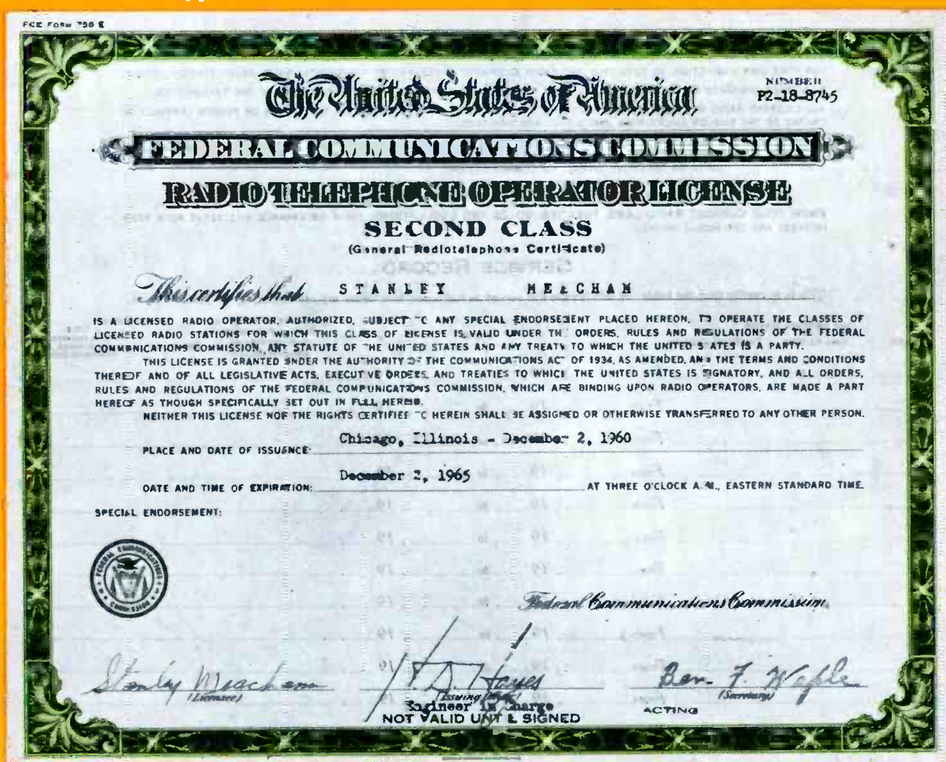
SEPTEMBER, 1961 35 CENTS

PF REPORTER

PHOTOFACT

including **Electronic Servicing**

SPECIMEN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The United States of America

NUMBER P2-18-8745

FEDERAL COMMUNICATIONS COMMISSION

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SECOND CLASS

(General Radiotelephone Certificate)

This certifies that STANLEY MEACHAM

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PLACE AND DATE OF ISSUANCE: Chicago, Illinois - December 2, 1960

DATE AND TIME OF EXPIRATION: December 2, 1965 AT THREE O'CLOCK A.M., EASTERN STANDARD TIME.

SPECIAL ENDORSEMENT:

Federal Communications Commission

Stanley Meacham (Licensee)

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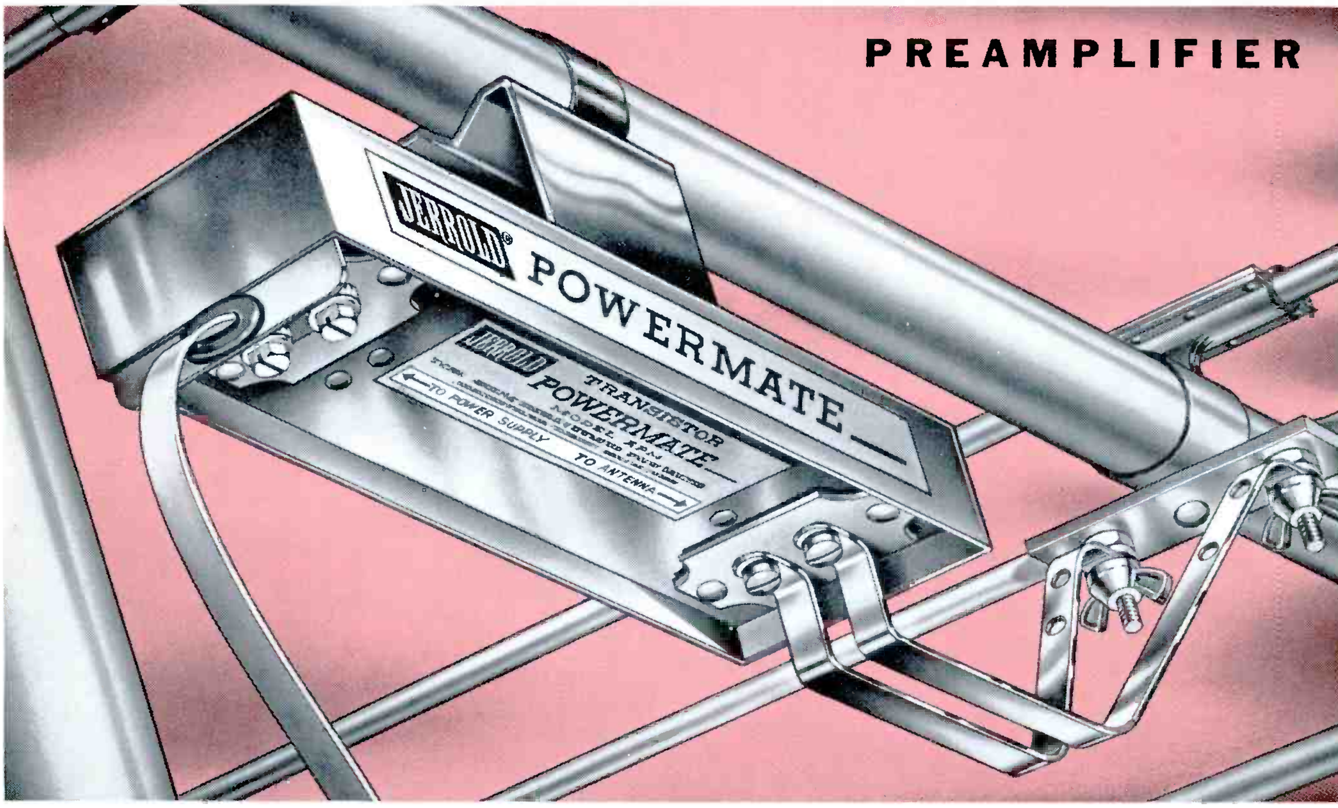

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Here's the preamplifier for every TV antenna in your area, whether new or up for years! The exclusive universal bracket of the new JERROLD Transistor POWERMATE permits mounting directly on the antenna boom (for greatest boost before downlead losses) or at *any* other point—along the mast, on the wall or windowsill, behind the set—anywhere your best judgment dictates.

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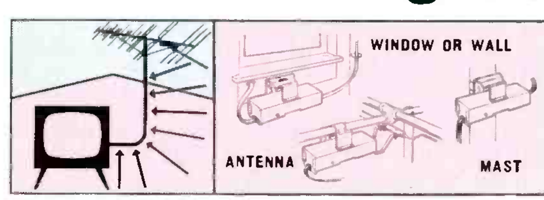

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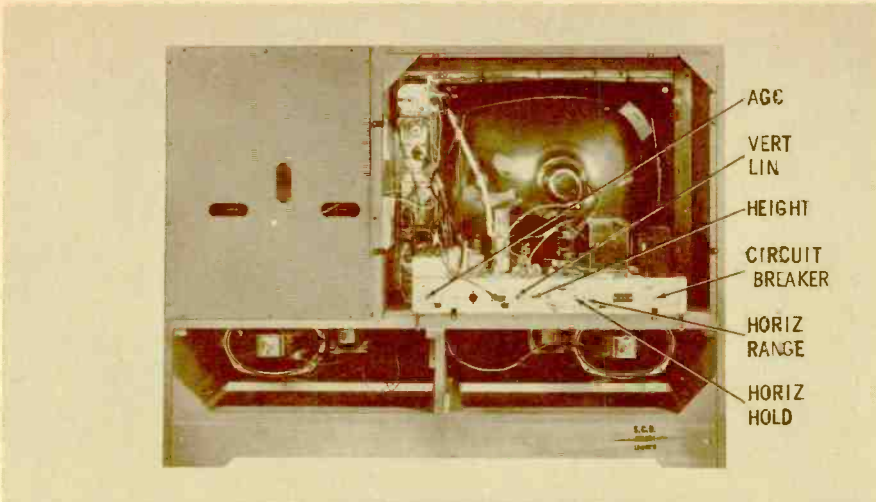
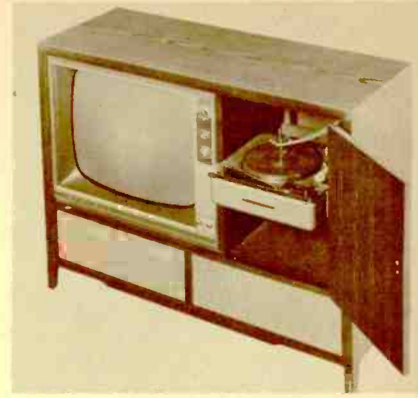
PREVIEWS of new sets — Admiral





Admiral Model STG24K131 Chassis 20L7

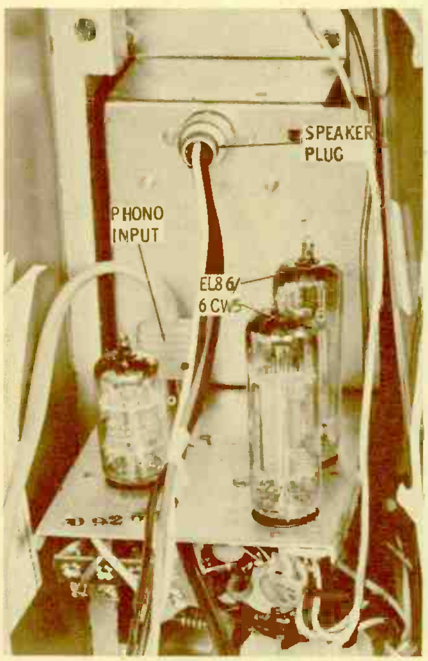
This combination TV and stereo phono, the *Berkeley* model from the *Presidential* line by Admiral, features a slide-out four-speed record changer of the RC7 series. The TV section uses a 92°, 23" picture tube with separate safety glass — a 23AHP4 in early-production models, or a 23AUP4 in chassis coded Run 11 and higher. All operational controls except horizontal hold are grouped on the escutcheon between the picture tube and the phonograph compartment; the hold control is a plastic tube projecting from the rear apron of the TV chassis.

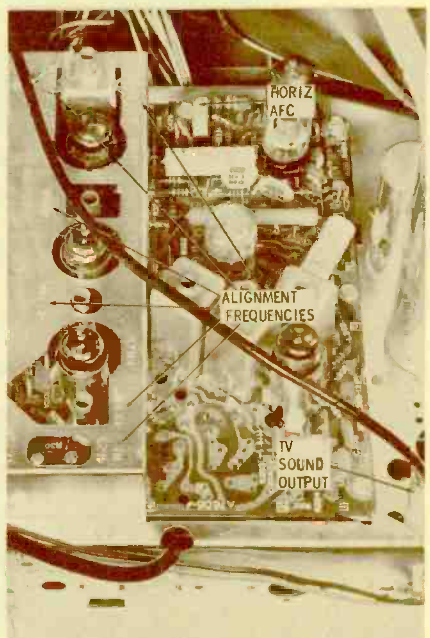
The 18-tube, transformer-powered chassis and the picture tube form a one-piece unit. Setup adjustments are clearly marked on the rear apron. The AGC and horizontal range controls are both covered with warning labels to protect them from customers and remind servicemen to follow procedures outlined in service data. When it becomes necessary to remove the chassis, the whole unit can be slid out the front of the cabinet after removal of the chassis bolts, as well as the four 5/16" hex screws which hold the mask in place and are located inside the front of the cabinet.

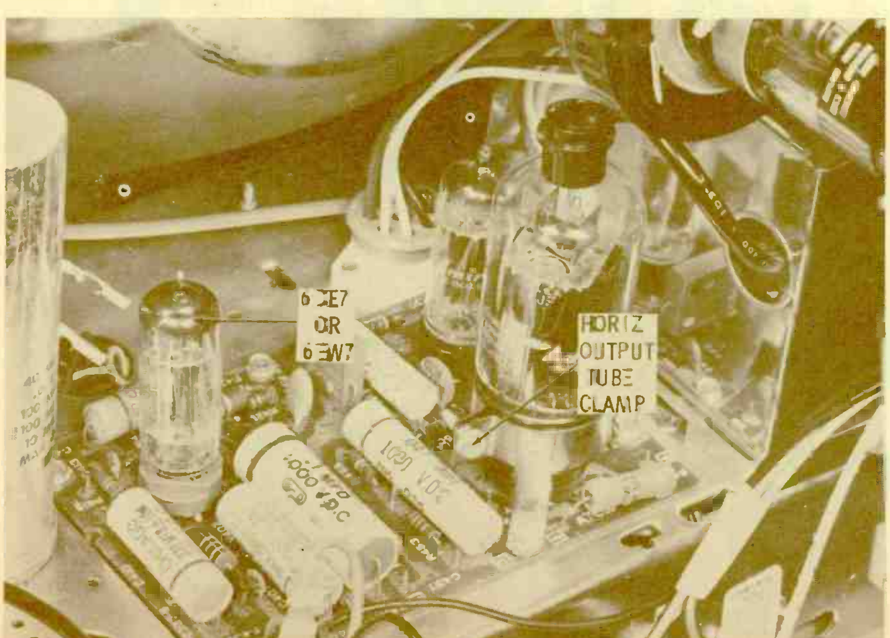
A compact, three-tube stereo amplifier chassis, using a pair of EL86/6CW5 output tubes, is mounted to the front escutcheon. Sockets for the speaker and phono-input plugs make it easy to disconnect the amplifier when removing the chassis.

TV sound output comes from a phono jack just to the right of the printed board which holds the signal circuits. As an aid in alignment, IF-coil frequencies are stamped into the shield covering the video IF strip. Although the remainder of the sweep circuits are contained on another board, the common-cathode AFC dual diode plugs into a socket on this board.

The sweep-circuit printed board includes the horizontal output stage, and the 6DQ6A used in this circuit is held rigidly in place by a screw-tightened clamp that grips the edges of the board. Early-production chassis had a 6DE7 tube in the combined vertical multivibrator and output circuit; however, starting with Run 11, a new type—the 6EW7— is used in this application.







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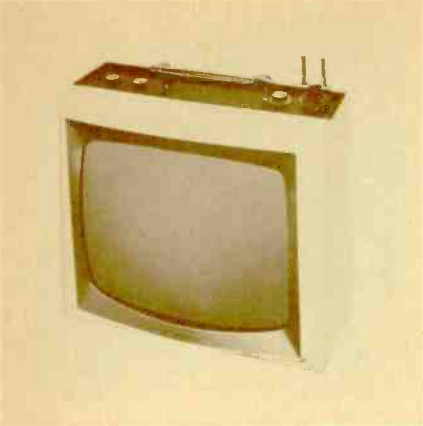
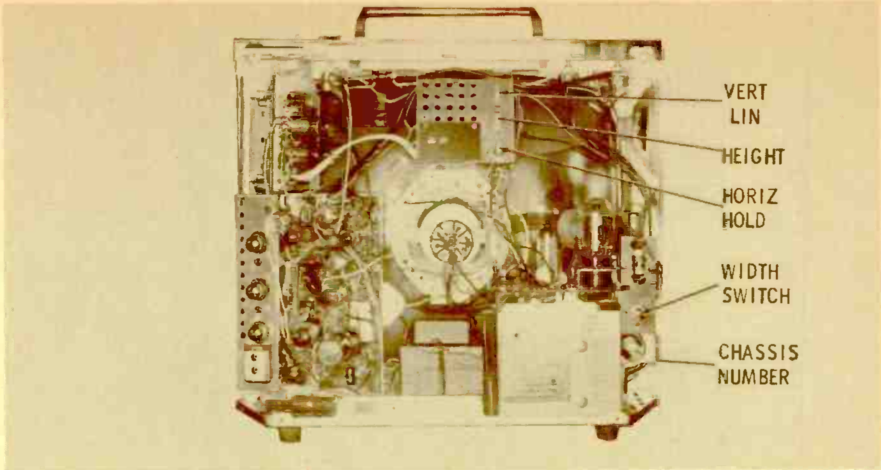


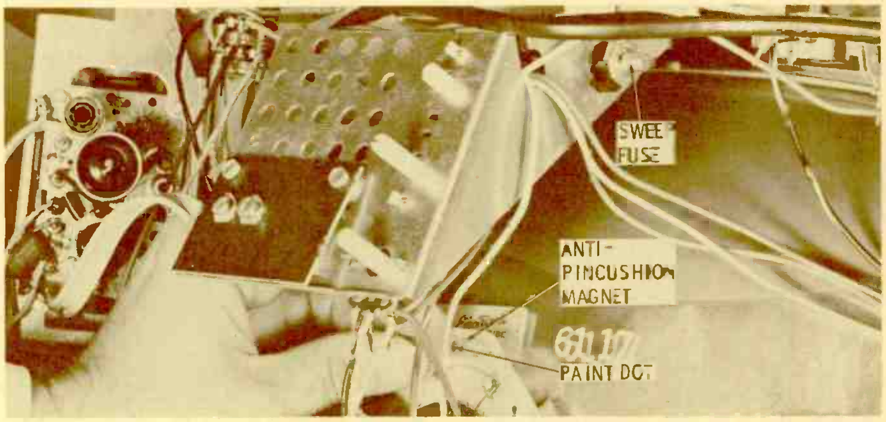


General Electric Model M240WVY Chassis LW

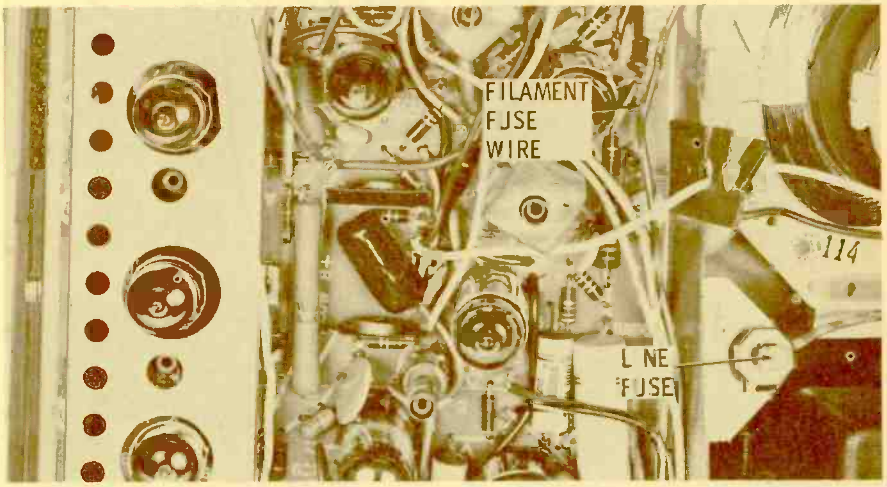
G-E has introduced a new line of portable TV sets. Known as the *Celebrity* series, these 19″ receivers have top-mounted controls and a built-in dipole antenna. All use a 114° 19ZP4 picture tube and a plastic safety glass. The inside of the glass can be cleaned after removing the chassis. *Caution:* Use only mild soap and water to prevent damage to the plastic.

The 16-tube, transformer-powered chassis fits snugly around the bell of the CRT. Printed circuitry is used for all stages except the power supply and damper. Setup adjustments, except for a width switch, are mounted on a top conrol panel.

A 3/10-amp, type-N sweep fuse is mounted on the right side of the control panel. At the top and bottom of the yoke, holes are provided for snap-in anti-pincushion magnets. The magnets may be omitted if no correction is needed, mounted on the back side of the yoke for moderate correction, or plugged into the front side of the yoke for maximum effect. A paint dot identifies the polarity of the magnets. For a magnet attached to the top of the yoke, this dot should face the sweep board; for a bottom magnet, it should face the main printed board.

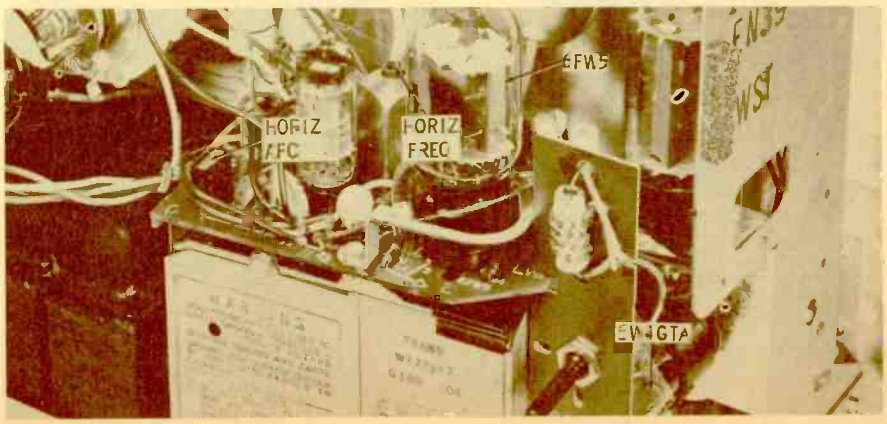


The latter contains all of the signal and vertical-sweep circuits. In addition, this section of the chassis includes a 2″ length of No. 26 wire protecting tube filaments, and a 3½-amp, type-C fuse in series with the transformer primary.



Tube-type numbers and lines indicating wiring paths are marked on the component side of both boards as a servicing aid. Although most service work can be performed from this side, it is also possible to gain access to the foil side of the main board by removing three metal screws from the left side and two from below.

Removing three metal screws from the sweep board also permits it to be raised for below-board servicing. The AFC diode and the horizontal multivibrator occupy the left end of the board. To the right is a new horizontal output tube with no cap, a 6FW5, held in place by a ring-type clamp. Below and to the right is the damper, a 6W4GTA — a modernized version of an old-time favorite.



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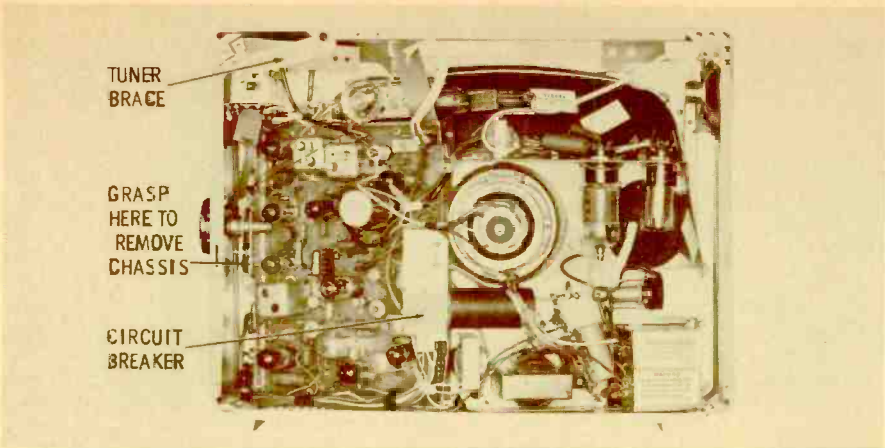
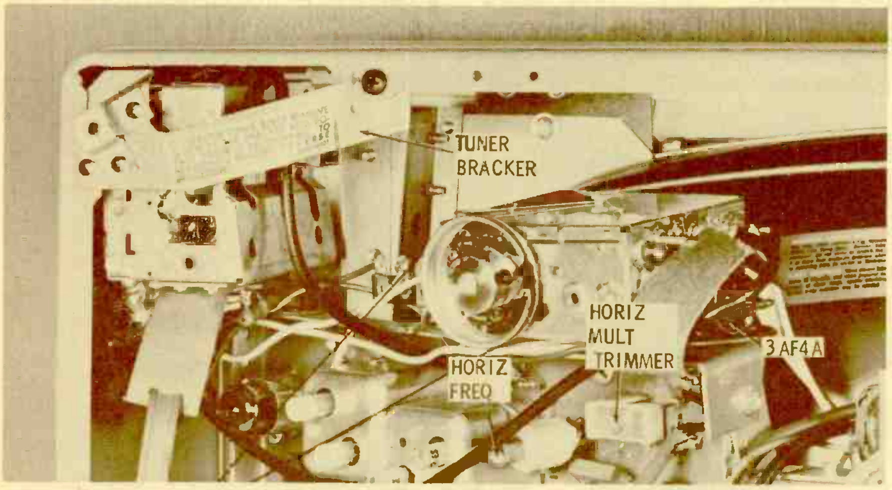


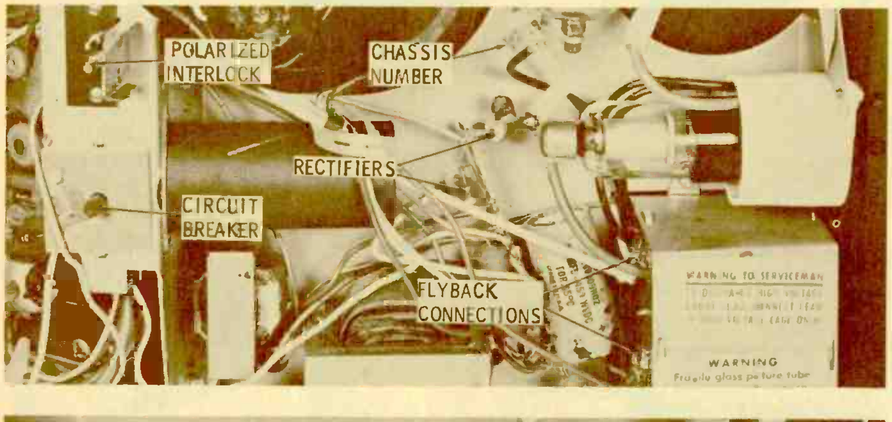
Westinghouse Model H-P3150U Chassis V-2384-15

The 1961 line of Westinghouse portables includes both 17" and 19" models. This one is a UHF version with a 110°, 17EBP4 picture tube. The 19" sets use a 114°, 19AHP4 CRT and a V-2412-series chassis. Plastic safety shields are used in all models. All controls are front-mounted. The height and vertical linearity adjustments are accessible through holes in the cabinet hidden by the VHF channel selector knob.

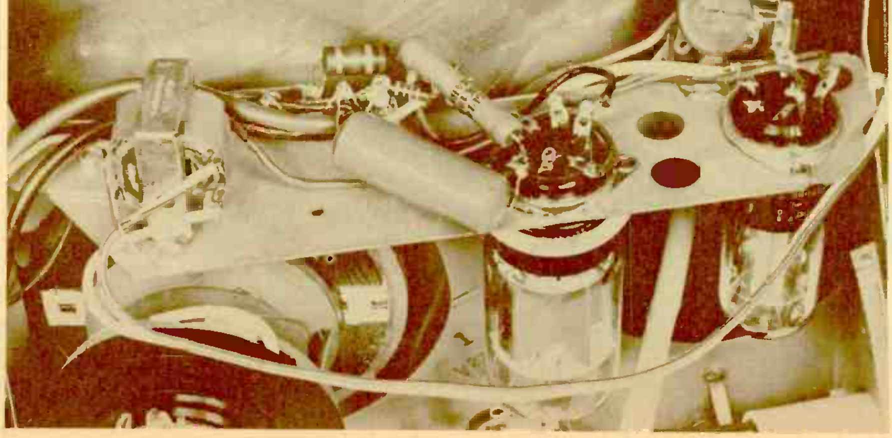
Nearly every component in the set is within easy reach when the back is removed. The compact, one-piece chassis is nestled around the picture-tube bell. Since it fits the cabinet so snugly, there is a special knack to removing it. After three bolts are removed from the front, and six from the bottom, a screw holding the tuner brace can be removed and the brace swung down. Grasp the chassis at the point indicated in the accompanying photo, and pull on the chassis as you pry on the tuner to clear the cabinet. Pull it out as far as it will go; then tip the chassis forward slightly and remove it from the cabinet, tuner end first.



The tuner bracket must also be loosened and swung out of the way to permit access to the tubes in the VHF tuner when the chassis is in the cabinet. Notice that a 3EA5 RF amplifier and 3AF4A UHF oscillator are used in this chassis. These 450-ma series-string tubes are rare enough that you probably don't have them in your caddy. The same thing goes for the 8CS7 serving the combined vertical multivibrator-output circuit.



The "hot" chassis has a polarized line plug and AC interlock, with one terminal of larger diameter than the other, to guard against accidental shocks. Circuit protection for this chassis comes from a circuit breaker in series with the power supply. The latter contains a pair of silicon rectifiers in a half-wave-doubler configuration. Notice that the flyback connections have been brought outside the cage to simplify servicing.



The upside-down mounting of the horizontal output and damper tubes, with socket connections out in the open, also facilitates troubleshooting the horizontal circuits.

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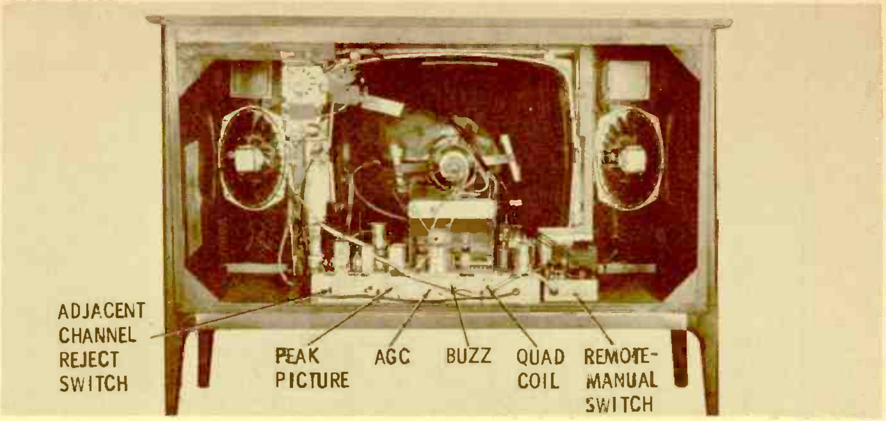


Zenith Model G3360W Chassis 17G28Q

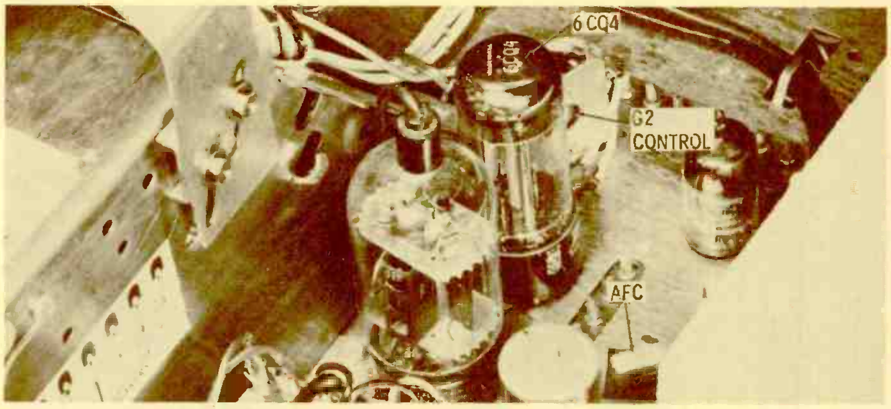
This is one of six models using the most deluxe chassis in the Zenith "G" line. All are equipped with the *Space Command 400* remote control system and a 92°, 23AFP4 picture tube with bonded safety shield. The tuner used in these receivers is the *Gold Video Guard*, a turret type with contacts made of a gold, silver and platinum alloy for improved performance. The door below the CRT covers most of the setup adjustments as well as the contrast and *dynamic contrast* push-pull switch. The latter is used to switch a DC restorer in or out of the circuit.

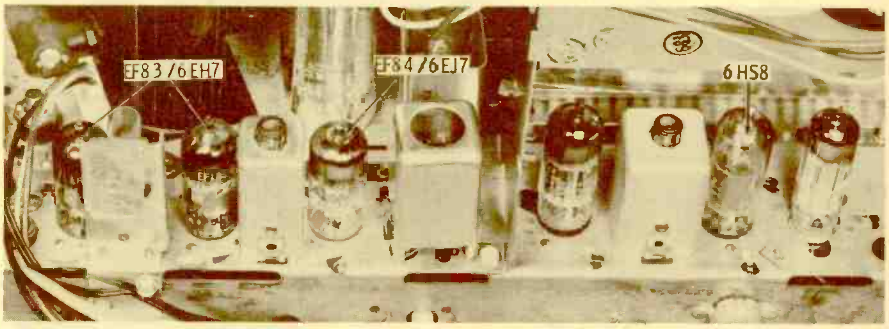
The rear apron of the chassis contains the remaining setup controls, plus a special switch and control which affect picture quality as follows: The *adjacent channel reject switch* cuts a 47.25-mc trap in and out of the circuit. If there is no interfering sound signal on the next lower channel, better video response is obtained with the switch in the OUT position. The *peak picture control* is a potentiometer in the video detector circuit for regulating video-frequency response.

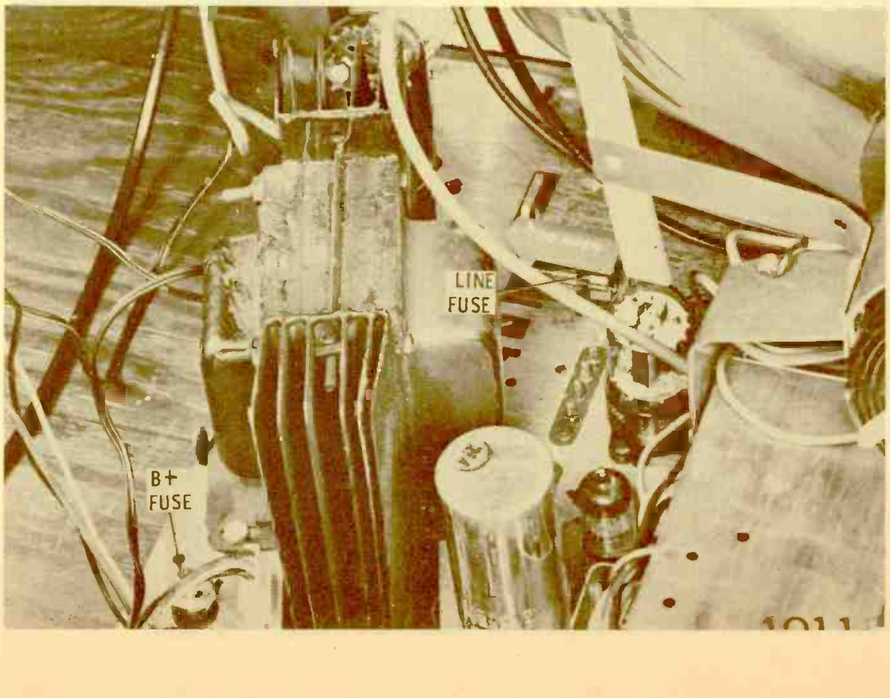
Atop the chassis, behind the new 6CQ4 damper, an unmarked control provides adjustment of the voltage applied to the accelerating anode (G2) of the CRT. It should be adjusted for 450 volts on pin 10 of the picture tube with a station signal tuned in. To the right of the damper you'll find the plug-in dual horizontal AFC diode.

Most of the tubes along the back edge of the chassis are new types. The first and second video IF stages each use an EF183/6EH7, and the third video IF tube is an EF184/6EJ7. Both types are 9-pin miniatures with built-in shields. A 6HS8, a hopped-up version of the 6BU8, serves as the sync separator, AGC keyer, and noise limiter.

