equipment.

The Photoelectric Relay

Essentially a light-operated switch, the photoelectric relay can be wired so that it either pulls in or drops out when a light beam is interrupted. This makes it possible to count objects on a moving conveyor without touching them, to open doors in supermarkets, and to dim headlights automatically — to name three of the most common applications.

The components used in this equipment are a photoelectric tube, light source, lens system, light filter, and electromagnetic relay.

The most commonly-employed photoelectric tube is a diode in which electron emission is produced by light striking a *photocathode*. The ratio of plate current to light is called the luminous sensitivity, expressed in microamps per lumen. (A lumen is the total light flux striking an object, whereas the more familiar term of foot-candle is the amount of light flux per unit area.)

Photocathodes are made of pure metals when response to ultraviolet light is desired, or coated with an alkali metal for operation by visible light or infrared rays. Coating the cathode also increases the sensitivity of the phototube to light energy. To further improve phototube sensitivity, gas may be added. Partial ionization of the gas results in five or more times as much plate current as in a comparable high-vacuum tube; this effect is known as *gas amplification*. The additional sensitivity gained by the use of gas is offset by a loss in linearity of response, and the nonlinear reaction of the gas phototube to different light intensities limits its application chiefly to switching, as in photo-relays. On the other hand, the high-vacuum phototube has a linear response characteristic which makes it ideally suited to more exacting jobs such as responding to the sound track on motion-picture film.

A more specialized phototube, the photomultiplier, is a high-vacuum device with a luminous sensitivity of six amperes per lumen (compared to a maximum of about 45 microamps per lumen for a high-vacuum phototube). One major use for photomultiplier tubes is in automatic headlight dimmers.

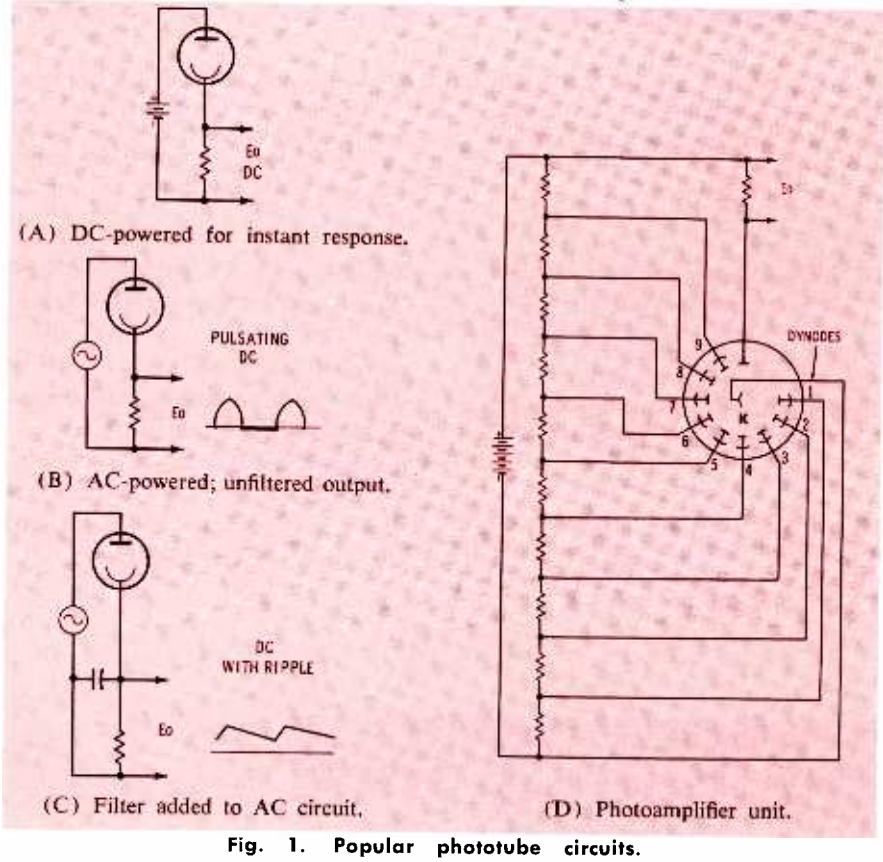

Fig. 1. Popular phototube circuits.

Photoelectric Circuits

Four common circuits involving phototubes are shown in Fig. 1. The simple hook-up of Fig. 1A is

CONTROL CIRCUITS

by Milton S. Kiver

used whenever instantaneous photorelay response is required. One application is in auto-race timers, where an interruption of the beam actuates the relay to start or stop the timing mechanism.

Fig. 1B is applicable to circuits where "dead-time" intervals of 1/120 second are permissible. Since the plate-supply voltage of the phototube is AC, conduction can occur only during the positive half cycle of plate voltage. During the other half cycle, the plate is negative, and the tube cannot respond to light changes. This circuit makes use of the rectifving action of the phototube, eliminating the need for a rectifier tube and its auxiliary component.

The arrangement of Fig. 1C also uses the phototube as a rectifier, but a filter capacitor across the load resistor removes much of the ripple from the output, and the remaining voltage is usable as DC in noncritical applications. However, the filter capacitor slows the speed of response, since there is a delay while it charges or discharges after a change of light.

Fig. 1D is a typical photomultiplier-tube circuit. Electron flow is started by light striking photocathode K, but here the similarity to the two-element phototube ends. Electrons emitted from the photocathode strike the first dynode element, which is about 100 volts more positive than the photocathode. This electrode is designed to give off additional electrons by secondary emission whenever bombarded from the cathode. The impact of a photocathode electron on dynode 1 releases two or more electrons which, in turn, are attracted to dynode 2—where they cause four or more electrons to be released. The process is repeated from dynode to dynode, and the final output is collected by a regular plate. The multiplying action accounts for the high luminous sensitivity of this tube. The required supply voltage is about 1000 volts.

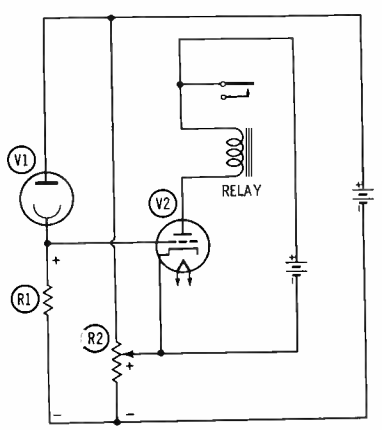

Fig. 2. A vacuum-tube amplifier used with DC-powered photoelectric tube.

Light System

The most frequently-used light source is an incandescent lamp. When an increased output of infrared light is desired, the lamp is operated slightly below its rated voltage; this lowers its temperature and shifts the light output towards the lower-frequency or infrared end of the light spectrum. An infrared filter is placed in front of the lamp to remove most of the visible light. When ultraviolet light is needed, it may be obtained from a special lamp with a built-in filter. Also in the ultraviolet region is sunlight itself, which is often used directly to actuate a relay controlling window-display, yard, or street lights. An ultraviolet phototube requires a special envelope, since ultraviolet rays are blocked by ordinary glass.

Lens System

The lens system focuses the light in the desired direction, just as a directional radio antenna emits RF energy in a specific direction to increase the efficiency of transmission. The lenses at the source and at the phototube are both convex. The former bends the light rays from the source until they are parallel, and the latter focuses them on the cathode. In some units, the distances from the lamp and phototube sockets to the lenses are adjustable and can be mechanically set for best results.

In practice, some of the light is lost by reflection from floating dust or water particles, or simply by a spreading of the beam that prevents all the light from reaching the phototube lens. These losses limit the maximum distance between the light source and the phototube.

The phototube is often placed in a shielded housing. Such an enclosure not only provides a natural support for the receiving lens, but also prevents stray light from reaching the phototube and desensitizing

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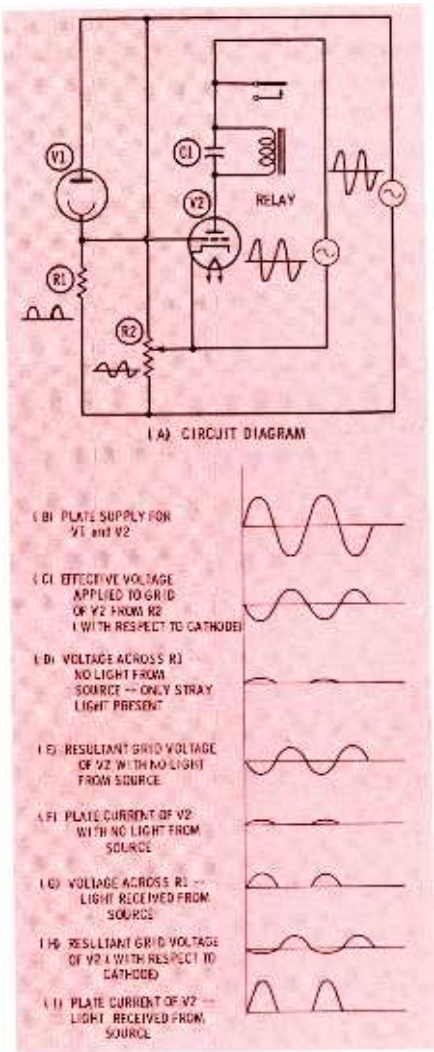

Fig. 3. Operation of a photoelectric control amplifier supplied with AC.

ACROSS THE BENCH

by Stan Prentiss

an experience with a COLOR set

Recently an RCA CTC7A color receiver (a 1957-1958 model) was hauled into the shop—cabinet and all—for what the outside man diagnosed as a "bum picture tube." To all appearances he was right. With the receiver turned on, rotation of the brightness control produced little change in illumination of the CRT screen. The raster was also badly defocused and responded only sluggishly when the focus control was adjusted. To top it off, there was not the slightest trace of color. I selected a VOM, partially unplugged the CRT socket, and measured the cathode and grid voltages at the picture tube pins. (See Fig. 1.) Surprisingly, the red cathode (pin 4) and red control grid (pin 2) read almost exactly the same, as did the equivalent elements of the green and blue guns. My first reaction was, "Shorted picture tube!" But, just as a precautionary check, I pulled the tube socket entirely free of the tube pins and remeasured the grid and cathode voltages. They read the same as before. Naturally, this verified one thing—whatever was wrong with the picture tube, it evidently wasn't shorted. Since the grid voltages were far above normal, something was apparently wrong with the R–Y, G–Y, and B–Y amplifiers.

The plate voltage for these three stages is delivered by the main 385-volt B+ supply through a trio of hefty 15K-ohm, 3-watt resistors.

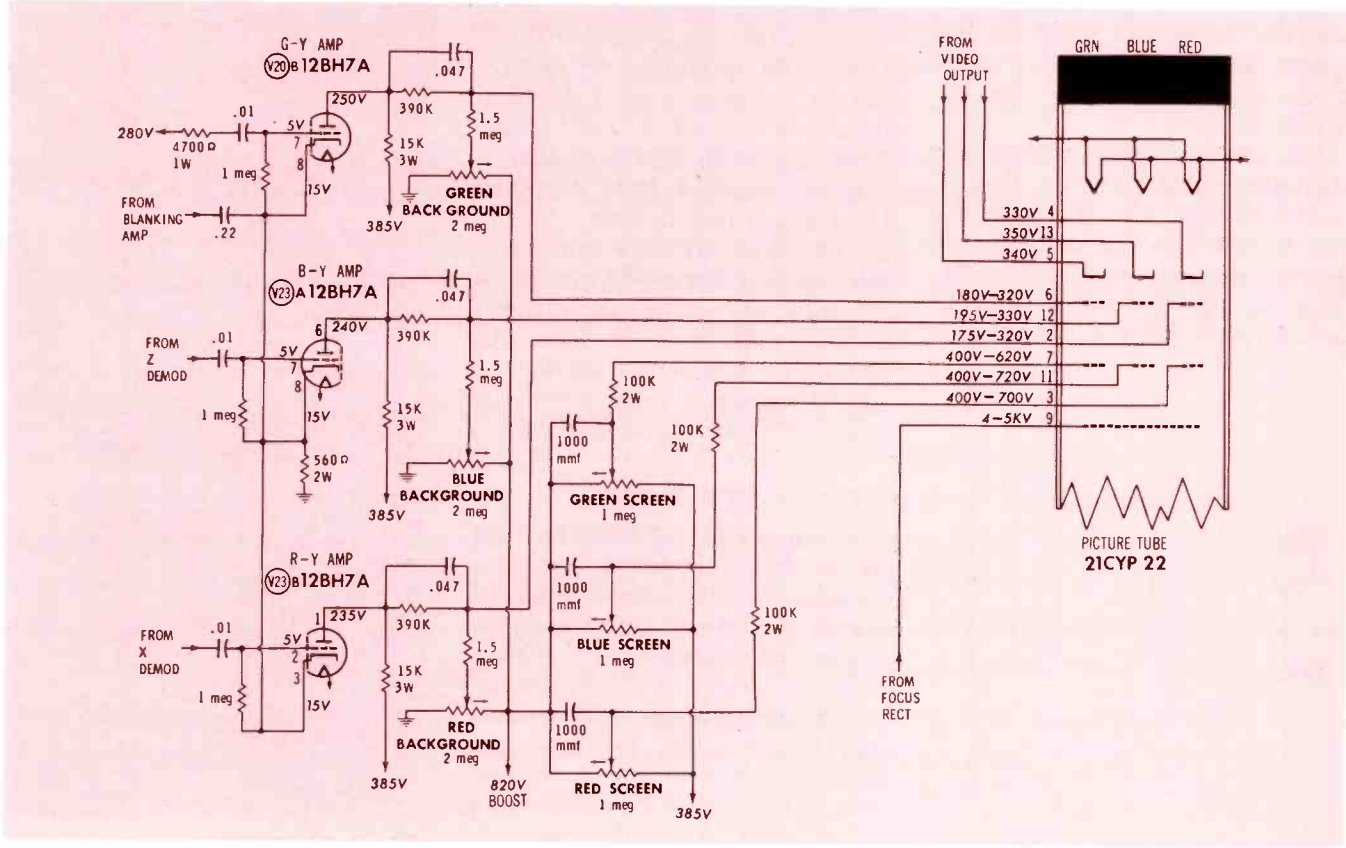

Fig. 1. Chroma amplifiers apply color informaion to grids of picture tube.

When the tubes are conducting as they should, their DC plate voltages should measure approximately 250 volts. These potentials have a hand in determining the color-CRT grid voltages, which normally swing from 200 to 370 volts DC when the respective background controls are adjusted. (Note that a B+ boost voltage of approximately 800 volts is applied across each control.) Turning down the background controls somewhat reduced the plate voltages of the three chroma amplifiers, but wouldn't take them below 300 volts. This meant an abnormally low voltage drop across the 3-watt load resistors — a sign that the amplifiers were not conducting. The receiver owner had told the outside man that the color had vanished before the brightness potentiometer lost control; chroma-amplifier trouble would account for this situation. But how could I remedy the defect in the chroma amplifiers, and what steps should I take to solve the rest of the problem?

Three Steps

There were three things I had to do now: First, test the color picture tube; second, discover the reason why the three chroma amplifiers were not conducting; and third, find out why the brightness control seemed practically useless.

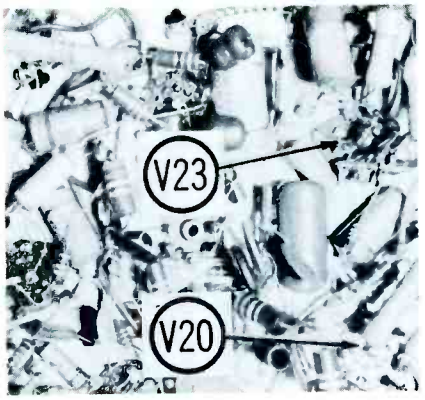

Fig. 2. Vertical position of chassis let melted wax run into tube sockets.

My tube tester, which has an attachment for independently checking the three guns of a color CRT, showed that practically no beam current was being emitted by the green, blue, or red cathode. Thus, I immediately knew I'd have to install a new picture tube, along with whatever other parts might be necessary to restore this four-year old receiver to satisfactory operating condition. The customer was promptly notified and agreed to have the work done, realizing that my estimate of $200 to put a fairly young receiver in first-class condition was a lot less than buying a new one.

Now that I was certain of the job, I went to work in earnest. I pulled the chassis from the cabinet, changed the picture tube, and then set up the receiver for bench servicing. Voltage checks at the cathodes of the three chroma amplifiers (V20B and both halves of V23 in Fig. 1) revealed a complete absence of voltage across the 560-ohm, 2-watt common cathode resistor. An ohms check showed the resistor to be well within its 10% tolerance, so the loss of tube conduction was not the fault of this component. Examining the two tube sockets (Fig. 2), I soon found the cause of the trouble. The CTC7A chassis is mounted on its side in the cabinet, high-voltage supply down. Apparently, wax from tubular capacitors in the chroma section had run down into the chroma-amplifier tube sockets and was interfering with several tube-pin connections.

I checked the 12BY7A's, rejected and replaced one, and then dipped

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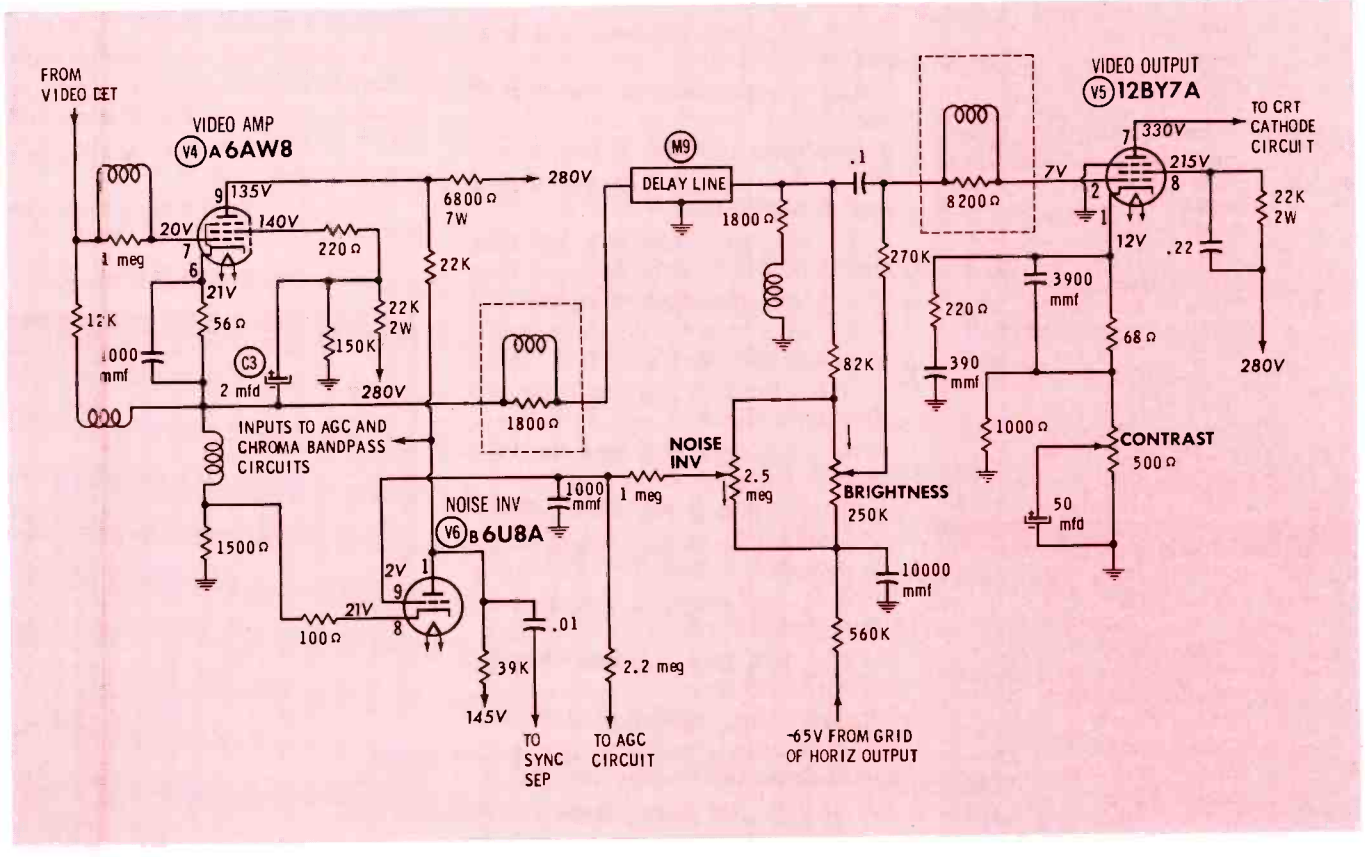


Fig. 3. Video amplifiers and noise-inverter stage of the RCA Chassis CTC7A.