The left side of the chassis contains a 3DG4 low voltage rectifier and a 6AL5 serving as a DC restorer and retrace clamper. Fuses for the transformer-powered chassis are also located in this area. They include a 7/10-amp, type-N unit protecting B+, and a 5-amp, slow-blow type in series with the primary of the transformer. The filaments are protected by a 1½" length of #24 copper wire located beneath the chassis.







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See PHOTOFACT SET 531, Folder 2

Mfr: Philco **Chassis No. 11H25**

Card No: PH 11H25-1

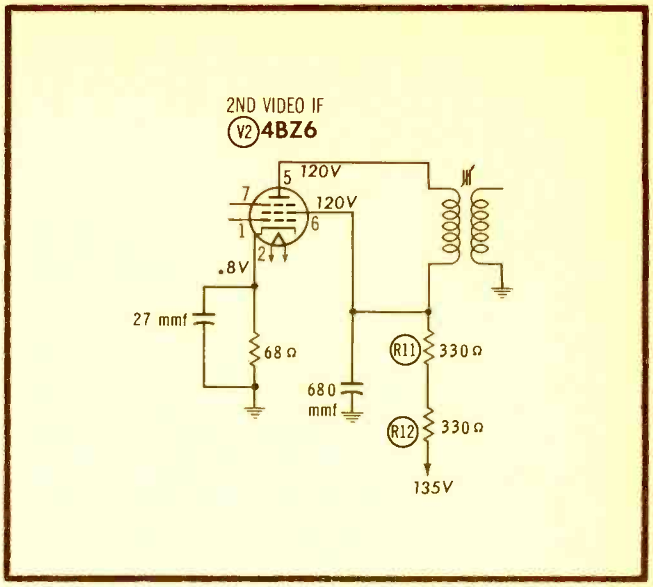
Section Affected: Pix and sound.

Symptoms: No picture or sound. Raster OK.

Cause: Shorted V2, 4BZ6 2nd video IF amplifier, causing decoupling resistors R11 and R12 to burn.

What To Do: Replace 4BZ6, and R11 and R12 (330 ohms each).

CAUTION: Replacing only tube will in some cases permit set to operate, but with lower IF gain. Be sure to check R11 and R12 when tube is replaced.



Mfr: Philco **Chassis No. 11H25**

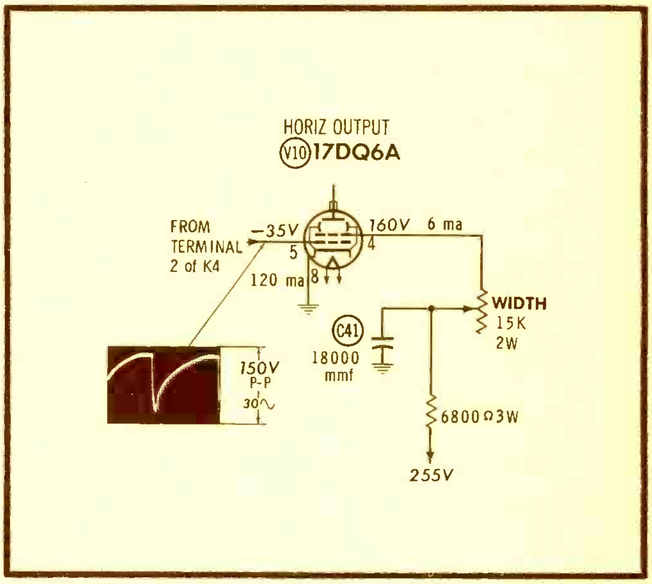
Card No: PH 11H25-2

Section Affected: Pix.

Symptoms: Picture shrinks horizontally.

Cause: Leaky horizontal output screen-bypass capacitor.

What To Do: Replace C41 (18000 mmf).



Mfr: Philco **Chassis No. 11H25**

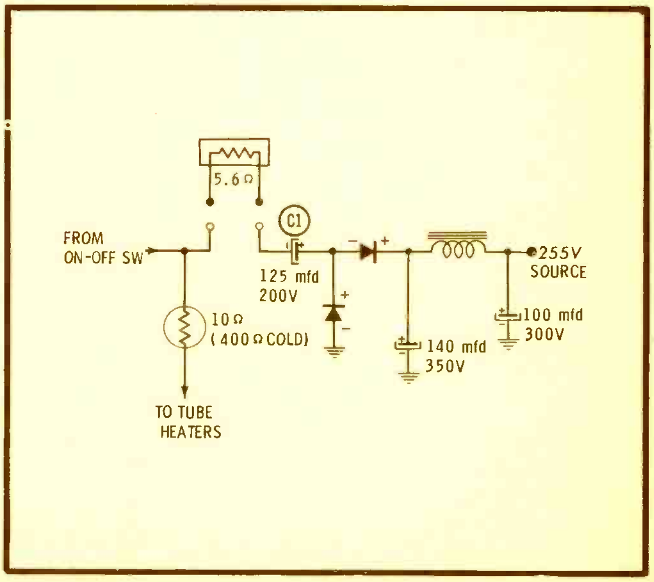
Card No: PH 11H25-3

Section Affected: Pix and sound.

Symptoms: No picture or sound; no B+.

Cause: Open series feed capacitor to B+ rectifier input circuit.

What To Do: Replace C1 (125 mfd—200V). Note that both ends of this capacitor are above ground and proper case insulation is required.



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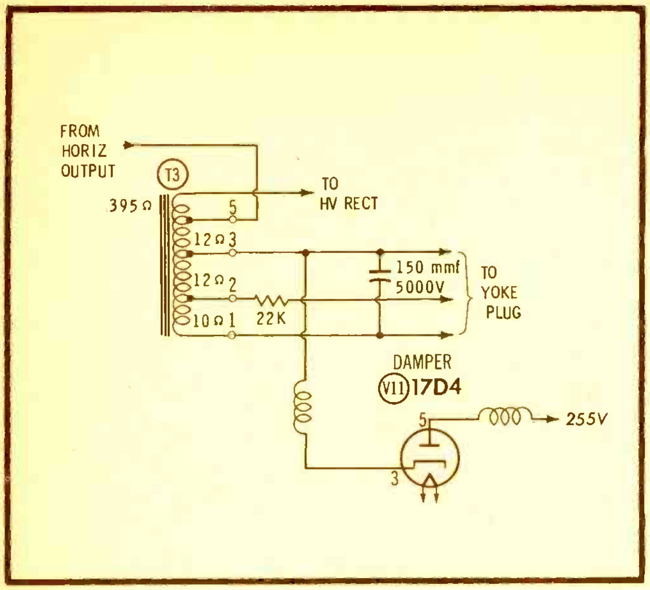
See PHOTOFACT SET 531, Folder 2



See PHOTOFACT SET 531, Folder 2

Mfr: Philco **Chassis No. 11H25**

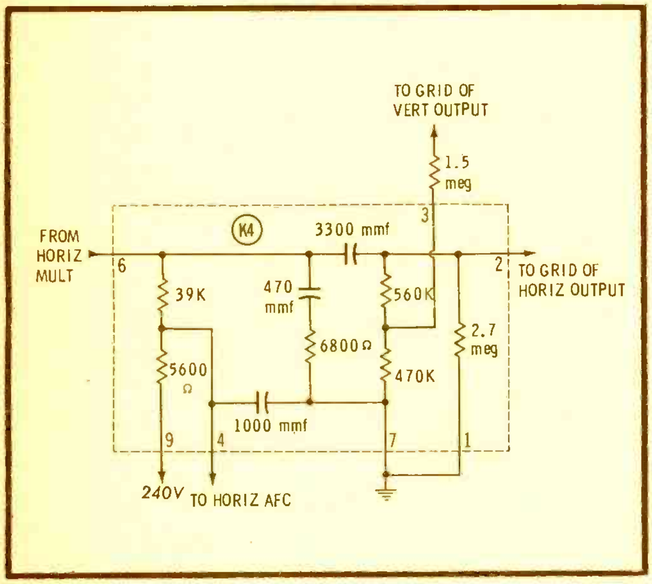
Card No: PH 11H25-4

Section Affected: Raster.

Symptoms: No raster; no high voltage.

Cause: Shorted flyback transformer.

What To Do: Replace T3. Check for proper voltages and waveforms in horizontal oscillator and output stages. Also check deflection yoke for leakage or shorts prior to changing transformer.



Mfr: Philco **Chassis No. 11H25**

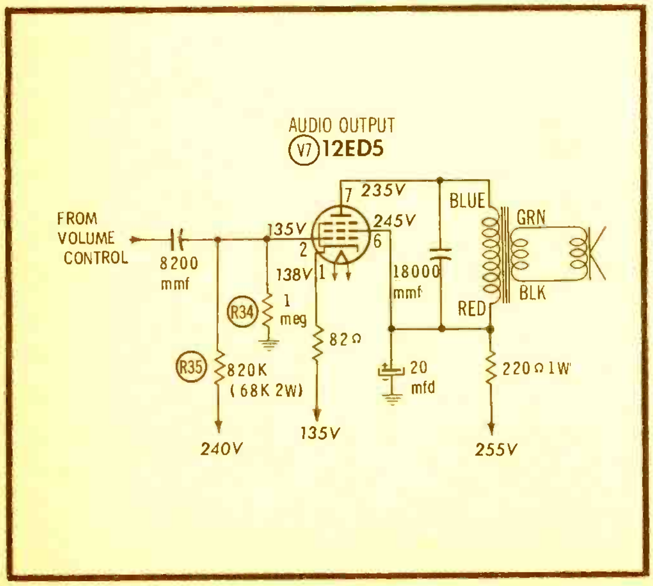
Card No: PH 11H25-5

Section Affected: Raster.

Symptoms: No high voltage; sound OK.

Cause: Shorted coupling capacitor in horizontal oscillator component pack K4.

What To Do: Replace K4 or capacitor section (3300 mmf) with a standard replacement. The component pack is designed so that individual components can be replaced.



Mfr: Philco **Chassis No. 11H25**

Card No: PH 11H25-6

Section Affected: Sound.

Symptoms: Distorted sound.

Cause: Audio output grid resistor increased in value.

What To Do: Replace R34 (1 meg, 5%).

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See PHOTOFACT Set 503, Folder 2

Mfr: Motorola **Chassis No. TS-567Y**

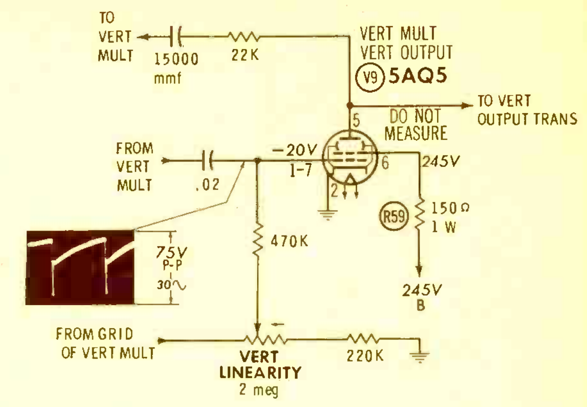
Card No: MO 567Y-1

Section Affected: Raster.

Symptoms: Vertical sweep collapses intermittently.

Cause: Vertical output screen-grid resistor open.

What To Do: Replace R59 (150 ohms — 1W).



Mfr: Motorola **Chassis No. TS-567Y**

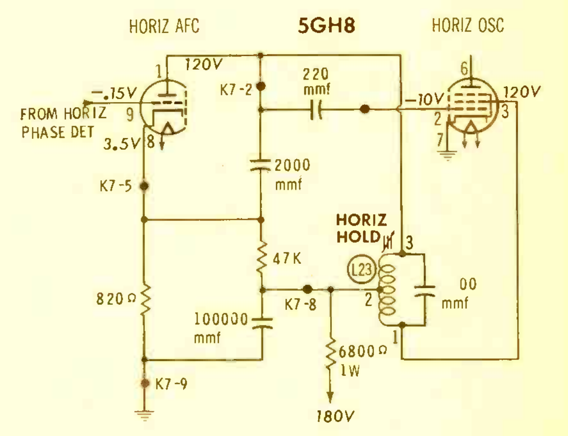
Card No: MO 567Y-2

Section Affected: Raster.

Symptoms: No raster; no high voltage.

Cause: Horizontal stabilizing coil open.

What To Do: Replace L23 or resolder open connection.



Mfr: Motorola **Chassis No. TS-567Y**

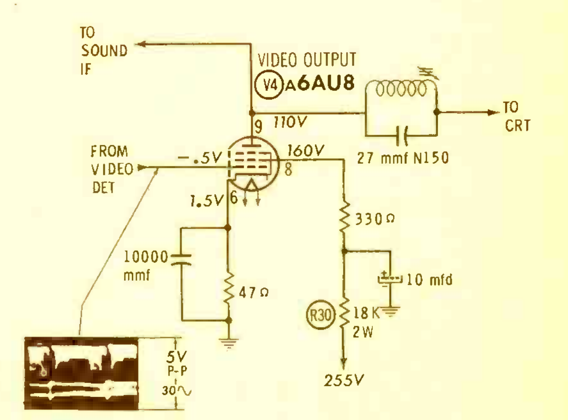
Card No: MO 567Y-3

Section Affected: Pix.

Symptoms: Weak video.

Cause: Video output screen resistor increased in value.

What To Do: Replace R30 (18K—2W).



See PHOTOFACT Set 503, Folder 2

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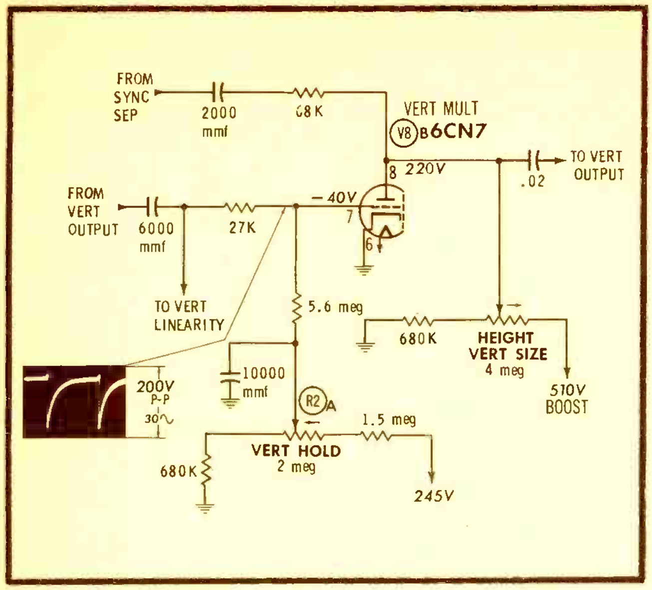
See PHOTOFACT Set 503, Folder 2



See PHOTOFACT Set 503, Folder 2

Mfr: Motorola **Chassis No. TS-567Y**

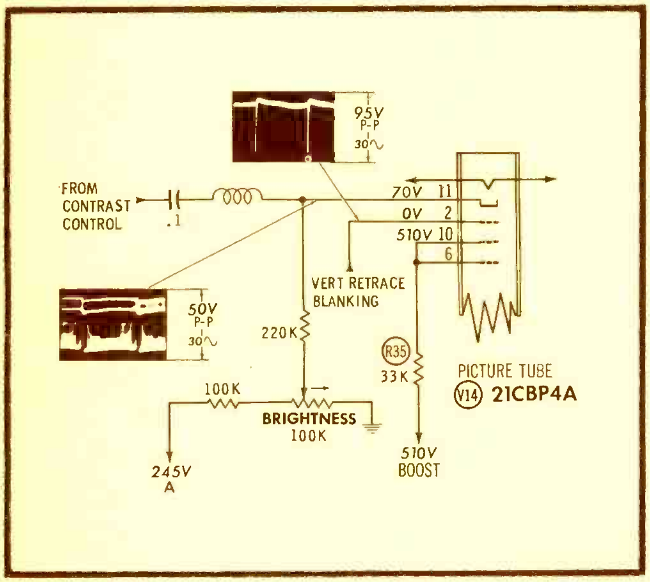
Card No: MO 567Y-4

Section Affected: Sync.

Symptoms: Drifting vertical hold.

Cause: Vertical hold control shorted to ground.

What To Do: Replace R2A (2 meg).



Mfr: Motorola **Chassis No. TS-567Y**

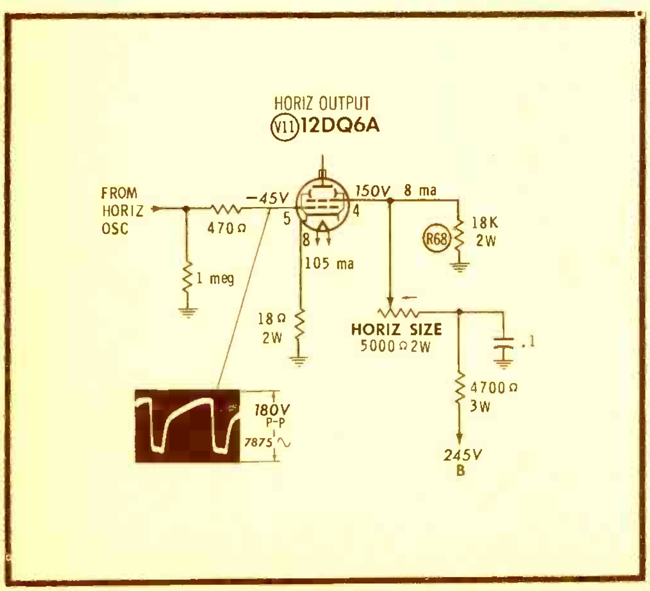
Card No: MO 567Y-5

Section Affected: Raster.

Symptoms: No raster.

Cause: Open series resistor in accelerating-grid circuit of picture tube.

What To Do: Replace R35 (33K).



Mfr: Motorola **Chassis No. TS-567Y**

Card No: MO 567Y-6

Section Affected: Raster.

Symptoms: Insufficient width. Voltage low at screen (pin 4) of V11, 12DQ6A horizontal output tube.

Cause: Screen grid voltage-divider resistor increased in value.

What To Do: Replace R68 (18K—2W).

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Average $2.85 more profit on every 21" tube

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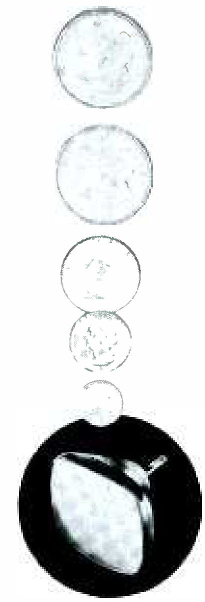

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Get the facts! Compare the Ensign line with your present replacement tubes. Compare quality, performance, prices and profits! Discover for yourself why dollar-wise servicemen are switching to the Admiral Ensign.

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AM 6-0401

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Los Angeles 54, California
RAymond 3-6451

Admiral Sales Corporation
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BElmont 9-0231

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KEystone 4-6274

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Orgill Brothers Louisiana Co.
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NOTICE: All materials and parts used in the manufacturing of Admiral Ensign tubes are *new*, except for the envelope, which prior to re-use, was carefully inspected to meet the standards of the original new envelope.

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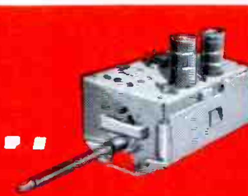
Standard Made It...



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SEE YOUR AUTHORIZED STANDARD DISTRIBUTOR

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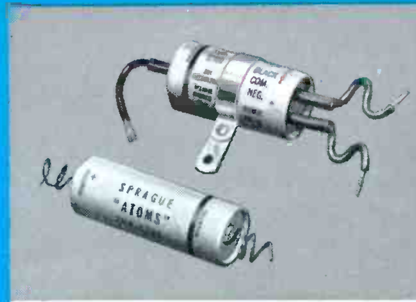
These 'lytics take on the toughest TV and radio duty, give maximum trouble-free service, *without HUMMM!* They are dependable at extremely high and low temperatures. Cathodes are etched to meet the needs of high ripple currents, high surge voltages.



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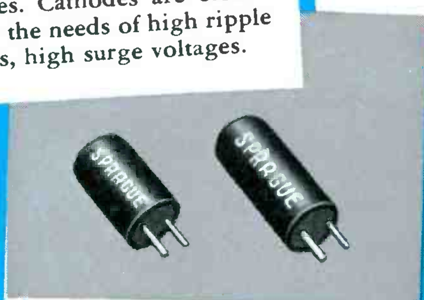

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EVERY 'LYTIC YOU NEED...

- **every value**
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*TRADEMARK

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PF REPORTER

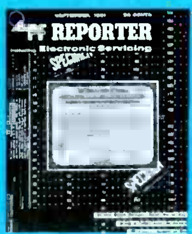
including Electronic Servicing

VOLUME 11, NO. 9 — SEPTEMBER, 1961

CONTENTS

ABOUT THE COVER

The second-class FCC radiotelephone license has a crisp, businesslike appearance, like a stock certificate. In fact, it is as good as a "gilt-edged security" because it unlocks many excellent sources of revenue. For tips on passing the exam to earn a license, turn to page 22.



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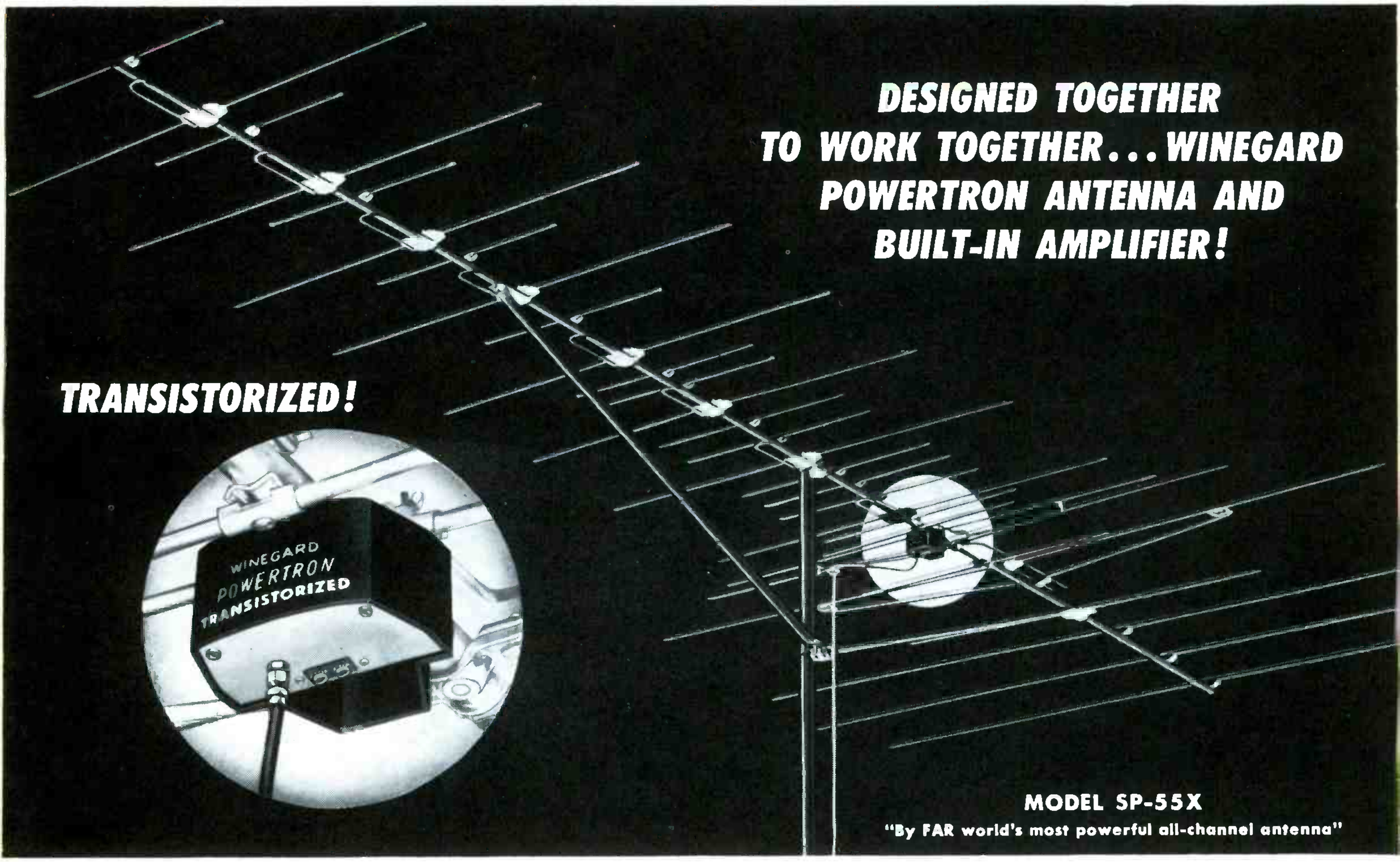
Why the WINEGARD ELECTRONIC MOST EFFECTIVE TV ANTENNA...



WHY? BECAUSE...

IT CAPTURES MORE SIGNAL than any other all-channel antenna ever made. Patented design, electro-lens director system, dual "TAPERED T" driven elements, 30 precision-tuned elements in all.

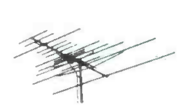
IT'S THE ONLY TRUE ELECTRONIC ANTENNA. Only the Winegard Powertron is built with the amplifier as part of the driven element—not an "add-on" attachment.

IT ELIMINATES ALL SIGNAL LOSS that normally occurs between the driven element and the amplifier due to transmission and coupling mis-match.

IT BOOSTS WEAK SIGNALS UP OUT OF THE SNOW far better than any other antenna or antenna-amplifier combination made.

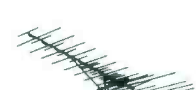
FOR VIVID COLOR, HIGH DEFINITION BLACK AND WHITE AND LONG DISTANCE RECEPTION, nothing can compare to the Super Powertron. Thousands have been installed all over the country and our files are full of testimonials from grateful TV viewers and Service-Technicians alike.

WINEGARD IS THE ONLY MANUFACTURER THAT MAKES BOTH ANTENNAS AND RF AMPLIFIERS. Because of this you can feel confident of getting the very best. But don't take our word for it—let your eyes and ears and field strength meter tell the story.



MODEL P-55
Powertron — transistorized, 14 elements.

MODEL P-55X
Powertron with Pack — Transistorized, 21 elements.



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Super Powertron — transistorized, 30 elements.

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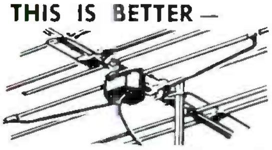
POWERTRON is by far WORLD'S

Not 60%...Not 70%...but over 95% efficient

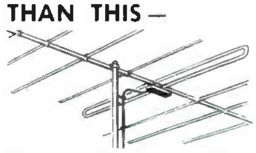
OUTFEATURES—OUTPERFORMS ORDINARY ANTENNAS WITH "ADD-ON" TYPE SIGNAL BOOSTERS!

THIS IS BETTER—



Exclusive amplified "Tapered T" driven element for perfect match and lowest possible signal-to-noise ratio. Only Powertron has it.

THAN THIS—



Not an after-thought "add on" signal booster hung on an ordinary antenna—not an old fashioned mast mounted booster.

ONLY POWERTRON HAS *BOTH* 300 OHM TWIN LEAD OR 75 OHM COAX TERMINALS ON BUILT-IN AMPLIFIER.

ONLY POWERTRON GIVES YOU YOUR CHOICE OF TRANSISTORS OR TUBES (TUBE MODELS 300 OHM ONLY).

POWERTRON HAS COMPLETELY AC POWER SUPPLY

Transistorized Model has rectifier and filter in power supply—not in amplifier, where servicing is difficult. No batteries. Costs 27c to operate for full year. Battery types require $5 to $9 in batteries a year to operate continuously at maximum efficiency.

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ONLY POWERTRON HAS AC PLUG-IN OUTLET FOR TV SET BUILT INTO THE POWER SUPPLY.

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2. Powertron will drive a TV signal through one-half mile of lead-in with signal to spare—permits you unprecedented flexibility for remote installations.

3. Powertron will virtually eliminate snow and interference even on an old TV set.

4. Powertron will deliver superlative color reception far better than a non-electronic antenna.

5. Powertron brings in stations beyond the reach of non-electronic antennas—delivers greatest reception distance.

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By every test ATR Auto-Radio Vibrators are best! ... and feature Ceramic Stack Spacers, Instant Starting, Large Oversized Tungsten Contacts, Perforated Reed, plus Highest Precision Construction and Workmanship and Quiet Operation!

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Ask your distributor for ATR's Low Priced type 1400, 6 volt 4-prong Vibrator; and 1843, 12 volt 3-prong; or 1840, 12 volt 4-prong Vibrator. THE WORLD'S FINEST!

There is a trim plate kit for YOUR CAR!

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Vibrator-Operated with Tone Control

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Model K-1279—12 for 12V Dealer Net Price ... $33.57
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Airplane Style Overhead Mounting under Cab Roof

NO PRINTED CIRCUITRY

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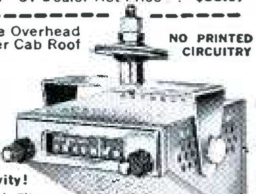

Excellent Tone, Volume, and Sensitivity!

Compact, yet powerful. Fits all trucks, station wagons, most cars and boats. Just drill a ⅝ inch hole in roof and suspend the one-piece unit (aerial, chassis and speaker) in minutes. Watertight mounting assembly holds antenna upright. Yoke-type bracket lets you tilt radio to any angle.

Extra-sensitive radio has 6 tubes (2 double-purpose), over-size Alnico 5 PM speaker for full, rich tone. Big, easy-to-read illuminated dial. Fingertip tuning control. Volume and tone controls. 33-in. stainless steel antenna. Neutral gray-tan enameled metal cabinet, 7 x 6½ x 4 in. high over-all. Shipping weight 10½ lbs.
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Quality Products Since 1931
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LETTERS TO THE EDITOR

Dear Editor:

Your troubleshooting articles would be much more helpful if you would show the picture pattern that appears on the screen when a trouble is present — not just the scope waveform. An example is the article on "Final Scope Checks" in the June issue.

BERNARD TURNER
Washington, D.C.

Now that you mention it, we have been a little neglectful on this point. We'll take immediate steps to incorporate more picture symptoms in the future.—Ed.

Dear Editor:

The enclosed photo of my son might be interesting to you. I've been a PF REPORTER fan from the start, and it looks as if he'll also be one.

WOODWARD RADIO & TELEVISION SERVICE
Roanoke, Va.

He looks like a real go-getter—but if he wants to get anywhere in this business, he'd better learn that the set should have a "diaper" under its chassis, too.—Ed.

Dear Editor:

In regard to your question as to whether anyone agrees with the views expressed by Anthony Annelli (May issue), I, too, find that some of your articles drag out to a monotonous degree.

Also, I believe that your format has changed for the worse over the past five years. Articles like "Electronic Depth Finders," "Industrial Electronic Test Equipment," and "Photoelectric Control Circuits" all leave me cold.

But even with the articles I don't read, I still feel that the balance of the magazine is worth the price. Actually, I don't believe you could ever expect to succeed in publishing a 100% satisfactory magazine. But keep trying!

CHARLES W. RUFFNER
Tuscon. Ariz.

Dear Editor:

With reference to John J. Zeder's letter in the July issue, complaining against the procedures followed by authors of various articles in PF REPORTER, I suggest he take time out to check the author's name on some article he is panning. He might find that the same man has written a book which has helped him solve a service problem.

This fellow must be sharp if he's ready to attack all jobs with no more than a meter. I've got news for him! To my way of thinking, it takes a meter, scope, sweep and marker generators, and any other piece of equipment you can get your hands on to conquer some of these TV dogs.

Glen Mason, who says there isn't enough down-to-earth servicing material in PF REPORTER, should check up on some of the answers to servicemen's problems in *The Troubleshooter* column. Not long ago, I was having a vertical-roll trouble with a Hotpoint Model 21S505. The defect was almost the same as described by Mr. V. Morris (see "Cold Rolls" on page 52 of the July issue), except that the raster would also pull up about 1¼" from the bottom of the screen. I thought I had checked everything that could possibly cause the trouble, but after reading the answer given to Mr. Morris, I found I had overlooked the surge-limiting resistor. After I changed this part, back came a full picture with no more vertical roll.

Thanks a million for the time you and your authors take to help the hard-core serviceman do a good job, no matter what instrument he needs to solve a problem.

HERMAN DAVIS
Chicago, Ill.

Dear Editor:

To answer the letter by John Zeder, I also fix many sets by "using my head," because I can't always interpret waveforms well enough to obtain needed clues. But on countless occasions the scope has saved me hours of time.

I welcome the articles on servicing with a scope, because they are helpful. However, you could improve them by always mentioning the type of probe used.

If any skeptic could see a good scope man repair a TV— especially a "tough dog"—he would be sold on this instrument.

DON ALLEN
Broadway TV Service
Dallas, Texas

Dear Editor:

In your May "Letters" column you let Anthony Annelli speak his mind, and asked if there are any others who agree with him. The answer to that question is, without doubt, a big YES; but this is not your fault at all. Tony answers his own dilemma. TV repair work is passing him by. As he says, "The articles are for engineers." The trend is to better-qualified TV men with more background and ability to analyze the systems presented.

Your magazine must do one of two things — either take the newcomers to

• *Please turn to page 18*

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Model 650
GRID CIRCUIT ANALYZER TUBE TESTER

Tests all standard tubes plus 10 pin miniatures, 12 pin Compactrons, 5 and 7 pin Nuvistors, Novar tubes and a wide variety of voltage regulator types, foreign and industrial tubes. Indicates gas current as low as 1 microampere. Leakage sensitivity over 100 megohms.
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ADAPTER G-140
MULTI-SOCKET ADAPTER UNIT

Modernizes any tube tester for the test of • 10 pin miniatures • 12 pin Compactrons • 5 and 7 pin Nuvistors and Novar tubes.
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A great time saver! Reveals open or shorted capacitors without removing them from the circuit. Electrolytic dial indicates actual in-circuit electrolytic values from 2 mfd. to 400 mfd.
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5 MC WIDE BAND OSCILLOSCOPE

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RF SIGNAL GENERATOR

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VACUUM TUBE VOLTMETER

All-purpose VTVM includes 7 DC (11 megohms input) and 7 AC ranges to 1,500 volts. Measures P-P to 4,000 volts. Resistance in 7 ranges to 1,000 megohms. Three-way probe for voltages and resistance included.
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In designing test equipment, Precision has always maintained a firm policy of quality first, price afterwards. Now, thanks to improved manufacturing techniques, we are able to offer a popular priced line which meets the same exacting standards of engineering that have made Precision a leader in the field of over a quarter of a century! This puts Precision Electronic Test Equipment within the reach of virtually every radio technician, student and engineer. On this page, you'll find apparatus that meets your own specific requirements. And you'll find you can save time and do more jobs when Precision does the trouble-shooting. REMEMBER, ALL PRECISION TEST EQUIPMENT IS GUARANTEED FOR ONE FULL YEAR!

See these and PRECISION'S Industrial Test Instruments at your local electronics distributor.

OTHER TOP ITEMS FROM THE NEW PRECISION LINE:

Model CB-26
Resistance-Capacity-Ratio Bridge .... Net Price: $79.95

Model P-28
Battery Eliminator and Charger
With Built-In Low-Ripple L/C Filter $64.95

Model RS-24
Regulated Power Supply $99.95

Model 1904
Decade Condenser $29.95

Model 1601
Decade Resistor/Divider $29.95

Model 1803
Condenser Substitution Box $12.95

Model 1702
Resistance Substitution Box $15.95

PRECISION Apparatus Company, Inc.,
70-31 84th Street, Glendale 27, N. Y.