DIODE & RECTIFIER REPLACEMENT GUIDE

Cross-reference data and replacement hints for radio-TV semiconductors . . . by Les Deane

Table I—Crystal Diodes

TYPICAL APPLICATIONS	ORIGINAL TYPE	RECOMMENDED SUBSTITUTES
BLACK AND WHITE TV		
VIDEO DETECTORS	1N34	1N34A, 1N38B
AGC RECTIFIERS	1N34A	1N34, 1N38B
BIAS CLAMPERS	1N60	1N34A, 1N54A, 1N295
SOUND DETECTORS	1N64	1N60, 1N295
(matched pair)	1N87	1N60, 1N295
	1N87A	1N60
	1N295	1N60
UHF MIXERS	1N82	1N82A
TABLE AND CONSOLE RADIOS		
AUDIO DETECTORS	1N60	1N34A, 1N54A, 1N295
BIAS CLAMPERS	1N64	1N60, 1N295
	1N295	1N60
FM DETECTORS	1N295	1N60
(matched pair)	1N541	1N295
	1N542	1N60, 1N295
TRANSISTOR RADIOS		
AUDIO DETECTORS	CK706	1N60
BIAS LIMITERS	CK706A	1N295
	CTP461	1N295
	SD6	1N295
	SD46	1N60, 1N295
	1N34A	1N34, 1N38B
	1N60	1N34A, 1N54A, 1N295
	1N60G	1N34A. 1N54A, 1N60, 1N295
	1N64	1N60, 1N295
	1N87	1N60, 1N295
	1N87G	1N60, 1N295
	1N295	1N60
	1T43	1N60
COLOR TV		
4.5-MC DETECTORS	1N60	1N34A, 1N54A, 1N295
	1N64	1N60, 1N295
	1N132	1N60, 1N64, 1N295
	CK706A	1N295
VIDEO DETECTORS	1N60	1N34A, 1N54A, 1N295
	1N64	1N60, 1N295
	1N295	1N295
	CK706A	1N60
UHF MIXERS	K3E	1N82, 1N82A
	1N82	1N82A
BIAS RECTIFIERS	1N60	1N34A, 1N54A, 1N295
	1N64	1N60, 1N295
	1N67	1N67A, 1N198

Because of the variety of diode and rectifier types used in present-day sets, many servicemen do not realize they can take care of most replacement needs with a very small stock—only a few types of diodes and two or three types of rectifiers. If you know which units to keep on hand, you can have a replacement ready for use on almost any service job in home or shop.

Crystal Diodes

Semiconductors used for demodulation, bias rectification, and low-voltage clamping are commonly called crystal diodes. These small germanium or silicon units pose no replacement problem as long as you know the original type number or circuit application.

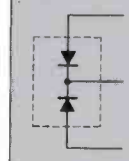
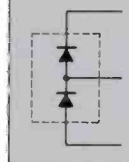
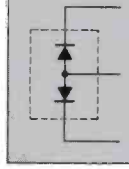
Diodes are identified by type numbers, which normally begin with 1N. Most miniature, glass-encased types are marked with three bands showing the standard EIA color code for the type number following the prefix. Epoxy- and ceramic-encased units generally have the type number stamped on the body.

When the unit has no identification markings, the application usually provides a clue for selecting a suitable replacement. Among the characteristics which must be considered are peak inverse voltage, forward- and reverse-current ratings, physical size, mounting facilities, and operating frequency. For your convenience in selecting suitable replacements, we have prepared the substitution guide shown in Table I. This cross-index of types covers practically every diode used in home entertainment equipment. Note that three types (1N34A, 1N60, and 1N295) take care of virtually all needs—except in UHF areas, where a 1N82A should also be stocked.

When a crystal diode is replaced, polarity must be observed. In many cases, a diode symbol (arrow for anode and bar for cathode) is stamped on the body of the component to designate the correct polarity. A single band, a ring of plus signs, or the abbreviations "K" or "CATH" are also used to identify the cathode end of various units. Polarity of glass-encased diodes is usually indicated by placing the three color bands nearest the cathode terminal.

When a replacement diode is installed in a circuit, the lead dress

Table II—AFC Dual Diodes

ORIGINAL CIRCUIT CONFIGURATIONS	REPLACEMENTS G-E	IR	IRC	ITT
	6GC1	DD04	D4	K-1615
	6GD1	DD05	D5	K-1616
	6GX1	DD06	D6	K-1617

should faithfully follow that of the original component, and a heat sink should be used during soldering.

Dual Diodes

Dual selenium diodes have almost completely taken over the horizontal AFC function in today's TV receivers. These molded three-lead components have two separate diode sections, with the center lead representing a common connection between the two. Internally, the diodes are connected either plate-to-plate, cathode-to-plate, or cathode-to-cathode. Many of these components are not labeled or coded as to polarity; therefore, you should always refer to a schematic to determine which circuit configuration is being used. Table II shows the standard replacements available for these units.

Replacing these dual components with individual crystal diodes (usually a matched pair of 1N67's or 1N64's) is sometimes feasible, but this substitution won't always work. The peak-inverse or forward-resistance characteristics may not be close enough for long-lasting or reliable operation. Also, a difference in the physical location of the diodes or a slight space separation between the two replacements can cause one to heat more than the other. This sometimes results in unbalanced conduction and poor circuit operation.

Before installing a dual-diode replacement, double-check its polarity. Also, if the original is mounted on a printed board, merely clip its leads close to the component body and solder the replacement to the remaining lead ends.

Power Rectifiers

Semiconductor rectifiers used in home entertainment equipment fall into three general categories—selenium, silicon, and germanium. In the selenium line are a wide variety of shapes and sizes with decidedly different electrical capabilities. Silicon and germanium units, on the other hand, are all of nearly the same physical size, and have few major electrical variations. Although the germanium power rectifiers in use today appear to be much larger than silicon types, the increase in size is due to the addition of a heat-sink

• *Please turn to page 61*

Table III—Replacements for Power Rectifiers

TYPICAL APPLICATION	ORIGINAL TYPE (130V RMS INPUT)	MAXIMUM DC CURRENT REQUIREMENT	GENERAL ELECTRIC	INTERNATIONAL RECTIFIER	ITT	MALLORY	MOTOROLA	RCA	RADIO RECEPTOR	RAYTHEON	SARKES TARZIAN	SEMITRONICS	SYLVANIA	TEXAS INSTRUMENTS	VIDAIRE	WESTINGHOUSE	WORKMAN TV
BIAS SUPPLY POWER OSC B+ RECT	SELENIUM	20 MA	1N540*	TO65/75	1234A-H	1N2094*	1N540*	1N1763*	RR65	1N1763*	50-75	RS-151	1N2070*	1N2070*	SR-74*	1N1169*	S500B*
B+ RECT BIAS SUPPLY	SILICON	25 MA	1N540	SD-500	RE 500	1N2094	1N540	1N1763	PT5	1N1763	2F4	SR 405	1N2070	1N2070	SR-74	1N1169	S500B
BIAS SUPPLY B+ RECT	SELENIUM	100 MA	1N540*	TD 75/150	1235A-H	1N2094*	1N540*	1N1763*	RR150	1N1763*	100-150	RS-152	1N2070*	1N2070*	SR-74*	1N1169*	S500B*
B+ RECT	SILICON	100 MA	1N540	SD-500	RE 500	1N2094	1N540	1N1763	PT5	1N1763	2F4	SR 405	1N2070	1N2070	SR-74	1N1169	S500B
B+ RECT (VIBRATOR SUPPLY)	SELENIUM (MINIATURE)	100 MA	1N540*	SD-500*	RE 500*	1N2094*	1N540*	1N1763*	PT5*	1N1763*	2F4*	SR 405*	1N2070*	1N2070*	SR-74*	1N1169*	S500B*
B+ RECT	SELENIUM	200 MA	1N540*	T200/300	1237A-H	1N2094*	1N540*	1N1763*	RR200	1N1763*	200-250	RS-153	1N2070*	1N2070*	SR-74*	1N1169*	S500B*
B+ RECT	SILICON	200 MA	1N540	SD-500	RE 500	1N2094	1N540	1N1763	PT5	1N1763	F-4	SR 405	1N2070	1N2070	SR-74	1N1169	S500B
B+ RECT	GERMANIUM	250 MA	1N1005	SD-500	RE 500	1N2094	1N540	1N1763	PT5	1N1763	F-4	SR 405	1N2070	1N2070	SR-74	1N1169	S500B
B+ RECT (DOUBLER ONLY)	GERMANIUM (DUAL UNIT)	250 MA	1N1016 ‡	SD-500+	RE 500+	1N2094+	1N540+	1N1763+	PT5+	1N1763+	F-4+	SR 405+	1N2070+	1N2070+	V1016 ‡	1N1169+	S500B+
B+ RECT	SELENIUM	300 MA	1N540*	T350/400	1237A-H	1N2094*	1N540*	1N1763*	RR350	1N1763*	300-500	RS-154	1N2070*	1N2070*	SR-74*	1N1169*	S500B*
B+ RECT	SILICON	300 MA	1N540	SD-500	RE 500	1N2094	1N540	1N1763	PT5	1N1763	F-4	SR 405	1N2070	1N2070	SR-74	1N1169	S500B
B+ RECT	GERMANIUM	350 MA	1N1007	SD-500	RE 500	1N2094	1N540	1N1763	PT5	1N1763	F-4	SR 405	1N2070	1N2070	V584	1N1169	S500B
B+ RECT DC FILAMENT SUPPLY	SELENIUM	500 MA	1N540*	T550/650	1237A-H	1N2094*	1N540*	1N1763*	RR500	1N1763*	300-500	RS-154	1N2070*	1N2070*	SR 74*	1N1169*	S500B*
B+ RECT	SILICON	500 MA	1N540	SD-500	RE 500	1N2094	1N540	1N1763	PT5	1N1763	F-4	SR 405	1N2070	1N2070	SR-74	1N1169	S500B
B+ RECT	SELENIUM (COLOR TV)	500 MA	1N547*	TV502*	6H600A	1N2094*	1N547*	1N1764*	RR659	1N1764*	F-6*	SR 605*	1N2071*	1N2071*			S750*
BIAS AND DC FILAMENT SUPPLY	SELENIUM	700 MA (TOTAL BRIDGE CKT.)	1N540*	T550/650	1237A-H	1N2094*	1N540*	1N1763*	RR500	1N1763*	300-500	RS-154	1N2070*	1N2070*	SR-74*	1N1169*	S500B*
DC FILAMENT SUPPLY B+ RECT	SILICON	700 MA (TOTAL BRIDGE CKT.)	1N540	SD-500	RE 500	1N2094	1N540	1N1763	PT5	1N1763	F-4	SR 405	1N2070	1N2070	SR-74	1N1169	S500B

+ TWO REQUIRED ‡ DUAL UNIT FOR VOLTAGE-DOUBLER CIRCUITS ONLY * SILICON SUBSTITUTE--ADD SERIES LIMITING RESISTOR

QUICKER SERVICING
by Les Deane

SHADOWING A SHADOW!

What could cause the strange sight in Fig. 1 ? Most servicemen have had little or no experience with this rather rare symptom, and you might guess at anything from a freakish horizontal-sweep trouble to external RF interference. If you act on your initial hunch and immediately begin checking circuits, you have a good chance of ending up with a "tough dog." As with any problem, this calls for some preliminary brain work before you even touch the inside of the set. You need to determine exactly what is wrong with the picture (you may have to fiddle with several control knobs before you're sure).

Let's apply this technique to the specific problem illustrated by Fig. 1. First try to get some evidence to prove or disprove your original impression of the trouble. For instance, suppose you have an idea it is being caused by RF interference entering the tuner. If so, switching to different channels or adjusting the fine-tuning control should have some effect on the symptom. In this case, it doesn't; so try something else.

Before dropping the idea of interference in the picture circuits, give the contrast control a twist. The shadow should change in intensity if the signal which causes it is mixed with the input to the video amplifier. This time, you evidently have some other trouble, because the bar remains as black as ever—although the rest of the picture "washes out"

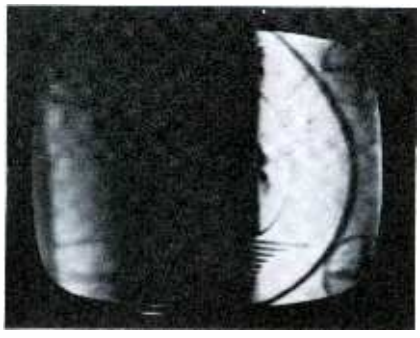


Fig. 1. Shadow blots out large part of raster, even at maximum brightness.

as you reduce the contrast setting. When you check the brightness control, you'll notice that it is turned all the way up. At lower brightness levels, the shadow becomes larger and engulfs almost two-thirds of the screen. This may have some significance, but it doesn't furnish concrete proof of a video-circuit defect.

What if it were sync trouble? The shadow does look something like the horizontal blanking bar which comes into view when the horizontal AFC has a phasing error. However, even without touching the set, you have two pieces of evidence to tell you this isn't an AFC problem. First, a blanking bar should be sharply defined, but this shadow is fuzzy—and the visible picture information is reasonably sharp. Second, the edges of the picture haven't been pulled out into the middle of the raster, as they would be if you had horizontal phasing trouble. When you look closely, you can see that the shadow appears to be superimposed on a normal picture. In fact, you can turn the horizontal hold control and watch the shadow remain almost stationary while the picture falls out of sync.

By this time, you may be entertaining the idea that you're faced with some odd sweep defect. If you try to reason this out, however, it will place quite a strain on your imagination. What could cause the CRT beam to begin a normal trace at the left side of the screen, suddenly skip across an area several inches wide, and then resume normal sweep? Conjure up the yoke-current waveform which would be required to execute this feat—and then try to imagine how such a waveform could be produced without visible evidence of foldover or even worse side effects. If you also take the video information into account, you can see that the symptom in Fig. 1 couldn't possibly be due to sweep trouble. A split raster, even if it could be produced, would still contain *all* the picture elements (although these would admittedly be distorted).

The thought of "blanking" should turn your attention back to the grid and cathode circuits of the picture tube. If heater-cathode leakage in this tube can produce a *horizontal* "hum bar" which is only slightly affected by the brightness-control setting, why couldn't some other trouble in the CRT circuits produce a *vertical* bar?

In the specific circuit in question (Fig. 2), a scope check of the CRT grid shows a normal video signal. The cathode waveform, viewed at a 30-cps sweep rate, contains not only the expected 60-cps vertical retrace-blanking pulses, but also much "grass" (Fig. 3A). Switching to 7875 cps to see the details of this "grass," you find the roller-coaster waveform shown in Fig. 3B. Its amplitude is close to 100 volts, with a high positive peak occurring for a short time in each cycle. The basic frequency is 15,750 cps; thus, a rounded positive pulse is being fed to the cathode of the CRT at the same point in each horizontal sweep cycle. This pulse blanks out a portion of every horizontal trace line, resulting in a fuzzy vertical bar.

Now that the interfering signal has been located, the next problem is to find out where it is originating.

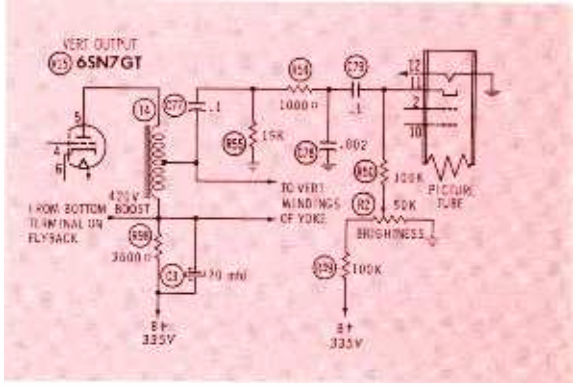


Fig. 2. Interfering signal can reach the CRT through retrace-blanking circuit.

It's taking the country by storm

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With thundering applause... here's what they say...

- *"It is the best tube tester I have ever owned."* F.M., MONROE, LA., TV TECHNICIAN
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- *"Mighty Mite has paid for itself the first month."* W.C., UNIONTOWN, PA., TV REPAIR
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MAGAZINE TEST LABS SAY . . .

PF Reporter, Nov., 1960, page 65 . . . "When putting the Model TC109 to work in the lab, I tried to 'trip up' the tester by throwing a few curves at it. Using my prized collection of rejected tubes that have mostly 'tough dog' defects, I proceeded with the tests given in the Sencore instructions." The results: The Mighty Mite found every trouble, even the toughest.

Les Deane

Electronics World, Jan., 1961, page 103 . . . "We checked two dozen tubes known to be defective. Many had been passed as 'good' by other testers. Each failed at least one of the three tests provided by the TC109. On the other hand, every new tube previously known to be in good condition checked good on the Mighty Mite."

Sencore Sam says

In a nut shell... here's why the Mighty Mite finds them all. It checks tube grid circuits with the same high sensitivity as the indispensable Sencore LC3 Leakage Checker; yet it checks emission, leakage and shorts just like the big, expensive testers. That's why we call it the Mighty Mite . . . you can't miss!

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Model TC114.....Dealer Net **67.50**

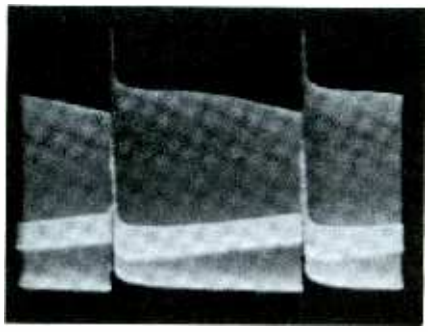
Its frequency indicates that it is coming from the horizontal section —but how? Since it is mixed with the vertical-blanking signal, the most logical move is to trace the latter to its source. Scoping on back to the center tap of the vertical output transformer, you find the shadow signal still present, with even greater amplitude. Take a close look at the schematic to see where you go from here.

You don't have far to look. The vertical output tube obtains its plate voltage from the boost source; in fact, the bottom of the vertical output transformer is tied directly to the lower end of the horizontal output transformer! Notice that a lone 20-mfd electrolytic capacitor (C3) is used to decouple the horizontal and vertical stages, besides acting as a boost capacitor. This unit has obviously lost much of its capacitance, since it is allowing a high-amplitude ripple waveform to appear on the boost line. Install the new capacitor, turn the set on, and your symptom is gone—that's all there is to it.

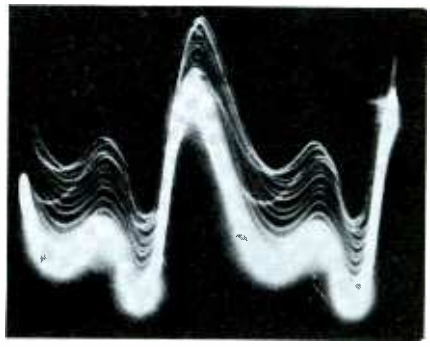
Related Troubles

Whenever a mysterious vertical bar appears on a TV screen, or when one side of the raster looks lighter than the other, be sure to check the schematic for possible coupling paths between the horizontal and CRT circuits. Some models, like the one just discussed, contain unusual hook-ups which give them a tendency to develop shadows.

To give another example, some of the old Philco split-chassis receivers have series-connected brightness and width controls to minimize the change in raster size at different brightness levels. The version of this circuit used in Chassis 91 (RF) and J-1 (sweep) is shown in Fig. 4. Normally, not much signal voltage is developed in the width-control circuit because of the bypassing action of a .047-mfd capacitor connected to the bottom of the control. If this capacitor opens, a fairly substantial signal with roughly a sawtooth waveshape develops in the width-control circuit. This reduces width, and at the same time results in a gradual variation in background brightness across the screen. The latter is produced because some of the sawtooth signal reaches the



(A) Sweep rate 30 cps.



(B) Sweep rate 7875 cps.

Fig. 3. Picture-tube cathode signal.

cathode of the picture tube through the brightness control. The amount of shading depends on both the brightness and width settings, as well as on the condition of other components in the CRT cathode circuit.

Many receivers have no interconnecting circuits through which a shadow-producing signal could logically be fed from the horizontal section to the CRT or video circuits. However, there is still the possibility that horizontal-sweep energy can be radiated and picked up by sensitive RF-IF amplifiers. In one extreme case recently observed, the entire left half of the picture was blacked out. This trouble was finally cured by replacing the 1B3 high-voltage rectifier. To solve problems which involve radiation from sweep circuits, follow two basic ground rules: Take nothing for granted, and make sure all shields are in place!

Regardless of whether the interference is due to radiation or to coupling through circuits, you can often obtain valuable clues by finding out where the horizontal sweep signal is entering the video section. To do this, use a scope with a low-capacitance probe to check the CRT grid and cathode signals. When you pick up the trail of the interference, signal-trace back through the circuits to find out where it is coming from. (When you have this type of trouble, you can often get meaning-

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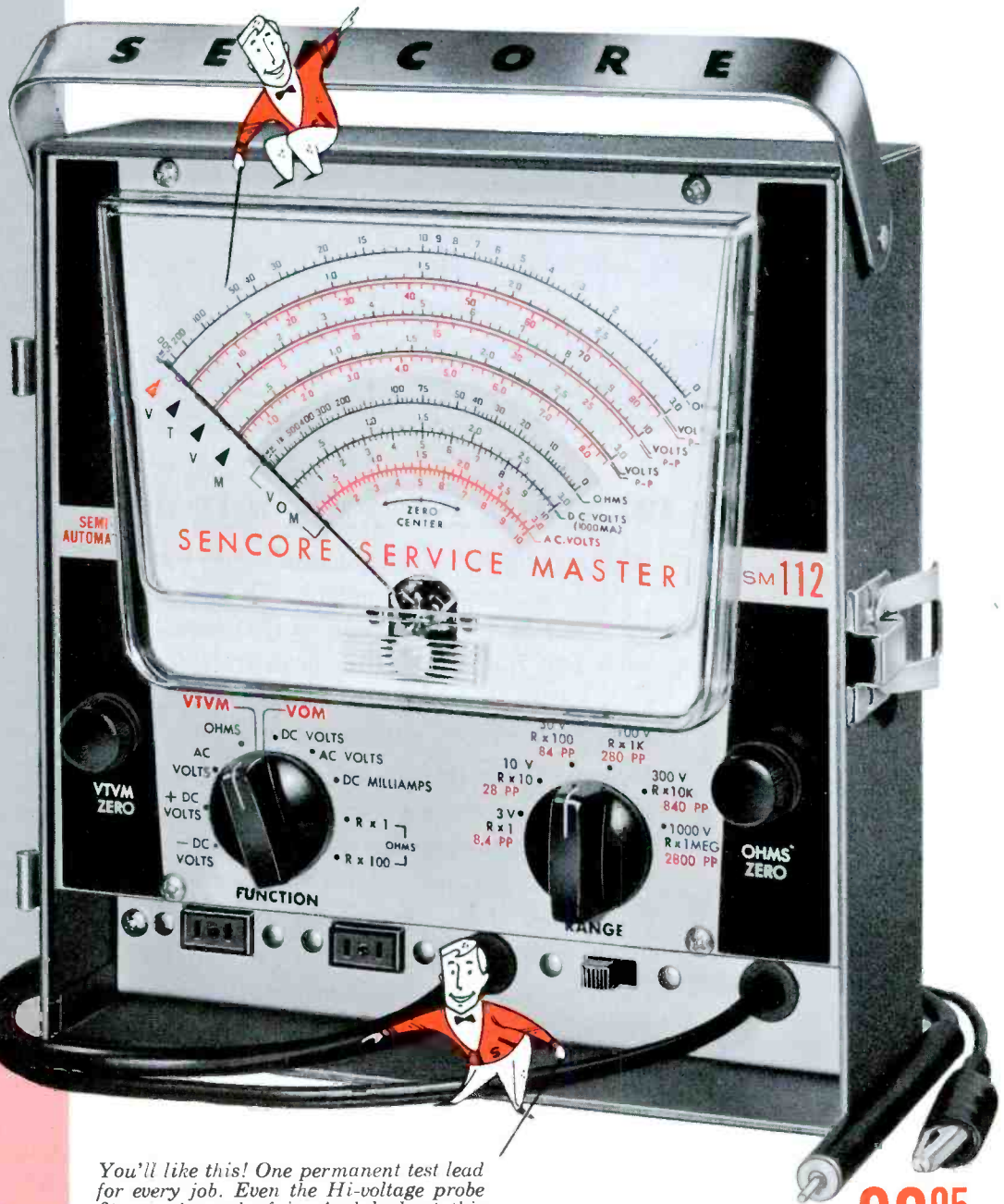

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Typical examples where a VTVM performs best . . .

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Typical examples where a portable VOM is best . . .

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6 AC and DC ranges from 0 to 1000 volts on both VTVM and VOM
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Zero center scale on VTVM

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6 ranges from 0 to 1000 megohm on VTVM
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one easy reading scale from 0 to 1000 milliamp on VOM

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3 percent on DC volts; 5 percent AC volts with a 6 inch, 200 microamp, 2 per cent meter.

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10 megohms on VTVM, 15,000 ohms on VOM low range, 5 megohms on highest range.

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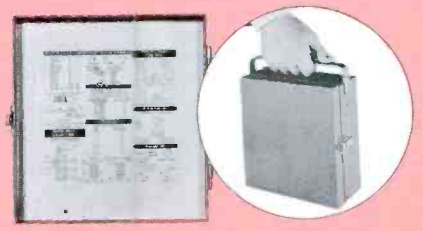

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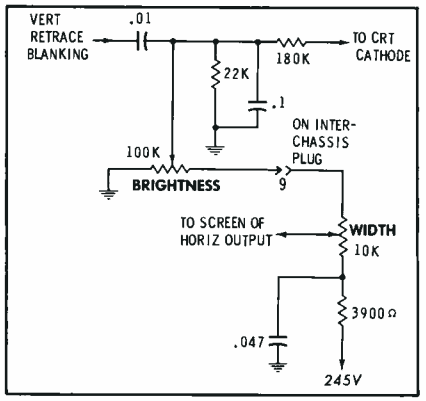


Fig. 4. Possible source of raster shading in the Philco Chassis 91 and J-1.

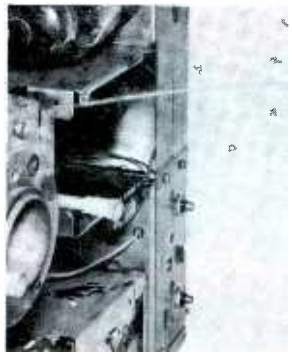
ful scope patterns even in the RF-IF section without using a demodulator probe.) This procedure will usually lead you to find a coupling circuit you didn't notice on the schematic, an error in lead dress, or a sweep-component defect causing excessive radiation.

Aerosol Squirt

Service chemicals in aerosol spray cans normally come out of the nozzle as a fine mist. However, I got a surprise the first time I tried *NO ARC Hi-Voltage Insulator,* made by Chemtronics, Inc., of Brooklyn, N. Y. This liquid gushes forth in a concentrated jet to apply a heavy coat of insulation to a small and accurately-pinpointed area.

Heavier than clear acrylic spray, but lighter than corona dope, *NO ARC* dried in 20 minutes to form a thick, moistureproof coating with enough dielectric strength to prevent a 20-kv arc. This insulating chemical is easily applied to trouble spots in the high-voltage cage to "squelch" arcing and corona. Some other uses are eliminating leakage between printed-wiring conductors, and waterproofing wires exposed to weather.

For those who are "gun-shy" about aerosol sprays, the same product is available in a 2-oz bottle with applicator brush. ▲



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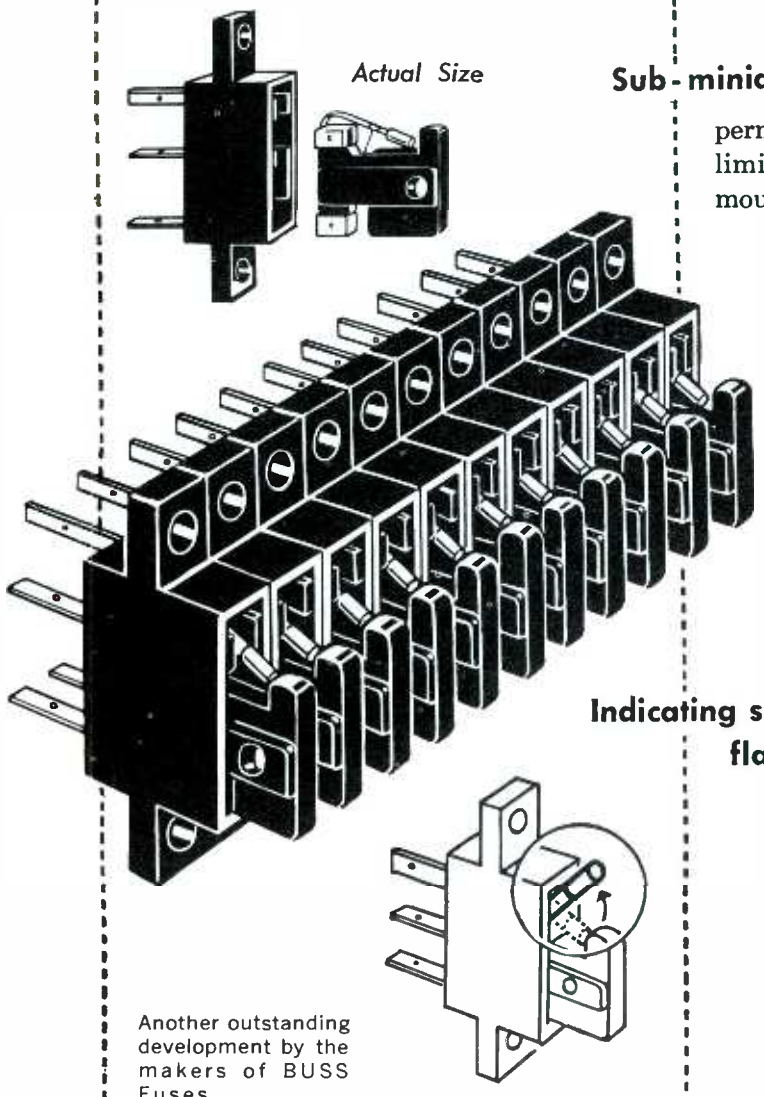
GMT Fuse & HLT Fuseholder



Sub-miniature design

permits multiple mounting of fuses in limited space. Fuseholders can be mounted on ¼ inch horizontal centers.

Fuse and holder combination readily adaptable for use in equipment operating at 300 volts or less, such as: communication equipment, business machines, computors, control equipment or other multiple circuit apparatus where space is at a premium.

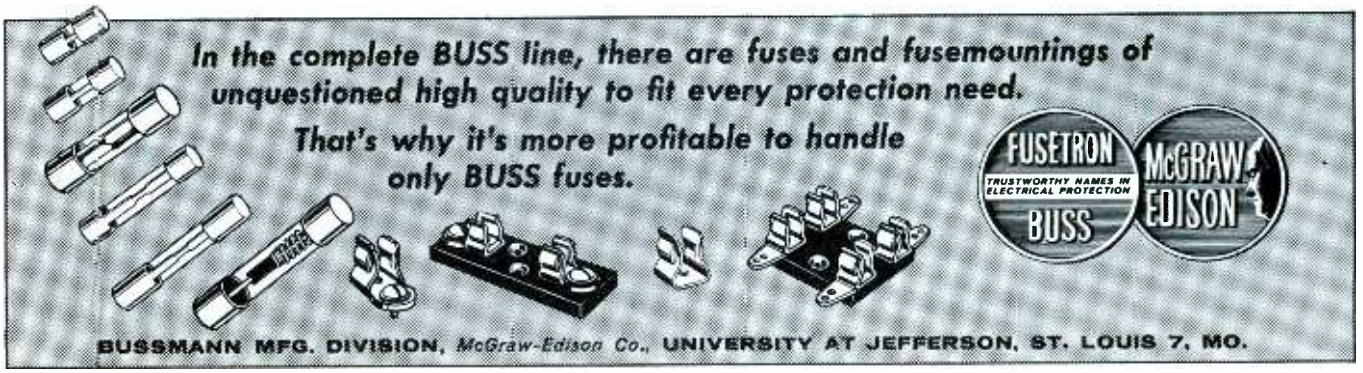
Indicating spring flashes color-coded flag when fuse opens

to give quick, positive identification of faulty circuit.

Indicator spring also makes contact with an alarm circuit so, it can be used to flash a light—or sound audible signal on fuse panel or at a remote location.

Ask for bulletin GMCS on BUSS GMT fuses and HLT holders.

Another outstanding development by the makers of BUSS Fuses.



DOLLAR & SENSE *Servicing*

by Joe A. Groves

HOME-CALL SALES TECHNIQUES

Every time you enter a customer's home, you're walking into a salesman's paradise. First of all, you're in the best spot for him to visualize his need for many products—and you're there at his invitation. As a service technician, you have his confidence, as well as the technical ability to advise him about electronic equipment and accessories. In fact, you're asked to give your professional opinion of at least one product almost every day.

Unfortunately, many servicemen fail to appreciate the sales opportunities that exist on every service call. Many feel they are technicians—not salesmen. Yet a good serviceman is, in a sense, a salesman of the highest caliber. He convinces customers he is qualified to service their equipment. And, considering the opportunities open to a service technician, it's only a short step from selling service to selling equipment.

How It's Done

Being a serviceman is your biggest asset. If you attempt to act like a salesman, customer resistance goes up. The way to lead up to a sale is to start the conversation going in the right direction without letting the customer know you have selling on your mind. Many customers will start the ball rolling by asking you what kind of a radio, TV, hi-fi, etc., you'd recommend. However, you'll miss many golden opportunities if you're not prepared to take the initiative yourself.

You can best serve your customers by providing them with what they need when they need it, instead of trying to "sell iceboxes to Eskimos." Use common sense, apply your knowledge of human nature, and take note of the surroundings; this will provide some clue to what the customer might be interested in buying.

Timing is another important consideration. In fact, it's as important to you as it is to a trapeze artist. The moment you walk in the door is no time to start a sales pitch—no matter how subtle the approach. Remember, you're there to service a set. Once you have it operating, you can begin a conversation to find out what frame of mind the customer is in while making out the repair bill. If you've obviously won his confidence, you are more apt to be successful in steering the conversation toward sales. On the other hand, if he shows any evidence of not being completely satisfied with the service job, it'll take all the salesmanship you can muster to settle this problem by itself.

Down to Cases

What's the best way to bring up the subject of sales? This depends a lot on your personality, how well you know your customer, and what obvious needs you may have noticed. Generally, asking your customer if he would like you to check his phonograph needle, or asking him if he needs any batteries for his portable radio, is a good way to start off. You'd be surprised how the law of averages pays off in sales. Also, asking about such items starts you on the road toward bigger items. Customers don't think any more about your asking such questions than they do about the service station attendant asking if they'd like their oil checked. They merely take it for granted you're there to serve them.

Sometimes it's better to approach a sale "through the back door"—especially if your suggestion is going to make your customer stop and think about whether or not he's interested. For example, the sight of a tape recorder in the room isn't an automatic cue to ask your customer if he'd like to buy some tape. Rather, take note of the recorder and ask him how he likes that brand. Talk about the uses he finds for it—recording and listening to music. What kind of tape does he use? Now you're on the subject, and you've made it seem as though you're interested from a purely technical point of view. Then you can tell him what tape and accessories you stock for his convenience. If he's interested in anything, you're "Johnny-on-the-spot" to provide him with what he wants.

To see how you can tailor the conversation to achieve the aim you have in mind, concentrate on how you ask questions. By carefully wording your end of the conversation, you can generally keep it going in the right direction.

To show you how this works, suppose you're in an average home, and you're just making out the bill for TV service to present to the lady of the house. While servicing the set, you've noticed the picture of a teenage boy. On the other side of the room is a radio-phono that appears to be about the same age as the teen-ager. These conditions set the stage for offering your customer a hi-fi or stereo unit. Use the picture to lead into your conversation: "Is that a picture of your son, Mrs. Jones?"

In case her reply is "No; that's . . . ," you can quietly drop the subject and try another approach—still with the idea of encouraging the housewife to think about enjoying good music from FM or hi-fi as she goes about her daily housework. Remember, though, always move toward the climax in a casual, conversational manner. The "switch" for the above illustration might go something like this:

"I saw your radio-phonograph over there and wondered if the boy had played enough records to wear out the needle. Do you play it much?"

"Not a lot. We mostly watch TV."

"What do you listen to during the daytime?"

"Oh, the radio sometimes, but I get tired of listening to it and turn it off."

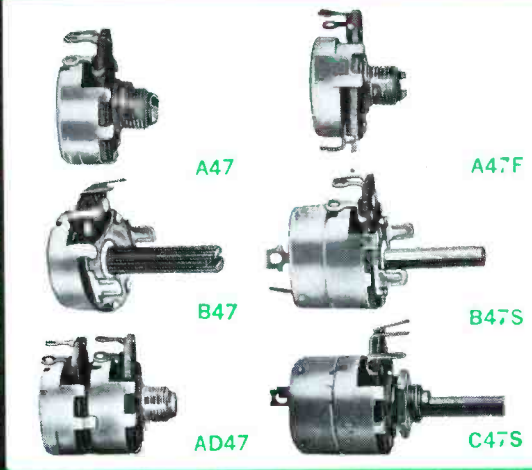
"Have you ever heard FM? Several of my customers play it all day long."

"Yes, Jane has FM, and it would be an improvement!"

BEST

For Radio/TV Servicing

SERIES A47, B47S, C47S CARBON CONTROLS



The ABC's of Servicing! Series 47 carbon controls are ½ watt units available in all popular values and tapers for volume control, tone control, and other radio and television functions.

Ad-A-Switch feature available on all types except B47 and C47S. Pick-A-Shaft advantage available on all except B47-B47S.

- **A47** ½ watt control.
- **A47F** ½ watt control with taps.
- **B47** ½ watt control, tab mounting, phenolic shaft for "hot" chassis.
- **B47S** ½ watt control, tab mounting, with SPST switch, metal shaft. Not for "hot" chassis.
- **AD47** ½ watt dual controls.
- **C47S** ½ watt control with push-pull switch.

SERIES A43 WIRE-WOUND CONTROLS

Resistance values up to 50K, 2-watt wire-wound controls meeting servicing requirements of radio and television with all popular values. Available with or without power switch. Your choice of shaft with Pick-A-Shaft feature. Clarostat also offers 3-watt Series 58 and 4-watt Series 10 wire-wound controls for heavier power requirements.

- **A43** 2-watt control.
- **A43S** 2-watt control with switch.

YOUR CHOICE OF SHAFT

Pick your control, then select the appropriate shaft from 13 different types!

Clarostat Pick-A-Shaft shafts snap into place for a permanent, dependable assembly. Your Clarostat distributor stocks all types. You get one FREE with every Clarostat Pick-A-Shaft control.

WRITE FOR CATALOG . . .

This is the most complete control/resistor catalog for the service trade. Also incorporates industrial products for commercial equipment servicing. Send for your local free copy today, or ask your local CLAROSTAT distributor.

CLAROSTAT

CLAROSTAT MFG. CO., INC.

DOVER, NEW HAMPSHIRE

"Have you seen the new FM and stereo combinations we have in our showroom?"

"No. But it would be nice to have one."

"Have you ever thought of trading in your radio? It would make the down payment and . . . "

In both of the above cases you've offered your customer something of interest, and the conversation has been as natural as could be.

To illustrate how you might offer a different type of equipment, let's assume you've noticed an outdoor antenna in need of repair as you enter a home. This gives you a clue about *what* the customer might buy, even before you enter the house. After you've got the set working, but before you total the bill, try a sales approach like this:

"Well, that has the set fixed, but I think we can get you a better picture. See that little bit of (snow, ghost, or movement in the background)?"

"Yes, it's been there for some time."

"It's probably being caused by your antenna. When I came in, I noticed that some of the rods were missing." Let him tell you about when they broke off, then follow with: "We've had exceptionally good results with such-and-such antenna in this neighborhood." If the customer shows interest, go on to say, "I can replace your antenna and lead-in for only X dollars. Anytime you'd like to have that picture cleared up, just give me a call and I'll be glad to schedule the job." Chances are you'll get the order then and there.

One Thing More

Before leaving the subject of home-call sales techniques, we should consider one of the most-often-overlooked services you can render your customers. Most of the homes you enter have a radio, a small appliance, or something else that needs service besides the TV you've been called to repair. Therefore, if you offer to take in additional units for service, you'll find your business booming.