Please send me more information on the model numbers circled below:

650	ES-150	P-28	1803
G-140	E-75	RS-24	1702
ST-22	48	1904	
IC-60	CB-26	1601	

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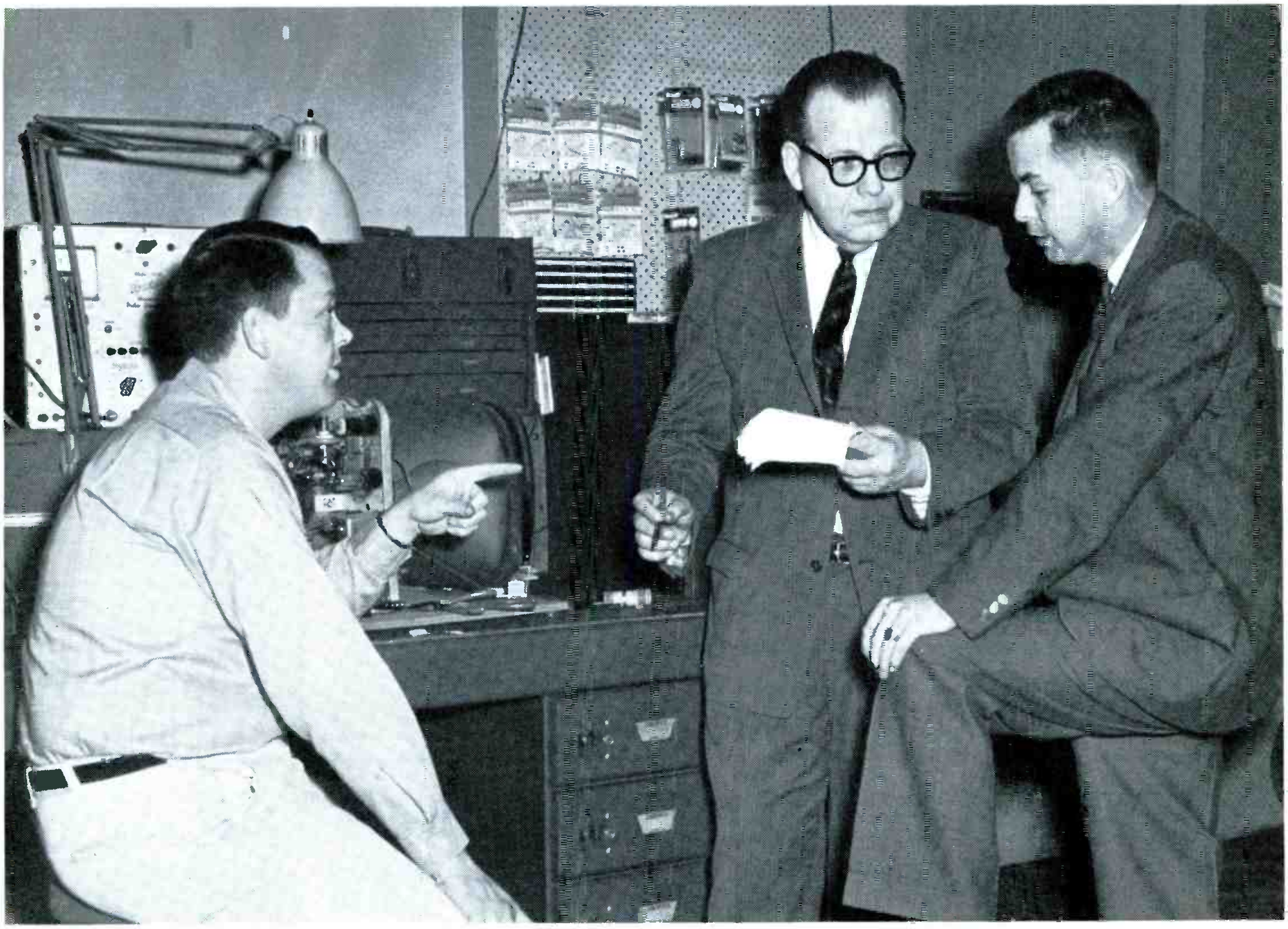

Don Domers (center), shown here with servicemen Everett Hammond and Jess Cody, has built a growing business on a reputation for quality servicing of radio, TV, auto radio, hi fi and stereo sets, and antennae installation. Don has had his own shop for 29 of his 34 years in radio servicing, now has 7 employees. He's also an authorized Philco, Motorola and Sylvania dealer, having carried the first two lines for 20 years.

Your Mallory distributor stocks these quality components

TC TUBULAR ELECTROLYTICS

Economical filter capacitors. Hermetically sealed. Also special TCX type for −55° C. Twin-pack keeps leads free from kinks.

FP ELECTROLYTICS

Original 85° C capacitor, now better than ever. Etched cathode gives hum-free performance. Chassis or printed circuit mounting.

STA-LOC® CONTROLS*

Your distributor can custom build in just 30 seconds, any of over 38,000 single or dual controls.

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

GOLD LABEL® VIBRATORS

Quietest ever made . . . for the best in auto radio servicing. Buttonless contact design gives longest trouble-free service, sure starts.

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says Don Domers, Terre Haute service dealer

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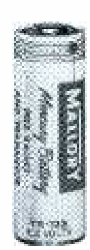

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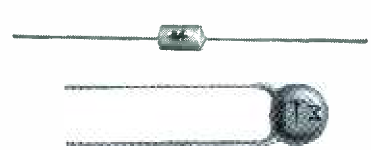

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9. Professional quality has gained world-wide acceptance for Nortronics super-laminated heads.
10. Fully guaranteed quality and workmanship.
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Please send me more information on Nortronics Dealer Sales Plan.

Name________

Dealer________

Address________

City______ Zone___ State____

Letters

(Continued from page 14)

school or progress with the trend of the times. You know the answer to that: Go ahead.

A serviceman need not be a full-fledged electronics engineer, but he should have the ability to understand the basic references to electronic functions. However, this brings up a criticism of the electronics industry as a whole. It is fast becoming a "Tower of Babel" in which new words are coined every day, often with several different expressions referring to the same thing. The result is general confusion, even among those in the know. The remedy: Issue a dictionary—make it stick.

Ernest Lukis

Tyler Electronics
Bronx, N.Y.

Dear Editor:

Messrs. Zeder and Mason are symptomatic of too large a segment of the servicing fraternity. They seem interested only in how something is accomplished, not in the "why" of the problem.

I once ran a service clinic for a New York City servicemen's organization. Any member had the privilege of bringing in his "dogs" for clinic treatment at the very nominal fee of $1 per set. Many availed themselves of this service, but it didn't take me long to realize that the great majority were abusing the privilege. A stock attitude was, "We don't care about your explanations; just fix the set and let us get out of here." In the face of such frank obnoxiousness, I quickly packed the project in.

Let us never forget the axiom, "He who knows *how* will always have a job, but he who knows *why* will always be his boss."

Harry M. Layden

Graduate TV Workshop
New York, N.Y.

Thanks to all for your comments, of which we've been able to print only a few representative examples. Generally, the response indicates that we should keep PF Reporter *just about the way it is.*

For Don Allen, "Picking the Probe for the Job" has been scheduled for the January issue. Mr. Lukis, we have the manuscript of a 10,000-word dictionary in the house, and hope to publish it late in November. To Harry Layden, we offer special thanks for coming through with such an appropriate axiom.—Ed.

Dear Editor:

Even though I subscribe to several TV magazines, the one I read from cover to cover and save for future reference is PF Reporter. The first article I read is always *Notes on Test Equipment,* because it has helped me very much in selecting good instruments.

I'd like to find out one more thing about the B & K Model 1076 *Television Analyst* described in the July issue. Is the high voltage used in the scanner system sufficient to cause X-ray emission?

Ali Heshmati

Carmel TV and Radio Service
Carmel, Calif.

No! It is less than the CRT anode voltage of a typical portable TV set—still high enough to be treated with plenty of respect, but not high enough to create an X-ray hazard.—Ed.

Dear Editor:

Your "Operation Vertical" articles in the January and February issues were tops, but they were too brief on two phases of the subject which should rate an entire article. One is vertical roll, especially intermittent upward rolling; the other is that peculiar condition in which the raster comes on full size, but the bottom creeps up an inch or more as the set plays. A high percentage of the TV sets in use have one or the other of these minor troubles, so an informative article on them would be appreciated.

Webster H. Foulon

Cheney, Wash.

This article is already in the works and will appear some time early next year.—Ed.

Dear Editor:

Because I am 80 years old, I'm retiring from active radio and TV work. However, I do want to say that I've been well pleased with your magazine over the years and have found it very useful and interesting.

James F. Gaffney

Steelton, Pa.

Thanks, J.F., and good luck to you. Incidentally, your letter is a jolting reminder of the great speed of modern progress; when you were born, electric lights were as great a novelty as transistorized TV is today!—Ed.

Dear Editor:

On examining the *Stock Guide for TV Tubes* which appeared in the May issue, I was amazed at the number of tubes you recommend for carrying on house calls. Is such a large stock really necessary for a man who makes 4 or 5 calls a day, if he restocks his caddy each morning?

I take along a sweep-circuit analyzer, VTVM, high-voltage probe, and tube-socket adapters, all of which I find useful for making complete repairs in the home.

Albert E. Morra

Winthrop, Mass.

From your list of in-the-home test equipment, we begin to see why you don't want to carry an overly large number of tubes!

In selecting the tube stock, we had in mind a hypothetical serviceman who makes 7 or 8 calls a day without restocking, and who relies heavily on relevant tube substitutions for in-the-home troubleshooting. He's really not so hypothetical, because we know many successful servicemen who carry two caddies full of tubes.

However, if you can return to the shop more often, or can get by with a smaller tube stock, you can proportionally reduce the chart figures. This means leaving out some of the least-needed types, as well as reducing the quantity of more common types. You can also increase the figures in order to use the chart as the basis for a shop stock.—Ed.

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The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by this license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain and operate certain radiotelephone equipment but not commercial broadcast station equipment.

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	License	Weeks
Thomas Schutte, 736 Clinton, Hamilton, Ohio	1st	12
Gary Harrison, 29 Spencer Drive, N. Kingston, R. I.	1st	12
Louis W. Pavek, 838 Page St., Berkeley 10, Calif.	1st	16
William F. Bratton, Jr., 435 Etna Street, Russell, Ky.	1st	12
Darrell E. Cloce, 25 E. 32nd St., Kansas City, Mo.	1st	12
Thomas J. Hoof, 216 S. Franklin St., Allentown, Pa.	1st	22
P. B. Jernigan, Route 2, Benson, North Carolina	1st	12
Edward R. Barber, 907 S. Winnifred, Tacoma, Wash.	1st	20
Claude Franklin White, Jr., c/o Radio Sta. WJMA, Orange, Va.	1st	12
John M. Morgan, c/o KIRI-TV, 1530 Queen Anne Ave., Seattle, Wash.	1st	9½

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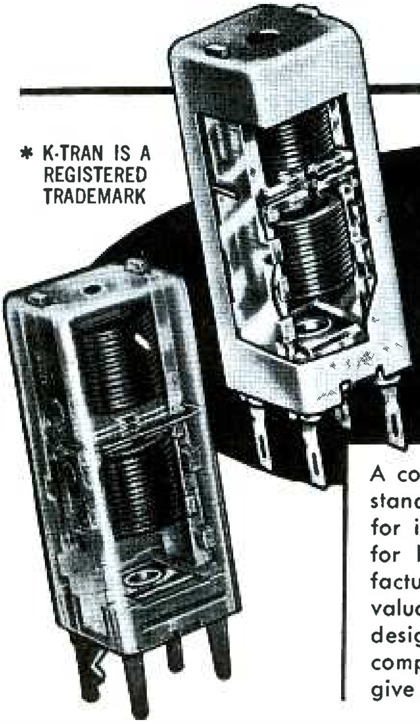

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Dimensions: ¾" square x 2" high

CAT. NO. Printed Circuit Types	CAT. NO. Regular Standard Types	FREQ.	USE
13-PH1	12-H1	262 KC	Input transformer
13-PH2	12-H2	262 KC	Output transformer
13-PH6	12-H6	262 KC	Output transformer with diode filter
13-PC1	12-C1	455 KC	Input transformer
13-PC2	12-C2	455 KC	Output transformer
13-PC6	12-C6	455 KC	Output transformer with diode filter
13-PC7	12-C7	455 KC	Input transformer for battery radios
13-PC8	12-C8	455 KC	Output transformer for battery radios
13-PC9	12-C9	455 KC	Input transformers for AC-DC radios
13-PC10	12-C10	455 KC	Output transformer for AC-DC radios
	12-C11	455 KC	IF transformer (G.E.-RTL 143 and 163)
	12-C12	455 KC	Tapped Pri. I.F. transformer
	12-C45	455 KC	Discriminator
	13-W1	1500 KC	Input and interstage transformer
	13-W2	1500 KC	Output transformer
6203-PC	6203	4.5 MC	Input or interstage transformer
6204-PC	6204	4.5 MC	Discriminator transformer
6205-PC	6205	4.5 MC	Ratio detector transformer
6206-PC		4.5 MC	Ratio Det. (GE-RTD-026)
6207-PC		4.5 MC	Ratio Det. (GE-RTD-025)
6208-PC		4.5 MC	Ratio Det. (GE-RTD-020)
1463-PC	1463	10.7 MC	Input or interstage transformer
1464-PC	1464	10.7 MC	Discriminator transformer
	1464-WB	10.7 MC	Discriminator 900 KC Peak to Peak
1465-PC	1465	10.7 MC	Ratio detector transformer
	1465-WB	10.7 MC	Ratio detector 800 KC Peak to Peak
	6260	21.25 MC	I.F. Transformer
	6261	21.25 MC	Discriminator transformer
	6262	21.25 MC	Ratio detector transformer
6230-PC	6230	44 MC	TV Converter I.F. Transformer
6231-PC	6231	44 MC	TV First I.F. Transformer
6232-PC	6232	42.5 MC	TV second I.F. Transformer
6233-PC	6233	42.5 MC	TV third I.F. Transformer
6234-PC	6234	44 MC	TV fourth I.F. Transformer

Miniature I.F. Transformers for printed circuit transistorized applications. These miniature I.F. Transformers have tuned primary and untuned secondary windings. Proper impedance match between primary and secondary insures optimum performance.
Dimensions: ½" square x ¾" high

CAT. NO.	FREQ.	SPECIFICATIONS
2031	455 KC	10K Ohm pri. to 600 Ohm Sec., Input
2032	455 KC	10K Ohm pri. to 1000 Ohm Sec., Output
2041	455 KC	25K Ohm pri. to 600 Ohm Sec., Input
2042	455 KC	25K Ohm pri. to 1000 Ohm Sec., Output
2051	455 KC	100K Ohm pri. to 1000 Ohm Sec., Input

Sub-Miniature I.F. Transformers for printed circuit transistorized applications. To our knowledge the smallest I.F. Transformers in existence. Ferrite cup core construction permits the use of extremely small shields without adversely affecting transformer operation. A high impedance, tapped primary winding coupled to a low impedance secondary provides optimum energy transfer between stages.
Dimensions: ⅜" square x ⅝" high

CAT. NO.	FREQ.	SPECIFICATIONS
9-C1	455 KC	25K Ohm pri. to 600 Ohm Sec., Input
9-C2	455 KC	25K Ohm pri. to 1000 Ohm Sec., Output

Also a sub-miniature I.F. Transformer for conventional circuitry using vacuum tubes. A 455 KC intermediate frequency transformer which has all the desirable features of the standard size I.F. and is smaller than a MINIATURE tube. Through the use of a ferrite cup core these sub-miniature I.F. Transformers offer the gain and bandwidth characteristics previously obtained only in larger I.F. assemblies. For AC-DC or battery radios.
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CAT. NO.	FREQ.	USE
10-C1	455 KC	Input transformer
10-C2	455 KC	Output transformer

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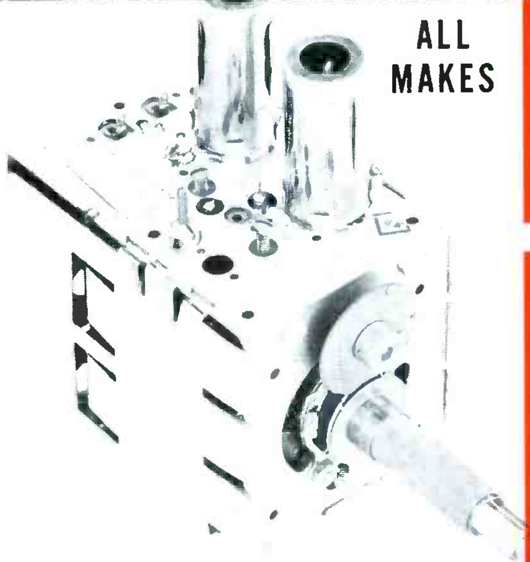

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Tarzian-made tuners are identified by this stamping. When inquiring about service on other tuners, always give tube complement . . . shaft length . . . filament . . . voltage . . . series or shunt heater . . . IF frequency . . . chassis identification.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

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PREPARING FOR THE 2ND-CLASS PHONE EXAM

How to build a solid background without cramming . . . by Edward M. Noll

Obtaining an FCC radiotelephone operator's license is a major milestone in the career of an electronic technician. Generally speaking, it provides tangible proof of his sound technical background, which raises his professional standing in the eyes of the public and of prospective employers. A more specific benefit of a license is that it opens the door to many new lines of work. To the independent serviceman, the most important of these is two-way radio. A second-class license qualifies him to work on all radiophone units licensed in the public safety, industrial, and land transportation services. He is also eligible to service Citizens band equipment and nearly all marine and aviation radiotelephone gear. The success story of CB is already well known; in addition, small-boat electronics has grown into a business with a sizable dollar volume, and even the smallest of private aircraft carry a variety of electronic equipment.

The vast increase in the number of two-way radio systems is only one reason why communications radio has a fast-growing influence on the independent electronics service industry. It is also true that many of the users of this gear are small businesses or private individuals who look to local repair firms for service on their equipment. In fact, the ready availability of good service is often the deciding factor in the original installation of a system. Here is a challenge that begs to be accepted. Your first step in meeting it is to aim for a second-class license.

Fig. 1. Sample of FCC Form 756, the application for a radiophone license.

The Exam—Where and How

Second-class radiotelephone license examinations are given at the various field offices of the Federal Communications Commission (listed in Table I), and also by traveling examiners in certain outlying districts according to an established schedule. You can obtain the necessary application form, and also find out when examinations are held, by writing to the field office nearest you.

A license application must be filed on FCC Form 756, a sample of which is shown in Fig. 1. This form is a single sheet with questions on both sides.

The examination takes several hours. Three sections (Elements I, II, and III) must be passed by applicants for a second-class license. Element I consists of 20 multiple-choice questions on **basic law**, and 5% credit is allowed for each question. Element II contains 50 multiple-choice questions on **basic operating practice**, with 2% credit for each question. Element III is on **basic radiotelephone**, and is made up of 100 questions—a mixture of multiple-choice, schematic completion, and correction of schematic error. Each question has 1% credit. The passing grade for each element is 75%. Portions of the examination use a machine-graded answer sheet of the type shown in Fig. 2.

What to Study

An experienced electronics service technician, if he prepares himself by studying in advance, should have no trouble passing the examination. Many of the questions in Element III are quite elementary. You probably know the answers now, or can soon recall them by reviewing your training in basic electronics. Element III questions can be broken down into several categories. These are:

Electronic Terms and Principles

A good review of common electronic terms such as resistance, power factor, conductance, etc. is in order. Know how to handle simple Ohm's law problems. Refresh your memory concerning the im-

• *Please turn to page 73*

Table I — FCC Field

All communications should be addressed to Engineer in Charge, FCC, at nearest field office. Mailing addresses are as follows:

Mobile 10, Ala.	New Orleans 12, La.
P.O. Box 644 Anchorage, Alaska	Baltimore 2, Md.
P.O. Box 1421 Juneau, Alaska	Boston 9, Mass.
Los Angeles 14, Calif.	Detroit 26, Mich.
San Diego 1, Calif.	St. Paul 2, Minn.
San Francisco 26, Calif.	Kansas City 6, Mo.
San Pedro, Calif.	Buffalo 3, N.Y.
Denver 2, Colo.	New York 14, N.Y.
Washington 25, D.C.	Portland 5, Ore.
P.O. Box 150 Miami 1, Fla.	Philadelphia 6, Pa.
Tampa 2, Fla.	P.O. Box 2987 San Juan 13, Puerto Rico
Atlanta 3, Ga.	P.O. Box 1527 Beaumont, Texas
P.O. Box 77 Savannah, Ga.	Dallas 22, Texas
Honolulu 13, Hawaii	Houston 11, Texas
Chicago 4, Ill.	Norfolk 10, Va.
	Seattle 4, Wash.

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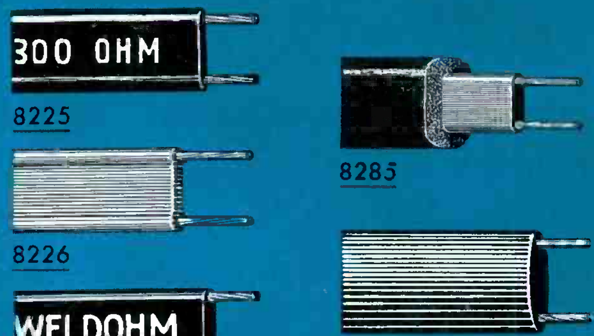
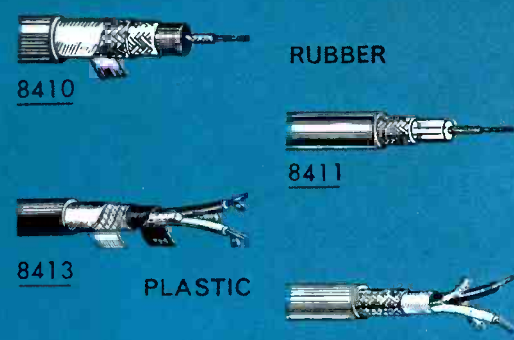
Transmission Line Cables



8225 · 8226 · 8230 · 8285 · 8235

Microphone and Shielded Power Supply Cables



RUBBER

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PLASTIC

8413 · 8420

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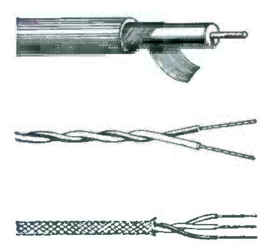
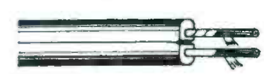


8421 · 8430 · 8419

Rubber-Vinyl Multiconductor Portable Cordage



8462
8888

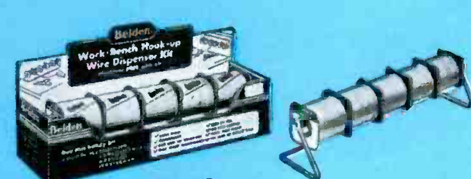
Power Supply Cords

17106

Antenna Rotor Cables

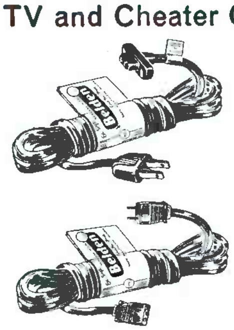
8464 · 8484

Hook-Up Wire



8800

TV and Cheater Cords



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NEW ideas in tube design

More efficient cousins of miniature glass tubes are coming into use . . . by Thomas A. Lesh

Fig. 1. G-E *Compactrons*. Left to right: 6C10, 6FJ7, 6B10, 6AX3, 6D10, 6K11.

Probably you've handled thousands of octal-based "GT" tubes (6SN7's, 6AX4's, etc.) and are thoroughly familiar with the 1⅛"-diameter "T9" tubular glass envelope used on these types. Although octals are getting rarer as they become outmoded by more modern designs, the T9 bulb has taken a new lease on life. Miniature-tube construction techniques have been applied to this generous-sized envelope, resulting in more efficient tubes. Developments are proceeding in several different directions at once, but they all boil down to only two major objectives. The new T9 tubes are designed for either *more different functions* or *more power capacity* than existing miniature types.

Three-In-Ones

In modernizing the T9 envelope, General Electric is concentrating mainly on developing multifunction designs to reduce the number of tubes needed in electronic equipment. *Compactrons* (Fig. 1) are radically changed from older T9 designs; G-E has replaced the octal base with a miniature-style, 12-pin base, and has found room inside the bulb for enough small, high-performance tube elements to make use of all 12 base connections. In low-power types, the small internal structures also permit using a "sawed-off" version of the T9 envelope. If you remember the 6H6 octal twin diode used in radios 20 years ago, and can visualize an all-glass unit the same size, you'll have some idea of a typical *Compactron.*

Several of these tubes have three independent triode sections, or other multiple-function arrangements never before used in radio-TV tubes. The operating characteristics and electrical ratings of each section are practically the same as for certain types of 7- and 9-pin miniature tubes; thus, existing circuits are easily adapted for use with *Compactrons.* These new devices have two main advantages over single- and dual-section tubes. First of all, wattage requirements are generally reduced because each *Compactron* draws less heater power than the combination of tubes it replaces. Furthermore, the physical layout of the chassis can be improved, since "centralizing" several circuit functions in one tube makes it more convenient to take advantage of modular construction, packaged circuitry, and other simplified, space-saving features. Even so, the wiring is not extremely crowded, because the 12 pins are arranged in a ¾" circle—compared to less than ½" for a 9-pin miniature type.

Compactrons are already appearing in current radio-TV set production. All the black-and-white sets in the 1962 Admiral line use a 6K11 or 6Q11 triple triode in a new "Picture Guard" circuit (Fig. 2). The respective tube sections operate as an AGC keyer, sync separator, and noise limiter.

Another *Compactron* you can expect to see soon in TV receivers is the 6B10 dual triode-dual diode, a combined horizontal multivibrator and AFC tube. Effectively, the 6B10 is the same thing as a 6CG7 with a common-cathode dual AFC diode "under the same roof." Any defect in this new tube would show up as

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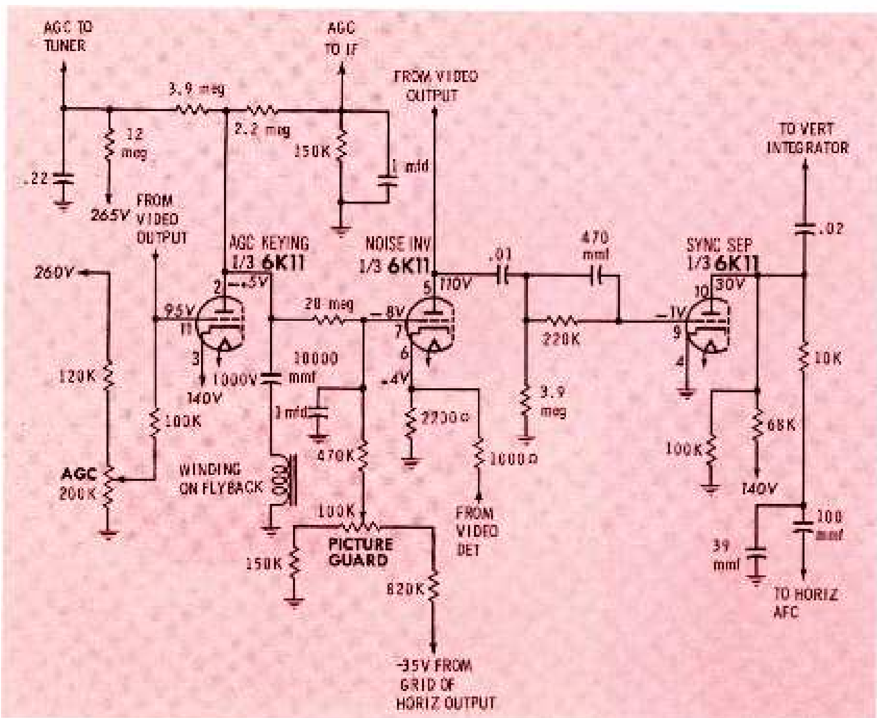

Fig. 2. *Picture Guard* circuit of Admiral Chassis 20A8, using *Compactron*.

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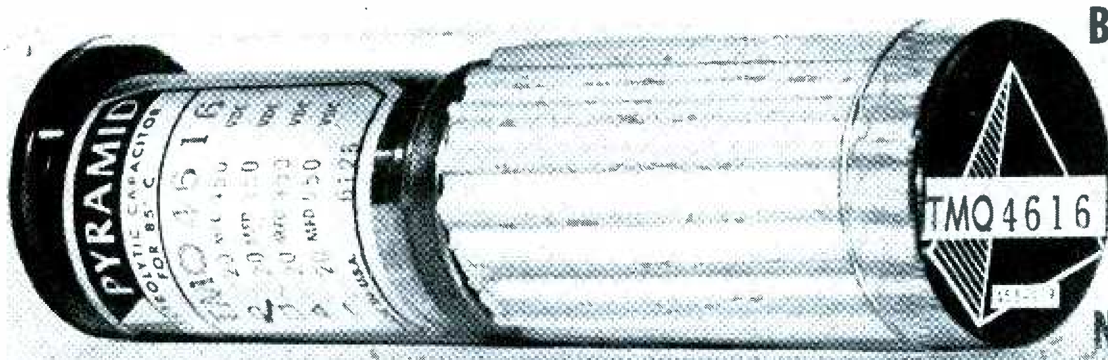

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TEST EQUIPMENT FOR AUDIO SERVICING

BY ALAN ANDREWS

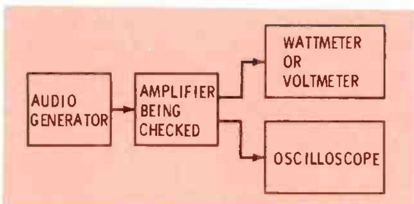

Fig. 1. Equipment connections for testing frequency response of amplifier.

Some repairs or adjustments to audio systems can be accomplished with the same test equipment used in radio and TV servicing—AC and DC voltmeters, ohmmeters, tube testers, oscilloscopes, and RF signal generators (both AM and FM). However, additional equipment is often necessary to get the job done properly. The most valuable types of specialized audio test instruments are the audio VTVM, audio signal generator, harmonic-distortion meter, and intermodulation-distortion analyzer. In addition, there are a number of other devices available for increasing the serviceman's efficiency in audio-servicing work.

Audio VTVM

Signal-level measurements are important in audio servicing, especially in test procedures involving signal tracing, signal generators, or distortion analyzers. Extremely small voltages are encountered in some phases of audio work; for example, the output signal from a magnetic phono cartridge may be as low as a few millivolts. Ordinary multimeters and VTVM's, which seldom have AC ranges of less than 3 volts, do not have sufficient accuracy to meet all these requirements. Thus, a special high-sensitivity AC meter is often needed.

An audio VTVM, designed specifically for AC measurements in the range from approximately 20 cps to 100 kc, fulfills the most critical audio requirements. The full-scale reading on the most sensitive scale is generally no higher than .03 volt, and several commercially-available meters have .01-volt ranges. As a further convenience, some of these instruments have several scales calibrated in decibels.

When a wattmeter is not available for amplifier-power measurements, an audio VTVM can be connected across the speaker terminals (or dummy-load resistor) to obtain a voltage reading from which the power can be calculated. Chart I shows the proper voltages across different load impedances for given power levels. For ratings not in the chart, the formula

$$E = \sqrt{PZ}$$

can be used to calculate the voltage from the power and the load impedance.

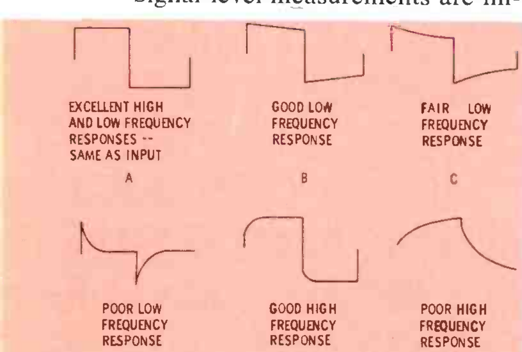

Fig. 2. Typical results of frequency-response tests using square waves.

Audio Signal Generator

Even the most routine servicing procedures can call for an audio signal generator with a minimum range of 20 to 20,000 cps, and an output extending up to 100,000 cps is useful for checking some of the more elaborate amplifiers.

Generators are available with either a sine- or square-wave output, or with both. Some dual-purpose generators basically produce a sine-wave output which can be modified to a square wave by simply switching a clipper stage into the circuit. The square-wave generator need not produce as wide a band of fundamental frequencies as a sine-wave generator, because of the high harmonic content of the square-wave output; a range of about 60 to 12,000 cps is adequate for most work. The rise time (the interval required for a square wave to change from 10 to 90% of peak amplitude) should be less than 2 microseconds over the audio range. For the sine-wave output, the maximum total harmonic distortion should be less than 1%. (Commercial models are

Chart I—Cross-Reference of Voltage and Power Readings

RATED MAXIMUM OUTPUT IN WATTS	VOLTAGE FOR 4 Ω LOAD	VOLTAGE FOR 8 Ω LOAD	VOLTAGE FOR 16 Ω LOAD
5	4.5	6.3	8.9
10	6.3	8.9	12.6
15	7.7	11.0	15.5
20	8.9	12.6	17.9
25	10.0	14.1	20.0
30	11.0	15.5	21.9
50	14.1	20.0	28.3

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available with distortion rated at less than 0.1% from 20-20,000 cps.)

In either type of generator, the output should remain constant within ±1 db over the full frequency range; otherwise it would be necessary to meter the output and readjust the voltage for every different frequency setting. Some generators are equipped with built-in voltmeters to aid in setting the desired output level.

Most audio generators have a maximum output of at least 10 volts —more than enough for practical use. In most cases, the generator-output impedance is low (usually 600 ohms), in order to obtain proper impedance matching between the generator and load. A high-impedance output may cause serious distortion and loading when feeding into a low-impedance input stage, unless a separate impedance-matching network is connected between the two units. On the other hand, a low-impedance output can be fed into a circuit of almost any impedance without these disadvantages.

Using the Generator

One of the main uses of a sine-wave audio generator is in measuring the frequency response of an amplifier or an audio system. The basic setup shown in Fig. 1 is used.

At a frequency of about 1000 cps, the amplifier and generator controls are adjusted until the trace on the scope begins to show distortion of the sine-wave signal. The output reading is then noted and, with the amplifier controls always in "flat" position, the same procedure is repeated for different frequencies from about 20 to 20,000 cps.

The response will normally drop off at both the low and high ends of the audio range; the extent of drop-off can be used to determine frequency response. A high signal level is used for the test, on the theory that if the response is adequate at maximum level, it will be even better at lower levels.

This same test procedure can be used for checking tone controls and equalizer circuits, except that the object here is to obtain different degrees of attenuation at different frequencies.

A general indication of frequency response can be obtained by connecting an audio square-wave generator to the input of an amplifier and an oscilloscope to the output. Any square wave is composed of a fundamental frequency plus a number of odd-order harmonics. As an illustration, a 100-cps wave contains elements of 100, 300, 500, 700, etc., on up to 2100 cps or higher. Thus, the insertion of a square wave at the amplifier input applies a large number of frequencies at once, and observation of the output waveform gives definite indications regarding the response of the amplifier.

For best reproduction of a square wave, the response of the amplifier must extend from about one-tenth to at least ten times the fundamental frequency. For example, to minimize phase-shift distortion of a 100-cps square wave, the response of an amplifier must extend down to about 10 cps.

An audio system can be satisfactorily checked by applying square waves of only two frequencies — say 200 and 2000 cps. If the amplifier being tested can faithfully reproduce a 200-cps square wave, this means the response is adequate from about 20 to 2000 cps. Satisfactory reproduction of the 2000-cps square wave would then indicate good response up to 20,000 cps. If further facts are required as to exact characteristics at other frequencies, additional inputs can be used.

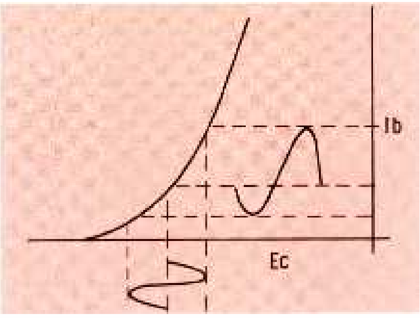

Fig. 3. This type of nonlinear amplification causes harmonic distortion.

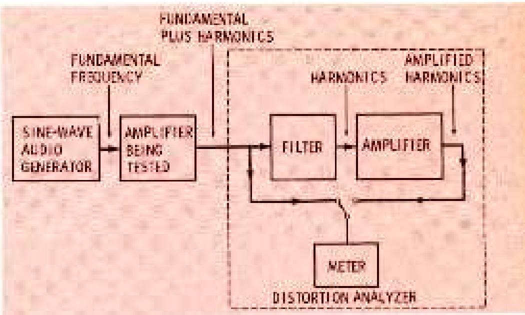

Fig. 4. Block diagram of test setup utilizing harmonic-distortion analyzer

Fig. 2 illustrates several possible results from square-wave testing. In part A, the output waveform is a perfect replica of the input, indicating excellent response. Increasingly poorer low-frequency response is shown in B, C, and D, while E and F present a contrast of good with poor high-frequency response. In using these comparisons, the input frequency must be considered. For example, if waveform A or B was observed when the input wave had a fundamental frequency of 2000 cps, good bass response would not necessarily be indicated.

Harmonic-Distortion Meter

Virtually all sounds contain harmonics which determine the tone quality or timbre of the sound. These harmonics are extremely desirable; in fact, the primary characteristic of a good hi-fi system is its ability to reproduce a wide range of harmonic frequencies. When some defect causes nonlinear operation of an amplifier, additional harmonics may be generated and introduced into the signal. Produced in small amounts, these additions are not too serious, since they literally "harmon-

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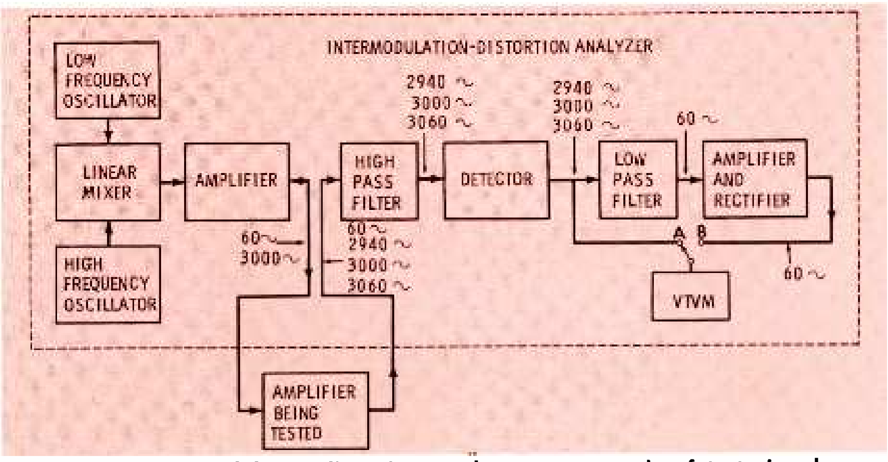

Fig. 5. Intermodulation-distortion analyzer uses a pair of test signals.

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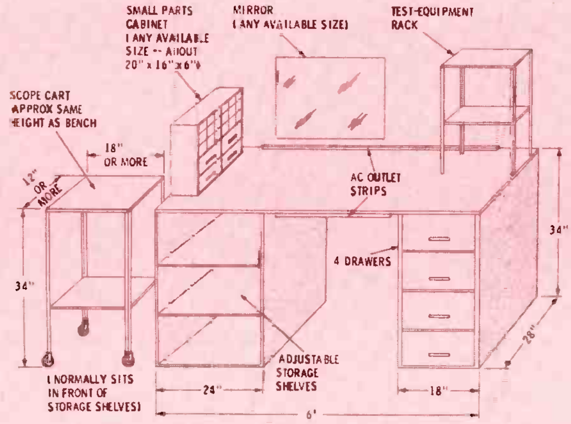
Right now, before the busy autumn season, would be a fine time to take stock of your present service-bench layout. Is it a help or a hindrance? A well-designed bench should satisfy two basic requirements:

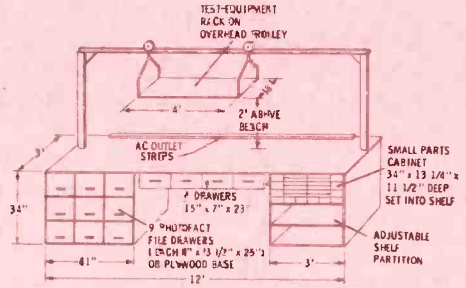
MAXIMUM CONVENIENCE—Test equipment should be out of the way of the chassis being serviced, but close enough so that leads will reach easily without constantly shuffling the instruments back and forth. Also, often-used small parts, tools, and service data should be close at hand.

BEST USE OF SHOP SPACE—Tailoring benches to fit existing areas helps to establish a neat, step-saving floor plan. To reduce clutter in the shop, it's a good idea to utilize the generous space under the bench for storage.

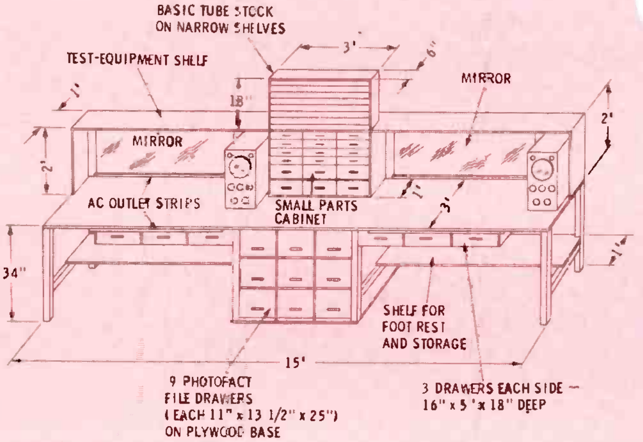
If an awkward arrangement is slowing you down, don't put up with it—make some changes! Use the representative bench designs on these pages as a source of ideas, freely modifying them to suit your individual needs. Also, suit yourself about building them "from scratch" or using ready-made components like those pictured.



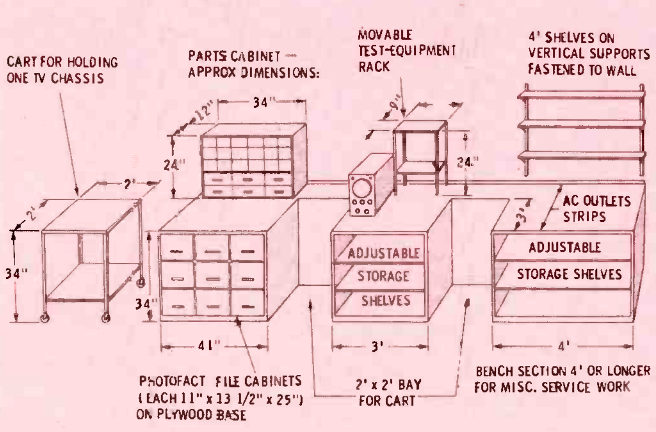
This compact one-man bench fits into close quarters, and yet provides uncramped work space. All commonly-used test instruments except the scope are on a three-decker rack, and less frequently-used equipment is parked in a corner; thus, there is plenty of room for work. To conserve bench space, the bulky scope is mounted on a movable cart which can be positioned in any convenient spot.



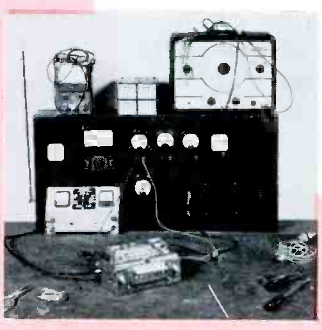
Here's an efficient setup for a man who always has several sets in process at one time. The bench top is cleared for action, with parts and schematics stowed away "below decks." Test equipment is mounted on a traveling cradle, suspended from an overhead trolley. Hardware similar to that used to hang a barn door, supported on strong steel posts, serves as a track. The cradle holds all essential test gear, including a scope.



Two men can work at this long bench, with equal access to the parts stock and service-data files. A bench top fully 3' deep is used so the shelf for test equipment will not interfere with the "head room" needed for large TV chassis. Supplies and tools are kept in drawers beneath the bench top. Several nonconductive materials are suitable for the work surface. Favorites are *Masonite*, rubber, and *Formica*. The latter has the advantage of being available in pale colors that reflect light, thereby brightening up the work area.



This system works well for anyone who frequently interrupts one job to take care of another, and it also lends itself to an "assembly-line" type of operation for larger shops. TV chassis can be loaded onto individual carts designed to roll neatly into "service bays." A central "island" holds all necessary items of TV test equipment. Bench space to the right of the bays can be utilized for special built-in servicing facilities such as the auto-radio service center shown in the photo.



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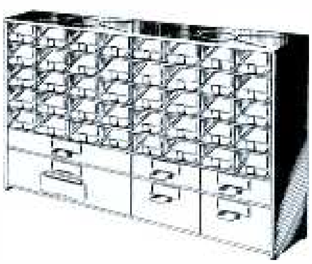
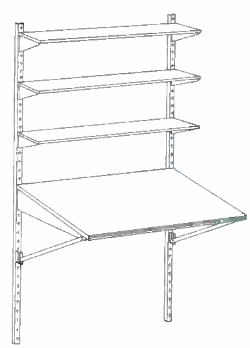
SERVICE BENCH DESIGNS

Build 'Em or Buy 'Em

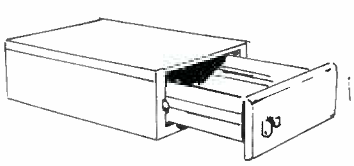
Compact metal racks serve as "test-equipment centers" to conserve space on bench top; size shown holds most-used items of equipment (except 5" scope).



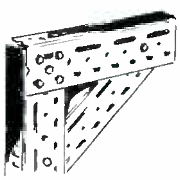
Cabinets with many small drawers are available in assorted shapes and sizes for handy, orderly storage of component stocks. Drawers usually have built-in dividers or compartmented trays.

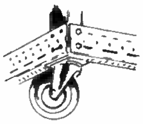


Shelves 3' or 4' wide can be mounted at any desired heights on vertical brackets attached to wall. Shelf of greater-than-usual depth, supported by diagonal braces, can be used as supplementary bench.



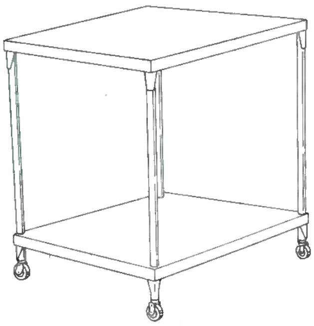
Encased metal drawer can be mounted under bench top, or several drawers can be interlocked or bolted into vertical stack.



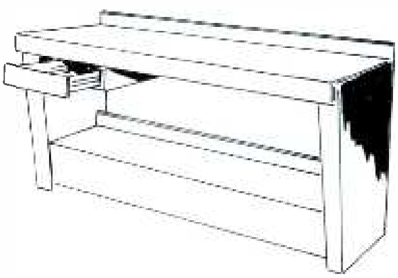


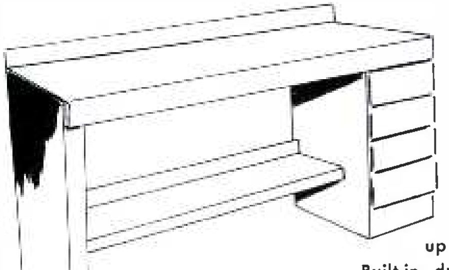
Girders of 12- or 14-gauge steel, supplied in 10' or 12' lengths, are useful for framing benches, racks, carts, etc. Perforations speed up work of bolting together. Several accessories (casters, etc.) are designed for easy attachment.

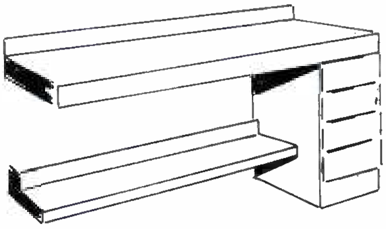
Metal cabinets and shelves are handy for storing additional test equipment, radios to be repaired, etc. Available in a wide variety of sizes, they can fit against end of bench or underneath bench top.



Placing each TV chassis on a "traveling" table is one way to increase convenience of shop layout. Tables can be utilized as movable bench sections.







Ready-made steel benches with *Masonite* or wood tops are obtainable in various lengths up to 6'; can be extended by adding "semi-trailer" units. Built-in drawers or cabinets are available, or user may add convenience features to suit his own needs.

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ACROSS THE BENCH

YOKE TROUBLE PLUS . . .

by Stan Prentiss

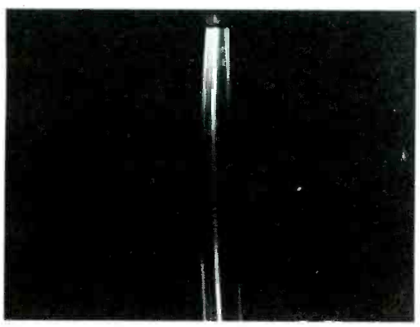

Fig. 1. Rare symptom: Horizontal sweep lost, but high voltage normal.

When the customer phoned and tried to describe his sadly distorted TV picture, my first thought was, "It can't look like that!" But when I arrived at his home and looked at the set, I realized he had been right; the raster was only a narrow vertical streak (Fig. 1). With the horizontal sweep all but dead, how could the set be developing enough high voltage to produce a visible raster? Whatever the answer might turn out to be, this was no run-of-the-mill service call.

Horizontal oscillator, output, and damper tube substitutions produced not the slightest corrective effect. The width control wouldn't budge the picture even a mite, and the horizontal linearity slug was frozen stiff to the coil form. I felt there was no point in going any farther, at least not in the home. Remembering my experience with "The Case of the 10-Minute Fuses" (May issue), I knew I might have to put in several hours of good, hard troubleshooting before finding the answer. Of course, this job could also turn out to be easy; fuses weren't blowing, there *was* a visible (though narrow) raster, and the fault looked as if it might have a single, definite cause. Nevertheless, since the ailing set was an older RCA model with a direct-drive horizontal sweep circuit (Fig. 2), experience told me to be prepared for possible complications.

With apologies and a word of explanation to the customer for having to pull the set, I hauled it back to the shop for further investigation and repair. The first thing I did, mainly out of curiosity, was to measure the high voltage. Oddly enough, it was exactly 11.5 kilovolts, a perfectly normal output for this receiver. Here was evidence that the flyback transformer was operating correctly. However, when I checked boost, it was just under 400 volts—the same as B+.

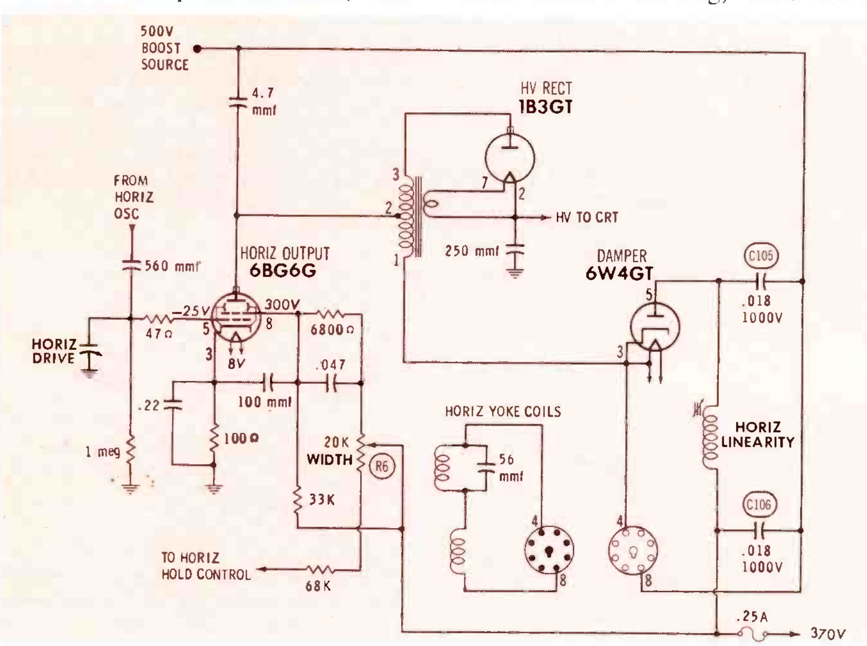

Fig. 2. Defect in this direct-drive circuit produced a pillar-shaped raster.

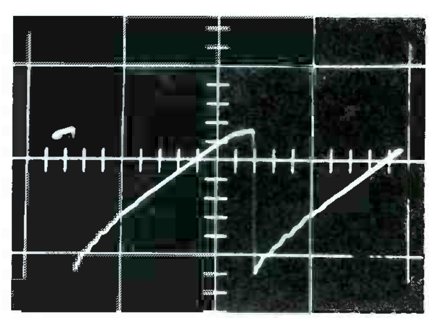

Fig. 3. Normal sawtooth wave at grid of horizontal output tube—150V p-p.

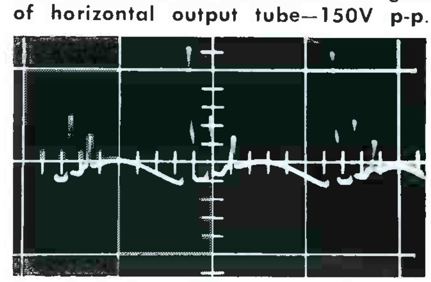

Fig. 4. Feeble, distorted waveform on high side of yoke indicated trouble.

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I looked at the drive waveform at the grid of the horizontal output tube, just to make certain the trouble was not being caused by extreme distortion of this sawtooth wave. But the DC scope displayed a normal pattern (Fig. 3), 150 volts peak to peak, with a relatively linear rise of voltage. The most critical part of this waveform is above the center reference line on the scope graticule. Since this output tube has cathode bias, it does not really begin to go into heavy conduction until the grid voltage approaches zero (with respect to ground). In Fig. 3, the continued linear rise of the trace above this level, with only a slightly flattened top, showed that the grid was not drawing excessive current. Although flattening of positive peaks is not considered normal for sets with cathode bias, a certain amount is sometimes noticed in old models—probably because of factors such as component aging.

What's Cookin'?

Since tubes, horizontal drive components, and the output transformer were all apparently good, what could the trouble be? I went back to my most tangible symptom — lack of boost. Conceivably, one or both of the boost capacitors (C105 and C106) could be at fault. For a quick check of these units, I pulled the damper tube. All voltage disappeared from the boost line, indicating no shorts or DC

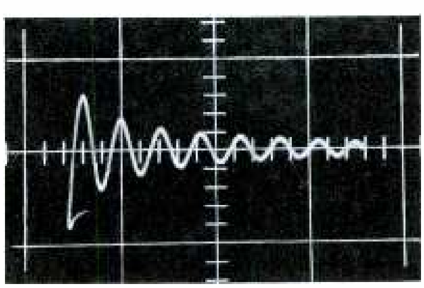

Fig. 5. Ringing test of bad yoke gave this overly-damped 120-kc waveform.

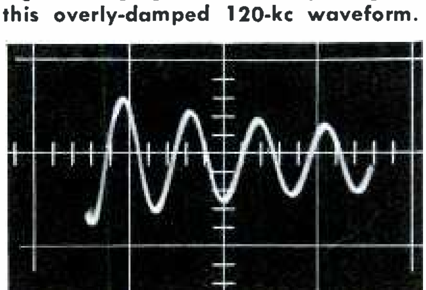

Fig. 6. Normal yoke should produce a gradually-damped wave—about 70 kc.

leakage from B+ to boost through the capacitors. I temporarily ruled out the rather remote possibility of an open boost capacitor, and decided that the next best approach was to tackle the horizontal coils of the deflection yoke. Although I wasn't completely sure of what waveforms to expect on either side of the yoke, I knew that the high end should receive a flyback pulse because it is tied directly to terminal 1 of the output transformer. Holding the tip of my scope probe against the insulated lead going to pin 4 of the yoke plug, I obtained the Raggedy Andy waveform in Fig. 4—a pair of undernourished spikes with transients popping out on either side. At pin 8, on the boost line, there wasn't enough of a waveform to record, even with the probe in direct contact with the circuit. I suspected more strongly than ever that the deflection yoke was the culprit. A quick look in the service literature produced the number for the replacement part. Luckily, I had one in stock; I'd bought it for a previous job, but hadn't needed it after all. When I plugged it in, boost returned, and all seemed well in TV land. A simple ringing test of the old yoke with my oscilloscope (see this month's *Troubleshooter* column) added further confirmation that I had found the trouble. Fig. 5 shows the damped sinusoidal wave I obtained in this check. Its frequency turned out to be 120 kc — well above the correct ringing frequency of 70 kc. Compare it with the indication produced by the new yoke (Fig. 6). Recalling your inductance theory, you may remember that shorted turns in a coil always produce a drop in voltage but an increase in frequency. This also explains why the wave in Fig. 5 is heavily damped, while Fig. 6 has the gradual taper that indicates a good coil in either the horizontal or vertical deflection circuit of *any* television receiver. Resting the scope probe on the lead going to the high side of the yoke produced the standard pattern of a smoothly-operating horizontal flyback system (Fig. 7).

Another Think . . .

The raster still wasn't com-

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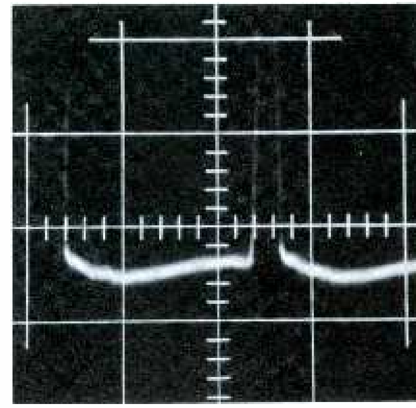

Fig. 7. Strong, clean flyback pulses indicated a return to normal operation.

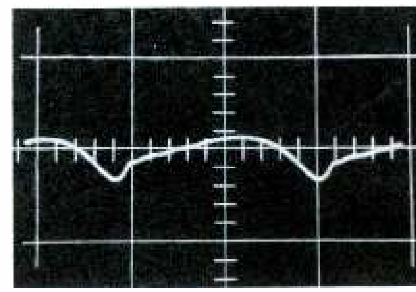

Fig. 8. Boost-ripple waveform should have this shape and 60-volt amplitude.

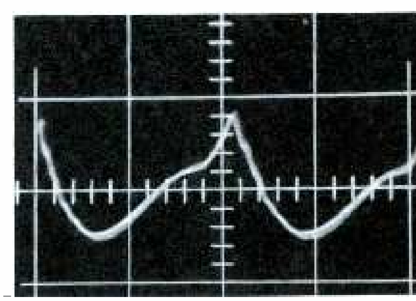

Fig. 9. Waveform found on boost line before the linearity coil was adjusted.

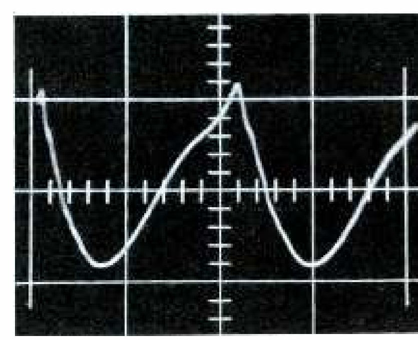

Fig. 10. Parabolic effect increased as linearity slug was turned wrong way.

Fig. 11. Nonlinear picture-tube display when waveform appeared as in Fig. 9.

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TV TUNERS

Although the tuner is an integral part of any TV receiver, it is generally thought of as a completely independent, self-contained component. This is natural, since it is usually a separate subassembly, and is often remotely positioned from the main chassis. Tuners are produced both by set manufacturers and by independent tuner companies; thus, servicemen are confronted with many different circuit hook-ups, all performing essentially the same duty.

Aside from variations in circuit design, there are several other reasons why many technicians consider TV-tuner servicing a headache. Some tuners are difficult to align, and, since relatively high frequencies are involved, the component values, tolerances, and lead dress are fairly critical. To complicate matters, all parts are usually confined in a small area.

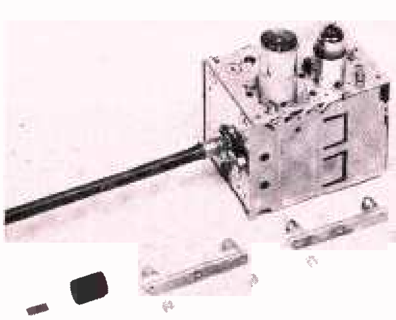
After isolating trouble to the tuner, you must naturally decide whether to repair the tuner yourself, have someone else repair the unit, or replace it entirely. Factors that will govern your decision include the nature of the trouble, availability of parts, time required to do the job, and over-all cost to the customer. What's the best way for the average serviceman to handle tuner problems? To answer this question, let's examine some of the alternatives for dealing with front-end trouble in a TV chassis.

Repairs

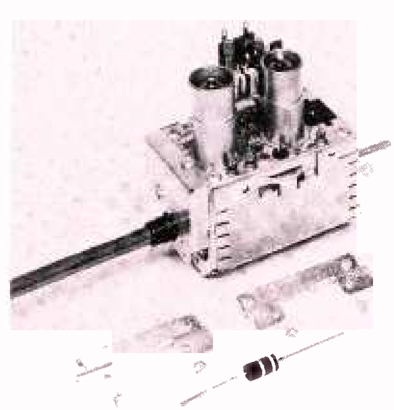
In deciding whether or not you'll do the job yourself, you should consider that alignment may be necessary after the repairs are completed. Do you have the necessary equipment for alignment, and do you know how to use it?

Many tuner repairs and adjustments are fairly easy. Some of these minor jobs include making oscillator adjustments, cleaning and tightening contacts, replacing strips of a turret tuner, repositioning oscillator slugs or screws that have fallen out, and replacing defective resistors or capacitors in untuned circuits (if readily accessible). In many cases, it is also a simple matter to tighten the contacts of a tube socket or to replace part of a fine-tuning or detent mechanism.

The number one cause of intermittent tuner operation is dirty or loose switch contacts. A wide selection of tuner cleaners are available to handle the dirt problem. Most of them are in spray cans with extended nozzles for reaching otherwise inaccessible spots in a tuner. As for adjusting switch contacts, the loop-spring units found in most turret tuners are relatively easy to tighten. Wafer switch contacts should be handled with greater care, since they require more precise alignment between fixed and movable contacts.



(A) Sarkes Tarzian switch type.



(B) Standard Coil turret type.

Fig. 1. Typical universal-replacement tuners from two manufacturers' lines.

When replacing resistors and capacitors, always make it a practice to check for any special component characteristics. In the case of a capacitor, check to see if a special temperature coefficient or tolerance is required; for resistors, it's a good practice to use only 5% units made of the same material as the original type.

If lightning has damaged the tuner, installing a new pair of antenna-input coils will often complete the repair job. However, it may be necessary to replace an entire contact bank or several components in an RF stage. This, of course, calls for patience, experience in tedious work, and realignment.

Other major tuner repairs include changing a tube socket, switch wafer, trimmer capacitor, or coil. Generally, any one of these operations calls for an RF-IF alignment when the repair is completed. The alignment of many TV tuners is not really difficult — provided you have the proper equipment and follow recommended procedures. *A word of caution*: If procedures call for expanding or compressing small incremental coils on a wafer switch, you'd better think twice before attempting a complete alignment. Unless you have had previous experience, you are apt to put more troubles into the tuner than you take out.

Specialized replacement parts, both electrical and mechanical, are usually available from the tuner manufacturer. To obtain specific parts, either refer to the parts list in the service data for the receiver, or consult a replacement-parts guide at your local distributor. In the latter case, you must know the make and model number of the tuner.

Most distributors also carry numerous replacement parts in addition to the usual tubes, resistors, and capacitors. For turret tuners, often-needed special parts are available in repair kits or as individual items. Also, while switch tuners generally require exact replacements for most parts, universal-replacement lines

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Repair or Replace

Considerations in handling front-end problems . . . by Les Deane

are carried for certain components such as antenna-input coils and fine-tuning shafts.

Troubleshooting a tuner fault, dismantling the unit, securing replacement parts, and perhaps performing an alignment may require more time and effort than you feel the job is worth. Should this be the case, there are a number of competent tuner service companies who offer professional repairs at very reasonable rates. For your convenience, a listing of such companies is included at the conclusion of this article. On the other hand, if you are bent on making your own TV tuner repairs, you'll find more specific information on this subject in the Howard W. Sams book, "Servicing TV Tuners."

Replacements

If a tuner is badly damaged, replacement parts are no longer available, or a customer's set must be returned immediately, it may be more practical to replace the tuner than to repair it. In this case, you also have several alternatives. You can obtain a new unit from the set manufacturer, exchange the original for a rebuilt unit of the same type, or select a recommended replacement from a line of universal tuners available to service dealers. Since the cost of a new duplicate tuner from a set manufacturer may be too high to let you price the job competitively, and an exchange transaction often requires a waiting period, universal replacements are finding increasing favor with many servicemen.

Two examples of universal-replacement tuners are shown in Fig.

• *Please turn to page 79*

Chart I—Universal-Replacement Tuners

REPLACEMENT SPECIFICATIONS	SARKES TARZIAN	STANDARD COIL
12-POSITION TUNERS		
21-mc IF; 6.3V fil.	VS35A (Parallel)*	GG-2290-A
21-mc IF; 600-ma fil.	VS35A (Series)*	GGS-2291-A
41-mc IF; 6.3V fil.	VS35B (Parallel)*	GG-4290-A
41-mc IF; 600-ma fil.	VS35B (Series)*	GGS-4291-A
13-POSITION TUNERS		
VHF only; 41-mc IF; 6.3V fil.	VID45C (Parallel)*	GG-4220-A
VHF only; 41-mc IF; 600-ma fil.	VID45C (Series)*	GGS-4221-A
VHF only; 21-mc IF; 6.3V fil.	. . . .	GG-2220-A
VHF only; 21-mc IF; 600-ma fil.	. . . .	GGS-2221-A
UHF-VHF; 41-mc IF; 6.3V fil.	UVID45D (Parallel)*	. . . .
UHF-VHF; 41-mc IF; 600-ma fil.	UVID45D (Series)*	. . . .

*Filament connection must be specified when replacement is ordered.

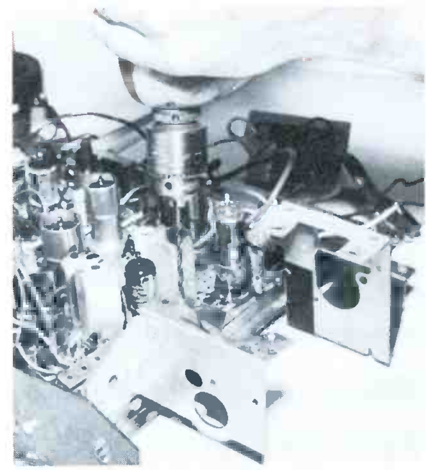
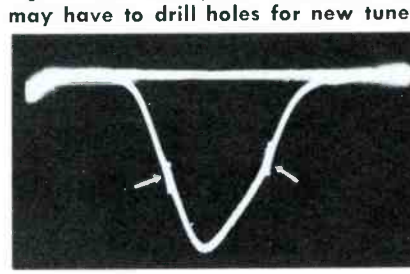
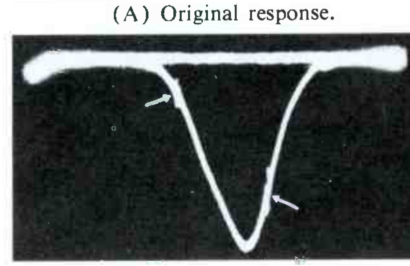


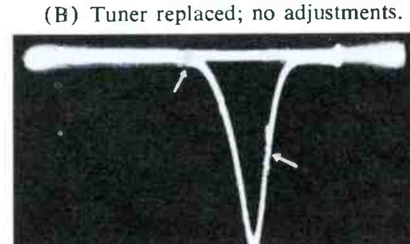
Fig. 2. On infrequent occasions, you may have to drill holes for new tuner.



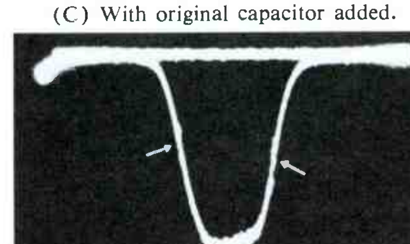
(A) Original response.



(B) Tuner replaced; no adjustments.



(C) With original capacitor added.



(D) Capacitor changed; set aligned.

Fig. 3. Response curve aids in process of matching a new tuner to IF strip.

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ELECTRONICS

WORLD SERIES WEEK

G. E. in Cooperation with Independent TV Servicemen Launches Unique National Campaign— Sells Immediate Need for Your Service to Millions of Set Owners.

Never before a sales-building campaign like this—combining the power, coverage and prestige of World Series television with the flexibility of actual business-building emphasis *to your customers in your own local area.* It is aimed at those set owners—your customers —who put up with sub-standard TV performance. *This is your campaign.* It sells the immediate need for your professional service right when demand hits its peak—World Series Time!

Plan now to tie-in with TV TUNE-UP WEEK. It's easy, effective— no red tape. Get full details from your General Electric tube distributor. HE MUST RECEIVE NAMES OF PARTICIPATING DEALERS BY SEPTEMBER 8. General Electric Company, Distributor Sales, Electronic Components Division, Room 7244D, Owensboro, Kentucky.

Complete sales package helps you cash in on TV TUNE-UP WEEK

FULL-PAGE AD PLUS YOUR NAME IN SEPTEMBER 30 ISSUE OF TV GUIDE

This hard-hitting message launches TV TUNE-UP WEEK to 8 million television families . . . alerts your customers to the World Series TV Tune-Up commercial and sells your professional repair and maintenance service. Your name-and-address listing here ties you in directly—in your local edition of TV Guide— with this nationwide campaign.

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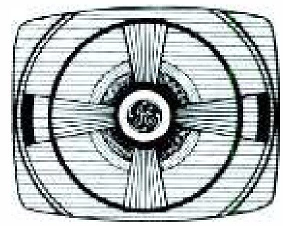
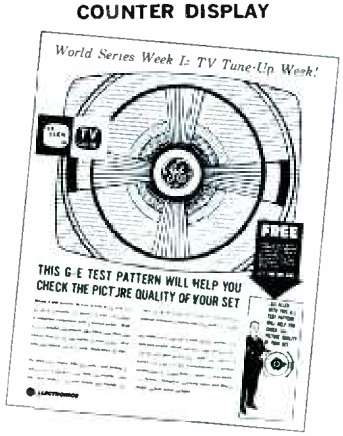
Here's a TV first! Commercials on your local station that feature an actual test pattern with which your customers can check the picture quality of their sets. You, the independent serviceman, are tied in directly through your listing in TV Guide.

IS TV TUNE-UP WEEK!



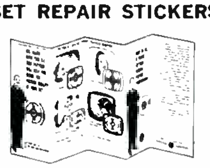
MOBILE WALL BANNER DISPLAY

COUNTER DISPLAY



AD MATS

SET REPAIR STICKERS



MAILERS

BUILDS BUSINESS FOR YOU 3 WAYS

1. TV Tune-Up Week builds an awareness of picture-quality deterioration—helps your customers prove to themselves the need for TV check-ups and preventive maintenance by you, their independent TV serviceman.