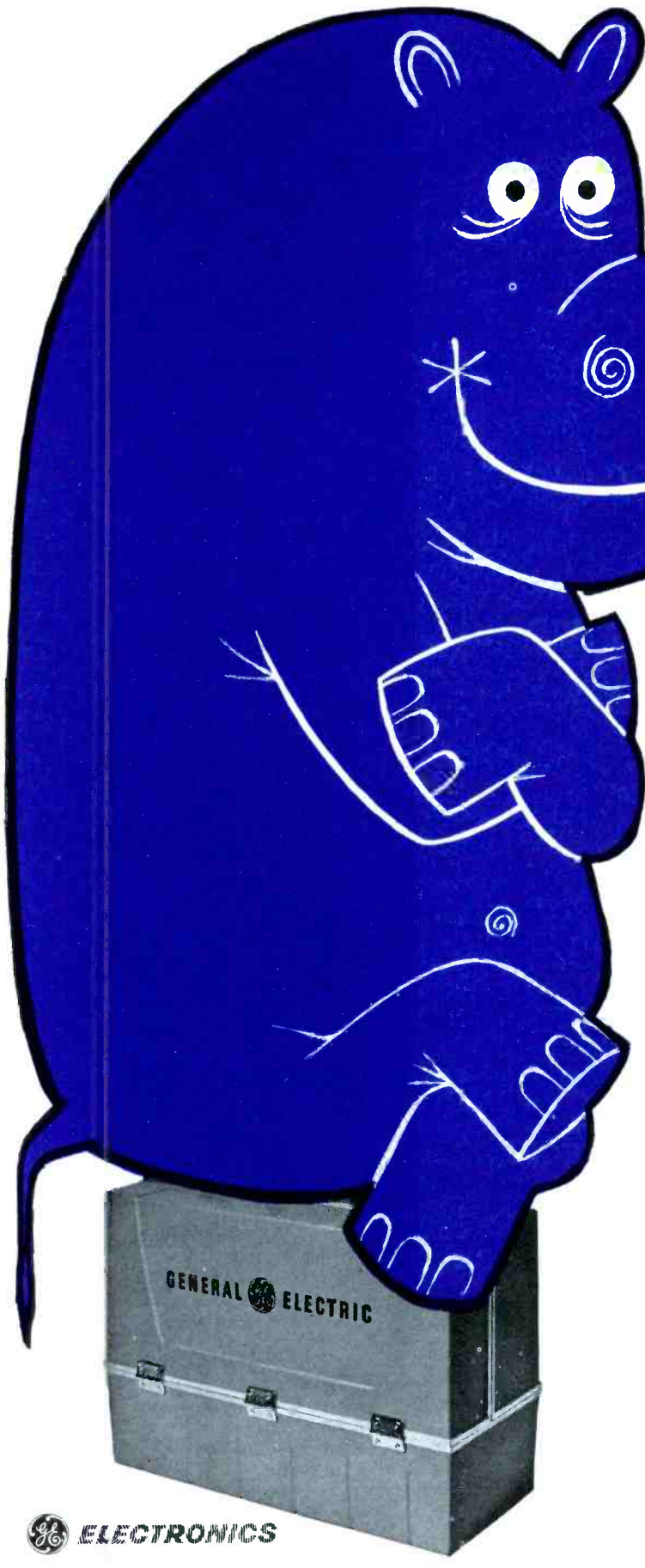
Getting additional work is almost a lead-pipe cinch if you go about it the right way. It isn't hard. In fact, when it comes to service you can use a very direct approach such as, "Well, that fixes your TV as good as new. How about your radios—would you like for me to take any of them in for service?" If you get a "No" reply to this question, say, "Good. Glad to know everything is working OK." If the situation seems to warrant it, you can pursue the subject further by inquiring about your customer's car radio. Chances are he *did* forget about his auto set when he replied earlier, and there is at least a fair prospect that it needs to be serviced.

By now it should be obvious that you should continually strive to watch for *every* opportunity to be of service to your customer by repairing, installing, or making available additional items. Remember, even if you don't make an immediate sale or take along extra service work, you do get in some of your best advertising—and it doesn't cost a cent.

Speaking of advertising, literature supplied by manufacturers and carrying your imprint will help you sell new items. You can present it along with the customer's copy of the bill and let it sell for you after you leave. Simply say, "I left a folder showing ..... with your bill. Just thought you might like to see what the new ..... are like. Call me if you have any more trouble."

You see, the whole key to successful sales is in *asking* your customers if you can serve them better. They will take it from there. ▲

NEW FROM G.E. ... A TOUGH PLASTIC SERVICE CASE THAT CAN REALLY TAKE IT!

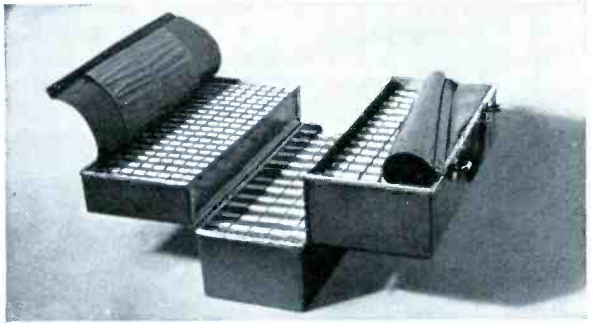


The first real innovation in service cases makes this the most durable case you can own. *It's built like fine luggage* —from tough Royalite* plastic, with aluminum binding, and luggage-type fasteners. Rugged! Bump it, bang it, drop it—this case can take it. Resists scarring or splintering. It's waterproof, won't stain, even resists acids, wipes clean.

Large Capacity—Here's plenty of space to carry a practical tube replacement inventory and tools (22¼" long, 8¾" wide, 15" high). Two top sections with egg-crate separators hold 152 miniature and 90 GT-type tubes. Snap-down curtains have extra pockets for job tickets, characteristics booklet and service tools. Carry 65 large glass tubes or volt-ohm-milliammeter and other tools in the big base section.

Lightweight—It weighs just 8 lbs.—4 lbs. less than most cases of comparable capacity.

Get this newest G-E Service Aid from your General Electric tube distributor, or mail coupon to Chicago warehouse address given. Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky. *T.M., U.S. Rubber Co.



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Please ship prepaid:

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My check or money order is enclosed for the required amount plus any sales or use tax applicable in my area.

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NOTES ON TEST EQUIPMENT

by Les Deane

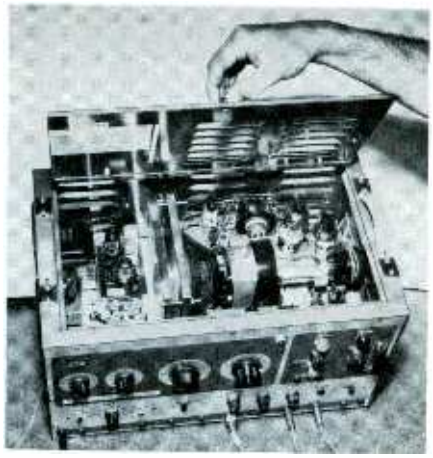


Fig. 2. B & K 1076 has many familiar TV circuits plus entire scanner system.

Do-All Generator

The instrument pictured in Fig. 1, a flying-spot scanner combined with a multiple-signal generator, is produced by B & K Mfg. Co. of Chicago.

Identified as the Model 1076 *Television Analyst*, the unit is designed to help the serviceman isolate TV troubles by signal substitution. In addition to producing signals that can be used to form a complete picture on a TV screen, the *Analyst* supplies test signals for RF, IF, video, sound, sync, and sweep sections of both monochrome and color receivers. The instrument is supplied with test leads, transparent slides, RF cable, high-voltage indicator, manual, and a book describing the techniques of using the *Analyst*.

Specifications are:

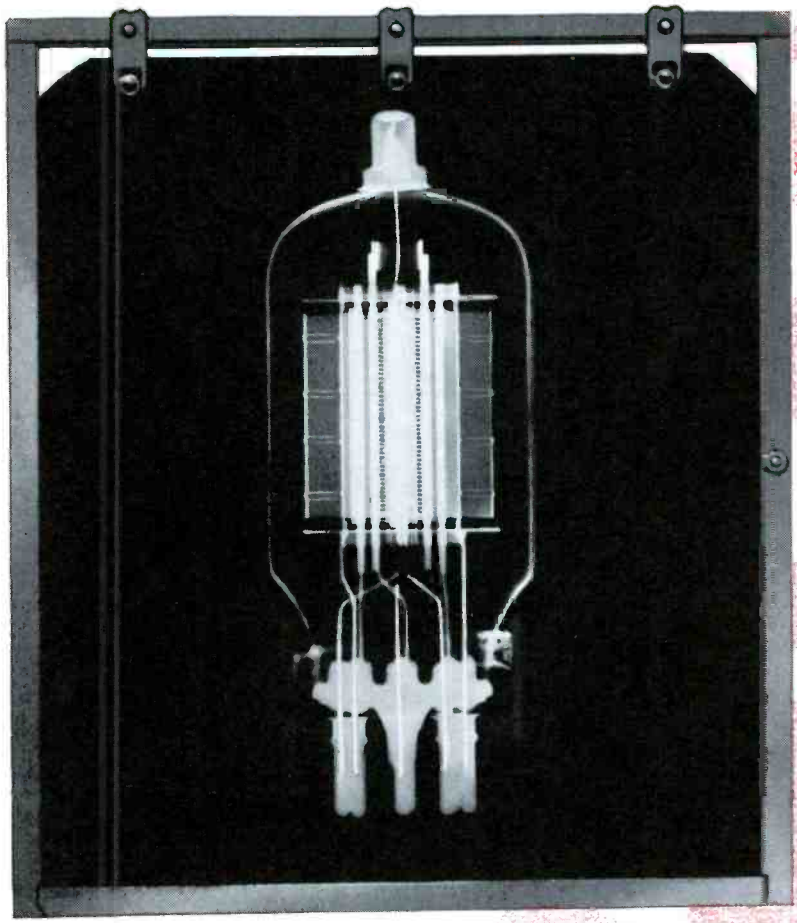
1. *Power Requirements — 110/120 volts, 60 cps AC; power consumption in standby approximately 75 watts; line fuse,* OFF-STBY-ON *switch, and indicator lamp provided.*
2. *RF Output — Composite video-, sync-, and sound-modulated carriers for VHF channels 2 through 6 and 7, 8, 12, and 13; switch-type tuner, horizontal frequency adjustment, output attenuator and video-modulation control provided.*
3. *IF Output — Video-, sync-, and sound-modulated carriers; continuous tuning from approximately 20 to 45 mc provided on front panel; RF-IF cable supplied.*
4. *Video Output — Composite video signal of either polarity (Warning—do not connect signal to a point with voltage over 350 volts); output control provided on panel.*
5. *Sync Output—Composite horizontal and vertical sync of either polarity; calibrated sync-amplitude control provided on panel.*
6. *Sound Output—4.5-mc carrier can be frequency-modulated by either internal 400-cycle tone or external source; modulation jack and input control provided; separate 400-cycle audio tone available on front panel.*
7. *Pulse Output — High-level 15,750-cps pulse available from separate jack for substitution of AGC keying pulse.*
8. *Color Output — Crystal-controlled offset-subcarrier modulation of RF IF, or video frequencies; color rainbow signal available at separate jack; white-dot, crosshatch, and color-bar transparencies supplied.*
9. *DC Supply—Low-impedance negative bias source, variable from zero to –50 volts; calibrated dial provided on front panel.*
10. *Sweep Signals — Vertical: Variable grid-drive pulse, fixed plate and transformer drives, and yoke test signal. Horizontal: Fixed plate and grid drives plus flyback and yoke test signal. (Boost and high-voltage indicators, plus leakage-continuity test, also provided.)*
11. *Size and Weight—Case 9" x 17" x 10¼", 26 lbs. approx.*

Fig. 1. The *Analyst*—a complete TV generator to save troubleshooting time.

Looking over the *Analyst* in the lab, I found that it combines functions of both the 1075 and the 1070 (B & K instruments described in this column in June, 1958, and February, 1960, respectively). In addition, the instrument has front-panel jacks for obtaining an AGC keying pulse and a variable negative-bias voltage. Also, a switch-type tuner is employed as the RF-IF selector switch, and a higher-level video output is provided for direct modulation of a CRT.

All tubes and chassis adjustments are accessible by simply raising the hinged lid as shown in Fig. 2. The chassis makes use of three printed boards, and its circuitry incorporates 14 conventional tubes plus a photomultiplier and a 5" CRT scanner. The one-tube tuner, which serves as an RF-IF oscillator, also contains a small printed-wiring board. To give you some idea of how the 1076 generates all of the signals outlined in the specifications, a basic block diagram of the instrument is shown in Fig. 3.

The front panel of the *Analyst* contains 10 control knobs, 4 slide-type switches, and 14 output or test jacks—plus a pair of ground terminals. You'll also find a clip holding the high-voltage indicator lamp, and two other neon bulbs to indi-



HORIZONTAL DEFLECTION TUBE PROGNOSIS INDICATES STABLE EMISSION OVER LONG LIFE SPAN

Prolonged observation of Tung-Sol horizontal deflection tubes indicates a consistent behavior pattern: virtual immunity to chronic deflection tube illnesses. They exhibit a remarkable ability to withstand the high temperatures and high pulse voltages encountered in TV deflection service, which too frequently have a fatal effect on tubes of less hardy ancestry. Diagnosis shows unusual physical fortitude. The plate design, with special large area cooling fins plus high conductivity core aluminum-clad steel material, is a combination of ingredients that safeguards against "hot-spotitis".

Tung-Sol "circuit design"* approach has eliminated Barkhausen oscillations and snivets. Qualified specialists agree that continued use of Tung-Sol deflection tubes is certain to result in an epidemic of successful service work of very pleasing proportions.

PRESCRIPTION FOR PROFIT

When diagnosis of your customer's TV set reveals an ailing horizontal deflection tube, it's best to prescribe Tung-Sol. Customer satisfaction with the results is certain to be contagious. These are some of the more popular Tung-Sol horizontal deflection tubes:

**Designed by Tung-Sol to fit circuits already in use in the market.*

6/12/17/25 BQ6G TB	6/12/17 DQ6B
6/12/17/25 CU6	6/25 DN6
6/12/25 BQ6GA	6CD6GA

25CD6GB

the first name to ask for when ordering

ts **TUNG-SOL®**

DEFLECTION TUBES

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

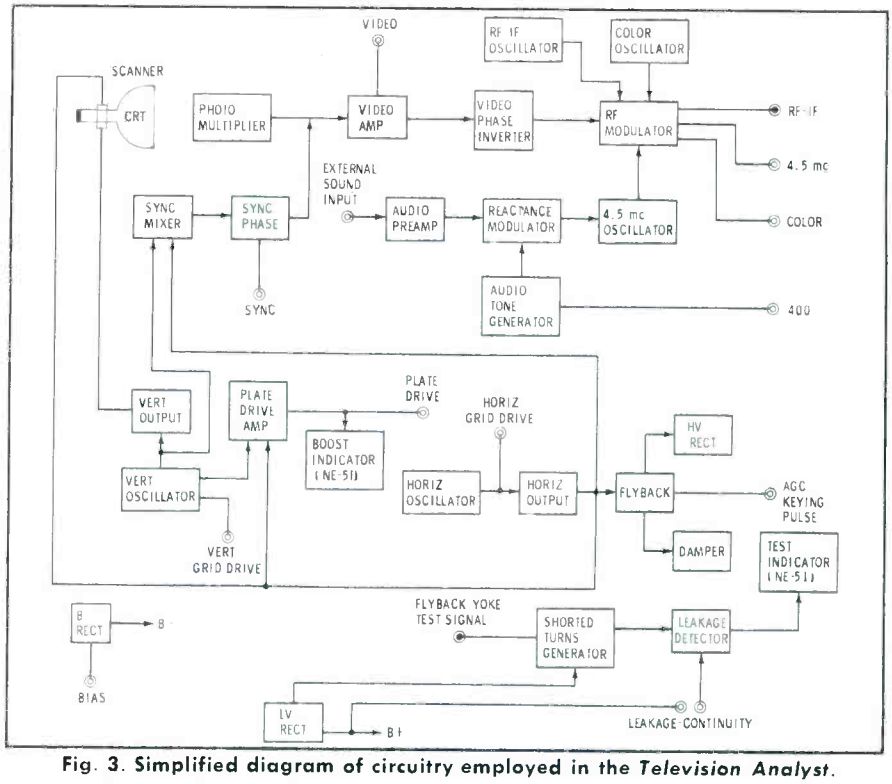


Fig. 3. Simplified diagram of circuitry employed in the *Television Analyst*.

cate B+ boost voltage and to test the flyback and yoke. An audio-input jack and level control for external sound modulation are situated on the rear of the case.

I was impressed by the ability of the 1076 to produce sweep by directly driving a flyback transformer—completely bypassing the horizontal oscillator and output stages. In addition it has a section to test yokes or flybacks for shorted turns. The circuit employs a pulse generator that develops bias for a DC amplifier. The latter, in turn, controls the firing of a neon bulb on the front panel. Since the circuit is sensitive to changes in inductance and Q, a short of only one turn will usually cause the neon indicator to glow. This same circuit can be used for leakage and continuity tests, providing a sensitivity of approximately 10 megohms.

One more-or-less obscured function of the instrument is its ability to produce a modulated sound IF signal for intercarrier receivers. This signal is available at the front-panel jack labeled 4.5 MC, and can be applied directly to grid or plate circuits to trace the sound path from the take-off point to the output of an FM detector. This feature is something I've found rather hard to come by in other test instruments. To check out the external modulation feature, I plugged a microphone into the input jack on the back of the instrument. As I spoke into the mike while advancing the input level control, I was able to hear my voice coming loud and clear from the speaker in the set. Although I was using this external-modulation feature to check the sound in this case, it can also be used on RF and IF outputs.

To sum up the capabilities of the B & K unit, it not only serves as a TV transmitter and IF-video generator for troubleshooting from antenna to picture tube or speaker, but supplies both sync and sweep signals as well. It is undoubtedly the most all-inclusive piece of signal-substitution equipment I've ever used for servicing TV.

In-Circuit Transistor Tester

In most transistorized portable radios, the transistors are soldered directly into the circuit—usually on printed wiring boards. Removal for testing is a nuisance, not only because unsoldering is inconvenient, but also because the transistors and printed boards are easily damaged by heat or force during the unsoldering operation.

To remedy this problem, Hickok Electrical Instrument Co. of Cleveland has recently developed a tester with which the serviceman can evaluate transistors without removing them from the circuit. This instrument, the Model 890, is shown in operation in Fig. 4.

Specifications are:

1. *Power Requirements—Self-contained supply includes four 1.5V Type C flashlight cells and one standard-type 22.5V battery (not furnished with instrument); selector switch on panel provides collector potentials of 0, 1.5, 3, and 4.5 volts.*
2. *In-Circuit Tests—measures leakage current in external circuit at zero Ic,* Z OHMS *(impedance of external circuit between base and emitter),* RIN *(dynamic input resistance of the transistor), and actual AC beta (gain quality of transistor); beta accuracy ±5% if external shunt impedance is above approximately 150 ohms; instrument includes a resistance-bridge circuit and source of variable-amplitude 1000-cps test signal; Ic and beta indicated directly on panel meter.*
3. *Out-of-Circuit Tests—measures all low- and medium-power transistors for* ICBO *(collector leakage current),* RIN *and AC beta; front-panel test socket and leads provided.*
4. *Meter—3" unit with 50-ua movement; Ic,* ICBO, *and beta scales; also used for null indications and beta-test calibrations.*
5. *Size and Weight—case 6½" x 9"-x 10¾" over-all; 7¾ lbs.*

Several of the front-panel controls

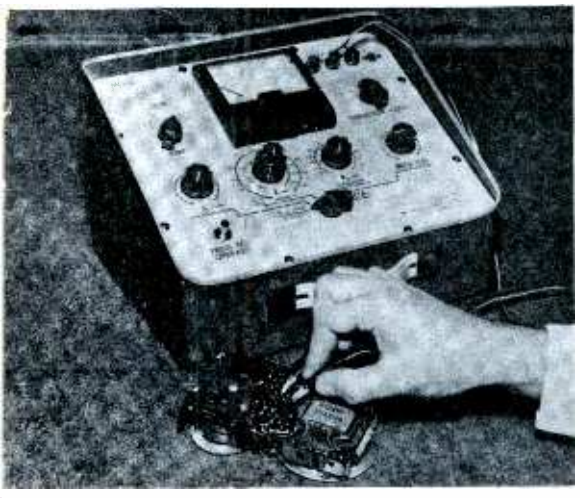


Fig. 4. The new Hickok Model 890 tests transistors either in or out of circuit.

(Fig. 5) have unfamiliar-looking calibrations, and their functions are not immediately obvious. The purpose of each control and the correct operating procedure can best be explained by a brief summary of the complete in-circuit test sequence.

To be valid, an in-circuit test must allow for the effect of the external circuitry; thus, several preliminary steps must be performed before the gain of the transistor can be checked. For example, current through any external shunt path between transistor elements must be subtracted from the indicated collector-circuit current to obtain the true collector current of the transistor. This check can be made on the 890 as follows: After setting the PNP-NPN switch and selecting the collector test potential (usually 1.5 volts), place the test selector in its Ic position; then turn the Ic control to minimum, to cut off collector current in the transistor, and push on the PRESS TO OPERATE switch. The reading on the Ic scale of the meter is a measurement of the shunt leakage current flowing through the external circuit at the established test voltage. After noting this reading, advance the control labeled Ic for a 1-ma increase. This establishes an actual collector current of 1 ma, a standard value for the gain test which is to be made. (Transistors designed to handle large signals may require a higher setting.)