2. You, the independent service dealer, are the hero of TV TUNE-UP WEEK. On World Series television and in your regional edition of TV Guide, *your customers are urged to see you for prompt, professional service.*

3. As a participating dealer, you benefit from this national campaign at the local level *—in your city, in your neighborhood, with your customers.*

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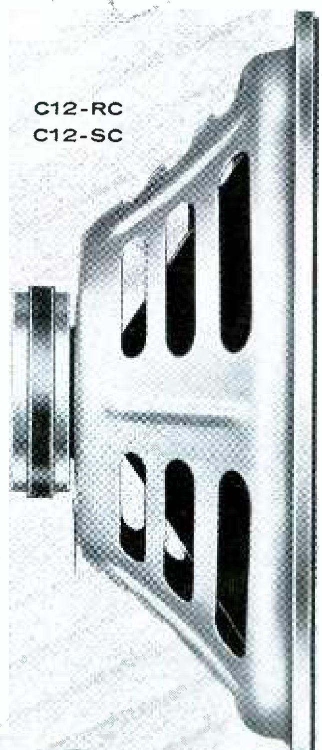
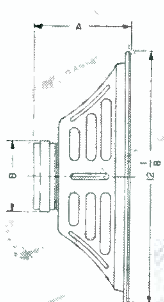
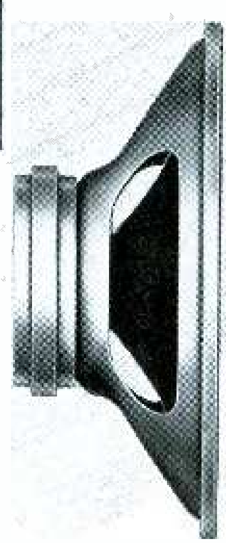
NEW Jensen PROFILE* LOUDSPEAKERS SERIES

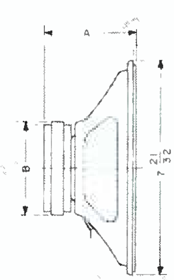
C12-RC
C12-SC





C8-RC
C8-SC





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MODEL	NOM. SIZE	POWER RATING	MAX. DIMENSIONS O.D.	DEPTH A	MAGNET DIA.-B	MAGNET WT. SYNTOX-6	EQUIV. AL 5	NET WT.	LIST PRICE
C8-RC	8"	12 watts	8 1/8"	3"	3 7/16"	10.0 oz.	6.8 oz.	2 lbs.	$12.95
C8-SC	8"	11 watts	8 1/8"	2 15/16"	3 1/4"	6.0 oz.	4.64 oz.	1 3/4 lbs.	10.95
C12-RC	12"	14 watts	12 1/8"	4 1/2"	3 7/16"	10.0 oz.	6.8 oz.	5 lbs.	16.00
C12-SC	12"	13 watts	12 1/8"	4 7/16"	3 1/4"	6.0 oz.	4.64 oz.	4 3/4 lbs.	14.75

NOTE: Mounting holes conform to all existing EIA standards.

*T.M.

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by JOE A. GROVES

RENTING SOUND EQUIPMENT *leads to Sales!*

Service-shop owners who are looking for a way to enter the commercial sound business should investigate the potential in renting sound equipment. Such a venture provides an economical start, little competition, and an opportunity for rapid growth. By the same token, equipment rental can help an established sound dealer to increase his income, promote sales, and smooth out the peaks and valleys in business activity.

There are two distinct markets for sound-equipment rental. The larger and more profitable category includes many business and industrial firms who rent complete sound systems on a long-term leasing basis. The other consists of individuals and groups who have only an occasional need for equipment. Although this latter market is often shunned by many as a "two-bit" operation, it does provide a much-needed opportunity for exposing sound equipment to likely prospects for sales or leasing, and also establishes a dealer as a well-known sound specialist.

Leased Equipment

Many companies prefer to lease sound equipment rather than buy it. For one thing, no initial outlay of capital is necessary. Also, the user can charge off the rental fee as an overhead expense rather than computing depreciation over a 10-year period—thus gaining substantial tax advantages. This, in effect, means that leasing equipment is a money-saving opportunity from the day the system is put into operation.

Before any agreement to lease a sound system can be "jelled" into specific terms, the dealer must plan the system. This isn't too difficult—not even for the beginner. Several books, full of detailed background information, are available; in addition, many magazine articles provide specific suggestions in the way of equipment, plus charts which show the requirements for average installations. (See "Breaking the Commercial Sound Barrier" in the June issue.) Manufacturers also provide much assistance, and are more than willing to cooperate with dealers in planning various systems.

After completing his plans for the system, the dealer must decide on a rental fee. The rate should be set high enough to provide an early return on his investment, yet low enough to be attractive to the customer. Other factors in determining the charge are the size of the installation, the solvency of the firm buying the contract, and—last but not least—the dealer's own ability to finance the venture.

The first step in quoting a fee is to compute the total investment in the system. To do this, the dealer figures his net cost of equipment; then he adds a normal mark-up, the expenses for installation, and the estimated maintenance cost for a period of 10 years. This total is divided into suitable monthly payments, which are typically large enough so that the dealer can recover his entire investment in one to three years. If he can collect for all of his expenses in less than three years, it's easy to see that he will have earned back twice his investment within six years. In nine years he will have, in effect, sold the system three times.

Another advantage of leasing complete systems is the built-in opportunity for selling extra equipment. It's easy to show users the desirability of expanding their systems to cover new areas and offer new services, for only a slight increase in the existing rental fee.

Looking beyond the simple fact that leased sound systems pay for themselves and then pay off profits, don't forget that the rental fee is based upon both the sale price and the maintenance cost. Therefore, each month's rent includes income for the service department. Since the contract continues for several years, the actual maintenance cost of the equipment is automatically paid for by the renter. In addition, the equipment still belongs to the dealer, who can depreciate it over a period of 10 years for tax purposes.

Occasional Renters

There is always a demand for sound equipment by the occasional renter. The Jaycees may be sponsoring a swimming meet, the Elks a dance, and the Tri Kappa a bingo party. All have a need for a complete sound system for a one-night stand. Naturally, none of them can afford to spend $250 for a system and then use it only once or twice a year. However, they can set aside $25 from an evening's recipts in order to rent equipment each time it is needed. Considering that a dealer may be able to rent a $250 system ten times in a month, each time for $25, it becomes obvious that there is good money in renting to the occasional user.

To serve this market, the dealer must determine who his renters will be, what equipment they will need, and how he can contact them. Once a dealer analyzes the prospects for sound-system rental in his own neighborhood, he will be able to tell what kind of equipment will be needed. For example, if most of his renters will be holding indoor events in auditoriums of approximately 5000 square feet or less, a 30-watt amplifier and two 12" speakers will fulfill most demands. Of course, he will also need two or three microphones, and perhaps a record player or tape recorder. On the other hand, if most of the renters will be using the equipment for outdoor events, they will need a 50-watt amplifier that can be operated from either an AC line or automotive-type battery supply. Also, instead of ordinary speakers in baffles, 12" re-entrant horn-type speakers will be required.

Much of the equipment available to the sound dealer can be purchased in combination outfits that offer a wide degree of versatility. Therefore, only a moderate investment in equipment will provide him with the basic systems he needs to serve the occasional renter.

"One-time" rental charges can be computed in much the same manner as discussed under leasing. The biggest differences occur in considering the size of the system, and in recovering the investment in ten rentals rather than over a period of years. Obviously there will be some maintenance costs to figure into the rental fee. However, as experience has shown, there is amazingly little damage to the equipment. The most frequent trouble is wear and tear on microphone leads from considerable handling.

It isn't difficult to contact people who are interested in renting sound equipment. Begin by making a list of the clubs, organizations, fraternal groups, churches, sororities, and similar prospects in your neighborhood. Then you can contact the officers of these groups and let them know you stand ready to serve them when they need sound equipment. They will undoubtedly be glad to learn they can get the equipment from a local source, and will be likely to call you when the need arises.

Once a dealer makes it known that he rents sound equipment, persons belonging to more than one group spread the word around and automatically increase the number of rentals. With a little promotional effort on the part of the dealer, he can soon build a repeat business. In addition, his increased association with renters invariably leads to sales of new systems. This, of course, places the dealer right where he wants to be—on the road to success in the sound-equipment business. ▲

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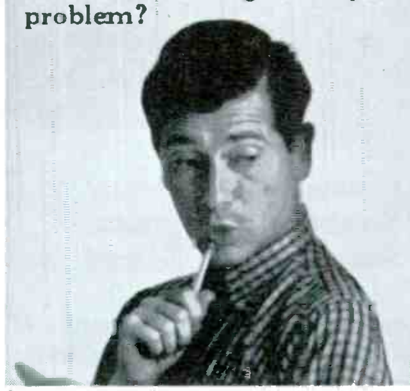
THERE'S ONE FOR EVERY CUSTOMER

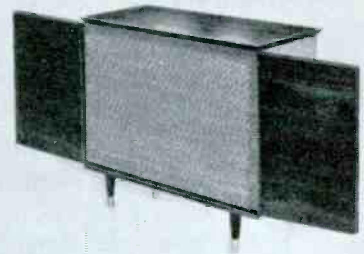
University has the product to help you sell every type of customer—for every possible purpose (even underwater high fidelity).

For instance. Got a hi-fi enthusiast who's got a space problem?



1

Show him the TMS-2 single cabinet stereo speaker system. Problem solved.



2

Lady customer with a decorating flair?

3

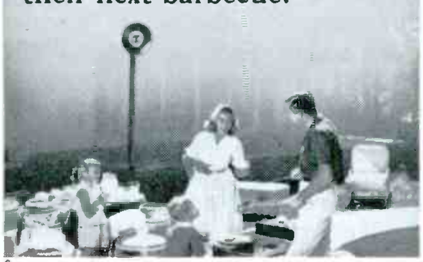
Let her see how the Medallion XII offers 5 different grille styles that snap on or off in seconds. (While you're at it, let her husband listen to its amazing sound.) Sold!

4

Is there a customer willing to pay for really big sound, but doesn't want a monster cabinet? Just give him a peek at the new Classic Mark II 3-way speaker system—only 35" wide. That's all the selling you'll have to do.

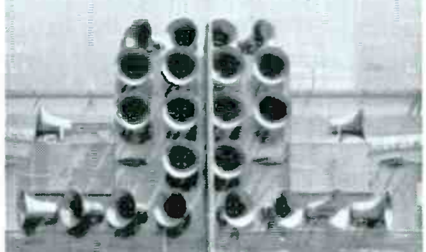
5

Are there patio or pool owners that demand outdoor hi-fi? Show them the University LC Series. They'll be so pleased with the price and the performance they'll invite you to their next barbecue.



6

Got a ball park that needs a super-powered public address system? Try the 4A4 like they did at Comiskey Park.



7

Is there a bridge that needs a total traffic communications system? The Cobraflex trumpet system used on the George Washington Bridge might just be the answer.

8

How about underwater speaker installations? University's got em. Or explosion-proof speakers? Those, too. And sound columns and paging speakers—and well, just too many to mention in this space.

9

We did say microphones? Of course. Dynamic Modular Microphones—with total interchangeability between any basic microphone and *all* adapters. Ask about them.

10

As a matter of fact, ask about *all* the University products—stereo speaker systems, hi-fi speakers, outdoor speakers, public address speakers, microphones. There's one for every *budget*, every *customer*. Your customer.

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QUICKER SERVICING

TRACK THAT DOWN

VISIBLE HUM

Back in the good old days, a radio used to develop quite a bit of hum before the owner noticed it. This was because the hum came into the sound gradually, as the filters aged. When the serviceman turned on the radio, it might have sounded pretty bad to him; but the owner often didn't even notice it.

Not so in TV work. The eye is a lot more critical than the ear, and even a small amount of hum modulation in the picture brings forth a complaint. Fortunately for the hum-hunting technician, this is one defect that gives you a pretty definite set of clues. They almost tap you on the shoulder and say, "Look, Mac, here I am!"

Tracking down hum is a process of elimination, like every other troubleshooting routine. So, let's take up the trail. First check the visible symptom—*how many* hum bars or wiggles are there? Then look to see what kind of power supply the set has. These two items of information will start you down the right track.

The most easily-analyzed type of hum consists of two horizontal bars on the screen. These may be fairly faint (Fig. 1) or pretty dark (Fig. 2). This kind of trouble is invariably found in sets with full-wave power supplies—including nearly all transformer-powered receivers and an occasional model which has a full-wave voltage doubler. Since these circuits rectify both halves of the 60-cps input, any ripple which appears in the DC output will have a frequency of 120 cps. Because the raster is being vertically scanned at a 60-cycle rate, two cycles of this ripple voltage will be picked up on each scan, and two hum bars will show on the screen. The characteristic soft shading at the edges of the bars tell us the waveform is sinusoidal. This pattern can't be produced by anything but a power-supply fault; so, if you see two bars, you may as well pull the chassis right away.

Once you have the set arranged so you can work on the power supply, you can track down the trouble in a hurry if you have a substitution box of electrolytic capacitors. (A typical unit includes several 450-volt capacitors in values ranging from 4 mfd up to 100 mfd or more.) Start out by bridging the output filter with the substitute unit nearest the rated size of the original. To be causing excessive ripple, the existing capacitor would have to be open or else have a high power factor; both of these conditions can readily be detected by the bridging test. Actually paralleling the suspected unit with an electrolytic of almost any size will tell you what's going on; even a 4-mfd substitution unit will cause a visible reduction in the density of the hum bars.

Before 120-cycle ripple gets bad enough to cause strong hum bars in the picture, it may attract your attention by producing horizontal or vertical instability, weaving, and in some cases an S-bend that is a very good counterfeit of AGC bending. But don't be fooled—if the raster displays a *double* S-curve, and if a new electrolytic snaps the picture up straight, it's "filteritis"!

60-Cycle Hum

The other major type of hum is caused by a 60-cps waveform; thus, it puts only one dark bar or bend in the picture (Fig. 3). This symptom *can* be caused by a bad filter capacitor somewhere in the B+ distribution system, especially if the power supply is a half-wave type; but a more common cause is heater-cathode leakage in a tube. However, for 60-cycle heater voltage to modulate the plate current of a tube, the circuit must include some resistance between cathode and ground, so that a fluctuating voltage drop can be developed between these points. The amplitude of this voltage is proportional to the amount of resistance to ground, and also depends on the point at which the heater is shorted to the cathode. To explain the latter point, suppose the heater of a 6-volt tube were shorted at the middle. This would place about 3 volts AC on the cathode. A short closer to the grounded end of the heater would

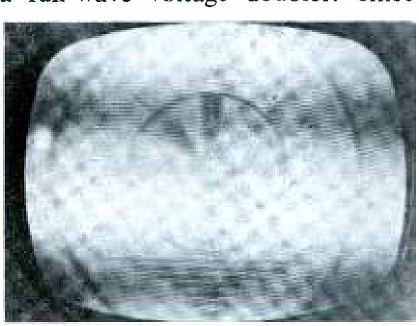

Fig. 1. Faint 120-cycle hum caused by moderate defect in filter capacitor.

Fig. 2. Fairly severe 120-cycle hum with snow (on an inactive channel).

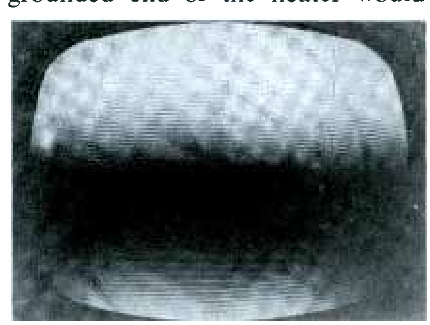

Fig. 3. Common cause of 60-cycle hum bar is heater-cathode short in tube.

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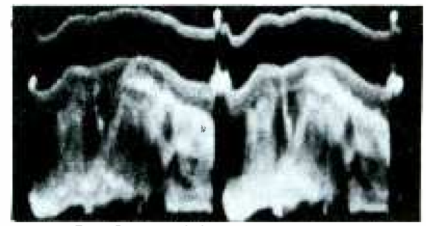
(A) Hum actually present in signal.



(B) Stray pickup on test probe.

Fig. 4. 60-cycle waveform distortion.

produce proportionately less hum voltage.

Although a heater-cathode short in a grounded-cathode stage has no effect as far as hum is concerned, some side effects can stem from this condition. For example, if the filament of a 6-volt tube were shorted through the cathode to ground at the 3-volt point, only half of the filament would still be connected across the 6.3-volt supply. So, this particular tube would light up like a country church on Wednesday night. Several other effects, even including a species of hum, could also be produced if part of the cathode reached very high temperatures and liberated gas in the tube.

The easiest *dependable* way to run down a heater-cathode short is by tube substitution. The symptom can sometimes be identified in parallel-wired sets by simply pulling various tubes in the signal path, but the trouble cannot always be exactly pinpointed by this method. Theoretically, the hum should disappear only when you break the signal path between the offending stage and the picture tube. However, hum in a video IF or similar stage may be noticeable only under certain bias conditions, and when the input signal to this stage is removed, the hum may go with it.

The contrast control furnishes a convenient check point for finding the source of hum bars. If they do not change in tone when you move the control knob, look for trouble between the control and the picture tube. When the set is on the bench, scope waveforms at a 30-cps sweep frequency can further help you to troubleshoot hum. An S-curved distortion of the whole signal (Fig. 4A) is a dead giveaway to the presence of hum at the point being checked. But beware of confusing this effect with the less clear-cut "humpback" pattern in Fig. 4B, which is typical of the stray hum pickup you often find while scoping high-impedance circuits.

In bench servicing, a signal-injection unit or pattern generator offers a rapid means of finding a heater-cathode short in the picture-signal circuits. Simply inject a fairly strong, unmodulated RF signal into each stage in turn, and watch for hum bars to appear. If a signal fed into the IF input produces no hum, but bars appear when a signal is placed on the antenna, look in the tuner for trouble.

Very bad cases of 60-cycle hum, caused by high-amplitude signals, can make the screen appear half black and half white (Fig. 5). Just a small slice of video remains visible at the center.

Some Weird Ones

In addition to bad filter capacitors, you will sometimes find some really strange causes of hum troubles. In most of them, you won't see the familiar hum bar; however, if you check the symptoms very closely, you'll see that each of them is *basically* a 60- or 120-cycle pattern.

One of these odd cases is the little "band of wiggles" that travels up or down the screen, usually on a pretty good picture. When it reaches the top or bottom of the screen, it can cause unstable vertical sync. This trouble is typically due to 60-cycle signal leakage somewhere in the picture or sync circuits. One case I handled was due to a leaky socket which allowed AC to cross over from the heater pin to the grid pin. Another trouble came from a very small heater-cathode leakage in a sync tube. Still another was due to moisture on a printed-wiring board. The cure: If the interference shows a basic 60-cycle repetition rate, change tubes (and check the power supply, if it's a half-wave type); if you've found a 120-cycle signal, start bridging all the electrolytics you can find, whether or not they're anywhere near the sus-

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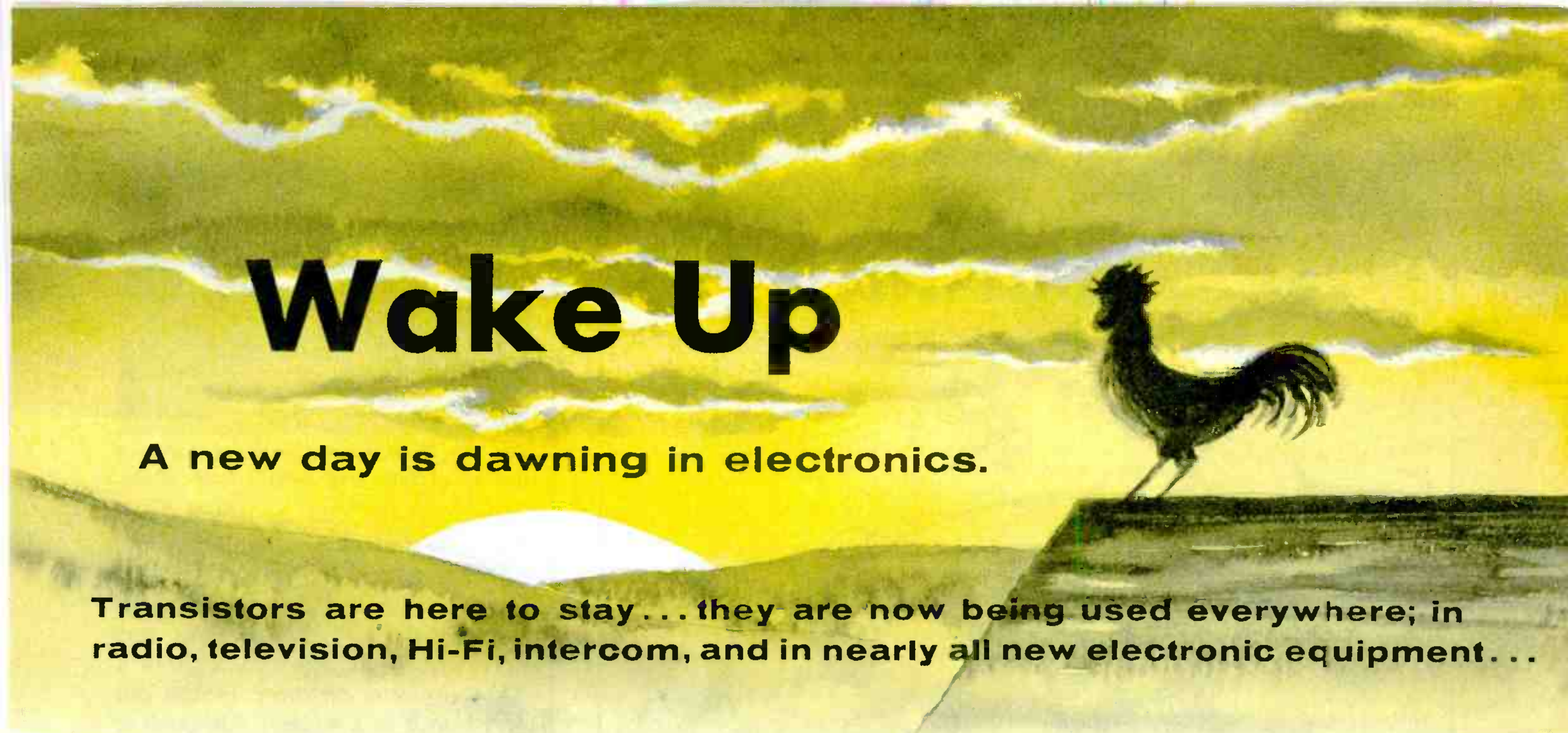

Wake Up

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

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

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

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

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

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

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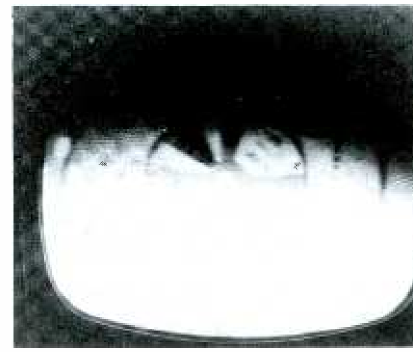

Fig. 5. Extreme 60-cycle modulation makes picture half black, half white.

pected circuit. You can track down the more difficult ones with a scope.

Another real howler that you'll find occasionally, if you're unlucky, is the "glitch." (This name was borrowed from a friend who is a TV transmitter engineer; he has 'em every once in a while.) Although it sounds like something out of *Alice in Wonderland,* the glitch is merely a small pip in the power-supply output voltage, due to an obscure trouble in the filter. A few sample causes are shorted turns in chokes, interelectrode leakage in multiple filter capacitors, peculiar resonances in the filters, and so on. The typical glitch causes a narrow bar to move slowly up or down the screen. It is usually about the same size as the vertical blanking bar, and the picture can even be synced with it! Glitches can be traced by looking for stray pips in the power-supply ripple waveform, as demonstrated in Fig. 6. In this case, a pip appears only on every other cycle of the 120-cps signal, indicating a freakish trouble in only one side of a full-wave power supply.

My favorite glitch story is about a family who owned two TV sets, a console and a portable. Both showed the characteristic narrow bar. After some head-scratching, I finally noticed that the little set worked perfectly when the console was turned off! One of the two 5U4's in the big set was found to be slightly gassy. New 5U4—no glitch! Evidently, the gassy tube went into a short burst of parasitic

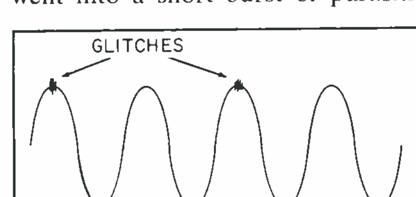

Fig. 6. Glitch is result of stray pip appearing in output of power supply.

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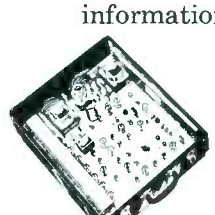

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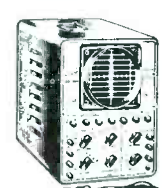

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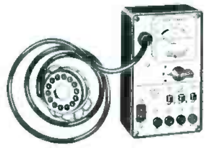

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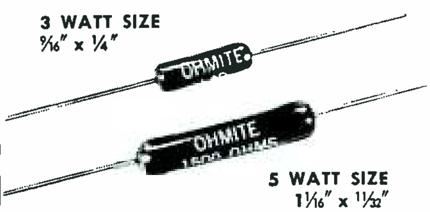

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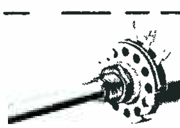

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Horizontal Hum

Page 34 of the July issue showed a dandy example of how 15,750-cycle interference from the horizontal sweep section can do the same things to the picture as 60-cycle interference — except, of course, the black bar runs up and down instead of across the screen. Almost all of these troubles are caused by insufficient filtering in the boost or horizontal circuits. I'd say the leading cause is failure of electrolytic capacitors between the boost line and the B+ source.

Now you know what to go looking for when you find a hum bar (either horizontal or vertical) on a TV screen. Keeping in mind the suggestion you've just read, you shouldn't have to look very far.

Miniature VOM

Many servicemen find it handy to carry a VOM along with them on home calls. If you're among those who do, you'll be interested in the *Pocketmeter* No. 30-240 recently introduced by Audiotex Mfg. Co., Div. of GC-Textron Electronics, Rockford, Ill.

Measuring only 5½" x 3½" x 1" and weighing a mere 14 ounces, the *Pocketmeter* is very versatile for its size. It provides the following ranges:

Current — 0-300 ua, 0-12 ma, 0-300 ma.
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Sensitivity of the meter is 6000 ohms/volt DC and 2700 ohms/volt AC.

Antenna Preamp

Tremendous strides have been made in improving TV-signal preamplifiers. Gone are the bulky boosters, almost as big as table radios, that used to sit on top of TV cabinets; in their stead we have mast-mounted, transistorized units not much larger than a blackboard eraser.

We recently examined and tested one of these new amplifiers, the *Powermate* Model APM-101 produced by Jerrold Electronics Corp. of Philadelphia. This device consists of two sections—the amplifier itself, and a remote power supply designed to be installed indoors near the TV set. The remote unit contains output-matching circuits for coupling two receivers to the antenna system; in addition, it includes a power transformer and an AC-coupling circuit which feeds approximately 20 volts AC to the mast-mounted section via the lead-in. A B+ rectifier and filter on the amplifier chassis supplies DC operating voltage to the 2N1742 transistor. Isolating networks couple the TV signals to the lead-in and provide protection for the RF circuits.

Since the amplifier is designed to be mounted as near to the antenna terminals as possible, the random noise picked up prior to amplification is held to a minimum. Also, the amplifier produces very little internal noise, so it has an excellent signal-to-noise ratio. The results of "before-after" tests on this unit, using several TV sets, showed that it can produce a good solid gain of 10 (measured at the video detector) with no perceptible increase in noise. ▲

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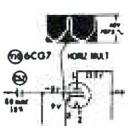
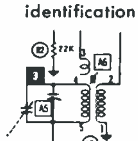


- Voltages at tube pins and test points
- Waveforms at appropriate points on TV schematics
- "CircuiTrace" identification numbers for printed circuits
- Schematic items keyed to chassis photos and parts lists
- Special capacitor and resistor ratings
- Coil and transformer color codes or terminal identification



- Test points labeled
- Special currents shown (B+. horizontal output cathode, horizontal output screen)
- Alignment adjustments and test points labeled
- Tube functions shown
- Control and switch functions shown
- Switch sequence indicated
- Power supply "sources" shown
- Fuse ratings indicated
- Coil resistance over 1 ohm shown
- Coding of electrolytic capacitors shown

REPLACEMENT PARTS LISTS

- Lists standard, locally available replacement parts
- Includes notes for special installation or other considerations
- Includes ratings and/or measured values for assisting in selection of replacement parts
- All parts keyed to chassis photos and schematics for quick reference

TUBE PLACEMENT DIAGRAMS

- Shows tube types and functions; top and bottom views shown
- Includes filament connections on series string
- Indicates TV sound and sync paths
- Tube failure check charts included
- Shows blank pin or locating key on each tube
- Includes fuse locations and ratings.

ALIGNMENT INSTRUCTIONS

- Gives step-by-step easy-to-follow alignment data
- Procedure makes use of standard service-type equipment
- Alignment frequencies are shown on chassis photos near adjustment number—adjustments are keyed to schematic and photos

"CIRCUITRACE" FEATURE

- Invaluable printed board servicing aid—indicates points on board photo and schematic for quick, easy measurement of components, or test locations

FULL PHOTO COVERAGE

- All chassis views are shown in actual photographs
- All parts are numbered and keyed to the schematic and parts lists
- Test and alignment points indicated

FIELD SERVICE NOTES

- Outlines procedure for "in the home" adjustments
- Gives hints on quick access to pertinent adjustments, safety glass removal, etc.

"BONUS" FEATURES

- Disassembly instructions
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- Record changer and tape recorder "exploded views" for easy mechanical parts replacement or service

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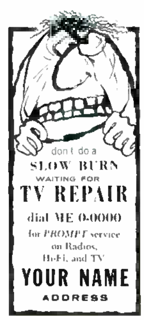
It's not too late to start your fall advertising campaign. You can add a lot of sparkle to your program by using a wide variety of ads to keep folks guessing about what you'll come up with next. If your promotional plans call for newspaper advertising, change ads every issue and repeat them every so often to obtain the best results. The whimsical cartoons featured in all of this month's ads will draw fresh attention to each new message.

Check with your printer to see if you should order newspaper mats ($1.75 per set of 5), reproduction proofs ($1 per set), or both ($2.50). Then, fill in the handy coupon on page 87 to order either this month's selection or the entire program of 60 ads. (With the latter, you receive a comb-bound book of proofs.) To be sure of getting your ads in time for your promotion, mail the request as early as possible.

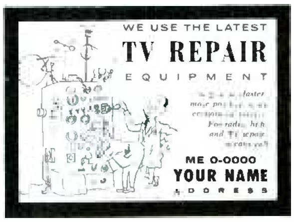


ES-17 1⅞" x 4¼"

Who doesn't do a "slow burn" while waiting for service? Use this hard-hitting cartoon and capitalize on your ability to offer prompt service on radio, TV, and hi-fi equipment.

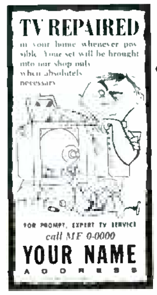
ES-24 1⅞" x 4¼"

Overcome customers' reluctance to let a "clumsy ox" work on their TV; this ad assures them you handle sets with the same loving care as if they were your own.



ES-34 3¾" x 2¾"

Ads that emphasize your modern equipment and techniques are always effective. The "Rube Goldberg" machine in this one adds just the right touch to bring sure-fire results.



ES-2 1⅞" x 3¾"

This ad tells the TV owner just what he wants to hear: You promise to repair sets in the home whenever possible, bringing them to the shop only when absolutely necessary.

ES-59 1⅞" x 3½"

Here's one that catches the reader's eye and raises a pert question, reminding him to have his hi-fi, TV, or radio repaired—by you, of course.

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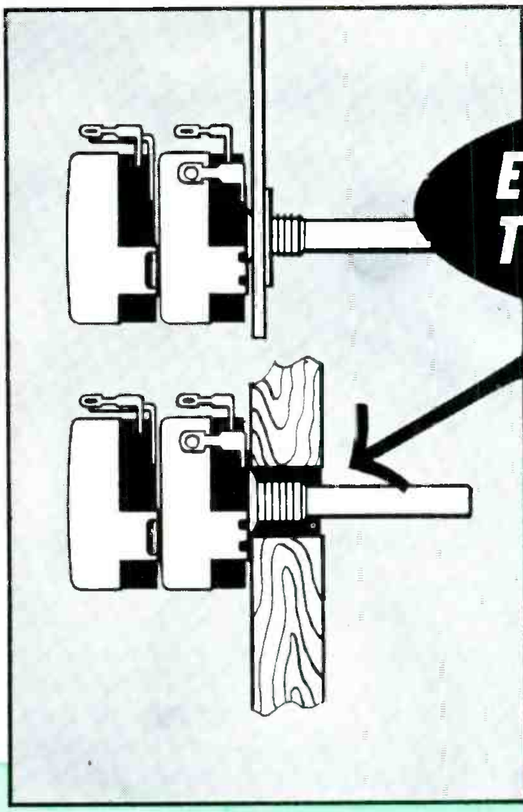

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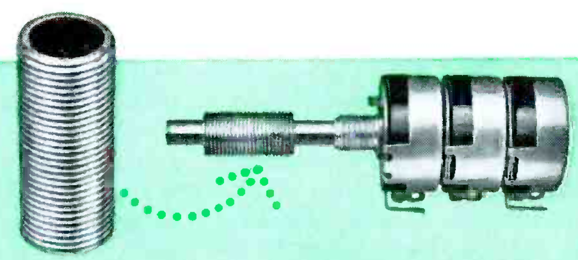
without dual bushing length stocking



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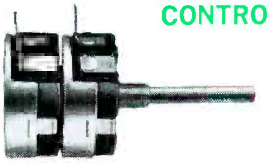
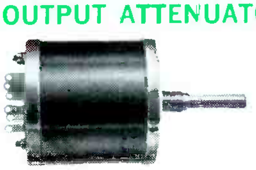


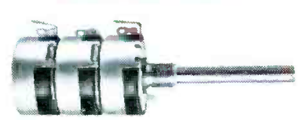
Self-compensating L-pads and T-pads rated at 10 watts audio. Continuous range from 0.5 to 30 db attenuation.

CONSTANT IMPEDANCE OUTPUT ATTENUATORS



Linear attenuation in 3 db steps up to 24 db. Rated at 30 watts audio. Equipped with dial plate and bar knob.

CONSTANT IMPEDANCE ATTENUATORS



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Using a Tube Tester to Advantage

Are you getting as much good out of this time-proved instrument as you could be? by Joe A. Groves

Although a tube tester is one of the oldest and most common electronic test instruments, few servicemen take full advantage of owning one. Many "old pros" no longer use theirs for troubleshooting because they have been fooled by earlier tests. As a result, they have retired the tester to a little corner of the shop "for customers' use only." On the other hand, many newcomers consider the tube checker to be their most loyal friend and accept the result of every test as gospel. Neither of these attitudes is wise.

Before going into the subject of how you can get the most good from your tube tester, it should be understood that expecting a tester to supply information beyond its design capabilities is as foolish as expecting a compact automobile to pull a semi-trailer over a mountain. Yet this is what has made many technicians lose faith in tube testers —they have expected too much from them.

Certainly, tube testers have limitations. There is no commercially-available tube tester that will give a 100% accurate indication of tube merit. However, this shouldn't be a stumbling block for any technician.

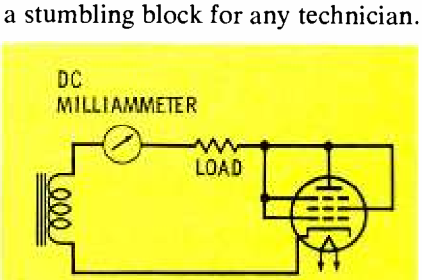

Fig. 1. All tube types are checked as diodes in an emission-type tube tester.