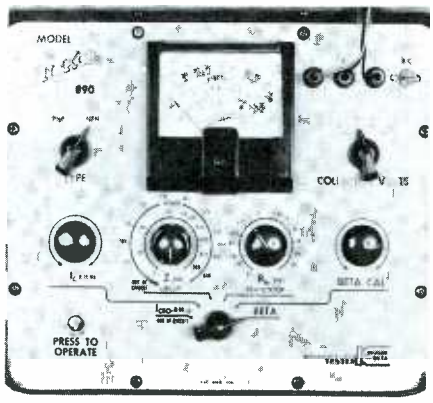


Fig. 5. Most controls are preliminary adjustments for setting up beta tests.

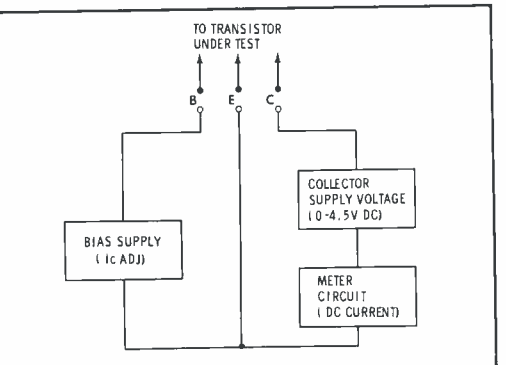
The next step is to determine the shunt impedance across the input circuit of the transistor. Move the test selector to its next clockwise position (Z OHMS CIRCUIT) and turn up the BETA CAL control until the meter needle registers one-half scale. Adjust both knobs of the concentric Z OHMS control to obtain a minimum deflection or null. Note the value indicated on the circular scale surrounding the Z OHMS control; this tells you the external shunt impedance.

To determine the input resistance of the transistor itself, advance the test selector to the position labeled RIN TRANSISTOR. While holding down the OPERATE switch, vary the RIN control to indicate a null. If the meter deflection is insufficient to show a distinct null point, advance the BETA CAL control. Read the resistance value directly from the calibrations around the RIN knob.

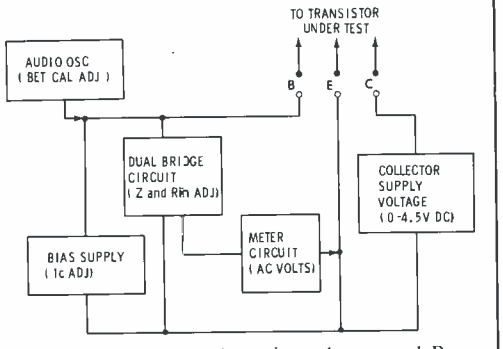
At this point you are all set to check the current gain (AC beta) of the transistor. Place the test selector in the BETA CAL position, and while depressing the OPERATE switch, adjust the BETA CAL knob for a deflection to the grid-scale calibration mark. Next, set the test selector to its BETA position and read beta directly on the 0-to-100 scale. Should the gain of the transistor exceed 100, reset the meter to the quarter-scale calibration mark, measure the beta again, and multiply the reading on the same scale by 2. On the other hand, beta values lower than 50 can be determined by resetting the BETA CAL control for full-scale deflection and reading the results on the separate 0-to-50 scale.

Testing known good transistors in typical portable radios, I consistently came up with the right indications — except when I encountered external shunt impedances lower than approximately 150 ohms. In these few cases, I did not obtain meaningful input-resistance or beta readings; however, this immediately told me that the transistor should be disconnected for testing. For the out-of-circuit tests listed in the specifications, the small knob of the Z OHMS control is turned fully counterclockwise to actuate an OUT-OF-CIRCUIT switch, and the shunt-impedance test is simply omitted. In borderline cases where the shunt impedance is close to the 150-ohm limit, the out-of-circuit tests can remove any doubts about the accuracy of the results.

The various steps of the in-circuit test procedure are easier to understand if you're familiar with what goes on inside the tester. The initial leakage-current and



(A) External shunt leakage current.



(B) Input shunt impedance and RIN.

Fig. 6. Special in-circuit tests.

shunt-impedance checks are actually calibration procedures which permit a more accurate evaluation of the input-resistance and beta characteristics of the transistor. Fig. 6A is a block diagram of the circuit used for measuring the stray leakage current which flows in the external circuitry when collector voltage is applied. The transistor itself is cut off by reverse bias between base and emitter, established by adjustment of the Ic control.

The test setup for measuring the shunt impedance of the external base-emitter circuitry is illustrated in Fig. 6B. The transistor is cut off, while a test signal is supplied from an audio oscillator stage. A variable resistance in the tester and the external impedance form a bridge network that can be balanced by varying the Z OHMS adjustment. A sensitive AC voltage-measuring circuit is placed between the base and emitter branches to serve as a balance indicator.

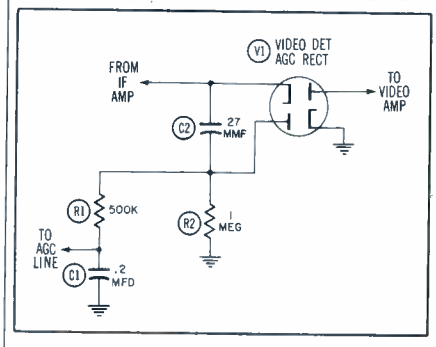
Dynamic input resistance is determined by forward-biasing the transistor and switching an additional variable resistance into the bridge network. The circuit is balanced by varying the RIN adjustment which, in turn, is calibrated in ohms.

In the beta-calibration and beta-measurement procedures, the circuit is the same as in Fig. 6B except that the voltmeter is first placed across the calibrating resistor in the bridge network and then connected across a 1-ohm sampling resistor located in the collector circuit.

The information provided by the new Hickok tester is more exact than a mere "go—no go" indication. Its extensive tests are well suited for the jobs of determining specific gain factors, selecting substitute transistor types, or matching units of the same type. ▲

THE TROUBLESHOOTER

answers your service problems



AGC Time

I recently had to replace a .25-mfd AGC filter in a Trad Model T20E. Since this capacitor had a fairly high value, I became interested in the RC time constant of the circuit. I found it had a charging time of .256 second and a discharge time of .275 second. I computed the times on some other sets and found they ranged from .1 to .375 seconds in charge time and around .32 to .38 seconds for discharge. The Sams book, "Servicing AGC Systems," shows a circuit (Fig. 1-4) with a .1-second charge time and .3-second discharge time. Can you explain the variations and suggest the best combination?

CHARLES H. WAGENMAN
Hempstead, N. Y.

Here's the circuit from AGC-2. There is no "best" figure which applies to all circuits. In designing a simple RC-type AGC circuit, a TV manufacturer has to work with these two basic objectives in mind:

1. *What video-signal amplitude must be developed at the detector to produce sufficient contrast on the CRT, considering the type of video output stage to be used?*
2. *What values of parts are readily available in the quantity needed at a reasonable price?*

Thus, designers consider various combinations of standard R and C values, seeking to peg the IF gain at a level that will allow sufficient contrast without giving the set a tendency toward overloading on strong signals. Of course, there are other practical limits; for instance, the time constant must not be long enough to make the AGC excessively slow in responding to signal fluctuations.

As things work out, the time constants for most sets run in a fairly consistent pattern—just as the design of IF strips, tuners, and video amplifiers tends to become somewhat standardized in the industry. However, there is room for the minor variations you noted.

Magnet Shrinker

I had an experience with a Motorola Chassis TS-14 that I'd like to pass along. The original focus coil was bad, and I replaced it with a permanent-magnet type. However, the magnets were too strong, and I couldn't get the picture to focus. After some experimenting, I found that installing a piece of cardboard between the magnets and the ring reduced the magnetic strength enough to provide excellent focus. Incidentally, an old tube carton proved to be just the right thickness.

PHILIP R. KIPP
Lexington Park, Md.

Found: Another way of reducing magnetic coupling. Thanks for the tip, Phil.

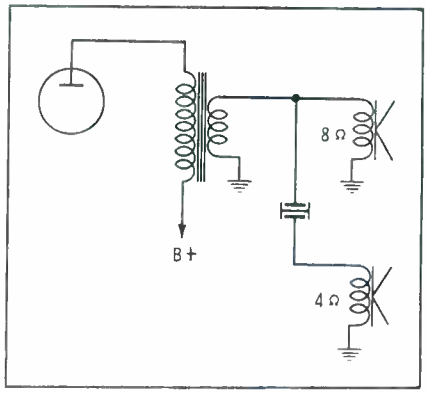
Speakers, Speakers, Speakers

I've been wondering what's the best thing to do when a TV chassis must be pulled from a receiver that has several speakers. For one-speaker models, I've always used my bench speaker and gotten along fine. I'm doing the same thing with sets having two or more speakers, but I'm not sure I'm doing right. I sure don't want to take all of the speakers out of the cabinet and haul them to the shop.

JOHN F. CUDNEY
Tonawanda, N. Y.

You can usually use your regular test speaker. It may not match the output transformer exactly, but unless the volume is set at a high level, or you're working on an audio distortion trouble, it should pose no problem.

Many sets with multiple speakers use output transformers having 8-ohm secondaries; the circuits are connected as shown. The speaker connected directly to the transformer has an 8-ohm voice coil. The other speakers are isolated by the crossover capacitor and do not affect the match. If you want a perfect match at



your bench, simply connect two 4-ohm speakers in series across the transformer secondary.

Breaking Tubes

I have a problem with a series-string Sylvania TV. I have to replace either the 12AX4 or 25DN6 tube every three or four weeks because a slight crack develops in the glass and the tube goes dead. I've tried different brands of tubes, and that hasn't helped. I've been servicing radios since 1929 and TV since it started, and have never run into anything like this. Any suggestions will be appreciated.

SAM FIORINO

Du Quoin, Ill.

Pinholes or "star cracks" sometimes occur in tubes located near high-voltage sources, as in the high voltage cage of some TV sets. These cracks result from high-velocity electrons striking small areas of the glass. Try moving any leads carrying high voltage as far away from the tubes as possible, and if there's any evidence of corona discharge, dope all connections to stop it.

Another factor that may be causing your problem is heat. Combined high voltage and high temperature often causes electrolysis in the glass, which finally produces a crack. Apparently the Sylvania in question is Chassis 1-532-1 covered in PHOTOFACT *Folder 321-2. If so, notice that the cage fits snugly around these tubes and that there is no provision for ventilation. Perhaps drilling a few holes in the cage will help.*

For additional information about why tubes fail, the Howard W. Sams book "Getting the Most Out of Vacuum Tubes" (VTT-1) contains a lot of useful facts on the subject.

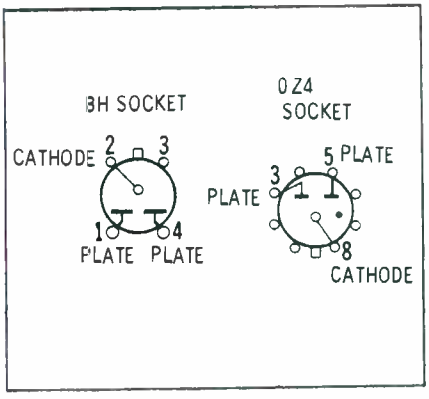
Tube Data

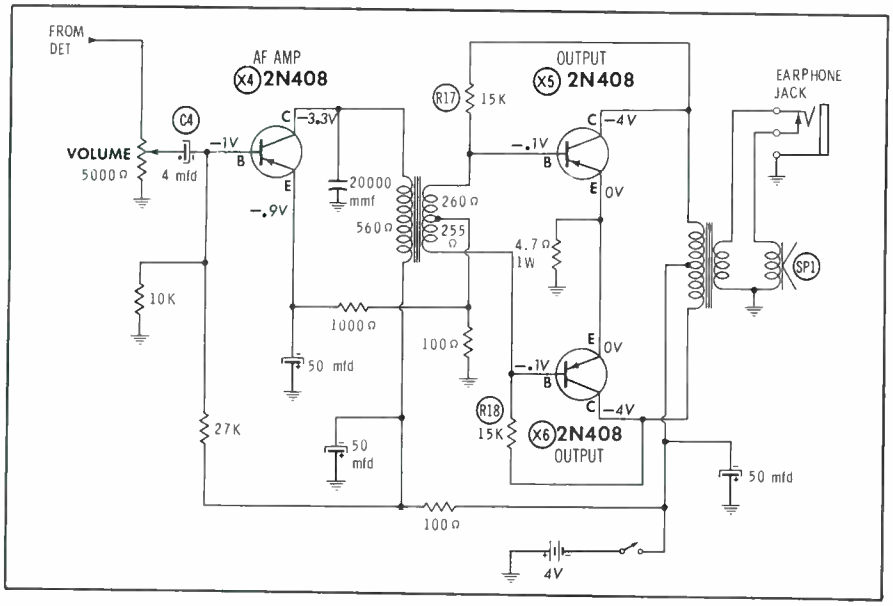
I have a Kingston Type 2 power supply that uses a Type BH tube. This tube needs replacing, but I've been unable to locate one. Is there a substitute that will work?

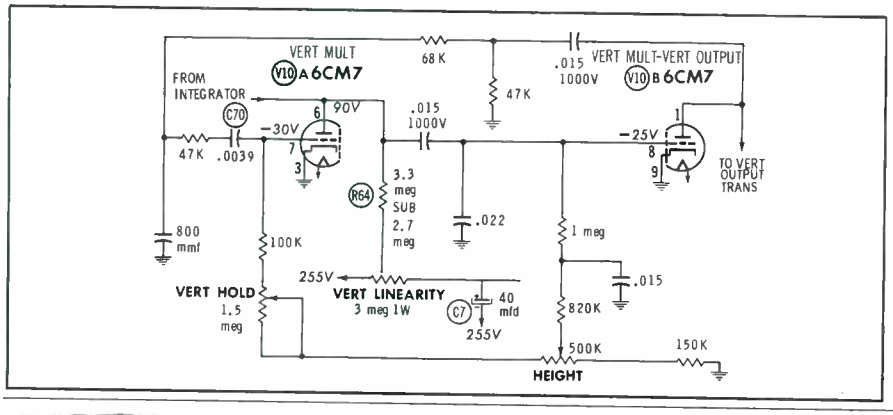
EUGENE NAGY

South Bend, Ind.

Yes. You can use an OZ4 by changing the socket to an octal type. Connect the leads from pins 1 and 4 of the old socket to pins 3 and 5 of the new—it doesn't matter which lead goes where, since these are the plate connections to a full-wave rectifier. Connect the lead from pin 2 of the original socket to pin 8 of the new socket to complete the substitution.







Speak Up

The volume on a Magnavox CR-744AA transistor radio is far below normal. When I disconnected C4 from X4 and fed the signal to another set, there was volume to spare, so I know the trouble is in the AF amplifier or output stages. The voltages on X4 are OK. X5 has zero on the emitter, –.17 on the base, and –3.8 on the collector. X6 has zero on the emitter, –.12 on the base, and –3.8 on the collector. I've tried new transistors and checked the parts to no avail.

JAMES F. DARBY
Bronx, N. Y.

Your trouble may be due to a poor connection in the earphone jack. However, it may be significant that the two output transistors have a slightly different bias between base and emitter. I presume, of course, that you measured the voltages with no signal applied—if not, they aren't too meaningful. Be certain the two output transistors are a matched pair and that R17 and R18 are also matched and within 10% of their rated 15K value. If this fails to solve the problem, use a scope to measure the input and output amplitudes of a constant-level signal (fed from a generator) to see where the loss is occurring.

Cold Rolls

A General Electric Model 17TO26 has to be locked in vertically several times during the first 15 minutes of operation. It finally holds, but never produces a linear picture. I've completely rebuilt the vertical circuit including all resistors, capacitors, controls, yoke, output transformer, integrator tube and tube socket. I have a silver mica in for C70; with a tubular in the circuit it won't even stop rolling in 15 minutes. I also replaced boost capacitor C7, but it didn't help.

V. MORRIS
Hickory, Ky.

Sounds as though you have tried almost everything to overcome your warm-up problem in this set. Incidentally, changing resistor R64 from a 3.3-meg to a 2.7-meg unit should solve your linearity problem.

Have you tried at least three or four different tubes in the circuit? Your trouble may be centered in a slow-warming tube. Also, be very critical of the surge-limiting resistor in series with the filaments, since it is a common offender in these receivers. If this fails to solve your problems, monitor the amplitude of the feedback waveform at pin 7 of V10.

Try spraying each component in the vertical circuit with a chilling chemical after the set has thoroughly warmed up. This will instantly reduce the temperaure and cause the picture to roll if the part is at fault.

It may be necessary to install some sort of heat shield between the horizontal tubes and the vertical circuit. This would deflect most of the heat away from the components and might overcome the problem.

SUPPOSE...

just **suppose** you realized that you could go further if you understood electronics — suppose you realized what a First Class FCC license would do for you, in raising your income. Let's say you figured that this ability would mean $20.00 more per week on your paycheck. This is a reasonable supposition.

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✓ IT MUST be one that can be completed successfully in a matter of WEEKS, not a course that goes *on and on!* Time is worth money. Every extra week which a "long course" may require is money *out of your pocket!* It costs more than tuition... it costs you real dollars! Let nothing delay YOU in preparing for your FCC license. Select a school that values YOUR TIME!

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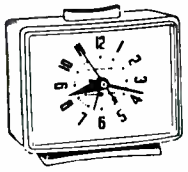
YOUR TIME



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19-K

SERVICE DEALER ADVERTISING PROGRAM PAYS OFF!!!

We felt our Service Dealer Advertising Program was something really needed by our readers when we introduced it in January. Just how successful it would be, we couldn't accurately predict—we're glad to report that results to the first three monthly selections far exceeded our expectations.

Furthermore, users of the ads have reported excellent results . . . several dealers, after ordering a single month's selection, subsequently ordered the entire series of 60 ads at the special price of $25.00.

For the benefit of those who are being exposed to this program for the first time, and who missed the general advertising suggestions made when the program was introduced in January, we offer the following:

1. Include something in every month's budget for promotional expenses (advertising, direct-mail, handouts, etc.).
2. Try various promotional tests to see which media or method produces the best results for you.
3. To be effective, advertising and promotional activities should be consistent . . . and continuous . . . to create and maintain a specific image.
4. Ask for guidance from the printers and publishers with whom you do business. Remember, as a steady customer, you will often rate special prices, and receive preferred space positioning as well as helpful free publicity.
5. Make the most of your promotional dollars through effective exposure of your messages. Place ads where people most likely to need your services will see them (yellow pages, TV program directories, neighborhood publications, etc.). Use direct-mail pieces to follow up on regular customers, and to solicit new ones. Distribute doorknob hangers and handbills in areas where you want to do business, and where you see there is business to be had (houses with broken-down antennas, for example).
6. Last, but not least, use promotional copy that is eye-catching, with a simple message showing potential customers you are thoroughly familiar with their problems, are firmly established in business, and are expert in servicing electronic equipment.

As you can see from this month's selection, the PF REPORTER program is specifically designed to fit into your advertising, direct-mail, and other promotional plans. Each month's selection is available to you at cost in two forms—durable newspaper mats at $1.75 per set of 5, or reproduction proofs printed on fine quality glossy paper at only $1.00 per set. The latter will serve as finished artwork for offset printing of handbills, postcards, doorknob hangers, direct-mail pieces, etc., or even for poster-size blowups which you can use in your store window, on the side of your truck, and in many other places.

Every ad is extremely flexible. In most cases, you'll probably use them as is (with your own name and address inserted), but you can easily have the wording changed to suit your needs—usually without any extra cost.

To order this month's selection, any of the six preceding series, or the entire program of 60 ads (with which you receive a comb-bound book of proofs), use the handy coupon on page 62.

ES-8 1⅞" x 3¾"
Cartoons always draw attention. Run the ad and make room for some sets.

ES-28 1⅞" x 5"
This striking ad offers potential customers JUST what they want — guaranteed performance, reasonable rates, and prompt service on radios, TV, and hi-fi.

ES-47 1⅞" x 3⅝"
Mr. Stork is carrying a load of new life for portable radios. This is the season, and the ad, to sell batteries.

ES-1 1⅞" x 5⅞"
A cartoon series that shows why prospective buyers need a second set, and suggests they buy a good used TV from you.

ES-52 3¾" x 1¾"
Want some new customers? This special offer will bring them running. It will fit nicely on a post card if you want to use it for a direct mail campaign.

Experience with Color

(Continued from page 31)

the pins of each tube in a household wax remover. I then inserted the tubes in their sockets several times, re-dipping the pins in the wax-dissolving liquid before each insertion. Then I carefully pinched together the contacts of the two 9-pin sockets, seated the tubes firmly in place, and turned on the receiver. The normal cathode and plate voltages promptly appeared, and I was now able to vary the CRT control-grid voltages over their normal range from 200 to 370 volts. The plate voltages of the chroma amplifiers settled down to a healthy 260 volts.

I figured that the trouble in the chroma circuits must have been responsible for the defocusing of the cathode-ray tube as well as for the loss of color, since the CRT grids had probably been driven positive with respect to the cathodes.