After all, you've learned to get along pretty well with VOM's and VTVM's, and find them useful test instruments. You accept a reading as an indication of the voltage present in a circuit, knowing full well that the meter introduces a parallel circuit path which causes a certain amount of change in the voltage. (For further explanation of this point, refer to "Pitfalls of Meter Readings" in the April, 1961 issue.) Why not learn to accept the limitations of a tube tester in the same way?

Types of Testers

Take off the frills, get down to bare facts, and you'll find three basic types of tube testers used by servicemen—emission, dynamic, and mutual conductance or transconductance. Each type is designed for certain applications and has certain limitations.

Emission Type

Tube checkers falling in the emission category are designed for easy operation. They show whether or not a tube is capable of emitting electrons, and provide a rough indication of merit. All tubes are connected as diodes (Fig. 1) and a DC milliammeter measures plate current. The load is selected for various tube types to obtain a GOOD indication for an average tube of the type under test.

This type of tester was developed primarily to show that tubes sold over the counter were good when they left the shop. The simple indication it provided eliminated the problem of a customer buying a "pig in a poke," and met the need of fulfilling a tube guarantee. (Usually the only guarantee on tubes sold directly to a consumer is that the tube is good at the time of purchase.) These testers serve the same purpose today that they did 30 years ago; thus, they are more of a sales tool than a troubleshooting instrument.

Dynamic Type

Dynamic tube testers offer a more accurate indication of how a tube will operate in a circuit than those classified as emission testers. As shown in Fig. 2, an AC signal is applied between grid and cathode, and a milliammeter reads plate current. However, only the DC component is measured. This reading can be affected by the emission, as well as by other factors which affect the amplifying ability of the tube. Therefore, higher-than-normal emission can "cover up" for conditions (such as poor grid alignment) which lead to inefficient tube operation. Dynamic testers thus tend to favor tubes of the remote-cutoff type and tubes with ample emission.

Dynamic testers are easy to set up and generally small in size. Since

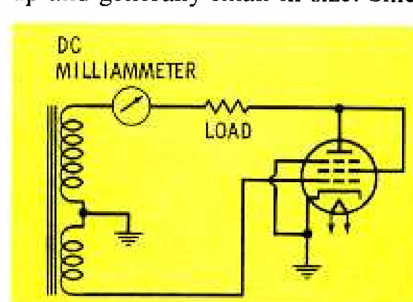

Fig. 2. Dynamic-type tester applies a signal to the grid and checks Ip.

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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.

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they provide at least some sort of an indication of the amplifying ability of a tube, they are often preferred over the emission type for tube-sale testing. In addition, they can be used for practical troubleshooting when their limitations are remembered.

Transconductance Type

Transconductance is the term used to indicate the amplifying ability of a tube. Testers designed to measure this characteristic use the basic test circuit shown in Fig. 3. Both an AC signal and a bias voltage are applied between grid and cathode. The metering circuit measures the amplitude of the AC signal appearing in the plate circuit to provide a reasonably accurate indication of transconductance.

Setup procedures for testers of this type are normally too complicated for the average layman to operate. Therefore, they are seldom used for do-it-yourself tube testing, even though they provide the most accurate quality check of any commercial tester.

One limitation of mutual-conductance testers is that they evaluate tubes as class A amplifiers. Since many TV circuits operate class B or C, and handle pulse signals, a class A test doesn't necessarily tell you how the tube will function under different bias conditions.

The Brighter Side

Now that we've looked at some of the limitations of tube checkers, let's examine their strong points. Obviously, they must serve a useful purpose, or they wouldn't be considered basic test equipment. For you skeptics, it's sheer nonsense to think public demand is the only reason a tube tester is a "must." Testers were being put to good use long before the do-it-yourself bug bit the American public.

In addition to checking tubes being sold to customers, a tester has many applications on the bench and on home calls. Up to this point we've considered only the emission and amplifying tests of tubes. So-called auxiliary tests such as shorts, leakage, gas, noise, etc., offer enough troubleshooting assistance in themselves to justify the price of a tester.

Testers at Work

Suppose you're on a home call

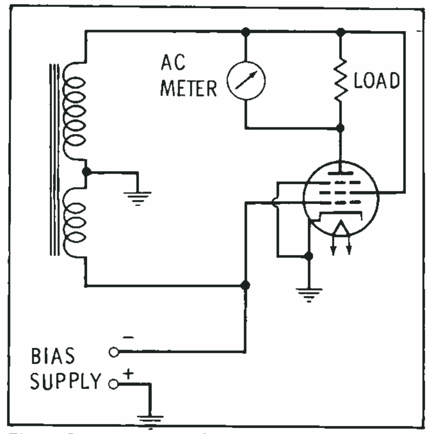

Fig. 3. Transconductance-type testers compare input and output AC signal.

to handle a complaint of vertical roll, and you've substituted the tubes in the sync and vertical circuits to no avail. What would you do next—abruptly tell your customer the set requires shop service, and start pulling the chassis? Hold on a minute—a tube could still be causing the trouble. There's a fairly good chance the problem is due to some fault like a heater-cathode short or excessive grid current in a video, IF, RF, or AGC tube. Why not check these on the spot? To the customer, this will seem like a logical approach—and it will look more professional than continuing to fumble around with tube substitution.

Try another example. This time, let's assume you were greeted by an overloaded picture which righted itself when you disconnected the antenna. It looks like AGC trouble, but substitution of the keyer tube and adjustment of the AGC control haven't solved the problem. You could substitute the RF and IF tubes, anticipating gas or grid leakage—but it would be best to try a complete set all at one time, since more than one tube may be causing trouble. What if you don't have enough tubes of the right types in your caddy? Here's another logical place to put a tube tester to work.

"Hey, Mister! There's that buzzing sound I was telling you—"

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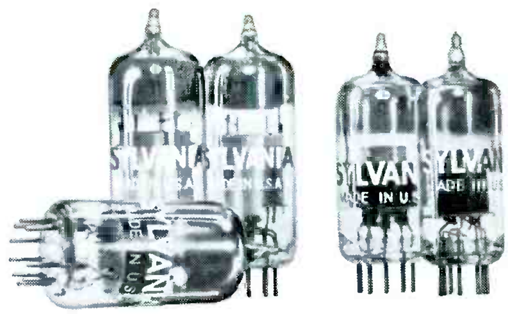

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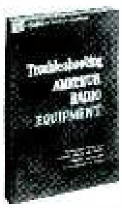
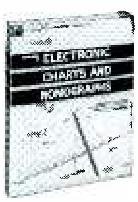


Howard S. Pyle, W7OE, provides a wonderful guide for all hams who want to repair their own equipment. The most common types of failures are stressed. You learn in detail what is most likely to cause the trouble and how to correct the problem right in the "shack". Includes 9 *complete* schematic diagrams for the most popular transmitters and receivers. Chapters cover: Receiver Troubles; Transmitter Troubles; the Antenna System; Accessory Equipment; Preventive Maintenance; Mobile Equipment; Component Color Codes; Schematic Symbols. 128 pages; 5½ x 8½". *Only* $2.50

Handbook of Electronic Charts and Nomographs



Allan Lytel's important time-saving book—contains 58 electronic charts and nomographs to provide solutions to hundreds of formulas and ratios—in just the time it takes to rule a line. Shows you how to use each nomograph; provides examples. Includes bound-in clear vinyl overlay sheet for positioning over any nomograph; permits ruling in erasable pencil lines connecting appropriate points on the graph scales; can be used repeatedly without injuring the nomograph. Comb-binding; book lies flat with its 8½ x 11" size providing large scales for best accuracy. Special chapter tells how to use nomographs most effectively and how to develop them on your own. 128 pages; 8½ x 11". *Only* $4.95

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The gas test of a tube tester really measures grid current, which may be caused by several things other than gas content. Regardless of cause, however, any appreciable "gas" indication when there is negative bias on the tube usually spells trouble. Testers use a circuit similar to the one in Fig. 4. Its sensitivity depends on the size of R. Grid current, if present, produces a voltage drop across R when the resistor is switched into the circuit. This alters the bias on the tube under test. Naturally, the greater the change in bias voltage, the greater the change in meter indication.

In some applications, grid current must be drawn on positive peaks of the input signal to establish grid-leak bias. The gas-test circuit of Fig. 4 can gauge the ability of a tube to meet this requirement. The fixed bias is reduced to zero, and a relative measurement of the resulting grid current is provided by the voltage drop across R. This check, like the test for absence of grid current at high bias voltages, can furnish valuable troubleshooting clues.

We've already pointed out that a gain or quality check in a tester can't predict for sure how a tube will operate in one of the sync or sweep circuits. Nevertheless, such a test does have definite benefits. It often confirms suspicions of trouble —or, more important, tells you when you're on the wrong track in blaming trouble on a tube.

To illustrate this point, suppose you're called on to widen a narrow picture, or answer a complaint that the raster takes too long to fill the screen vertically. You put a new tube in the suspected stage, and the trouble is apparently cured. So, you make out your bill, collect, and go on your merry way, only to receive a call in a day or two telling you the same trouble has returned. Chances are the original tube wasn't any more at fault than the replacement—there's undoubtedly a circuit defect at the bottom of the trouble. In fact, you may have to pull the set for bench service on the second call. But what about that tube you've billed your customer for, and what about your lost time on the callback? Then the thought occurs to you, "Why didn't I check the original tube before I replaced it?"

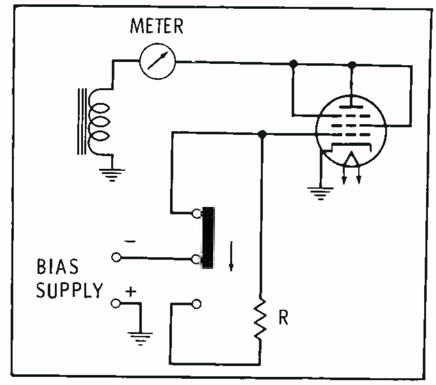
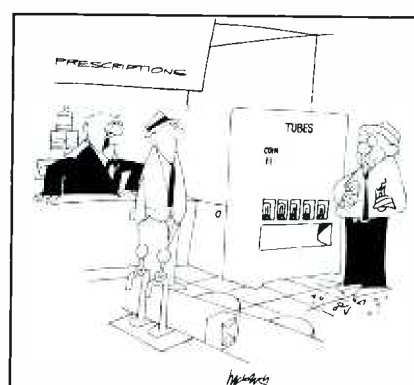


Fig. 4. Grid current through R alters bias and changes the meter indication.

An indication of excessive grid current *and* weak emission might have tipped you off to a leaky grid coupling capacitor. Or, if the tube had checked normal in every respect, this would have put you on the alert for the possibility of trouble in some component besides the tube.

When you're holding a "post-mortem" on a tube replacement that didn't hold up, there's every possibility in the world that the original and new tubes will both check up to par. The reason why the replacement provided a short-lived solution to the problem is that its initial high performance temporarily covered up a circuit defect. You'll probably find, in cases like this, that the original tube will work fine when you've solved the real problem.

Even though testers are not infallible in judging tubes "good" or "bad," they are *valid* and *valuable* servicing aids as long as you properly interpret the results. Developing this skill requires that you pay close attention to all tests, so you can learn the normal reaction of your instrument to different tube types. Make a practice of *critically* testing *all* tubes, and you'll soon learn how to get the most out of your tester. ▲



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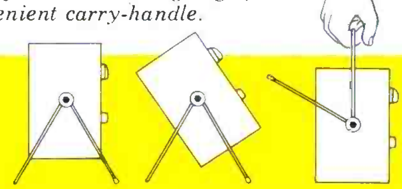

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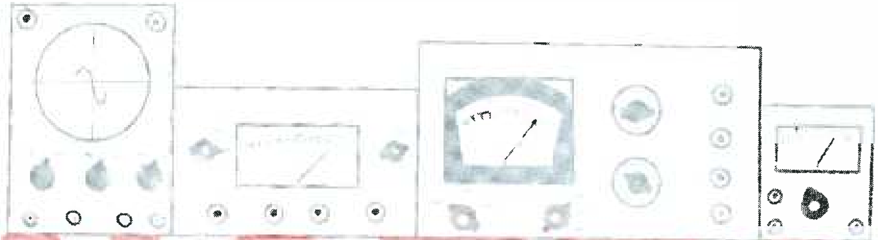


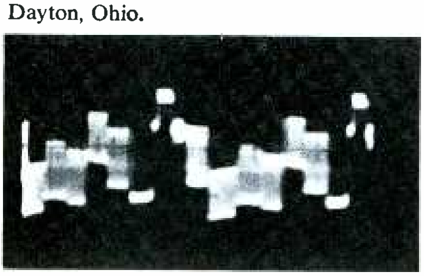
NOTES ON TEST EQUIPMENT

by Les Deane

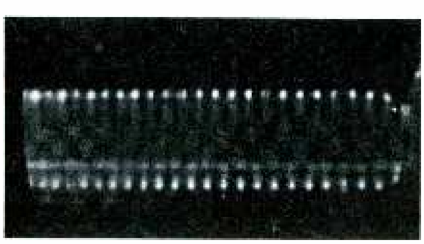
Convertible Scope

Fig. 1. Jackson 5" scope has ample response and gain for any service work.

If you're having trouble deciding between a wide-band oscilloscope and a narrower-band, higher-gain type for your shop, you'll be interested in the unit shown in Fig. 1. By flipping a front-panel switch, you can modify the vertical amplifier to favor either bandwidth or gain. This scope is the new Model 600 produced by the Jackson Electrical Instrument Co. of Dayton, Ohio.



(A) NTSC color-bar signal.



(B) Expanded 3.58-mc signal.

Fig. 2. Waveforms photographed from screen of new Model 600 oscilloscope.

Specifications are:

1. *Power Requirements—105/125 volts, 60 cps; power consumption 75 watts; regulated supply line-isolated and fuse-protected; pilot light on panel.*
2. *Vertical System—input impedance 1.5 megohms shunted by 20 mmf (30 mmf for x1 position); maximum input 600 volts rms (or peak AC plus DC); attenuator switch with three positions for wide-band and three for high-sensitivity operation, plus vernier control; wide-band operation gives flat frequency response from less than 10 cps to 4.9 mc ± 1 db, down 3 db at 5.2 mc and 6 db at 5.6 mc, with sensitivity of .3 volt rms/inch; narrow-band operation gives frequency response from less than 10 cps to 120 kc ± 1 db, down 3 db at 200 kc, and 6 db at 400 kc, with sensitivity .02-volt rms/inch; input cable supplied.*
3. *Horizontal System—input impedance 1.1 megohms shunted by 22 mmf (12 mmf with x10 attenuator switched in); maximum input 600 volts AC plus DC; frequency response from less than 10 cps to 200 kc ± 2 db, down 6 db at 650 kc; sensitivity .8 volt rms/inch.*
4. *Internal Sweep System—frequency continuously variable in six overlapping ranges from 10 cps to 100 kc; internal 60-cycle sweep, gain control, and variable sweep expansion provided.*
5. *Sync Provisions—vertical input signal, internal 60 or 120 cps, and external source;* SYNC LEVEL *and* STABILITY *controls provided on panel; maximum external sync input 100 volts AC, 400 volts AC plus DC.*
6. *Other Features—flat-face 5" CRT with lighted graticule, signal polarity reversal, internal and external intensity modulation, astigmatism control, negative gate-pulse output, built-in 10V P-P calibration voltage, direct deflection inputs, and camera mount provided; accessory low-capacitance, demodulator, and high-voltage probes available.*
7. *Size and Weight—15" x 9 1/8" x 13", 24 1/4 lbs.*

The vertical amplifier of a scope can go only so far in offering both high gain and broad frequency response, without increasing the number of stages beyond a "point of no return." Thus, if a scope has a flat response out to 4 or 6 mc, its sensitivity is likely to be relatively low. Consequently, you may be able to view every detail of a high-frequency waveform, but may not obtain sufficient vertical deflection when sampling low-level signals. If a scope has a high sensitivity, on the other hand, its frequency response will generally be limited; therefore, the abrupt voltage changes in a high-frequency signal will not be accurately reproduced. Instead of compromising between wide-band and high-sensitivity operation, the Model 600 offers a choice of one or the other—depending on the attenuator-switch setting.

While lab-testing the instrument, I fed in a composite color-bar signal from our closed-circuit transmitter to see how it would be reproduced in wide-band operation. The results are indicated in Fig. 2A, taken with the scope sweep set at ½ the horizontal sync-pulse rate to show two complete lines of the composite signal. In Fig. 2B, I increased the sweep rate and used the expanded-sweep feature of the instrument to reproduce a 3.58-mc chroma signal from a color-bar generator. Although brightness is reduced, the waveform is clearly visible.

To check the sensitivity of the instrument, I viewed waveforms produced by microphone and phono-cartridge outputs, small B+ ripple voltages, and demodulated video-IF signals. The gain of the vertical system was more than adequate to reproduce these signals for clear observation and peak-to-peak measurements. Employing an audio analyzer with built-in output meter as a signal source, I found that the scope could actually reproduce a usable waveform down to signal levels of less than .005 volts rms. The built-in calibration-voltage source and scaled graticule are useful aids in measuring signal amplitudes.

The negative gate terminal mentioned in the specifications furnishes a pulse output for testing inductive components by a simple ringing process outlined in the manual.

Two-in-One Meter

If you do much servicing or maintenance work, you undoubtedly have frequent use for both a portable volt-ohm-meter and a vacuum-tube voltmeter—one for quick reference checks in the field and the other for troubleshooting and alignment jobs at the bench. Realizing this twofold need, Sencore, Inc., of Addison, Illinois has introduced a new meter that combines all the functions of both instruments in one compact unit. (See Fig. 3.) The *Service Master* Model SM112 also offers a number of unique features not found in conventional VOM's or VTVM's.

VTVM specifications are:

1. *DC Voltmeter—six ranges of from 0 to 3, 10, 30, 100, 300 and 1000 volts; input resistance 10 megohms; accuracy ± 3% of full-scale deflec-*

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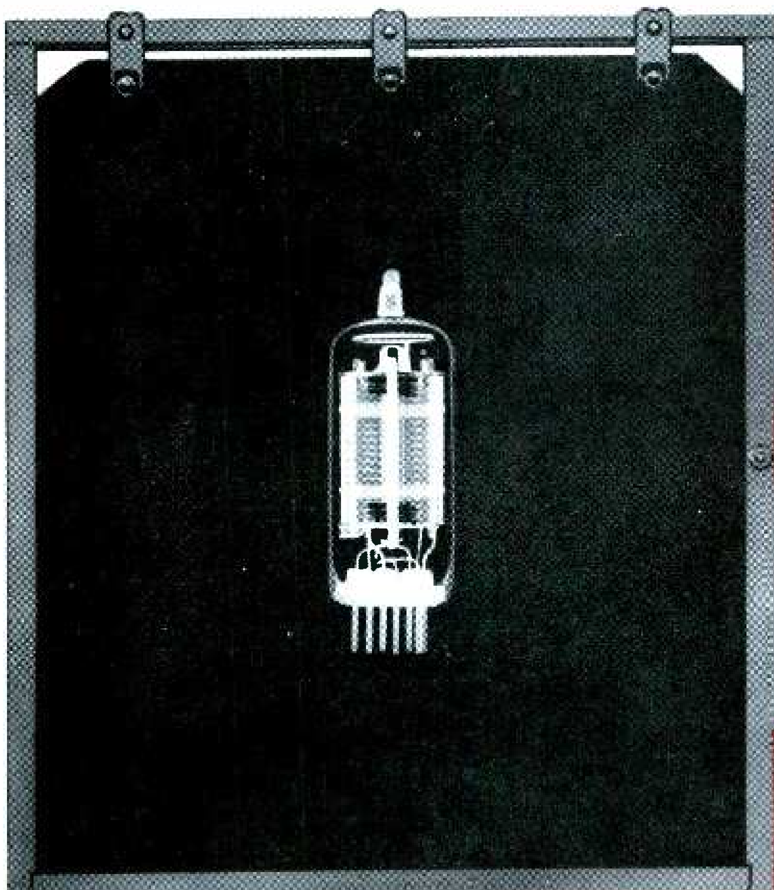

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REPAIRING TRANSISTOR RADIOS *by S. Libes (Dir. Technical Publ., Bogen-Presto).* Provides practical procedures which you can apply to faster trouble-shooting and to finding those elusive 'dog troubles.' Basic theory is presented in a way that you will understand easily, quickly. Operation and service of the latest transistorized circuit designs are covered. All new ideas about transistors as used in current transistor radios are explained. Also included are the latest design practices in transistor portables, AM, multi-band, imported, all-transistor, auto-hybrid and FM radio receivers. High power transistorized P.A. power amplifiers and high fidelity applications covered. #270. **$3.50.**

BASICS OF FRACTIONAL HORSEPOWER MOTORS & REPAIR *by Gerald Schweitzer.* Training & Service Publications Supervisor, Fedders Corp. Fractional horsepower motors are used in air conditioners, fans, refrigerators, washing machines, dishwashers, sewing machines, record changers, power motors, power tools, etc. It is so easy to learn the theory of fractional horsepower motors from this 'pictured-text' course so that you can apply it to servicing and maintenance for additional profits. #236, **$3.90;** #236-H, cloth, **$4.90.**

HOW TO INSTALL & SERVICE INTERCOMMUNICATION SYSTEMS *by Jack Darr.* A most lucrative and rewarding field for the service-technician who has the know-how. This book covers the entire field of commercial intercommunication equipment — installation and maintenance. It deals with basic amplifiers, special speakers, switching arrangements, AC and AC/DC systems, wireless systems, cabling networks, all-call systems, paging systems, remote and master systems, one and two-way intercom systems, installation for home and industrial use, outdoor wiring, and system requirements for particular applications. The text on servicing techniques covers amplifiers, power supplies, boosters, components, tubes, intermittents, switching, cabling, speakers and microphones. Also, test equipment and tools needed for trouble-shooting. Illustrations of test set-ups. #189, **$3.60.**

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tion; zero-center scale and polarity-reversal switch provided.

2. *AC Voltmeter—6 rms ranges of from 0 to 3, 10, 30, 100, 300, and 1000 volts; 6 peak-to-peak ranges of from 0 to 8.4, 28, 84, 280, 840, and 2800 volts; accuracy ± 5% of full-scale deflection; frequency response approximately 30 cps to 4.5 mc.*
3. *Ohmmeter—six ranges with multipliers of R x 1, 10, 100, 1K, 10K, and 1 meg; center-scale value 10; zero and ohms-adjust knobs on panel.*

VOM specifications are:

1. *DC Voltmeter—six ranges of from 0 to 3, 10, 30, 100, 300, and 1000 volts; sensitivity 5000 ohms/volt; accuracy ± 3% of full-scale deflection.*
2. *AC Voltmeter—six rms ranges of from 0 to 3, 10, 30, 100, 300, and 1000 volts; sensitivity 500 ohms/volt; accuracy ± 5% of full-scale deflection.*
3. *DC Ammeter—full-scale range 1 amp; smallest scale division 20 ma; accuracy ± 3%.*
4. *Ohmmeter—two ranges with multipliers of R x 1 and R x 100; center scale value 75. Ohms-adjust provided on panel.*

General specifications are:

1. *Power Requirements — 105/125 volts, 60 cps; power consumption less than 10 watts; supply isolated from AC line; standard flashlight battery supplied for VOM-VTVM resistance measurements.*
2. *Panel Meter—6" face, 200-ua movement; accuracy ± 2%; separate scales for VTVM and VOM functions; scale-indicating lights provided for VTVM ranges.*
3. *Size and Weight—8⅛" x 7⅝" x 3½", 5 lbs.*

Since using a conventional multimeter or VTVM is second nature to many of us, we're often apt to take its facilities for granted. Thus, it comes as a pleasant surprise to find a basic design innovation such as the combining of a VOM and VTVM into one easy-to-use piece of equipment. Another appealing feature of the SM112 is its simplicity of operation, which stems from the fact that only one pair of permanently-attached test leads is used for all measurements, and only two panel knobs select the numerous functions and ranges.

Fig. 3. New Sencore instrument is both a sensitive VTVM and portable VOM.

Since the VTVM section affords the accuracy and sensitivity necessary for precise measurements, the VOM was purposely designed with a relatively low sensitivity for rugged field work. Requiring no AC power, it serves as a handy portable meter for such applications as checking antenna and speaker systems in remote locations and servicing mobile equipment. An all-steel case with detachable lid protects the instrument during transit, and a storage compartment for test leads and power cord adds to its portability.

One of the most ingenious extra features of the Model SM112 is the automatic indicator that tells you which scale to read when employing various functions and ranges of the VTVM. As illustrated in Fig. 4, a small arrow-shaped cutout is lined up with the left edge of each

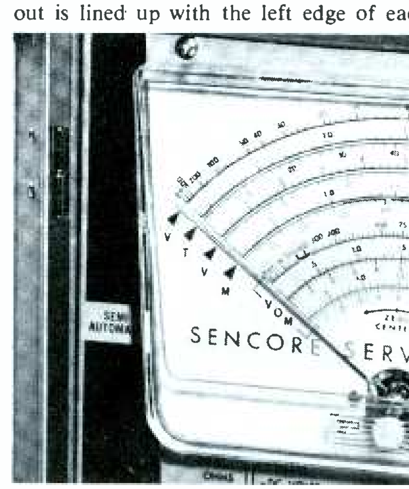

Fig. 4. Neon lights on VTVM scales are an unusual *Service Master* feature.

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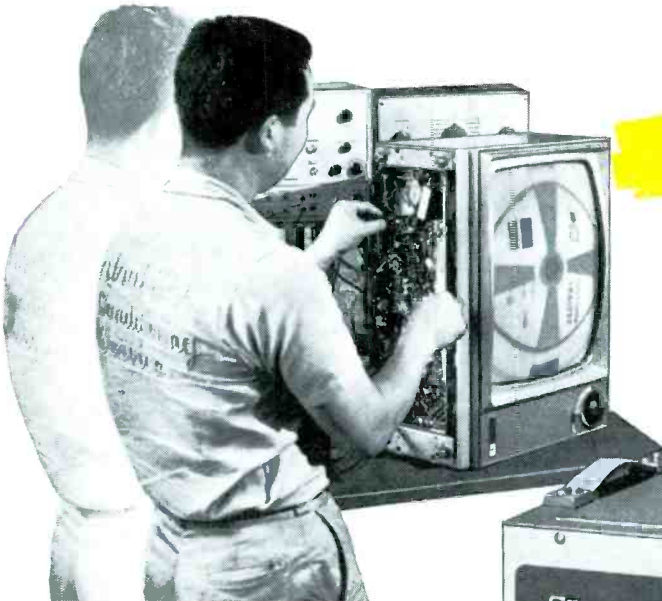

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VTVM scale. Behind these panel cutouts are four miniature neon bulbs wired to a separate switch section that operates in step with the function and range selectors. As each VTVM function and range is selected, the neon bulb glows to mark the appropriate scale. This feature greatly aids readability—especially on a meter with so many scales.

Other features include often-used measurement and circuit-reference data (printed inside the lid), and two AC receptacles on the recessed control panel for powering soldering guns, other test units, or the equipment being serviced. A high-voltage probe is also available for use with the *Service Master*. This accessory fits directly on the tip of the regular test probe and extends the DC range of the VTVM to 30,000 volts.

Pattern Maker

With color TV sets moving into more and more homes each year, progressive servicemen are finding an increased need for specialized equipment to troubleshoot and adjust these receivers. RCA, Camden, N.J., has recently made a contribution toward this end in the form of a relatively low-cost pattern generator. Pictured in operation in Fig. 5, the Model WR-64A generates RF signals for producing color-bar, dot, or crosshatch displays.

Specifications are:

1. *Power Requirements — 105/125 volts, 60 cps; power consumption 40 watts; line-isolated supply; pilot light on panel.*
2. *RF Output—modulated picture carrier with or without unmodulated sound carrier for TV channel 3 (instrument may be realigned for channel 4 output); maximum picture-carrier output .05 volts rms with 10% sound carrier level.*
3. *Output Impedance — approximately 300 ohms; 4' permanently-attached output cable supplied.*
4. *Color-Bar Pattern—provides 10 bars simultaneously at 30° phase intervals including R–Y, B–Y, G–Y, I, and Q signals; crystal-controlled offset subcarrier of 3,563,795 cps ± 20 cps, keyed at 189 kc; signal amplitude continuously variable; color sequence yellow-orange, orange, red, magenta, reddish blue, blue, greenish blue, cyan, bluish green, and green.*
5. *Dot Pattern—RF modulation producing 9 vertical and 14 horizontal rows of white dots on normally-operating receiver; fixed size and number.*
6. *Crosshatch Pattern — RF modulation producing fixed display of 9 vertical and 14 horizontal narrow white bars.*
7. *Sychronization—internally generated 60- and 15,750-cps sync signals for reproduction of standard interlaced raster; external sync not required.*
8. *Size and Weight—10" x 13½" x 8", 13¼ lbs.*

The Model WR-64A is a keyed rainbow generator utilizing an "offset subcarrier" method to generate color-bar signals equally spaced at 30° phase intervals. Briefly, here's how the instrument works: Its crystal-controlled subcarrier operates below the standard color-oscillator frequency of 3.579545 mc by one horizontal-scan interval (or 15,750 cps). This 3.563795-mc signal is keyed at a rate of 189 kc and fed to the color receiver. The resultant output signals from the chroma demodulators (15,750-cps sine waves of different phase relationships) control the color guns in the CRT. Thus, for each horizontal scan, a series of color bars is displayed across the screen.

Fig. 5. New RCA pattern generator furnishes a pulse-modulated RF output.

The instrument is portable for in-the-home servicing, and has only three controls and a single output cable for simpli-

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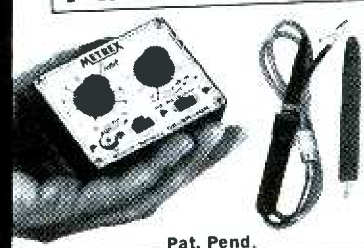

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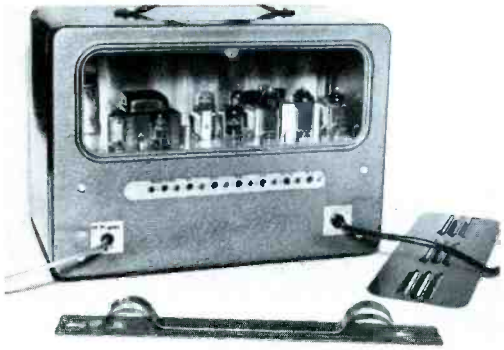

Fig. 6. Tubes, test points, and adjustments as seen from rear of WR-64A.

fied operation. A reproduction of the color-bar pattern is printed on the front panel of the instrument for reference. A removable panel on the rear of the case makes all tubes and test points readily accessible. Fig. 6 shows this panel removed and also reveals the location of the service and calibration controls. Incidentally, a cable-holding bracket (visible in the foreground of Fig. 6 is attached to the removable panel.

The output is strictly RF—factory-aligned to the picture-carrier frequency of channel 3. If interference is caused by a strong local station on this channel, the RF oscillator can be accurately realigned for channel-4 operation by following the instructions given in the manual.

Actual patterns produced by the Model WR-64A are shown in Fig. 7. I set these up on color receivers in the lab and found all three to be stable and jitter-free for adjusting and troubleshooting the receivers. The crosshatch display also proved to be of value for checking linearity and overscan in black-and-white receivers. ▲

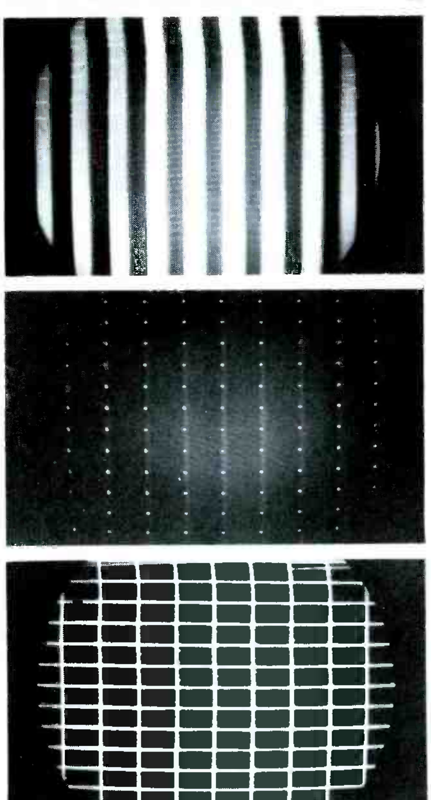

Fig. 7. Color-bar, dot, and crosshatch patterns produced by RCA generator.

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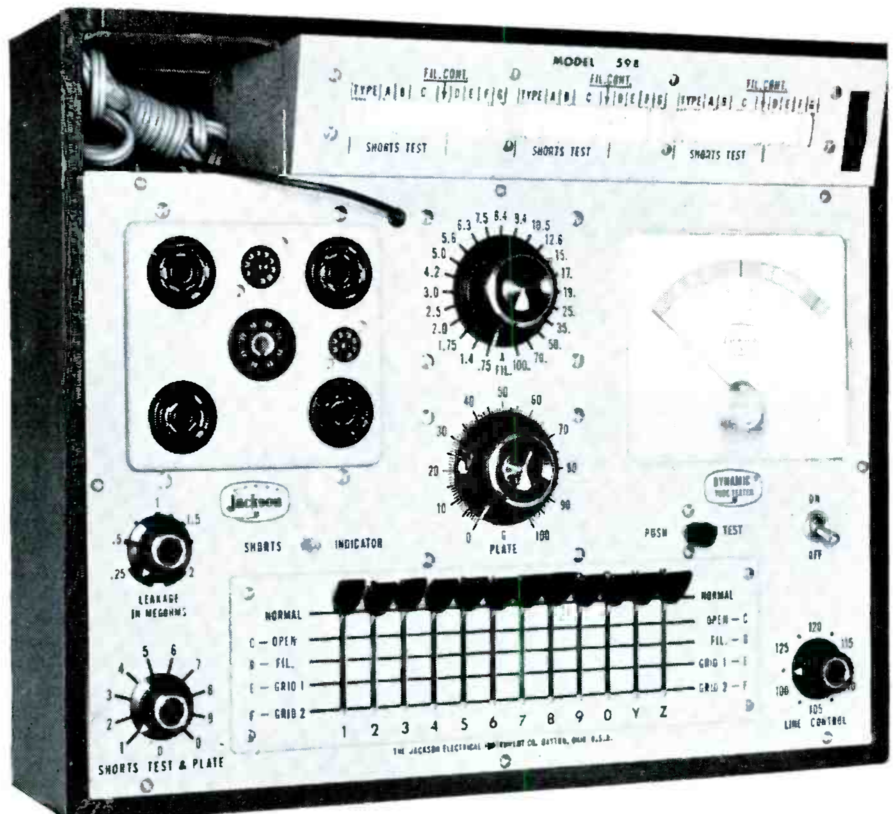

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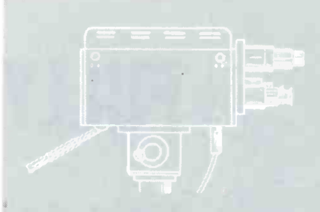
Export Dept., Roburn Agencies Inc., 431 Greenwich St., New York 13, N. Y.



The Electronic Scanner

New Westinghouse Warranty-Service Plan

Independent service dealers will be appointed by local **Westinghouse** distributors to handle all service work on TV, radio, and hi-fi equipment under the terms of a new 90-day labor warranty plan. Ken Brown, service manager of the **Westinghouse** TV-radio division, explained that the appointments would be made on an open-bid basis. "It is our opinion," Mr. Brown said, "that this method of local control at prevailing local service rates is most fair and equitable for the independent service contractors to whom we look for product support."

The plan features a telephone information service; owners of **Westinghouse** sets can phone **Western Union** Operator 25 to locate the nearest authorized service dealer.