The Toughie

Now for the tough nut — the brightness fault. In Fig. 3, observe that the brightness control is in the grid circuit of video output tube V5, acting as a bias adjustment. When the DC operating point of V5 is changed by means of this control, the average plate voltage is increased or decreased. Since the video output stage is direct-coupled to the picture tube, a shift in plate voltage also causes a change in the CRT cathode voltages—thus altering the bias to produce the necessary control over brightness.

A negative voltage is applied to the lower end of the brightness control through a filter circuit from the grid of the 6DQ5 horizontal output tube. In addition, a small positive voltage is fed to the upper end of the control from the cathode circuit of the first video amplifier. The lat-

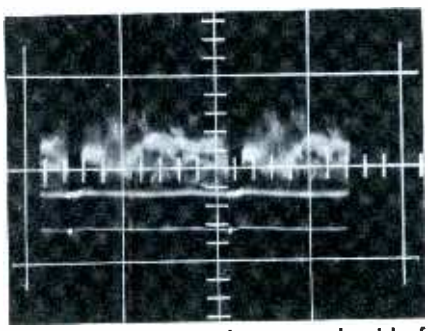


Fig. 4. Normal signal at control grid of video output tube (30 cps; 14V p-p).

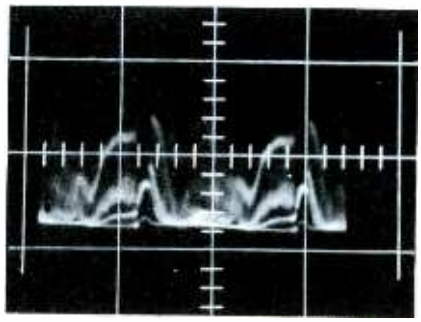


Fig. 5. Distorted sync-separator output due to open noise-inverter control.

ter connection also serves as an interstage coupling circuit for the composite video signal, since the first video stage functions as a cathode follower. Normally, the waveform at the grid of the video output stage measures 10 to 16 volts peak to peak and appears as in Fig. 4.

The circuit includes several other features which could have some influence on brightness-control operation. For example, the contrast control and other components in the cathode circuit of the video output tube affect the bias on this stage. Furthermore, a noise-inverter control (which regulates the grid voltage on a sync noise-inverter stage) is in parallel with the brightness control; also, the cathode of this noise-inverter stage is tied back to the cathode circuit of the first video amplifier. Finally, a composite video signal is developed at the plate of the first video stage and applied to the chroma bandpass, AGC, and sync circuits—with an added connection to the plate of the noise inverter.

As you can see, a great many things could go wrong in this circuit—so I began by taking a complete round of tube-pin voltage measurements. Those on the two video stages were as expected with no signal applied. However, when I got as far as noise-inverter tube V6B, I found exactly 10 volts on the grid instead of the normal 2 volts. Immediately, the thought of grid-to-cathode leakage came to my mind, but then I remembered that the grid voltage can be varied with the noise-inverter control. When I turned this 2.5-megohm potentiometer, the grid voltage suddenly dropped to normal—an obvious indication of a faulty control. Removing all leads from the control and making an ohmmeter check from the arm to one side of the potentiometer, I located an open spot on the element as I rotated the slider through its range.

At first glance, you might think that finding the bad noise-inverter control would solve the whole problem, since this component and the brightness control are in parallel. However, you haven't heard the whole story.

Since the negative bias voltage applied to the lower end of the controls is from a high-impedance source, it's true that the change in load due to the open noise-inverter control will be reflected in a slight change of voltage at the arm of the brightness control. Nevertheless, this change is not enough to disrupt the operation of the video output stage. Here is where the real mischief comes in: With a strong positive voltage on the grid of the noise inverter, this tube conducts hard and compresses the sync pulses in the input signal to the sync separator. (Fig. 5 shows the resulting output from the sync-separator stage.) The loss of sync causes interaction through the keyed AGC system, which completely upsets video reception. However, the brightness fault is mostly due to another defect!

At Long Last

All right, then, what about the real cause of the brightness trouble? The control itself was checked and found to be good. The 1-microsecond luminance-delay line M9 was obviously not open, since there had been some sort of black-and-white reproduction on the face of the cathode-ray tube in spite of all the other troubles. Resistors between the video amplifiers were spot-checked to see if they were within relative tolerance (they were). The 2-mfd electrolytic bypass capacitor C3 wired between the screen and cathode circuits of the first video amplifier (Fig. 3) next caught my attention. This capacitor, which was the subject of an RCA service bulletin a few months ago, is included in several of the more recent RCA color chassis. Because of its critical placement affecting the color, sync, AGC, and video circuits, a defective C3 can cause

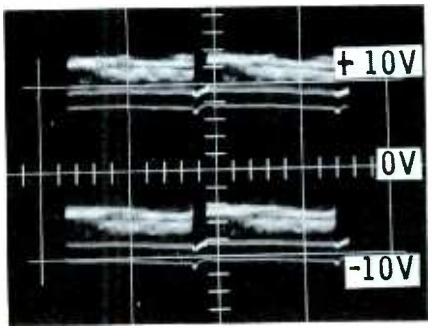


Fig. 6. Brightness control has this much effect on DC level of grid signal.

AGC overload, picture smear, and vertical retrace lines at the top of the picture. The particular trouble depends on whether C3 is leaky, has developed internal resistance, or has changed value. In the receiver on my bench, C3 measured 2.9 mfd, with a power factor of 10; so I thought I'd better try a replacement. With a new unit hooked up, I again checked the voltage swing at the grid of the video output tube with the DC oscilloscope. As shown in Fig. 6, the average value of the waveform could now be swung from a negative 6 to a positive 12 volts, enough for good control of plate current in the output stage. This, I decided, was it!

Back in the cabinet went the CTC7A, and I proceeded with a quick degaussing of the front and sides of the new picture tube, color-purity checks, AGC and noise control adjustments, static convergence, red, blue, and green screen-control adjustments for satisfactory color temperature and gray-scale tracking, and finally, dynamic convergence.

As I worked along through the CRT-setup procedure, it dawned on me that the old picture tube had been partly responsible for the limited control over brightness. With this extremely weak tube in the set, it had been necessary to turn the screen and background controls very high to reach an acceptable brightness level. Under these conditions, the indirect-acting brightness control did not have sufficient range to extinguish the raster, even at the minimum setting. After installing the new tube, I was then able to reset the screen and background controls to more normal positions, and the brightness control acted more nearly like that of a black-and-white set. My problems with this color receiver were over, thank goodness! ▲

Transistor Portables

(Continued from page 24)

six-transistor portables. Of course, there are *minor* variations in the sets, and component values differ between makes and models. The important thing, however, is that all of the units have very similar circuits.

Take another look at the converter stage in Fig. 1. This same circuit was used in American transistor sets over four years ago. The same thing holds true for the IF, detector, driver, and output stages. The greatest variation you'll find is in the AVC circuits. You'll find some sets using an AVC limiter diode and slightly different feedback circuits in order to get greater gain.

Naturally, sets with different numbers of transistors will have variations in circuitry. In radios with fewer than six transistors, the major change will be found in the IF and output circuits. Instead of the set having push-pull output, it will use only a single stage. The intermediate or second IF stage will be the next to disappear as the number of transistors is reduced. However, the remaining circuits continue to be very similar to those shown in Fig. 1.

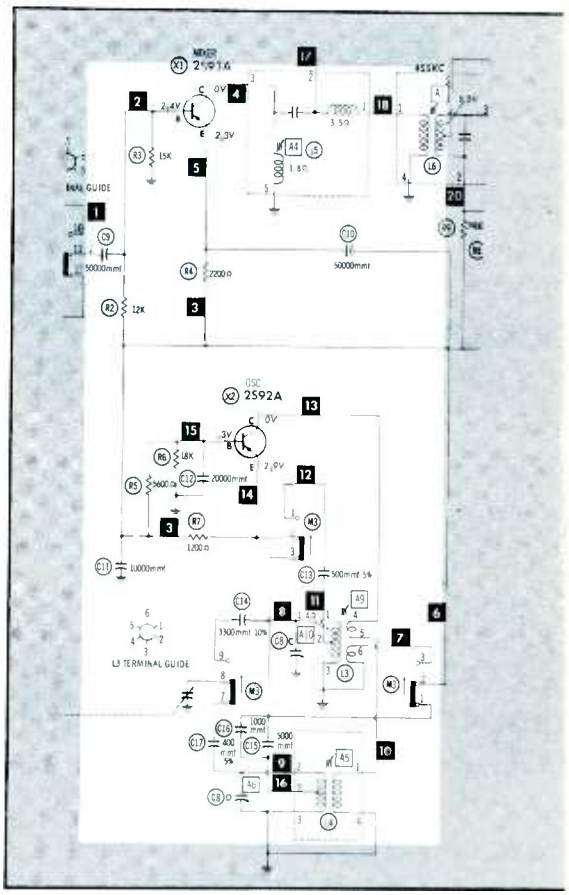


Fig. 2. Typical mixer-oscillator circuit used in many multiband receivers.

Many imported sets with more than six transistors are multiband models. There are exceptions which simply have an added transistor in the detector-AVC circuit, but these, too, have American counterparts. In multiband sets, a mixer-oscillator circuit is often used instead of the simple converter stage, and the necessary switch and oscillator coils are provided for the additional bands. A typical circuit is shown in Fig. 2. While this circuit is more difficult to service without a schematic, there are ways to overcome this obstacle.

Finding Service Data

One way to save time in servicing imported equipment is to locate a schematic of an identical or similar unit. Although there are dozens of brand names, relatively few manufacturers are producing these imported transistor portables. Therefore, it's often possible to identify a receiver in question as being similar to one you have service data for. You may be able to do this by looking for the same model number in an index of transistor radios. For

example, notice that the index in the Howard W. Sams book, "Servicing Transistor Radios" (Fig. 3), shows several makes with model numbers that follow a certain pattern (indicated by lines drawn to the left of the model number). If the model number of a radio corresponds to one from this index, you can be reasonably sure the two sets are alike. At least, it's a lead to follow.

In case the model number doesn't hold a clue, you can often find a similar unit by comparing the set in question with photographs of printed boards, chassis layouts, etc. Fig. 4 illustrates this method of identification. The *Petite Model NTR-800* is being compared to a *Continental Model TR-300* which has the same basic layout and the same number and types of transistors. By taking advantage of this method of identification, you can often obtain information to simplify the job of troubleshooting, although there may be minor variations in the two receivers.

Of course, the more sets you service, the easier it becomes to identify them. Developing your own list of similar models can often help you out of a pinch when servicing these imports. You'll find many other clues to help you identify a set if you make it a practice to look for them. Printed boards, for example, are often stamped with an identifying number. Comparing such numbers (Fig. 5) makes it possible to associate the *Coronado Model RA60-9899A* (to the right) with an *Olympic Model 780*, which has a schematic inside the back cover. Although the *Coronado* uses a 3.9-volt battery and the *Olympic* uses a 9-volt battery, the sets are alike except for a few resistors.

"Let me put it this way, you've got low B+ voltage and a slight sync buzz"

Following the sleuthing procedures outlined, we have found the following makes of sets using identical chassis. Add to the list as you go about your daily servicing activities, and you'll save considerable time in looking up "like" models.

Airline, Continental, Sharp
Baylor, Marvel, Trans-ette, Yokotsee
Bulova, NEC
Delmonico, Fuji Denki
Delmonico, Kawa, Olympic
J. C. Penney, Toshiba

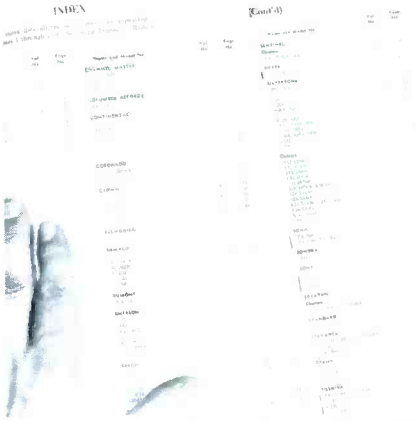


Fig. 3. Compare the model number with those in an index to find "like" sets.

Jefferson-Travis, Standard
Maco, Matsushita, National
Realtone, Supreme

Obtaining Parts

One of the misconceptions many servicemen have about servicing imported portables is that replacement parts are not readily obtainable. This simply isn't true. Nearly every component in a transistor portable has an equivalent replacement on your electronics distributor's shelf. The resistors are all standard values; electrolytic and fixed capacitors all have available replacements; antennas, oscillator and IF coils (¼" and ⅜" units) are packaged as direct replacements; and even the transistors pose no problem.

Refer again to Fig. 1 and notice that PNP transistors are used throughout. This is common among imported transistor radios — more so than in their American counterparts. This fact alone makes it easier to service these units, since you need to master the theory of operation for only one type of transistor. Granted, the foreign identification of the transistors makes them a little more difficult to identify, but an ample number of cross-indexes are available to match them to American equivalents.

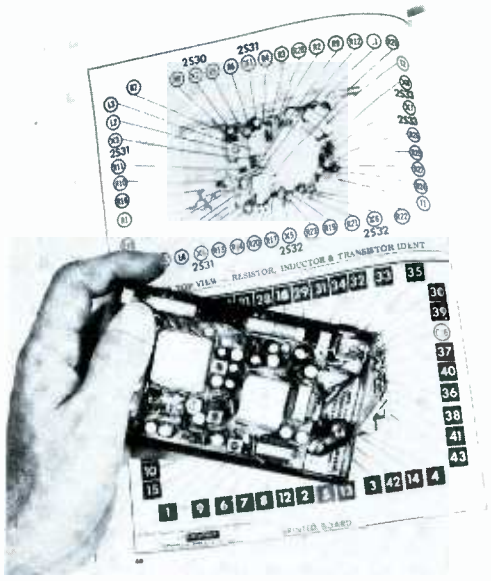


Fig. 4. Comparing the set with photos helps locate service data you can use.

In those cases where you can't identify the transistor type, a quick check of the voltages at the base, emitter, and collector will tell you definitely whether you're dealing with a PNP or NPN type. The collector *always* has the most negative voltage of any element in a PNP circuit. Once the type is identified, the application of the transistor classifies it sufficiently to select a suitable replacement.

So you see, servicing imported portables isn't as difficult as it might seem. Following the hints given above will help you locate service data, which provides the vital missing link you need to make your job easier. ▲

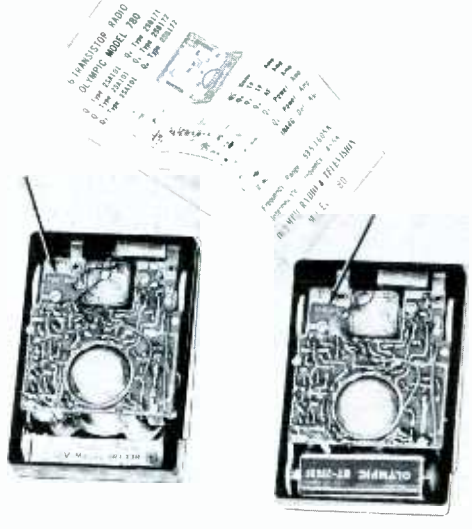


Fig. 5. Printed boards often contain numbers that can be used to match sets.

Diodes and Rectifiers

(Continued from page 33)

assembly to the basic diodes.

Ignoring mounting differences, the three most important ratings to consider when replacing a power rectifier are DC forward current, peak inverse voltage, and AC input voltage. DC output-current demands range from approximately 1 ma (for bias applications) to around one-half amp for B+ rectifiers used in color television receivers. Load-current requirements for replacement units can be determined by referring to the service data for the current rating of the original unit, or by noting the current normally drawn by the load circuit. (The latter is often shown as the current rating of the filter choke.) It's a good idea to see that the replacement is rated at least 10% higher than the actual current load.

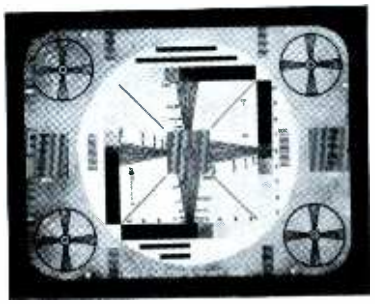
The peak inverse-voltage (PIV) rating of a semiconductor refers to the maximum potential difference that should be applied across the component. To calculate this rating, both AC and DC voltages in the circuit must be considered — the peak rectified DC on one side of the diode and the peak AC swing on the other. Regardless of circuit configuration, B+ rectifiers used in home entertainment equipment are subjected to peak inverse voltages ranging from 300 to 360 volts when connected across the AC line or operated from the secondary of a 1:1 line-isolation transformer. Therefore, most replacement rectifiers have a PIV rating of about 400 volts. Notable exceptions are those used in certain bias and DC-filament applications, and units connected to transformer secondaries providing more than 130V AC. Selenium units found in some of the older color receivers are typical examples of the latter circuit. Silicon rectifiers with higher AC-input and PIV ratings than conventional types are available, however, and are suitable as replacements.

Table III shows typical applications, original types of rectifiers employed, maximum current requirements, and standard replacements for just about any type of semiconductor rectifier you'll encounter in home entertainment equipment. All silicon replacements listed are popular pigtail types. In many cases, other styles are available with identical ratings.

You will note that many of the replacements listed for selenium units are of either the silicon or germanium type. Since these latter components have a lower forward resistance than the original seleniums, a resistor must be added in series with each rectifier to reduce surge current. (A 10-watt unit ranging in value from 10 to 22 ohms will do nicely.) All original surge-limiting resistors, fuses, and circuit breakers should be left in the circuit when this modification is made.

Selecting a Stock

Now that we've shown suitable replacements for the diodes and rectifiers you normally encounter, you should have no trouble deciding what to carry in your caddy and stock on your shelves. Maintaining a supply of suitable replacements assures you of having the parts you need on hand when you need them. Also, you can weed slow-moving items from your stock and increase the size of your diode and rectifier orders to take advantage of quantity discounts. ▲



TV TIPS FROM TRIAD

NO. 13 IN A SERIES, PART 1

"This 'orphan' came in the basket of a 'borrowed' supermarket cart," began Joe, "and when I had laid out the chassis, yoke, flyback, picture tube, miscellaneous parts and leads, I knew it had finally happened to me.

"The character said his 'fixit' book called for replacing the flyback when he had no light on the picture tube so he carefully unsoldered everything in the cage, took the flyback down to Public Wholesale where he was told he would have to give them the model or chassis number, plus the part number before they could look it up. Since this job had no numbers that made any sense he was stuck.

"At this point he lost interest and dumped the mess on me."

"Sucker," said Bill. "No disconnect chart either, I suppose?"

"Right. I think I found the original trouble which was an open 5 mfd electrolytic on the cathode of the horizontal output, so I reinstalled the flyback as far as I could go. I can get a raster at normal plate and screen current, but the video overloads. I have no horizontal or vertical hold and it looks like this job used horizontal blanking. The flyback has a separate winding which is tapped, so my problem is to recover AFC, AGC, and blanking, without having to try the eight wrong combinations first. Is there anyway I can connect them correctly, the first time?"

"If you take care of the obvious first," said Bill, "and then clear the circuits based on what 'you know for sure' you should be able to cut down on the experimental part.

"The first step is to gain control of your video system because you cannot check your AFC or AGC unless you have incoming sync available.

"Therefore," continued Bill as he rapidly traced the circuit layout, "since you have a single -CB6 video stage driving the cathode of the CRT you adjust your bias box to show about four volts peak to peak of video with negative going sync at your video detector output."

"I knew the scope would get into the act some place," said Joe with a grin.

"Well, the video detector measurement is probably the most valuable scope measurement in servicing," answered Bill. "It's one of the 'for sure' factors and it's much more accurate than attempting to gauge video levels on a CRT where hold and blanking are out. As a final touch see that video represents at least 25% of the total signal at all levels of picture information. You are then ready to solve the AGC, AFC, and blanking in the proper sequence."

* * *

MORAL: More next month; but in the meantime PTM #4, to be published soon, will show an inexpensive circuit and parts list for a bias box. In addition, other devices and service procedures to make possible more accurate correction of "Multiple Trouble" problems will be discussed. You will receive PTM #4 if you have ever registered for the Triad PTM mailing list. If not, a request to *Renewal Division, Triad Transformer Corp.*, 4055 Redwood Ave., Venice, Calif., will bring you a copy.

Photoelectric Control

(Continued from page 29)

the system. This stray light is sometimes stronger than the signal light, and if it were permitted to reach the tube, it would render the system completely inoperative.