Sencore Holds Clinic in Chicago Suburb

More than 500 service clinics held by **Sencore, Inc.,** have been attended by servicemen across the nation in the past two years. One of the latest, held at the Oak Park Arms Hotel in Oak Park, Ill., was sponsored by **Melvin Electronics.** Over 200 Chicago-area servicemen took advantage of the meeting, which highlighted transistor-radio and TV sweep-circuit troubleshooting. Ed Flaxman, **Sencore** V-P, and Jim Newman, product specialist, conducted the meeting.

EIA Predicts 6.2 Million TV Sales This Year

Mr. Frank W. Mansfield, Chairman of the EIA Marketing Data Policy Committee, has predicted that the public will buy 6.2 million or more TV sets during 1961. This projected total, based on reports gathered during the first five months of this year, is substantially higher than 1959 and 1960 sales figures—which were 5.7 and 5.9 million, respectively. This upward trend is appearing even though the TV market has changed from a demand for initial installations to one for replacements and extra sets.

Musi-Pak Expands Franchise Program

One of the best-known names in background music has opened its doors to the radio-television servicing industry. **Musi-Pak, Inc.** of Valley Stream, N.Y., offers an opportunity for qualified technicians, who have at least two years of servicing experience, to become franchised dealers in a nationally-known organization.

Earlier this year, the **U.S. Background Music Institute** presented **Musi-Pak** with the "No. 1 Award for Finest Programming in Music Service, Originality, and Design" for 1961.

"World Series Week Is TV Tune Up Week"

This is the title of an advertising campaign prepared by **General Electric Co.** on behalf of independent radio and television service dealers, to be televised during the week of Sept. 30 to Oct. 6—coinciding with the start of the World Series. Coverage will include the top 70 markets in the nation, and is expected to reach 24 million homes and 55 million people.

Mel Allen, noted sports announcer, will be featured in the commercials. Based on a "test pattern" theme and keyed to preventive maintenance, the ads will urge people to put their sets in top operating shape so a breakdown won't occur ". . . in the last of the ninth, when three men are on base, two out, and the call on the last batter is three and two."

Kits of promotional material will be available through **General Electric** tube distributors to help service dealers tie in with the program.

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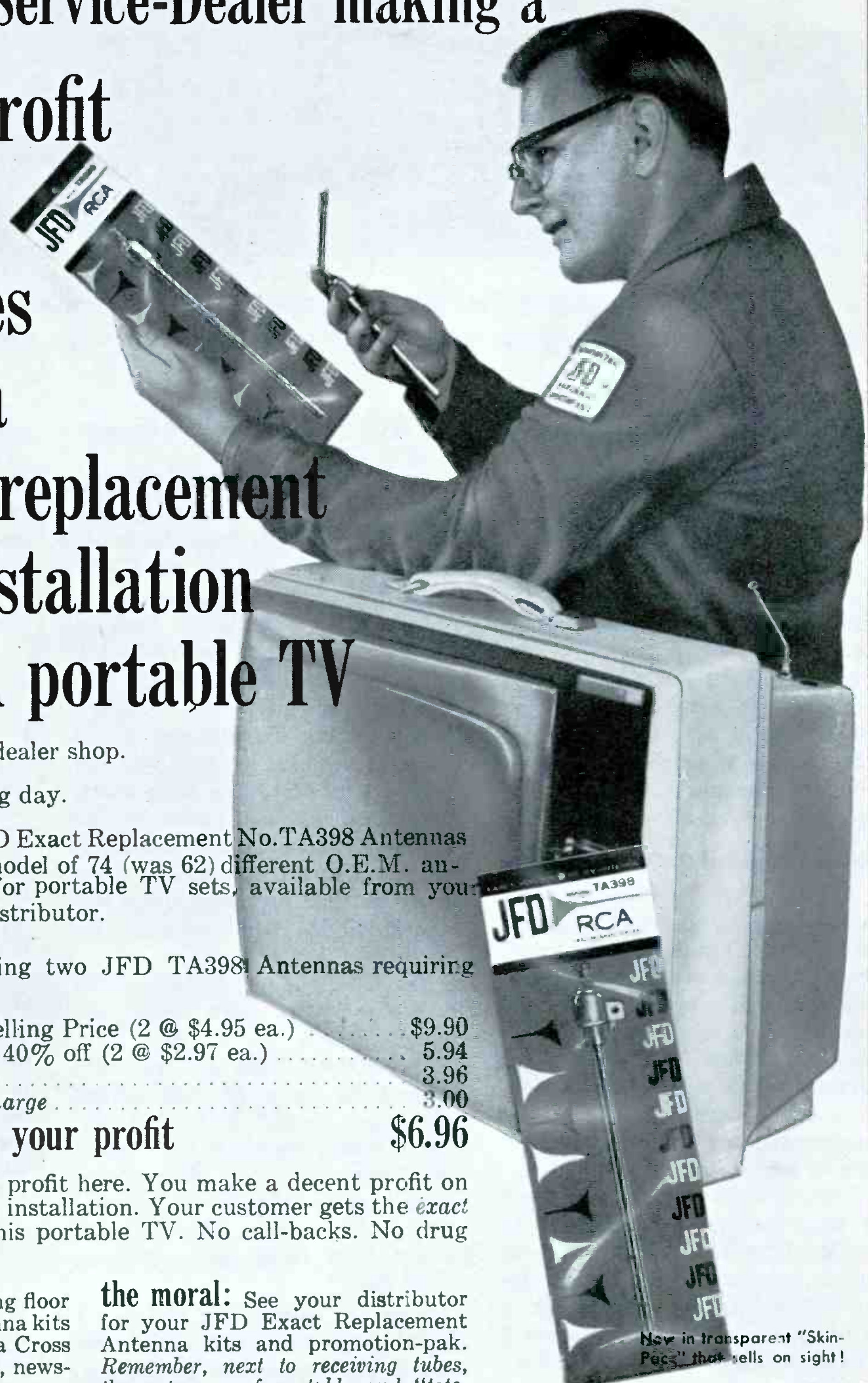
Picture of a Service-Dealer making a $6.96 profit

in 7 minutes installing a JFD exact replacement antenna installation for an RCA portable TV



the place: Any service-dealer shop.

the time: Every working day.

the product: Two JFD Exact Replacement No.TA398 Antennas—one model of 74 (was 62) different O.E.M. antennas for portable TV sets, available from your JFD distributor.

the facts: RCA set using two JFD TA398 Antennas requiring replacement

Your *Actual* Selling Price (2 @ $4.95 ea.)	$9.90
Dealer Cost at 40% off (2 @ $2.97 ea.)	5.94
Profit on Sale	3.96
Installation *Charge*	3.00
your profit	**$6.96**

No cut-down "rabbit-ear" profit here. You make a decent profit on the sale *and* a profit on the installation. Your customer gets the *exact* antenna replacement for his portable TV. No call-backs. No drug store competition ever.

the aids: Self-merchandising floor and counter displays...antenna kits ...1961 portable TV Antenna Cross Reference Guide...streamers, newspaper mats, direct mail literature... listings in Sams Photofact folders.

the moral: See your distributor for your JFD Exact Replacement Antenna kits and promotion-pak. *Remember, next to receiving tubes, the antennas of portable and "toteable" sets require the most frequent replacement.*

THIS COUPON HAS STARTED THOUSANDS OF SERVICE-DEALERS IN TODAY'S PROFITABLE $3,500,000 PORTABLE TV ANTENNA REPLACEMENT BUSINESS. MAIL IT IN TODAY!

JFD

THE BRAND THAT PUTS YOU IN COMMAND OF THE MARKET

JFD ELECTRONICS CORPORATION
6101 Sixteenth Avenue, Brooklyn 4, New York
JFD International, 15 Moore Street, New York, New York
JFD Canada, Ltd., 51 McCormack Street, Toronto, Ont., Canada

JFD ELECTRONICS CORPORATION
6101 Sixteenth Avenue, Brooklyn 4, N. Y.

Gentlemen:
- ☐ I want to participate in the JFD Exact Replacement Profit Plan. Send me full details.
- ☐ Also send me the name of my local JFD distributor.
- ☐ Send FREE JFD 1961 Exact Replacement Wall Chart.

The name of my local JFD distributor is: ____________

NAME ____________
ADDRESS ____________
CITY ________ ZONE ______ STATE ______

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DEVELOPING YOUR HOME CALL TECHNIQUES

ADVICE FROM A SUCCESSFUL SERVICE MANAGER ON CULTIVATING A GOOD "SETSIDE MANNER"—BY ART MARGOLIS

At least twice a week I get up from my service manager's desk, grab my tube caddy, and take a turn on house calls. Besides the fact that I enjoy getting away from supervising and getting my hands on TV's, I always come up with ideas for customer satisfaction I can get in no other way.

My last few field trips were no exception. I came up with four policies we are all aware of but do not put enough emphasis on, even though the emphasis means dollar bills in our pockets.

Keep Technical Data Up to Date

The first thing I did upon getting back to my desk was to set up a wire basket labeled "Latest Service Info." Then I checked over the tech literature that arrives by mail, and made sure we were receiving everything available. While this should be standard procedure for every service shop, one of the calls I had just completed drove home the importance of this point.

The call, oddly enough, was from an electronic design engineer. At present John is working on computers; however, he had once developed TV circuit designs for a well-known manufacturer. When I arrived at his home, he was busy installing a new CRT.

He moaned, "Art, this is the fourth picture tube I've put in this thing, and it's only two months old. Something must be burning them out, but I can't figure what."

I began checking voltages—everything read correctly. He finished the installation and turned on the TV. The picture came on bright and clear. Two pugilists began a waltz around a ring. I asked, "What did you need me for?" His wife brought in some coffee.

"Wait," he answered. In the middle of the second round it happened. The raster cut off, came back on, and then went out for good. We could hear the crowd screaming.

Both of us went to the back of the TV set. I tapped the CRT neck and jiggled the base socket. The picture came on and went off again. The symptoms did resemble a bad picture tube. John left the room and came back in with his tube tester. He opened the case, pulled out the 110° CRT adapter, and started to connect it to the new tube. I knew then what had happened. John was not up on the latest technical information.

"Hold it, buddy," I warned. "Is that how you've been testing the tubes?"

He nodded with a look that showed he knew he had goofed somehow. "John," I said slowly, "You've been booby-trapped. Didn't you know that your picture tube takes only 2.68 volts for its filaments? Your tester provides 6.3. You'll burn those filaments open every time."

While he mulled over this fact, I found a cold-solder joint at the cathode connection on the printed circuit board. A little heat from my soldering gun cured that.

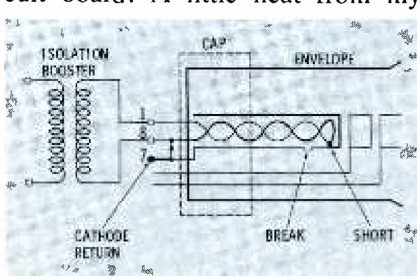

Fig. 1. CRT heater-cathode short is remedied by isolation unit and jumper.

I made a firm resolution to make sure our technicians would never make the same mistake—and they would never be lacking in the latest service data!

Keep an Adequate Tube Stock

After a recent call, I grabbed the first parts salesman who came in the door, gave him a comfortable chair, and made him go over our tube inventory with me, tube by tube. I didn't want a repeat performance of what happened to me at *that* stop.

Naturally, you should carry all needed tubes in your tube caddy. Yet you also want to avoid duplication, so you find out which ones will serve as substitutes. For instance, a 6BQ7 does an excellent job in replacing a 6BK7, 6BZ7, 6BC8, X155, etc. There's no real reason to carry them all when the 6BQ7 does the trick. However, be sure of *your* tube facts, or you'll find yourself in a situation like this.

Since I go out on the street only occasionally, I carry a small tube caddy. I was servicing this portable TV just around the corner from the shop. The symptom was easy — snowy picture. I examined the tubes in the tuner. The RF amplifier was a 5BQ7, and one of its twin lights was out. I looked in my caddy. I didn't have a 5BQ7, but I did have a 5BK7. I removed the 5BQ7, substituted the 5BK7, and turned the TV on again. The snow was still there. I figured the 5BQ7 had shorted and burned out one of the B+ dropping resistors.

I took the set into the shop and placed it on the counter. Since it belonged to our neighbor, I was going

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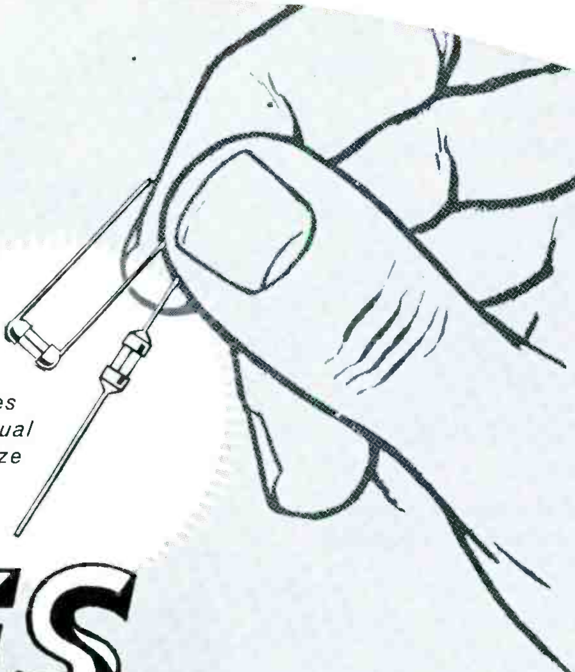
Another outstanding development by the Makers of BUSS fuses

TRON FUSES



Fuses actual size

Sub-miniatures — hermetically sealed   *Body size only .140 x .300 inches*

For Use Where Space is at a Premium

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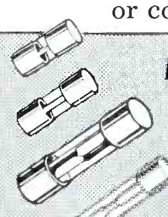
They are self-protecting and operate without exterior flash or venting, so they can be installed anywhere in the circuit. Likewise, they may be teamed in one capsule or replaceable unit with such components as resistors or condensers.

Available in ratings from 1/20 to 5 amps. for use on circuits of 125 volts or less where available fault current is not over 50 amps. Color coding indicates ampere rating and assists in final inspection of fused circuits.

Made with Axial pigtails that are adapted to feed through automatic wire forming machines — or with right angle pigtails conveniently spaced for assembly on printed circuit chassis.

Get the full story: —
Write for BUSS Bulletin TRON



In the complete BUSS line, there are fuses and fusemountings of unquestioned high quality to fit every protection need.

That's why it's more profitable to handle only BUSS fuses.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
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Servicing Unique Electronic Apparatus

Cash in on growing new opportunities in electronics servicing. Jack Darr gives you the know-how on such equipment as: Watchmaster watch timer and tester; RF diathermy machines; liquid-flow timers; electronic photoflash units; electric scoreboards; RF heaters, gas-fired boiler controls; garage-door openers; movie sound systems; strobe tuning devices; photoelectric cells; ultrasonic cleaners, etc. 128 pages; 5½ x 8½".
No. SED-1. *Only*........ $2.50

Howard W. Sams Handbook of Electronic Tables and Formulas

A time-saving, one-source reference for all those valuable charts, tables, formulas, and laws indispensable to the service technician. This is the reference book you'll refer to again and again. Five comprehensive sections contain most-used and most-needed information on: Formulas and Laws; Constants, Standards, Symbols, and Codes; Service and Installation Data; Mathematical Tables and Formulas; Miscellaneous Data. Full-color six-page foldout shows frequency spectrum chart, based on latest FCC allocations. 134 pages; 5½ x 8½", hardbound.
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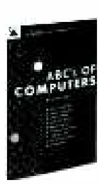
Handbook of Electronic Circuits

A practical reference book on important circuits. Covers: 4 power supply circuits; 14 circuits used in radio stages; 8 circuits used in transmitter stages; 32 circuits used in TV receiver stages; 7 additional circuits having special applications. An analysis of the operation of each circuit is given; a schematic for each is included; a component failure analysis describes troubles which could occur if particular components should fail. Of real value to service technicians, engineers, and students. 72 pages; 8½ x 11".
No. HEC-1. *Only*........ $1.00

ABC's of Computers



Allan Lytel's clearly written book tells what computers are, how they operate, and what they can be expected to do. Contains clear and concise explanations of analog and digital computers, binary numbers, computer circuitry, memory devices, arithmetic functions, symbolic logic, input-output devices, programming, information storage. A perfect introduction to this fantastically-expanding field, especially valuable to technicians and engineers. 128 pages; 5½ x 8½".
No. ABC-1. *Only*........ $1.95

Electronics Reference Data, Vol. 2

A valuable compilation of reference data. This volume covers: antennas and transmission lines; UHF television; circuit design; audio measurements; radar; meters and measurements; microwave tubes; RF transistors; traveling wave amplifier; etc. 122 pages; 8½ x 11".
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to throw in the resistor and return it immediately. After removing the chassis and exposing the "innards" of the tuner, I aimed my flashlight at the pins of the 5BQ7 tube socket. The resistors all looked shiny—not a charred one in the lot.

I took some B+ plate readings—they were all on the nose. Then some light filtered through to my brain. I pulled out a tube manual. Yes, the pin connections were exactly alike for both the 5BK7 and the 5BQ7. Their characteristics were similar—all except one! The 5BQ7 needed only 450 ma of filament current, while the 5BK7 needed 600. With only 450 mils flowing in this series circuit, the 5BK7 wasn't getting hot enough to do any good.

I installed a 5BQ7 from the shelf and the snow disappeared. As I put the compact TV back together, I mentally kicked my seat. I vowed I'd have the right tube the next time, or be doubly sure of my substitutions.

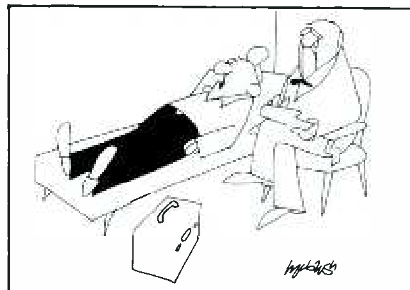
Increase the Use of Tube Testers

Ask any TV serviceman what he thinks is the best way to test a tube, and he'll answer, "Direct substitution." While this is true, it does not discount a tube tester's worth. For example, if you don't have a replacement for the tube you suspect, you can test it with a tube tester. Of course it's not 100% perfect, but it provides information you wouldn't have otherwise!

A tube tester is a valuable piece of service equipment in the hands of a skilled technician who understands its limitations. It is, of course, much less valuable in the hands of an inexperienced operator — but such people generally don't realize this. They take the red-green meter reading as gospel. There's nothing much you can do to change that situation. However, there *is* some "public-relations work" you can do to give your customers more confidence in you. This was one of the points brought home strongly to me on one of my latest sojourns.

The call was from a perplexed do-it-yourselfer. He pointed to the TV and said, "I tested all the tubes. It must be something else."

I asked him what was wrong. It boiled down to the fact that he was getting a raster and slight snow—but no picture or sound.



"Then I tried the 1B3, still no brightness, . . . then the 6BQ6, 6W4 . .

I plucked out the local oscillator (a 5EU8), replaced it as a first try, and then turned on the TV. The sound and picture came on loud and clear. He was astounded. "You test that tube!" he demanded.

"I did," I answered, "by direct substitution."

"No—I mean really—on a tube tester." he said. I obliged, and the 5EU8 read GOOD. He made me put it back in the TV. Again, the TV wouldn't work. He was very upset.

I explained, "Tube testers can't check the wide variety of tubes used in television in exactly the same circuits that they occupy in your receiver. This tube might work OK in some other type of circuit, but not in this one. Here—I'll show you. You tested all the tubes before calling me. Now I'll test them, interpret my findings and show you the difference." I tested all of his tubes; six of them read shorted or gassy. Replacing them gave him increased contrast and width, and eliminated a slight vertical fold.

The customer was happier when I left. His faith in tube testers was restored, and he understood plainly that the tester is used to best advantage in the hands of a technician. My servicemen won't leave the shop without one. It doesn't hurt the profit picture a bit, either.

"6BQ6GT, 6BQ6GTA, 6BQ6GA, 6BQ6GTB, 6CU6, 6DNG, 6DQ6, 6DQ6A. . . . When will it ever end?"

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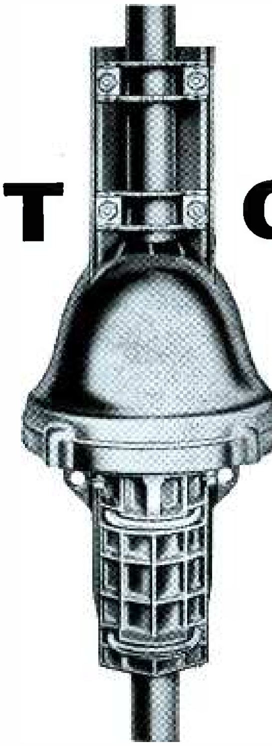
DON'T OPEN,



EVER!

(and watch your profits and reputation soar)

The housing lock screws on Cornell-Dubilier's Radiart AR-22 antenna rotor are the last thing you'd ever want to touch on this heavy-duty beauty. Why? Because this rugged standard of the industry is backed by CDE's lifetime service warranty — a warranty that offers you a big, extra Profit-and-Reputation Builder. In fact, the AR-22 offers you three big Profit-and-Reputation Builders.

Profit-and-Reputation Builder No. 1. In appearance and performance, the AR-22 practically sells itself. The rotor's one-piece streamlined aluminum housing is rugged, rust-proof and it's sealed against the worst possible weather conditions. Rain, snow or ice just can't affect it. It shrugs off hurricane winds.

Your prospect has immediate confidence in the AR-22, and in you for carrying such an obviously reliable product line. If he hasn't agreed to buy yet, point out that inside the famous bell-shaped housing is an in-line precision planetary gear train and 12 heavy-duty bearings in two 6½" ball-bearing races, for smoother turning power, more dependability, longer life.

But that's just half the performance story, because the AR-22 is completely automatic! Just set the selector on its handsome control box and walk away. The antenna turns and stops precisely at the desired position —even in the most severe weather! That's the clincher ...your prospect is now your customer!

On the sale price alone, you've made a handsome profit. Dealer cost of the AR-22 is $31.95. List price to your customer is $45.95. Your profit: $14.00. Sweet? You said it! But that's just the beginning.

Profit-and-Reputation Builder No. 2. Installation of the AR-22 is a breeze, on mast, tower or platform. Installation charges are your own business, but if you can install the AR-22 safely, quickly, neatly ...need we say more?

Profit-and-Reputation Builder No. 3. Here's where those housing lock screws come in. Years pass. The AR-22 continues to deliver perfect, trouble-free performance. More years pass. Has CDE forgotten you? Not on your life!

One day, a phone call from your AR-22 customer. What's this? The AR-22 that you sold six, eight years ago is starting to creak a bit and will you be good enough to repair same?

Are you worried? Has technology left you behind? Do you have the right spare parts? Is there any profit in it for you?

No need to fret. CDE will take on the headaches. But you take the profit. And the reputation. Here's all you do:

Remove the rotor and ship it, with the control box, to us. Enclose a check for $7.50. And before you can say "Cornell-Dubilier has the best darned rotor program in the world," your rotor and control box will be back in your shop, factory-rebuilt, retested, resealed.

How much can you charge your customer for this service? That's your business. But the lock screws are our business. And that's why we say, "Don't open...ever!"

CDE makes a complete line of Profit-and-Reputation Building rotors: ham, heavy-duty automatic, heavy-duty manual, standard-duty automatic, standard-duty manual. See your CDE Radiart distributor.

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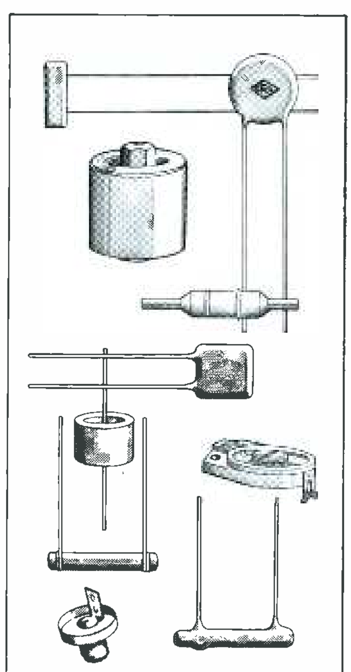
Sometimes we get so wound up in talking about our "only from CENTRALAB" ceramic capacitors that we forget to remind you about the *standard* ones.

CENTRALAB has plenty of both—as well we should. We *pioneered* ceramic capacitors many years ago—and we still give you the finest product and the widest choice.

Discs, tubulars, buffers, trimmers, feed-thrus—for every standard and special application, in radio-tv servicing or industrial use—CENTRALAB makes them and makes them best. That's why CENTRALAB is the best ceramic capacitor line for you to buy.



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PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS

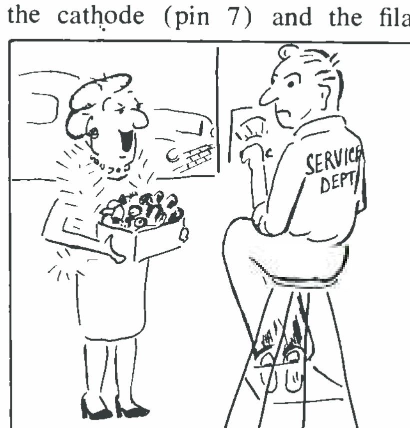
Identify With the Big Names

One of the best, and most obvious, bets we all lose out on is identifying ourselves with large, heavily-advertised manufacturers. To insure that we obtain maximum benefits from these free plugs, I posted a bulletin that everybody must be in some kind of uniform during working hours. Through the years we've all accumulated plenty of uniforms.

I realized the benefits while I was servicing a name-brand portable. The set owner was a nice old widow who didn't have any money to spare. The video was gone, the raster was bright, and hum bars rolled merrily through the picture.

I was about to start checking the tuner and IF tubes for filament-to-cathode leakage when I realized the audio was loud and clear. While this wasn't a definite indication, I figured, "Oh-oh, filament to cathode in the CRT." My CRT tester confirmed the suspicion.

I took out a CRT isolation unit for the miniature - necked picture tube and plugged it in. The raster disappeared. The loss of raster added a complication. If there is a simple filament - to - cathode short, and you install an isolation unit, your repair is complete. However, the heater short will sometimes break the cathode structure, causing an open cathode. That's what happened this time. The raster stayed on because the heater connections provide a cathode return. When the isolation transformer was installed, it opened the cathode circuit. The problem was to provide some sort of cathode return with the isolation transformer installed. This was easy. On this tube (a 17BRP4) it meant connecting a piece of wire between the cathode (pin 7) and the fila-



"I understand there is no charge for testing tubes."

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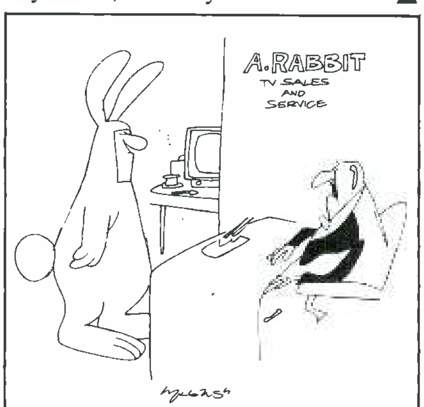
ment (pin 8). This I did, and the picture returned bright and clear. (See Fig. 1.)

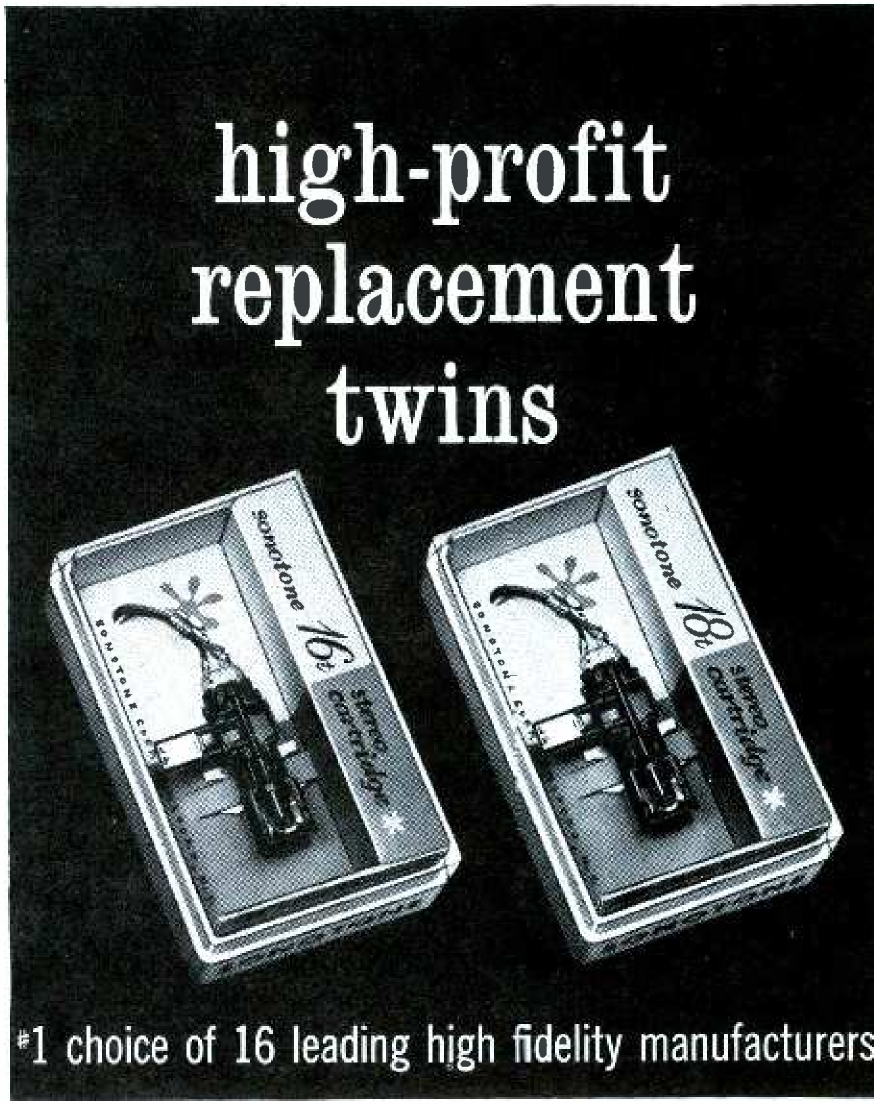
If the CRT had simply shorted between the filament and cathode, it would have brought the cathode potential down to the heater level, which is right near ground. The isolation transformer would have taken the heater off ground level and left it floating. Thus, the two shorted units would have reassumed the normal cathode potential, and the CRT would have worked again.

As I replaced the back, I could see that the widow was quite pleased with the repair. She smiled, pointed at a manufacturer-supplied pocket holder I was wearing and said, "I knew you knew your way around my TV when I saw that." I smiled, wrote up the bill and left. She was really impressed with the pocket holder. She didn't say a word, though, about my shirt (which plugged another manufacturer) or about my tube caddy (which bore still another trade name).

Anyway, reflecting upon my latest setside experiences, they boil down to these four points: (1) Obtain and make use of all the technical data you can, whether it comes in printed form or is learned through your own or other servicemen's experiences. (2) Make sure your tube stock is adequate; use substitutes if you must, but be sure they won't cause you or your customer trouble. (3) Make effective use of your tube tester. (4) And, last but not least, use the advertising materials available from brand-name manufacturers to best advantage. These hints have helped us—and I'm sure that, properly applied, they'll help you. Try them, won't you? ▲



"You're required to wear the uniform on calls. If you want to hop that's your business."



These 2 new Sonotone stereo cartridges are "original replacements" for the bulk of sets you service. They give brilliant, crisp highs...full lows. Satisfy the most critical audiophile's ear!

When you're all stocked up on Sonotone cartridges, good servicing is easy to do—and really brings in the profits.

The Sonotone 16T and 18T stereo cartridges are natural replacements. They are already being used as original equipment by America's leading phonograph manufacturers.

As for sets without Sonotone, replacement with a Sonotone will make 2 out of 3 sound better. The specifications—especially the channel separation—would do anyone proud. The cartridges have no audible hum—never sound tinny.

There are Sonotones for every kind of set—from the simplest portable to the most extravagant stereo equipment. Stock Sonotone, and keep your customers happy ...your profits high!

SPECIFICATIONS

	Sonotone 16T	Sonotone 18T
Response	flat ±1 db from 20 to 10,000 cps, with smooth rolloff to 12,000 cps.	flat ±1 db from 20 to 10,000 cps, with smooth rolloff to 12,000 cps.
Output Voltage	0.5 volt	0.7 volt
Compliance	2.4 x 10^{-6} cm/dyne	1.5 x 10^{-6} cm/dyne
Tracking Force	4-6 grams for professional arms. 5-7 grams for changers.	6-8 grams for professional arms. 7-9 grams for changers.
Mounting Dimensions	fits all standard mounting centers.	fits all standard mounting centers.

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ELECTRONIC APPLICATIONS DIVISION, DEPT. C10-91, ELMSFORD, N. Y.
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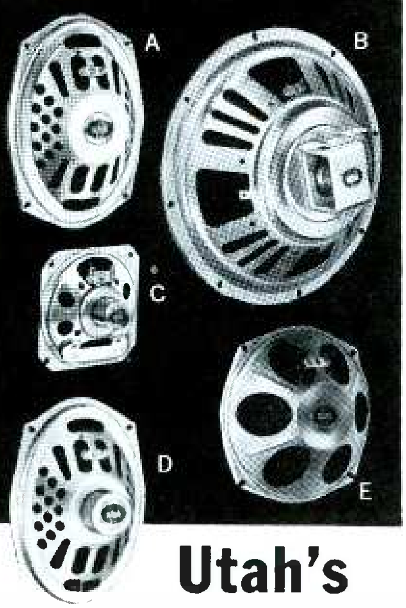

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Faulty Flickerer

A Telectro Model 300 tape recorder operates normally in both RECORD and PLAYBACK positions, but the record-level indicator doesn't work. The only voltage reading that's out of line is at the grid of V2B, where I get +.7 volts rather than the —.5 volts called for. All resistors and capacitors check normal. Help!

LEON HENNES
Riverdale, N.D.

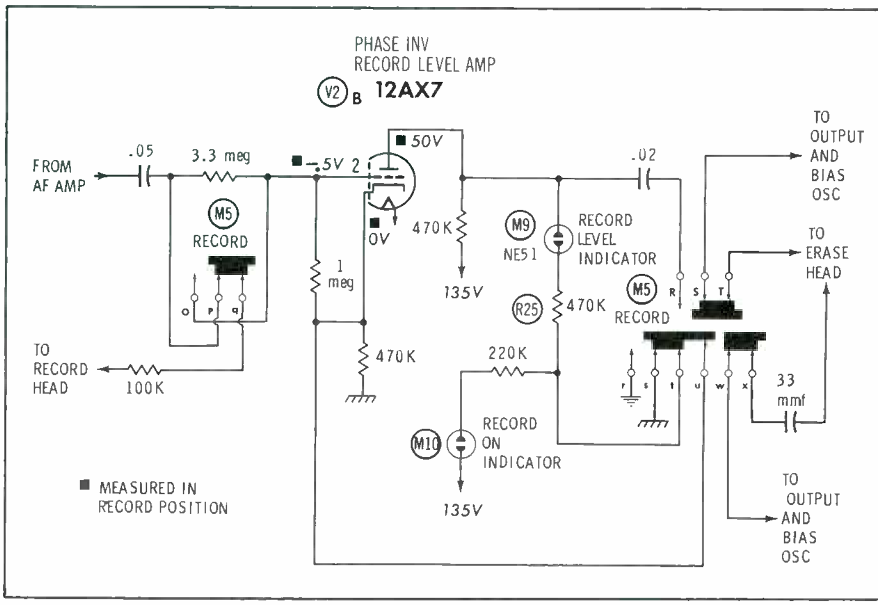
The most likely causes of this trouble are a faulty M9, an open R25, or a defect in the PLAY-RECORD *switch between terminals s, t, and u. However, since V2B operates only as a record-level amplifier when the machine is recording, the symptom you describe could also be caused by a defect in this tube section or the surrounding circuit. To help isolate the trouble, operate the unit in* RECORD *position and use a scope to see if a signal is present at the plate of V2B.*

Hi-Fi Headphone Hook-Up

I have a pair of hi-fi crystal headphones (85K-ohm) I want to hook into an Admiral Chassis 19B1. When I disconnect the speaker and connect the headphones from the plate of the 6AS5 to ground, I get weak sound with the volume wide open, but it's distorted. How can I hook up the headphones to get the best results?