Amplifiers

Fig. 2 shows the simplest amplifier circuit used in DC-powered photoelectric systems. The bias on V2 is determined by two opposing DC voltages. One of these, the DC output developed across R1 by the plate current of the phototube, attempts to drive the grid positive. The second voltage, an adjustable DC bias obtained from R2, is applied to the cathode. Since this voltage is positive at the cathode, it is negative insofar as the grid is concerned. R2 is adjustable to permit compensation for any stray light that may reach the phototube when the light source is interrupted. This control should be adjusted to the point where it just barely causes the relay to drop out under the most severe stray-light conditions.

When the light from the source strikes the phototube, the voltage across R1 increases, lessening the effect of the voltage from R2. This results in an increase of plate current through V2, pulling in the relay. When the light beam is interrupted, the plate current of V1 is reduced, as is the voltage across R1. This cancels less of the voltage from R2—thus leaving the grid effectively more negative than before, reducing the plate current of V2, and causing the relay to drop out.

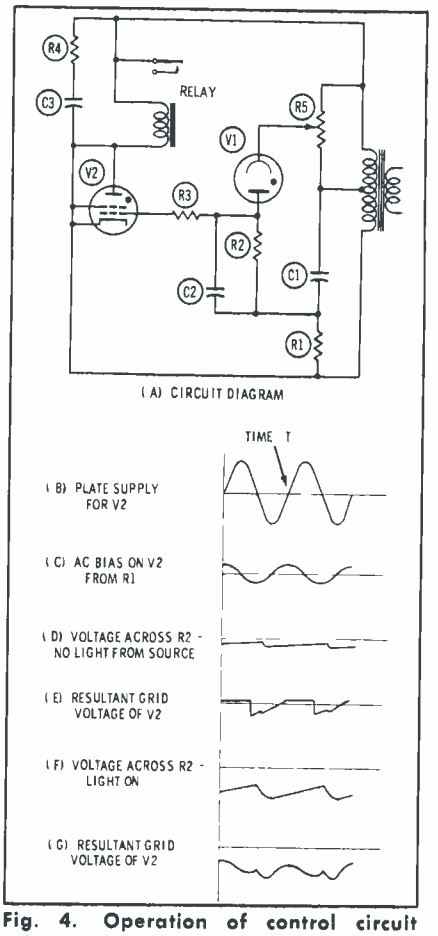


Fig. 4. Operation of control circuit using a gas phototube and thyratron.

Fig. 3A shows an AC-powered version of the circuit in Fig. 2. Note that a capacitor is added across the relay coil to eliminate relay chatter arising from the pulsating plate current of V2. Here, again, the bias on V2 is controlled by the opposing voltages across R1 and R2. Both of these are in phase with the plate-supply voltage of V2; however, they act in opposition because one voltage is fed to the cathode and the other to the grid.

R2 is adjusted so that the relay is barely de-energized under the most severe stray-light conditions (see Fig. 3C through 3F). When light strikes the phototube, a larger pulsating voltage is developed

across R1 to oppose the voltage across R2. V2 then conducts more strongly on the positive half cycles of its supply voltage (Figs. 3G through 3I), and the relay is actuated.

In this circuit, you can expect to obtain a negative reading when you measure the DC voltage at the plate of V2 with respect to the cathode. However, if you recall that the tube is acting as a rectifier, the mystery is solved. This negative plate voltage is similar to what we normally find in a video detector or keyed AGC circuit.

The popular photoelectric relay system shown in Fig. 4 has a gas tube instead of a high-vacuum tube to control the current through the relay. Gas tubes are ideal in photoelectric relays because they supply either maximum plate current or no plate current.

In Fig. 4, as in Fig. 3, AC plate-supply voltages are used. The additional component R4 in the plate circuit of V2 is required to limit the surge current through V2 to a safe value when C3 is charging.

The bias on V2 depends on two voltages, as in the previous circuits. The grid is supplied with negative DC, in addition to an AC component which leads the plate voltage of V2 by 90°. The former is derived from the voltage developed across R2 by the plate current of V1, filtered by C2; the latter is obtained from the AC supply by means of a phase-shifting network (C1 and R1). Referring to Figs. 4B and 4C, note that the AC voltage on the grid of V2 is at its positive peak when the plate voltage is just starting its positive half cycle (time T). This ensures that V2 will fire promptly at time T whenever there is insufficient negative DC grid voltage to hold the tube in cutoff.

When the light from the regular source is interrupted, only a small amount of stray light reaches the

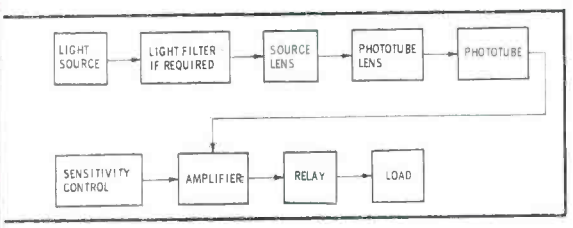


Fig. 5. Block diagram of photoelectric system is aid in troubleshooting.

phototube, and very little negative voltage is developed across R2 (see Fig. 4D). Therefore, the resultant of the AC and DC voltages at the grid of V2 is positive at time T, as shown in Fig. 4E. The tube then fires, energizing the relay.

As soon as light from the source is again permitted to reach V1, a larger negative DC voltage (Fig. 4F) is developed across R2. This voltage, combined with the waveform in Fig. 4C, gives the resultant grid voltage shown in Fig. 4G—which is negative at all times. Thus, V2 is prevented from firing, the current through the relay coil is zero, and the relay drops out whenever V1 receives more than a faint glimmer of light.

The sensitivity adjustment in this circuit is not a variable bias voltage in the grid circuit of the relay amplifier tube, as in the previous circuit; instead, it is a variable plate-supply voltage to the phototube. If we consider V1 and its plate load R2 as a voltage divider, it can be seen that moving R5 upward increases the supply voltage and thus raises the voltage drop across each component. This produces an increased signal voltage and a greater sensitivity to light. With light from the source shining on the phototube, R5 is adjusted until the relay drops out. (Remember that light on the phototube in the circuit of Fig. 4 causes the relay to drop out; in the previous circuits, the opposite action occurred.)

General Servicing

The following equipment is required for servicing:

- Multimeter or VTVM
- Flashlight
- Glass cleaner similar to that used for cleaning television picture tubes
- Tube tester
- Normal radio or television tool kit
- Burnishing tool for relay contacts

Optional equipment:

- Oscilloscope
- Megger

The photoelectric system may be broken down into blocks as shown in Fig. 5 for the purpose of analyzing troubles. The first check, after energizing the system — provided there is no odor of overheated parts—is to check the light source. *Caution: If the light source is ultraviolet, do not look directly at it, since it can cause temporary blindness and permanent damage to your eyes.* If the light source is infrared or white light, it may be checked by direct observation. Note that infrared filters never completely remove all of the visible light; that is why they may be checked visually. Unless it is an ultraviolet light source, the lamp may be removed and the filament observed to see if it is broken. Finally, the lamp may be checked with an ohmmeter.

Next, measure the voltage at the lamp socket of the light source.

After checking the light source, check the light-filter system and clean it. It would be well at this time to clean all lenses and mirrors as a routine matter—being extremely careful not to scratch their surfaces.

Fourth, check the alignment of the light system to be certain the light from the source reaches the phototube.

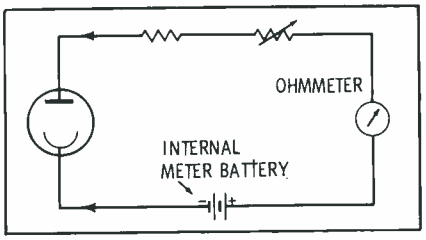


Fig. 6. Phototube can be checked by ohmmeter if proper polarity is used.

Fifth, interrupt the light beam to see if the relay operates. This may be heard as a sound ranging from a click to a thump, depending on relay size—or the action may be observed visually. If nothing happens, adjust the sensitivity control as described previously, and retest by interrupting the light beam.

Sixth, remove the phototube and check it with an ohmmeter, as shown in Fig. 6. Connect the ohmmeter so that its negative lead connects to the cathode and the positive lead to the plate of the phototube. (Note: Check meter polarity with another meter.) Aim a flashlight at the photocathode and alternately turn the light on and off. There should be a variation in the resistance reading—the amount depending upon the type of phototube and the intensity of the light source. The resistance of a gas phototube may run between 1 and 10 megohms, and that of a high-vacuum tube between 5 and 40 megohms, with light on the phototube.

Seventh, check the amplifier tube. If a thyratron tube is used, its emission may be evaluated with an ordinary tube checker, but its true operating characteristics require a special industrial tube tester; so substitution is generally a more reliable test method. The thyratron itself may be used as an indicator to tell how the circuit is functioning, if you watch for the ionization glow present during conduction. If the opportunity presents itself to study an operating system using a thyratron, interrupt the light beam and watch the thyratron glow appear and disappear.

Eighth, remove the amplifier from its case and make a voltage and resistance analysis. The load resistance of a gas phototube may be from 1 to 10 megohms, whereas the load for high-vacuum phototubes may run as high as 100 megohms. Therefore, even with a VTVM, the loading effect of the instrument on the circuit may be considerable.

The high-resistance plate load required by the high-vacuum phototube necessitates special low-leakage tube sockets. Under extremely moist atmospheric conditions, the leakage between the socket pins may be sufficient to upset the circuit action. These tube sockets must be cleaned with considerable care. In extreme cases, it may be necessary to use a megger to check the leakage resistance. Normally this should be in excess of one thousand megohms.

Ninth, the relay-coil resistance should be checked. It should be approximately 2500 ohms for a thyratron and around 10,000 ohms for a high-vacuum tube. The relay contacts should be cleaned or burnished if a resistance check shows them to be intermittent.

Finally, trace out the wiring between the relay contacts and the load circuit.

By following this check list, you'll waste no time in discovering the source of any malfunction in a photoelectric control device. ▲

Radio Antennas

(Continued from page 22)

energy radiated into space is less than that obtained by using a true quarter-wave dimension.

Even if no loading coil is used, the mounting hardware has some tendency to decrease the resonant frequency of a practical whip antenna. Table II shows an example of this effect for a typical design used in HF communications. The actual rod length is less than the theoretical "free-space" quarter-wave dimension because of end effect, the inductive action of the spring, and the influence of other mounting elements. The third column shows the further reduction in length made possible by addition of a loading coil. Notice that the antenna can be physically shortened by as much as 20" and still be made resonant at the desired frequency.

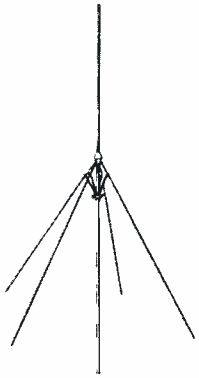
Base Installations

Antennas used at base stations can be more elaborate and more efficient than mobile types, since they do not have such severe restrictions on size or on height above ground.

Ground-Plane Antenna

The simplest type of base-station antenna is fundamentally a vertical quarter-wave unit; however, since it is normally mounted too high to utilize actual ground as its "lower section," some kind of artificial ground surface must be used to insure reliable operation and proper impedance matching.

A typical *ground plane* used for this purpose usually consists of a number of radial elements, each a quarter-wavelength long and positioned horizontally beneath the vertical element. More than anything else, the ground plane provides uniformity of antenna performance; in other words, it does not permit the antenna characteristics to vary with ground conditions, environmental changes, and height above ground. In addition, a good low-angle (close to horizon) vertical radiation pattern can be maintained.



Quarter-wave antennas mounted high in air use ground plane to stabilize operating characteristics.

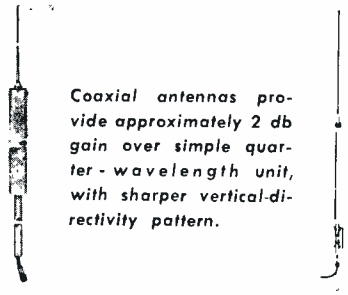
Table II—Practical Lengths of HF Whip Antennas

FREQUENCY MC	FREE-SPACE QUARTER-WAVELENGTH IN INCHES	WHIP LENGTH CONSIDERING END EFFECT AND SPRING	WHIP LENGTH WHEN USING TYPICAL LOADING COIL
27	109	102	92.8
29	102	95.6	84.5
31	95.2	89	78
33	89.4	83.5	72.5
35	84.3	78.6	66.2
37	79.8	74.7	61.5
39	75.7	70.2	56.5
41	72.1	66.5	52
43	68.7	63.3	47.5
45	65.7	60.3	42.5
47	62.7	57.4	—
49	60.3	55	—

Higher-Gain Designs

The freedom from antenna-size limitations at base stations makes it possible to employ higher-gain antennas using extended antenna elements or a group of radiating elements positioned one above the other. These more complex types of antennas make more effective use of transmitter power than simple antennas, thus improving the reliable transmission range of the system.

One popular base-station unit of the extended type is the coaxial half-wave antenna. In this arrangement, the transmission line (coax) is fed up through the center of a tubular "quarter-wave skirt," and the inner conductor is connected to the bottom of a smaller-diameter quarter-wave section that extends above the skirt. The outer (grounded) conductor of the transmission line is connected to the skirt at its upper end. This arrangement minimizes RF current on the outer conductor, thus increasing signal radiation at low vertical angles.

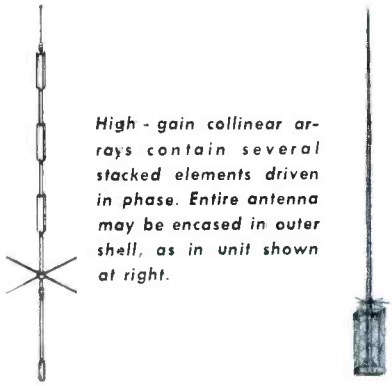


Coaxial antennas provide approximately 2 db gain over simple quarter-wavelength unit, with sharper vertical-directivity pattern.

Additional vertical-pattern directivity and gain may also be obtained by extending a half-wave antenna to

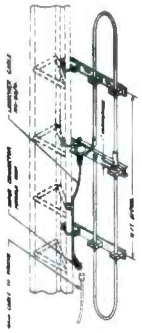
make it 5/8 wavelength long. At the center feed point, such an antenna displays a low enough impedance and reactance for convenient matching to a transmission line. This dimension is about the limit to which a simple pair of antenna elements can be extended in length. Beyond this dimension, additional vertical lobe patterns develop. Therefore, more of the radiated energy is directed upward and is of little benefit for ordinary two-way radio communications.

An antenna with even higher gain is the vertical collinear type, in which a number of half-wave antenna elements are stacked one above the other and fed in phase. A



High-gain collinear arrays contain several stacked elements driven in phase. Entire antenna may be encased in outer shell, as in unit shown at right.

vertical collinear arrangement maintains a fully omnidirectional horizontal pattern, but further sharpens the vertical directivity pattern. The gain of the resultant antenna is a function of the number of collinear elements added. Practical gains as high as 10 db can be obtained in this type of system.



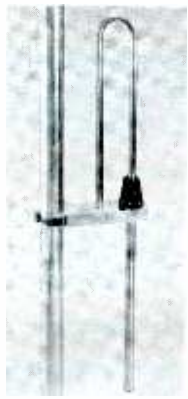
Special tower-mounted design, developed for CB use, utilizes tower as one leg of antenna. Various collinear stacking arrangements provide gains up to 5 db more than simple dipole.

Broadband Types

Single-element vertical antennas have a rather narrow bandwidth. As mentioned previously, they must be designed specifically for the assigned frequency. Otherwise, they must be cut, or a telescoping arrangement must be tuned exactly to frequency. In some communications assign-

ments, more than one transmitting frequency is used. If the frequencies are widely separated, it is necessary to use individual narrow-band antennas, or else compromise as much as possible by making a median cut between the two frequencies.

An alternate solution is to use an antenna in which the quarter-wave element is folded or has a large cross-sectional area. Either of these



Folded element, or "jay-pole," gives uniform results over wider band of frequencies than simple antenna rod; is vertically stacked for high-gain VHF operation.

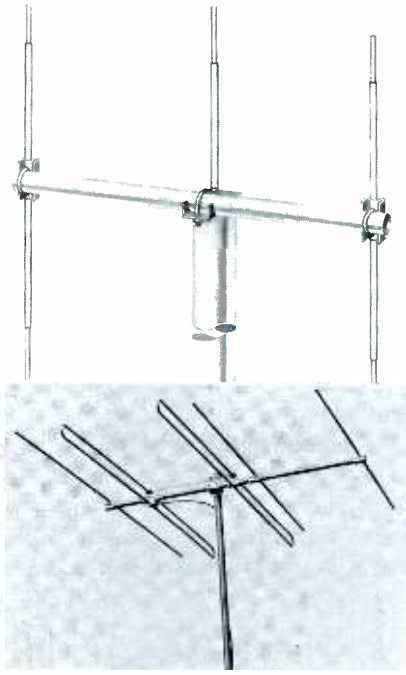
features helps to present a higher and more constant impedance to the transmission line over a wider-than-usual band of frequencies.

Point-to-Point Communications

In fixed, point-to-point communications services, directional antennas are often employed. In addition, this type of operation is also suitable for some base stations which communicate with a group of mobile stations, provided that the communications are all in the same general direction from the base location. Antennas are made directional by use of parasitic elements, or by feeding groups of elements in phased arrangements. Yagi antennas, similar to the cut-to-channel types used for TV reception, are among the most common directional designs in communications work. The narrower the directivity desired, the more parasitic elements can be added to the Yagi.

Conclusion

Antenna design is an important factor in compensating for differences in radio-wave propagation characteristics at various frequencies. For example, the short wavelength dimensions at UHF make it practical to build a very high-gain, multielement antenna for this band; such an antenna helps to lengthen the inherently short UHF transmission range. Similar antennas would be too huge and unwieldy to be



Three-element beam antenna—driven dipole flanked by reflector and director—has unidirectional reception pattern whether mounted horizontally or vertically. Additional parasitic (and driven) elements give beam or Yagi antennas higher gain, sharper directivity, and narrower bandwidth. Horizontal polarization is common in various point-to-point communications services.

practical on the longer-wave HF band, but this limitation on antenna gain is compensated for by the higher signal strength normally obtainable at a given distance from the transmitter at HF as compared to UHF.

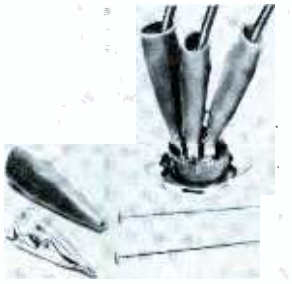
The objectives of any two-way communications system are very clearly defined from the beginning. Cost, convenience, and wise use of the airwaves all dictate that a highly efficient system be used; therefore, all components must be chosen to fulfill the exact requirements of the job as closely as possible. An intelligent choice of antennas plays a large part in meeting these needs. ▲

"I hate to send you up there, Frimly, but you know how difficult it would be to replace one of the other technicians."

PRODUCT report

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

Miniature Alligator Clip (37D)



The tip of the **Mueller** "Micro-Gator" test clip has jaws 1/32" wide, with a 7/32" maximum spread. This clip, available in cadmium-plated steel or solid copper, can be soldered onto #20 or smaller wires and crimped in place with strain-relieving ears. Sold separately are skin-tight, flexible vinyl insulators, which cover the entire clip, but are split at the tip to allow the jaws to open.

Portable CB Radio (38D)

Transistorized except for two tubes in the transmitter section, the **Vocaline** "Commaire" Model PT-27 Citizens band transceiver operates from a rechargeable battery. The unit transmits on any four CB channels, while the receiver circuit includes a switch to provide either fixed CB tuning or continuous tuning of the CB and standard AM broadcast bands. RF power output is ½ watt. A loading circuit and tuning meter aid in adjusting the built-in whip antenna for maximum efficiency.

Stereo Headset (39D)

Telex "Stereo Dyna-Twin" headphone sets have high sensitivity and extended frequency response to provide high-fidelity stereo listening. New-type muffs, made of soft foam rubber with secondary ear seals, form large cavities which cup the ears and keep out ambient noise. These headsets are made of stainless steel and "Tenite" plastic, with "Mylar" diaphragm and plastic headband.

Mobile TV Stand (40D)

The **Virginia** "Classroom TV Stand," for use in schools, hospitals, institutions, and industrial plants, holds a TV set approximately 5' above the floor—with a 5° downward tilt to reduce glare. The unit rolls on 4" ball-bearing casters with ⅞" tread (two of which are equipped with locks); clearances are high enough to permit the stand to be wheeled over a row of auditorium seats. Shelves are of ¾" plywood with natural lacquer finish.

Combination VTVM-VOM (41D)

Depending on the function-switch setting, the **Sencore** Model SM112 "Service Master" can be used as an AC-powered VTVM or as a portable VOM. A single, soldered-in test lead is used on all functions. The VOM section includes a DC current range, and the VTVM scales on the 6" meter are marked with arrows which light up to indicate which scale is in use. The only battery required is a Size D cell. Price is $69.50.

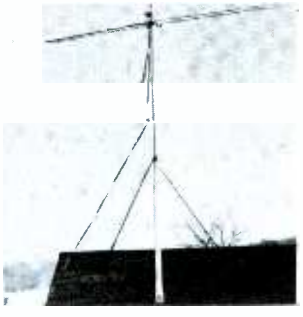
Transistor-Radio Components (42D)

Full complements of IF transformers and oscillator coils for pocket transistor radios are offered by **Vidaire** in both ¼" square and ⅜" square sizes. Two types of flat ferrite-loop antennas are also supplied—Model LA-21 for use with 211-mmf variable capacitors, and Model LA-36 for use with 365-mmf capacitors. Loop inductance is adjustable for tracking.

Extension Speaker System (43D)

Suggested as a supplementary speaker system, the **Jensen** Model X-10 has about 1/6 the bulk of a conventional bookshelf-type enclosure. (Dimensions are 7¼" x 13" x 4⅝".) A miniature, long-travel woofer is teamed with a 3" direct-radiator tweeter. A front-panel knob provides a volume adjustment. This system can be connected to amplifiers with output impedances of 4, 8 or 16 ohms; its power rating is 6 watts. The cabinet finish is oiled walnut, and the net price is $29.75.

Antenna Mount (44D)



The **TACO** "Bi-Mount" attaches a TV or FM antenna to a roof, utilizing the mast as one leg of a tripod. The structure can be fastened to a pitched roof, either straddling the peak or on a slope—or it may be placed on a flat roof. No guy wires are required. Two models are available: "Regular" with short mast, or "Super" with 10' mast. All necessary mounting hardware is furnished, including 50' of twin-lead if desired.

CONELRAD Alert (45D)

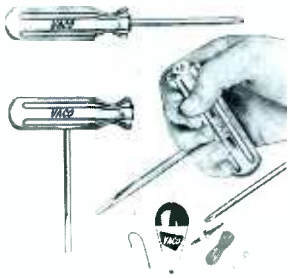
A new, more compact version of **Kaar Engineering's** "CONALERT III" silent CONELRAD monitor is obtainable either with cabinet (as shown) or for rack mounting. When the carrier of a received station goes off the air, or the signal is interrupted by receiver failure, a warning signal is given. A red lamp lights on the front panel, and an external alarm system can also be triggered. Price is $149.

Tube-Tester Data Book (46D)

A revised setup-data chart for the **Seco** Model 107 tube tester has been issued in a new format—a 70-page, 7½" x 3½" booklet printed on heavy card stock. Pages are thumb-indexed to speed up location of tube types. A 13-ring flexible plastic binding allows the book to lie flat when opened to any page. Coverage includes foreign and industrial tube types as well as domestic entertainment types. Price of this FC-4 index is $2.

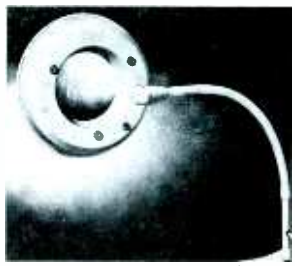
Screwdriver Kit (47D)

A blade can be inserted in either the side or the end of the handle supplied with the **Vaco** "Side Arm" screwdriver set, so the tool can be used as a high-torque "T"-handle unit as well as in normal fashion. The kit includes a ¼" x 5" regular blade and a No. 2 Phillips tip, plus a bonus item—a "Handi-Angler" fishing kit. Separately available are 12 other blades to fit this handle.



Gooseneck Inspection Lamp (48D)

An illuminated magnifier connected by a swivel joint to a 15" gooseneck stem, the **Swing-O-Lite** "Inspector" Model M4, has a 22-watt, shadow-free "Circline" fluorescent lamp surrounding a magnifying glass with 13" focus. (Stronger-magnification lenses are available.) Units are offered in three colors with a choice of permanent, wall, or table mounts.



Dual Concentric Controls (49D)

Replacements for over 200 types of dual concentric controls can be made up from the **Clarostat** "Uni-Tite" line, which consists of 35 basic rear units, 30 front units, 3 switches, and assorted shafts. Assembly procedure is as follows: Snap a shaft onto each control to be used, slide the two units together, turn 45° to lock, and add a switch if one is called for.

Volt-Ohmmeter (50D)

The **Triplett** Model 800 VOM measures DC voltages in six ranges from 0.6 to 1200V full scale; AC voltages in five ranges from 3 to 1200V; ohms in six ranges of x1 to x100K; and current in five ranges from 1.2 ma to 12 amps. An accessory probe extends voltage scales to 6000V. Also, polarity-reversing and range-dividing positions are provided on the function switch to give a total of 70 ranges. AC readings are frequency-compensated from 40 cps to 20 kc. Sensitivity is 20,000 ohms per volt on DC and 10,000 ohms per volt on AC.

Inverted Oval Speaker (51D)

A new 5" x 7" replacement speaker for auto radios, the **Utah** Model SP57NC, uses inverted construction (with the magnetic structure in front of the cone). This feature keeps total depth down to 1¾"—28% less than for a typical conventional unit. Mounting dimensions follow EIA standards. Magnet weight is 1.47 oz; peak power is 8 watts; list price is $7.25.

Receiving Tubes (52D)

Seven new types have been added to the **Sylvania** line of entertainment-type receiving tubes. Descriptions and applications are as follows: 4GS8/4BU8 twin pentode, sync separator-noise limiter-keyed AGC in series-string receivers; 6DT6A pentode, amplifier and FM detector; 6HJ8 diode-pentode, IF amplifier-video detector; 6HS8 twin pentode, sync-AGC combination; 6EW7 double triode in 9-T9 construction, combined vertical oscillator-output; 12FQ8 twin double-plate triode, harmonic generator in electronic organs; and 14GT8 duplex diode-triode, FM detector-AF amplifier in home radios.

Antenna-Signal Amplifier (53D)

The amplifier circuit in the **Winegard** AT-6 "Booster-Pack" broadband TV-FM amplifier, using a low-noise MADT transistor, develops a gain of 16 db on the low VHF band and 14 db on the high band. A three-position switch selects full gain, reduced gain, or amplification of signals picked up on the line cord in strong-signal areas. The unit obtains AC power through an isolation-transformer supply. List price is $34.95.

Public Address Speaker (54D)

An array of 12 cone-type 4" speakers in a curved housing, the **Electro-Voice** LR-4 "Line Radiator," provides unusually broad (160°) sound dispersion in a horizontal plane, while minimizing upward and downward radiation. Frequency response extends up to 10 kc, but is cut off below 200 cps to reduce resonant effects. The wooden enclosure measures 49" high x 7" wide x 13" deep. Impedance is 8 ohms; "program power" rating is 30 watts; price is $80.

Semiconductor Devices (55D)

The newly-announced **International Rectifier** Commercial Products line includes the following items: Solder-in and plug-in selenium rectifiers (some with installation kits), selenium dual-diode AFC units, compact selenium power rectifiers with ratings from 75 to 650 ma, Type TV-500 "Unistac" silicon rectifiers mounted on heat sinks, Type TV-502 silicon rectifiers for color TV receivers, solar cells, and photocells.

Commercial Speaker Baffle (56D)

Designed for room-corner installation in schools, offices, and public places, the **Lowell** Model RJA loudspeaker baffle is available in three versions to accommodate 6", 7", and 8" speakers. The aluminum grille is normally supplied with a clear lacquer finish, suitable as a primer for painting; however, anodized grilles in various colors are also obtainable. The metal enclosure behind the grille is heavily undercoated to damp out resonance, and is large enough to provide room for line-matching transformers and volume controls.

Garage-Door Opener (57D)

The latest **Perma-Power** garage-door operator, No. G653, uses an all-transistor receiver to actuate the door mechanism. The transmitter, also transistorized, is housed in a molded plastic case (see photo), small enough to clip onto the sun visor of the car. The operating range of the system is more than 50'. As protection against interference or unauthorized operation, 72 different radio-frequency channels are available. The system is designed for one-man installation and has a list price of $224.95.

INDEX TO ADVERTISERS

July, 1961

ANTENNAS AND ACCESSORIES

1D. JFD—New 1961 *Exact-Replacement Antenna Guide Wallchart for Portable and Toteable TV Sets.* Gives TV-receiver model number, manufacturer's antenna part number, and model number of corresponding JFD exact-replacement antenna. Also Form 940 dealer catalog illustrating and describing 1961 line of natural silver and gold-anodized *Hi-Fi* TV antennas, mounts, masts, *Mardi Gras* TV tables, accessories.

2D. JERROLD—"Products For Better Televiewing," a 12-page catalog of home TV reception aids, TV distribution systems, antenna-system test equipment, and accessories. *See ad 2nd cover.*

3D. WINEGARD—4-page technical brochure on distribution amplifiers, accessories, and *Powertron* antennas; also information sheet on transistorized *Booster-Pak*. *See ad page 21.*

AUDIO AND HI-FI

4D. CENTRALAB—New catalog giving detailed data on new miniature L & T pads as well as special switches and hardware for sound-system applications. *See ad page 38.*

5D. ELECTRO-VOICE—"PA Speaker Factbook and Installation Guide," *Power Point* needle and cartridge catalog No. 143, and commercial sound microphone catalog No. 141.

6D. SONOTONE—Flyer SAH-41 on low-impedance ceramic microphone CM-12A equipped with "push-to-talk" button. *See ad page 49.*

7D. SWITCHCRAFT—New Product Bulletin No. 112, describing new *Handy Adapter Caddy Kit* for servicemen. Kit contains 11 adapters and one "universal application" cord for hundreds of interconnections.

BUSINESS AIDS

8D. OELRICH—Free sample pack of six most popular salesbook and "one-time carbon" forms for radio-TV service use; also condensed catalog.

9D. SYLVANIA—Free window streamer to sell your service for expert repairs on transistorized radios, auto radios, and hi-fi. *See ad page 25.*

COMMUNICATIONS RADIO

10D. ANTENNA SPECIALISTS—"Choosing the Proper Antenna for Class D Citizens Band Equipment" (Form SD-157), and "Class D Citizens Band Channels-to-Mc" conversion chart (Form SD-155).

11D. EICO—New 32-page catalog of kits and wired equipment for Citizens band transceivers, ham gear, transistor radios, stereo and monophonic hi-fi, and test equipment. Also, "Stereo Hi-Fi Guide," and "Short Course for Novice License." *See ad page 71.*

12D. ELECTRO PRODUCTS LABS — Product-information sheet on Model PS-30 heavy-duty DC power supply for communications servicing, which provides 30 amps at 12 volts in continuous duty, with less than 1% ripple. *See ad page 48.*

13D. HY-GAIN — Pocket-sized Citizens band antenna catalog, including details on all-new line of antennas for mobile installations.

14D. MARK MOBILE—Data sheets on base-station and vehicular antennas for use on 27-mc Citizens band; also information on models for two-way communications services in 25-50 mc, 144-174 mc, and 450-470 mc bands. *See ad page 66.*

COMPONENTS

15D. ARCO—Circular on *Deal No. 140W* kit, including 140 *Elmenco dp* dipped *Mylar*-paper capacitors (in 10 most popular values) plus 100-watt soldering gun, at special combination price of $29.95. *See ad page 15.*

16D. BUSSMANN—Form SFB, 24-page booklet giving detailed information on complete line of *BUSS* and *FUSETRON Small Dimension* fuses and fuse holders —the ones most used in protecting electronic equipment. *See ad page 39.*

17D. CLAROSTAT — Information sheet on new *Uni-Tite* line of universal-replacement dual concentric controls. *See ad page 41.*

18D. SPRAGUE—Catalog C-457, in form of hanging wall chart, showing all popular types of capacitors for TV-radio replacement use. *See ad page 10.*

19D. STANCOR—New catalog S-106 listing nearly 900 stock transformers and chokes for radio, television, communications, and industrial applications.

RADIOS

20D. ATR—Literature on *Customized Karadios,* ideal for use in small imported cars. Units feature excellent sensitivity, tone, and volume, with eight-tube performance. *See ad page 14.*

SEMICONDUCTORS

21D. SEMITRONICS—Replacement and interchangeability charts covering domestic and Japanese transistors, in addition to selenium and silicon power rectifiers. *See ad page 63.*

SERVICE AIDS

22D. BERNS—Data on 3-in-1 picture-tube repair tool, 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 46.*

23D. CASTLE—Leaflet describing fast overhauling service on television tuners of all makes and models. *See ad page 59.*

24D. MAGNAVOX—Information on *Handi-Tool* four-way wrench for removing special nuts from TV and stereo control assemblies; *Record Changer Hardware Kit* including 113 springs, clips, washers, and similar parts; and 12" stereo-monophonic test record for hi-fi servicing.

25D. PRECISION TUNER — Information on repair and alignment service available for any type of TV tuner. *See ad page 48.*

26D. YEATS — Literature describing *Appliance Dolly* and padded delivery covers. *See ad page 64.*

SPECIAL EQUIPMENT

27D. ACME ELECTRIC — Catalog sheet 17-BL01 on portable and rack-mounted DC power supplies with continuously variable output from 0 to 45 volts, stabilized within ±1%; maximum current output 2.5 amps. *See ad page 70.*

28D. G-E COMMUNICATIONS—Series of 4-page bulletins on 14", 17", and 21" monitor receivers for closed-circuit TV installations and broadcast-station use.

29D. VIRGINIA—Data sheet on *Classroom TV Stand*—a rack with tubular metal frame, mounted on casters, which holds TV set approximately 5' off floor for viewing in schools, hospitals, institutions, and industry. *See ad page 65.*

TECHNICAL PUBLICATIONS

30D. GRANTHAM — Booklet entitled, "Careers in Electronics," outlining training courses available. *See ad page 53.*

31D. RIDER — Latest book list. *See ad page 42.*

32D. HOWARD W. SAMS — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics servicing. *See ads pages 50, 51, 54, 64.*

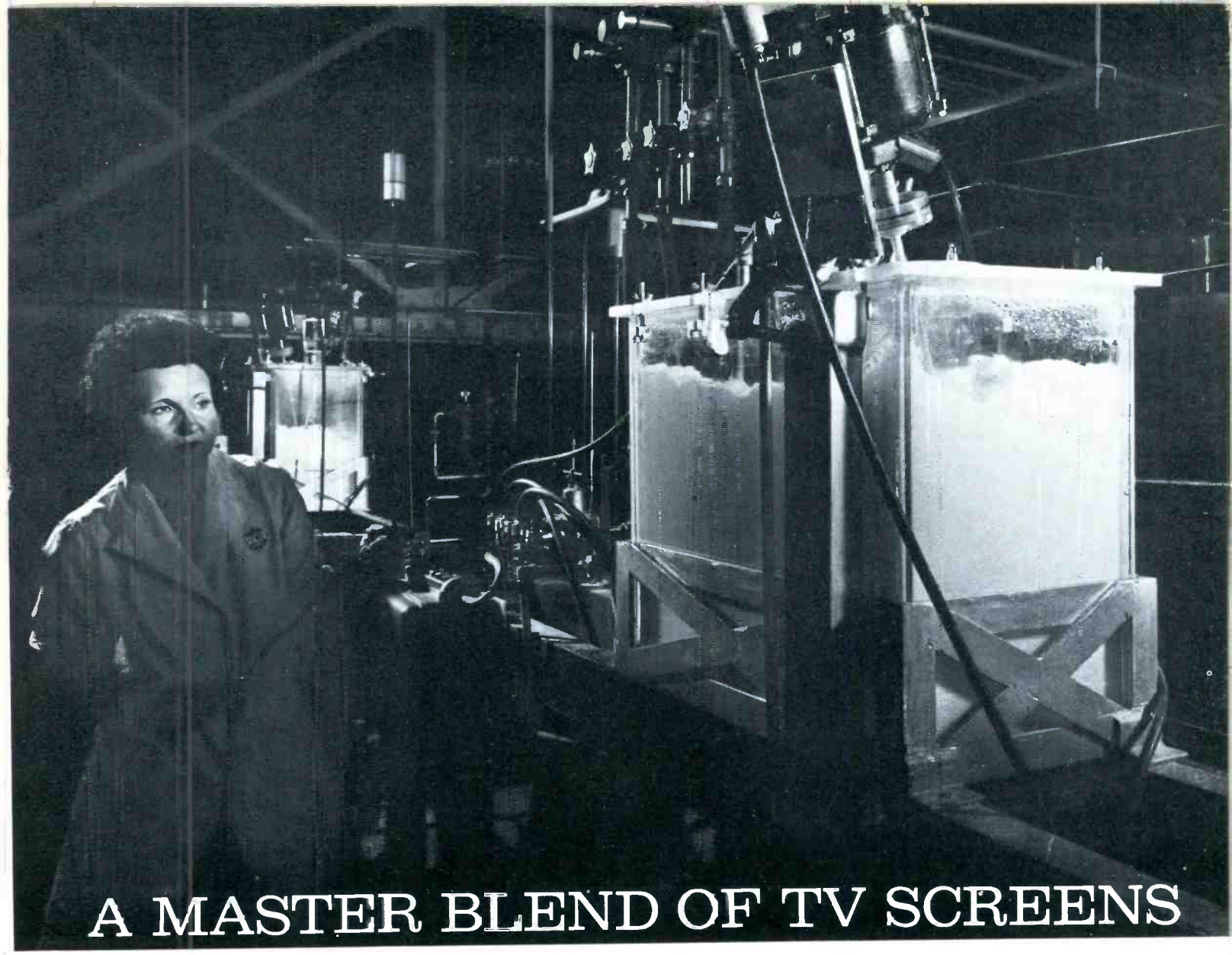
TEST EQUIPMENT

33D. B & K—Catalog AP-17R giving information on new *V O Matic 360 Automatic Volt-Ohm-Milliammeter,* new Model 600 *Dyna-Quik* tube tester, Model 1076 *Television Analyst,* Models 1070 and A107 *Dyna-Sweep Circuit Analyzers,* Model 610 test panel, Model 160 transistor tester, and Model 440 CRT cathode rejuvenator-tester. *See ad page 13.*

34D. HICKOK—Form TT611 describing new Model 890 in-circuit transistor tester and complete line of other transistor testers. *See ad page 57.*

35D. METREX—Serviceman's guide, "Cramful of Shortcuts," dealing with trouble-shooting, alignment, and calibration of radio, TV, hi-fi, and related equipment; also manual for operation of new *Genie* pocket-size signal generator. *See ad page 46.*

36D. SENCORE—New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter,* plus brochure on complete line of *timesaver* instruments. *See ads pages 35, 37.*



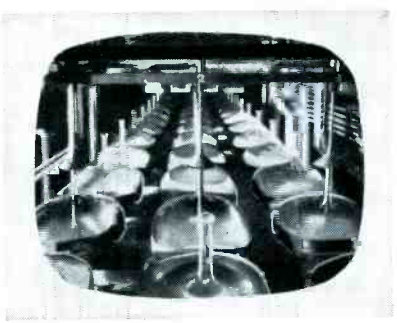
A MASTER BLEND OF TV SCREENS

RCA's Precise Control of Phosphors Assures Finest Picture Quality

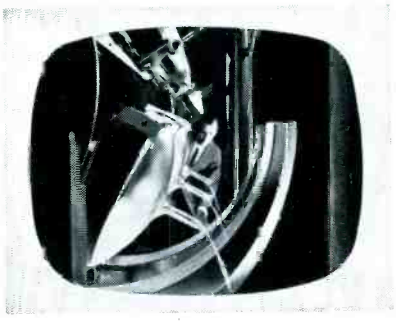
Here RCA Silverama Picture Tube screens have their beginning.

Phosphor in a solution of demineralized water (impurity level: less than 1 part per million!) is continuously agitated by electric blenders to maintain uniform suspension. When mixing is complete, solution is sprayed into Silverama's glass envelope which has been scrubbed and rinsed until it is chemically clean. Then with tube on slow-moving, vibration free settling belts (below), phosphor settles evenly over the entire faceplate to provide the smooth, grain-free screen for which Silverama is famous.

This same painstaking care goes into every part of RCA Silverama picture tubes. It is your assurance that every Silverama is the finest replacement picture tube modern science and technology can produce. It contains a precision electron gun—the finest parts and materials, plus a thoroughly clean and inspected reused envelope. Such built-in quality means a better picture in your customers' sets—and therefore, more business, fewer callbacks and valuable word-of-mouth advertising for you. See your Authorized RCA Distributor this week.



Settling belt moves at less than 10 inches per minute to give ample time for gradual settling and smooth adherence of phosphor to faceplate.



When settling is complete, excess liquid is poured slowly and gently from neck of envelope to avoid disturbing smooth phosphor coating.

RCA ELECTRON TUBE DIVISION, HARRISON, N. J.

RCA®

The Most Trusted Name in Electronics

RADIO CORPORATION OF AMERICA

dealer-serviceman's fuse rack . . .

. . . for wall mounting

most needed

most wanted

. . . the FUSEMASTER!

dealer-serviceman's fuse requirements at a glance