SHIG TAKAHASHI
Richmond, Calif.

The easiest way is to use a double-pole, single-throw switch and a phone jack.



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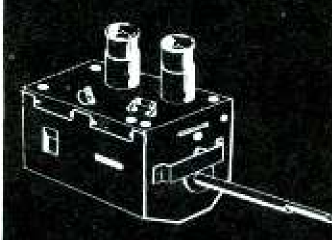

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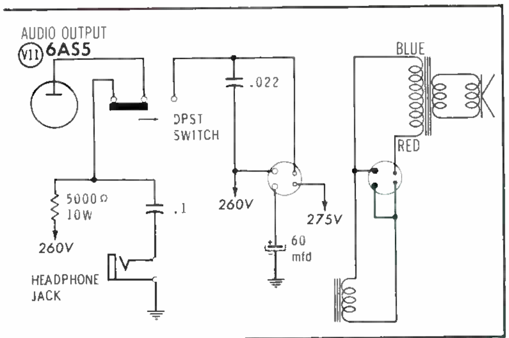

Crystal headphones don't operate like carbon types. They won't pass DC voltage, and they have a high-impedance input. When you disconnect the speaker, you must feed plate voltage to the 6AS5 through a 4500- to 5000-ohm, 10-watt resistor and connect the phones in series with a .1-mfd capacitor between the plate and ground. Hook it up as shown in this schematic and you should get good sound with plenty of volume if the phones are in good condition.

Scope Test Verification

The December, 1960 article, "A Little Trouble With an Admiral 21F1" by Stan Prentiss, mentioned a way to add a 680-mmf capacitor to a scope to test sweep transformers and coils. I've tried this with my scope, but the only "waveforms" I've been able to obtain are stray AC or a diagonal line. What is wrong?

CHARLES R. WHITE
Winston-Salem, N.C.

Make certain the 680-mmf capacitor is connected to the high side of the common cathode resistor in the sweep multivibrator circuit of the scope. Unless the resistor has a very low value, you should obtain enough signal for the test.

Run a test lead from the unattached end of the capacitor to one lead of the transformer being tested, and connect the vertical input of the scope to the other lead of the same winding. The scope ground lead should be connected to the TV chassis. In general, the scope sweep rate should be adjusted to provide the maximum amplitude indication. For vertical components, this will normally be attained with the sweep rate set on one of the lower ranges. To test horizontal components, you'll find that a sweep rate of 2500-5000 cycles will give the best indication.

Choosy Interference

I'm having trouble eliminating ignition interference from an Emerson Model 1153. Another set, operating right alongside, has no trace of interference. I've tried using filters such as amateurs use, but have had no success. Can you suggest a solution?

PETER GERNAT
Warren, Ohio

The trouble is probably in the antenna or RF circuits of the tuner. By all means substitute for the RF amplifier. If this doesn't solve the problem, you'll undoubtedly find an open or shorted component that is reducing the signal-to-noise ratio.

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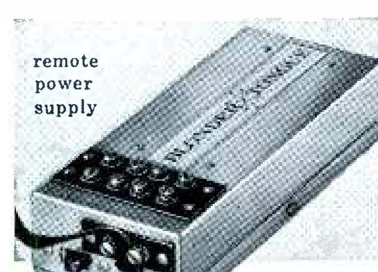

1 set	2 sets	3 sets	4 sets
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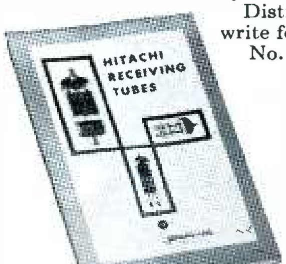

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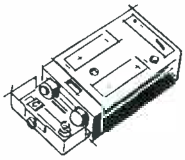

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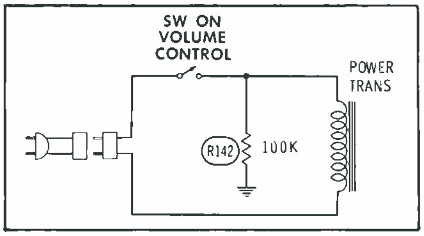


Transformer-Powered But "Hot"

Occasionally I encounter a transformer-powered TV that has a "hot" chassis. My latest experience was with an RCA KCS108C. My shop has a cement floor, and an AC voltmeter showed 110 volts AC either between the TV chassis and the floor or from the chassis to my hand. When I sat on a chair and lifted my feet, the reading dropped to between 20 and 30 volts. What makes these chassis hot?

LESTER C. HICKS

West Alexander, Pa.

Notice that one side of the AC line is connected to chassis through R142 in the primary circuit of the transformer. Undoubtedly you obtained the reading when R142 was connected to the "hot" side of the AC line. The cement floor is obviously damp enough to provide a good earth ground. Therefore, even though the 100K value of R142 prevented any appreciable current from flowing, you were still able to obtain a reading of full line voltage from the chassis to ground. When you sat on the chair you were, in effect, adding series resistance between chassis and ground. You were measuring only the voltage drop across your body; the remaining 80 to 90 volts was dropped across the chair.

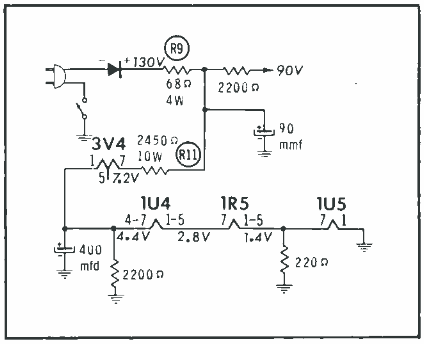
"Three-Way" Question

A General Electric Model 670 portable keeps burning out the 1R5. All voltages and resistances check out. Can you offer a possible solution?

THOMAS J. TUCCI

Philadelphia, Pa.

Did you check filament voltage? Adjust the applied AC voltage to 117 volts and see if the DC voltages indicated on the schematic are actually being applied to all of the filaments. If not, R9 or R11 may have changed value. If the voltages are correct, they should stay very close to normal when the AC input is varied from 100-125 volts AC. Any appreciable change in filament voltage means there's trouble along the filament line.



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Phone Exam

(Continued from page 22)

portant properties of resistors, capacitors, inductors, conductors, and insulators. Review frequency and wavelength relationships, plus frequency assignments and propagation characteristics.

Tubes and Transistors

Certainly you are already well up on these subjects. However, a good review will help to consolidate the facts you know almost instinctively. Refresh yourself on major tube characteristics and classes of amplifier operation. Transistor questions are very basic.

Power Sources

Questions on power sources cover the subject in a fundamental way from dry cells and storage batteries through rectifier power supplies to motors and generators. You will probably have to spend more review time on the battery and motor-generator supplies than on half-wave and full-wave rectifiers using tubes or semiconductors. Go over filter characteristics. Give some time to vibrators and special rectifier tubes.

Transmitters; Antenna Systems

The study of this material will probably be your most time-consuming job unless you have been a radio amateur or have had other experience with transmitters. You must know the various types of oscillators and have a good knowledge of class-C amplifiers. Tuning procedures are important. Become familiar with the modulation process and various types of modulators. Interstage and antenna coupling systems must be understood, and a review of antenna fundamentals will also be of help. Use of meters in tuning and troubleshooting are important topics.

Receivers

These questions will be right down your "channel." However, there are some questions on types of detectors you may have thought no longer existed. Review operation and schematics.

Measurements and Regulations

Making measurements and using meters are subjects you know instinctively. However, you may have forgotten how some of the basic meter movements function. The use of meter shunts and series resistors are topics one is likely to forget. Some additional FCC rules and regulations of a more technical nature than those in Element I are also included in Element III.

Since you can count on already knowing much of the material included in the FCC examination elements, you're much better off than if you were starting from scratch. The main problem is that

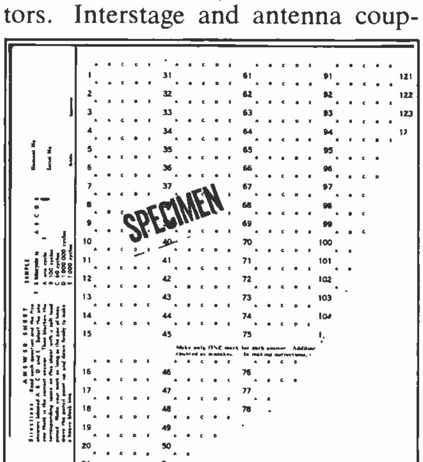

Fig. 2. Part of exam uses electrically-graded multiple-choice answer sheet.

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of organizing your present knowledge so it can be readily recalled during the exam. A careful review will serve this purpose, and will probably enable you to answer more than 50% of the Element III questions correctly. Additional concentrated study of transmitter topics should make Element III a breeze. The passing of Elements I and II is a matter of memory and common sense.

Study Aids

The FCC makes available a complete set of study questions for the various elements. This "Study Guide and Reference Material for Commercial Radio Operator Examinations" is available from the U.S. Government Printing Office, Washington, D.C. for 75c. Answers are not given in this publication. However, the questions are the basis for several "question and answer" books which are available from various commercial sources to help license applicants prepare for FCC examinations. (One such book is the "Second-Class Radiotelephone License Handbook" published by Howard W. Sams & Co., Inc.) Some "Q & A" material gives special emphasis to two-way radio equipment, thus familiarizing you with communications-radio practices as you study for the examination.

Those who feel they need more than a "brush-up," or want a better-organized training program than they can obtain by independent study, would do well to consider investing in a home-study or evening-school course specifically designed to prepare applicants for the license exam.

If your purpose in obtaining a license is to qualify for two-way radio servicing, you can find much useful theory and practical data in the large variety of handbooks and textbooks now on the market. (In searching for background information on transmitters, don't overlook amateur publications dealing with mobile and VHF equipment.) Books on mobile radio, marine electronics, Citizens radio and related equipment will not only help you to get ready for the examination, but will also prepare you for earning money in communications-radio work. ▲

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Audio Test Equipment

(Continued from page 27)

ize" with the original input. However, they can be developed in sufficient quantity to cause serious distortion.

Fig. 3 shows one way in which spurious harmonics are added to the signal. In this case, the tube is operating on a nonlinear portion of the Ib-Ec curve; so, although a pure sine wave (only one frequency) is applied to the grid, the increase of plate current on the positive half-cycle of grid voltage is greater than the decrease on the negative half cycle. This is equivalent to adding even-numbered harmonics to the basic signal, and is thus defined as harmonic distortion.

Any measurement of harmonic distortion consists of measuring the amplitude of the added harmonics with respect to that of the fundamental frequency. Fig. 4 shows, in simplified block form, the method generally used. An audio sine-wave generator supplies a single-frequency input signal to the amplifier being tested, and the output of the amplifier—consisting of the fundamental frequency plus any added harmonics—is applied to the distortion analyzer (enclosed in dashed lines). The meter-selector switch is first set in the position shown, and the meter setting is adjusted to a level which indicates the amplitude of the fundamental plus harmonics.

The meter switch is then changed to the other position, so the meter can read the output of the analyzer. The filter is either a high-pass type which eliminates all frequencies lower than and including the fundamental, or a rejection type which attenuates only the fundamental. (An advantage of the high-pass filter is that it also eliminates hum, which might artificially increase the indicated harmonic amplitude.) This filtering action leaves only the harmonics, which are amplified before being applied to the meter. The amplification and meter circuits are designed so that the amplitude of the harmonic signal is read as "percentage distortion" when the meter adjustment is left at the setting established in the first step of the procedure. A reading of 5% distortion, for example, would mean that 5% of the total signal consisted of harmonics added by the amplifier

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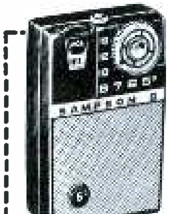

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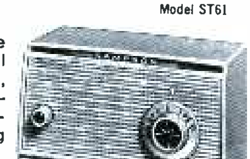

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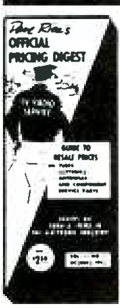

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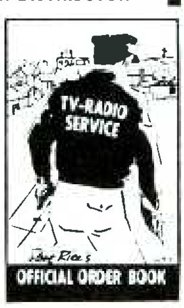

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under test. For good reproduction, the total harmonic distortion should be less than 2%, although 2-5% is often considered within the limits of acceptable reproduction. Most analyzers can also be used to measure noise or hum by the same general methods, but using zero input signal. Different makes and models vary somewhat as to specific details of operation and procedure, but proper results can be obtained by carefully following the directions given in the instruction manual.

Intermodulation-Distortion Analyzer

When the operation of an audio amplifier is not completely linear, other frequencies besides harmonics can be introduced. The various frequencies making up the complex audio signal heterodyne with each other in the nonlinear stage, producing sum and difference frequencies. As an illustration, input-signal components of 80 and 2000 cps can heterodyne to produce "beat notes" of 2000 + 80 or 2080 cps, and 2000–80 or 1920 cps. The numerical relationships between the original and beat frequencies usually do not correspond to the musical scale; hence, discordant sounds are produced. This type of distortion is usually more prevalent at the higher signal levels, since nonlinear operation shows up more severely when stronger input signals are used. This statement also applies to harmonic distortion.

Although harmonic and intermodulation distortion both stem from the same basic cause (nonlinearity), they are separate and distinct entities, and are therefore measured differently. Measurement of intermodulation distortion involves applying two audio frequencies to the amplifier under test and determining the total amplitude of the additional frequencies created.

A simplified block diagram of an intermodulation analyzer is given in Fig. 5. The low-frequency oscillator in most models produces a signal at 100 cps or below; some units make direct use of the 60-cycle line voltage. The output of the high-frequency oscillator is usually at several thousand cycles. Amplitude of the low-frequency signal is several times that of the high-frequency

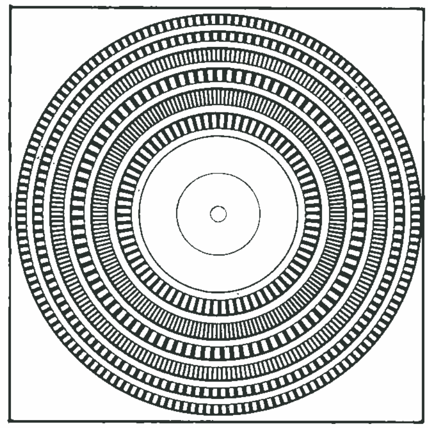

Fig. 6. Stroboscope disc for checking speed of phono-turntable rotation.

signal (usually by a 4:1 ratio), to simulate the signal conditions normally encountered in actual service.

These two signals are mixed in a linear circuit which produces no intermodulation; then they are amplified and passed through a calibrated attenuator before being applied to the amplifier under test. If there is intermodulation, two additional frequencies are present at the amplifier output. Using inputs of 60 and 3000 cps as an example, beat frequencies of 2940 and 3060 cps would be added. All four frequencies are fed back to the proper terminals of the analyzer, and the high-pass filter removes the low-frequency component. The detector stage demodulates the signal, producing 60-cps beat notes between the components in the 3000-cps range. The higher-frequency signals are eliminated by the low-pass filter. This leaves the 60-cps components, which are then amplified, rectified, and applied to terminal B of the VTVM switch.

The total output of the detector is available at position A of the VTVM for use in adjusting the meter to a predetermined level. The switch is then changed to position B, and the resulting reading is in terms of "percent intermodulation distortion." For best results in audio amplification, the reading should be less than 5%, although up to 10% is often considered acceptable.

Optional Equipment

In addition to the four basic pieces of audio test equipment just described, there are other items which can help the audio serviceman increase his efficiency. Among these are a wow and flutter meter, stroboscope disc, test records, and audio wattmeter.

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Wow and Flutter Meter

When the sound source of an audio system is either a tape or a disc recording, the frequency (pitch) of the reproduced sound is determined in part by the speed of rotation. If the motor runs at a constant speed, even though it might be slightly different from the recording speed, no adverse effects are noted (except by a trained musician, who might observe the change in pitch). But if the tape drive or turntable does not run at a constant speed, the result is "flutter" (rapid variations in speed) or "wow" (slow variations). Both are quite annoying because of the continual changes in pitch. A "wow and flutter meter" can be used to measure the extent of these variations.

In order to use this meter, a constant-frequency signal—usually several thousand cycles—must be applied to the audio system from a test record or tape. The meter contains a bandpass filter which eliminates all frequencies except the test tone and any frequency modulations caused by flutter or wow. Amplitude variations are clipped by a limiter stage, and then the signal is applied to a discriminator which transforms the frequency change into a voltage for actuating the meter in the instrument. The meter scale is calibrated in "percentage of flutter," which can be defined by the following:

$$\%\ \text{flutter} = \frac{\text{max.-min. freq.}}{\text{avg. freq.}} \times 100$$

Average frequency is that applied to the system, and max. freq. – min. freq. represents the total frequency change due to motor-speed variations. A reading of less than 1% is acceptable; better-quality systems may give readings as low as 0.1%.

Stroboscope Disc

The speed of a phonograph turntable (or tape reel) can be measured quite easily by using a stroboscope disc (Fig. 6). The several rings of dots or lines correspond to various standard speeds of rotation. When the disc is placed on the turntable and viewed under AC incandescent, neon, or fluorescent light with the turntable in motion, the appropriate ring should seem to stand still. When rotation is too slow, the marks in the ring will appear to move counterclockwise; when rotation is too fast,

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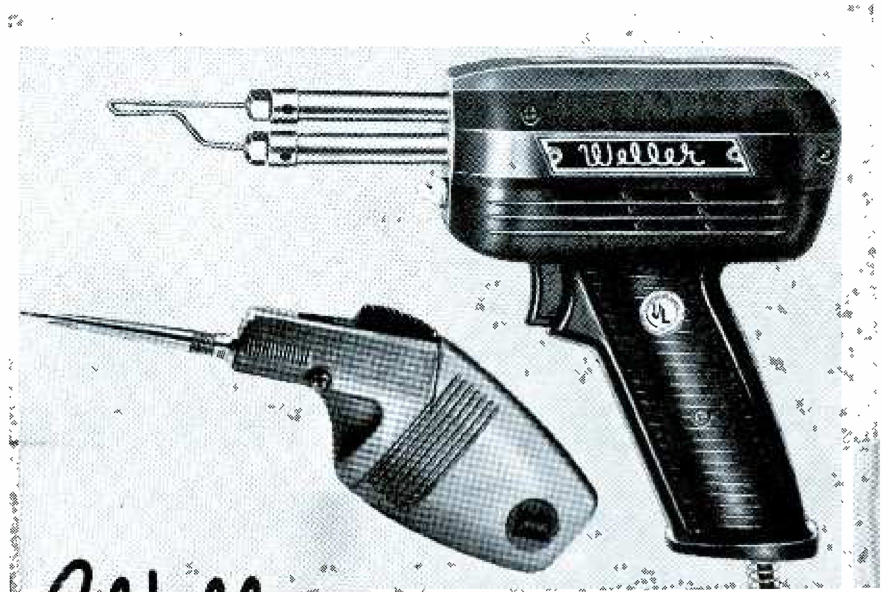

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they will move clockwise.

Test Records

Musical recordings give some idea of how a hi-fi system sounds, but do not provide truly accurate information about the over-all performance of the system. Also, while signal generators can furnish concrete indications of amplifier capabilities, they are unable to test a system all the way back to the disc or tape source. So, to provide more complete "stem-to-stern" testing, a number of test records and tapes have been developed.

For measuring frequency response, the test recording includes bands of different frequencies, usually ranging from about 50 to 10,000 cps. The reproduced output for each frequency can be measured with an AC VTVM or a wattmeter for purposes of comparison.

Sweep-frequency records can also be used in determining response. These contain a sries of "frequency runs" varying from 50 to 10,000 cps or more, all occurring at a constant rate. The output of the system is applied to the vertical input terminals of an oscilloscope. The horizontal sweep of the scope is synchronized to the sweep-repetition rate used on the record, so that the screen presents a graph of the frequency response.

Intermodulation test records can be used to check an entire system, including the phonograph, and one such type can be used without an intermodulation analyzer. This record includes two tones which sweep downward very slowly, always staying 1000 cycles apart in frequency. When there is intermodulation distortion, a 1000 cps difference tone is heard. Comparing the loudness of the 1000-cycle tone with a reference-level tone on the record gives an approximate indication of distortion. When the two tones have equal loudness, the distortion is 2%. Other test records are available to measure hum, rumble, noise, stylus wear, tracking ability, wow, and flutter, among other things.

Audio Wattmeter

As previously stated, output-power measurements can be calculated from AC-voltmeter readings when the load resistance is known. This is a time-consuming process, especially if a large number of readings are necessary. Audio wattmeters, usable at any audio frequency, contain several load resistors (usually 4, 8, 16, and 600 ohms) which can be selected by a front-panel switch. Readings on the meter are in terms of watts, and the measurable levels may vary from about 5 milliwatts to 50 watts or more. Most audio wattmeters also contain a decibel scale.

Accessory Equipment

Other items which may be found useful from time to time are a noise generator, a calibrated microphone, an audio sweep generator, and a complete hi-fi system arranged so that other units can be quickly and easily inserted for checking or testing. This hi-fi system could include a tuner (AM, FM, or both), three-speed turntable, preamplifier, amplifier, and speaker system. These units should be of high quality to make it easier to spot troubles in equipment being checked.

As a matter of fact, all audio test equipment should be of a quality equal to or better than the components being checked. Good-quality test instruments in many reasonably-priced forms are available to technicians in the audio field. ▲

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TV Tuners

(Continued from page 33)

1. A is a Sarkes Tarzian switch-type unit with a tetrode RF stage, and B is a Standard Coil *Guided Grid* turret tuner. Both offer high gain and exceptional signal-to-noise ratios. The units are relatively compact, but have conventional mounting provisions. They are supplied with mounting hardware, installation adapters, and complete replacement instructions. Each manufacturer has a line of eight different tuners—four with 12-position and four with 13-position detents. The various models are designed to replace original UHF-VHF and VHF-only tuners having 21- or 41-mc IF's, with either series or parallel filament arrangements. (See Chart I.)

Authorized parts distributors who stock the general-replacement units have TV-tuner replacement guides showing the correct universal models to use in replacing various original tuners. Each replacement line covers most other units produced by the same manufacturer, and also many tuners made by other companies. Electrically, the replacements can always be made to work; the only limitations have to do with physical mounting and adaptations of special knobs or accessories (for example, automatic and remote tuning devices).

Installing Replacements

Let's take a look at a typical replacement installation to see how much work is involved. After you have selected a proper replacement and removed the original tuner, size up the new tuner and figure out a good physical mounting. Once you know where the tuner will fit, dismantle the fine-tuning shaft assembly and cut both the channel-selector and fine-tuning shafts to the required length. Then reassemble the shaft and mount the tuner securely in place. By the way, always check the original mounting for any special insulation that must be replaced when the new tuner is installed. The tuner may be isolated from its mounting bracket, especially in series-string receivers.

If the original and replacement tuners were both produced by the same manufacturer, you should have no trouble mounting the unit. In some cases, however, it may be necessary to drill new mounting holes as illustrated in Fig. 2. If any alterations must be made in the mounting, always be sure the tuner shaft is long enough and doesn't bind.

You can make all electrical connections by following the simple diagrams on the installation instruction sheet. These include the filament supply leads, AGC, either one or two B+ supply lines, the IF output cable, and, of course, the antenna lead-in. For optimum fringe-area performance, B+ voltage to the tuner should be close to the value recommended in the replacement instructions. A series dropping resistor is necessary in some cases, but an ordinary 2-watt unit should fill this need. Leads to the tuner may be shortened or extended, except for the IF output cable. If at all possible, the original length and lead dress of this cable should be carefully preserved. In a few instances, it may be necessary to remove a plug from the end of the IF cable in order to connect it to the replacement tuner.

After installing the tuner, check to see that all shields are in place;

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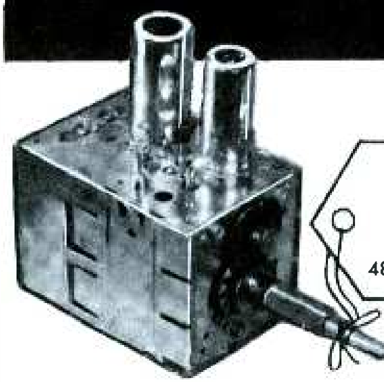

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then connect an antenna, and apply power to the receiver. Before making an operational check, tune in a local station and permit the set to warm up for at least five or ten minutes. If the rest of the receiver is functioning properly, both picture and sound should be reproduced. Normally, it is necessary to touch up the IF-output adjustment on the tuner and the IF-input adjustment on the receiver, until a clear, snow-free picture with sufficient sound is obtained on each available channel. Certain signal-coupling circuits between tuner and IF strip may require modification, although this step is seldom necessary. Recommendations for such changes are offered in the installation instructions.

For a final touch-up when installing a new tuner, you may wish to perform an over-all response check. Follow the regular procedure for a final alignment touch-up, using an oscilloscope in combination with both sweep and marker generators. The response patterns shown in Fig. 3 are typical of what you will encounter in recent-model sets. Pattern A represents the normal IF response of a receiver, with markers placed at the 50% point on each slope of the curve for reference. (Note arrows.) Pattern B is the response obtained after installation of a universal-replacement tuner, but before adjustment of the IF coupling circuits. Notice that the peak is narrower and has shifted to the right, thus placing one of the markers too high on the slope and the other too low. Under such conditions, the picture and sound may still appear fairly normal to the untrained eye. This does not, however, eliminate the need for touching up the IF-coupling alignment.

In this particular example, the original tuner had a 100-mmf capacitor connected directly across the IF-output cable at the tuner end. Connecting this component in the same spot on the replacement tuner did not improve the response, but actually narrowed it even more (see pattern C of Fig. 3). Adjustment of only the tuner-output and IF-input coils broadened this response somewhat, but at the expense of considerable gain. In making this replacement, it was found that reducing the value of the capacitor from 100 to 50 mmf and retouching the IF-coupling adjustments resulted in the response of pattern D —actually a more desirable IF curve than the original. Although such improvement is exceptional, this example shows how picture quality can be increased by the installation of a replacement tuner. ▲

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L. A. Tuner Exchange
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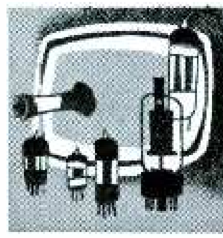
Yoke Trouble

(Continued from page 31)

pletely normal, though. There was not quite enough width, and the picture appeared somewhat compressed toward the center. Remembering that the linearity slug was solidly stuck, I disconnected the coil from the receiver and very carefully flowed a little household wax solvent into the coil form. Then, for the sake of accuracy in setting up the linearity adjustment, I connected a bar-dot generator to the antenna terminals of the receiver, and hooked up the scope to the lower (boost) side of the horizontal yoke coils. In place of the normal boost-ripple waveform (Fig. 8), I found the peculiar, almost parabolic pattern shown in Fig. 9.

As I turned the core counterclockwise to back off the linearity adjustment, the waveform on the oscilloscope began to rise and form a truer parabola such as you see in Fig. 10. The vertical-bar display on the TV screen then appeared as in Fig. 11—compressed in the center, and spread apart at the sides. Turning the linearity coil back clockwise through its range lowered the peaks of voltage and even introduced secondary humps into the waveform (Fig. 12). The pattern on the CRT began to widen appreciably, and the bars pulled into more normally-spaced positions. Eventually, the waveform looked as in Fig. 8, and a series of evenly-spaced vertical lines covered the TV screen. Flipping a switch on the signal generator and turning up the brightness on the TV, I obtained the familiar dot pattern (Fig. 13) which has found so much use in color-television static and dynamic convergence. This time, though, I just wanted to use the dots to confirm that the linearity had been properly adjusted.

As a final touch, I slightly advanced the setting of width control R6 (Fig. 2) so that the raster filled the screen. I was relieved to find that R6 functioned normally, because this component in the KCS47 bears careful watching. Note that it feeds variable DC voltages to the horizontal hold control and the screen (pin 8) of the horizontal output. Minimum screen voltage is obtained with the control turned fully clockwise. Adjusting the screen voltage has a great effect on the



The "Big Picture"

...informative shop talk from Sylvania Field Service Headquarters

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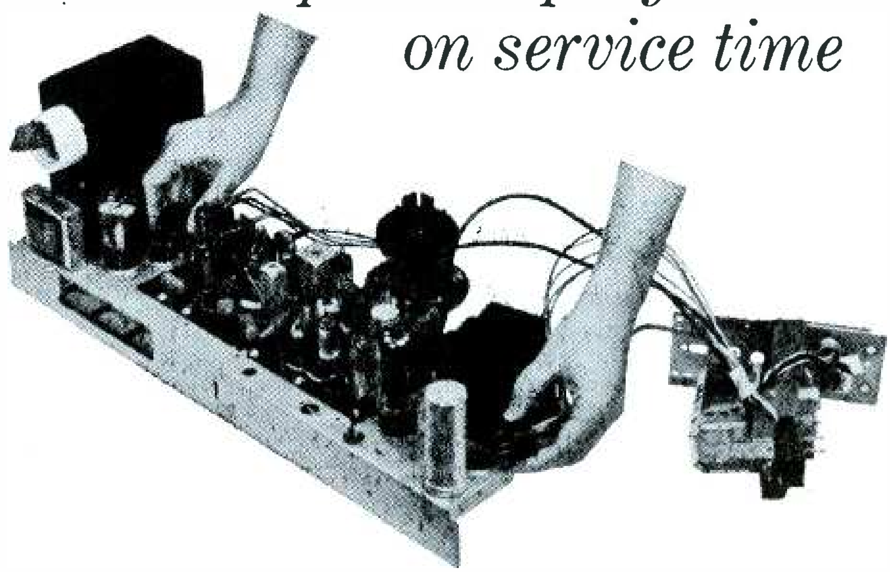

"Time is money," you know... and untangling, pulling and remounting wired-together TV assemblies eats up plenty of valuable service time. But see how this new GT-555 chassis on the new 1962 Sylvania TV Sets "unplugs" that time-tangle and frees you for profitable servicing.

All wiring from major components to the chassis has easy-to-remove plugs ...tuner cluster, deflection yoke, picture tube high voltage lead, speaker system and remote receiver. The HaloLight® mechanism is also a plug-in. Now you can separate and pull whole assemblies in seconds (put them back in seconds, too, so you're saving time at both ends).

But that's not the whole "plug-in" story. The mountings make good use of the same principle. The chassis, for instance, has push-studs on front that fit neatly into special cabinet-mounted brackets. That means no more of those tough-to-get-at front screws to struggle with.

You don't have to remove any screws to get at the Mylar-insulated high voltage transformer, either. It has a new, hinged lid (with safety-lock device) for easy access. A simple thing, but typical of the thought and care in this new, service-designed GT-555 chassis, and another reason why TV service experts like the new Sylvania TV Sets.

SERVICE TIP OF THE MONTH

Symptom—Noisy or intermittent tuner (button contact type).

Cause—Faulty bonding of buttons to solder strips at the rear of the wafers.

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high voltage, which may range from approximately 10.5 kv (at maximum width setting) to 15.5 kv (at minimum width). Naturally, then, R6 will affect the brightness and sharpness of the picture as much as it will influence the width of the raster.

There are definite limitations on using R6 to compensate for inefficient operation of other components. If the width control is set at maximum to make up for weak horizontal drive, the high voltage suffers. Below 11 kv, brightness and contrast are not likely to be acceptable, and blooming becomes a problem. On the other hand, beware of sacrificing width to improve picture clarity when the picture tube or video amplifier is old and weary. The high voltage should not exceed 13 kv, or you'll probably hear frying or arcing in the high-voltage cage. This "cry for help" indicates overdriving of the flyback transformer, which frequently results in arcing from the high-voltage rectifier filament winding to the lower section (between taps 1 and 2) of the transformer. Should this occur, the filament winding will have to be replaced; or, if the arcing is severe enough to melt the wax insulation on the main winding, you may have to replace the entire transformer. Some part of the flyback may even become open and extinguish the high voltage.

With current continually flowing through it year after year, R6 is likely to increase in value and cause gradual "softening" of the picture. During the long career of a typical KCS47, some serviceman may even have put this trouble into the set by applying a soldering iron to R6 for too long a period. If you ever encounter this defect, go ahead and replace the control, but watch that high voltage!

Comments

This case happened to involve one of our favorite "whipping boys"—an RCA KCS47. However, you'll be dealing with many of the same troubleshooting procedures and waveforms when you work on other receivers with similar troubles. Of course, the KCS47 is exceptional in one important re-

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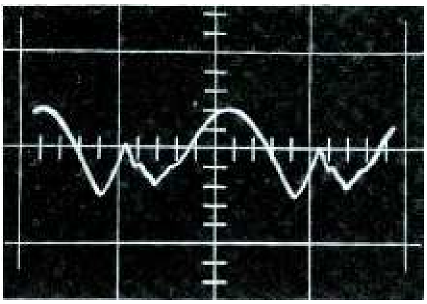

Fig. 12. Secondary peaks appear in trace at some linearity-slug settings.

spect—it has a linearity coil to help you stretch or squeeze the raster into the correct shape after a horizontal-circuit repair. Very few of the receivers made during the past several years have any provision for adjusting the damper-current waveform, although I've noticed that several of the very latest models do include a tunable linearity coil.

As Figs. 9 through 13 have demonstrated, the linearity coil does its job by shifting the phase of the ripple waveform at the damper plate. This is often all you need to smooth out the transition between damper-tube conduction and output-tube conduction, and thus eliminate bunching or stretching in the sweep trace.

Although fixed-current damper circuits do not offer this convenience, they are relatively noncritical, and are not prone to develop linearity troubles. If changing a flyback or deflection yoke in one of these systems should ever result in nonlinearity of the picture (and you're sure the new part is a correct replacement and in good condition), you can ofter make the required correction by slightly altering the value of the boost capacitors; or, if you've installed a multitapped output transformer, try connecting the damper to a different point for additional stretch or compression. ▲

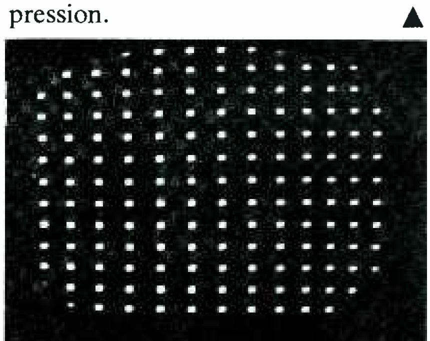

Fig. 13. Final linearity adjustment resulted in acceptable horizontal scan.

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New Tube Design

(Continued from page 24)

a form of horizontal sync or sweep trouble.

Two other examples of *Compactrons* are the 6C10 and 6D10, triple triodes with identical basing but different characteristics. The former, an audio tube, can be used as a two-stage RC-coupled amplifier and phase inverter; the latter is intended for use in FM radio "front ends" as an RF amplifier, converter, and AFC tube.

As you've probably noticed, the numbering system is the same as for conventional tubes, but the large number of active elements usually makes the final number either 10 or 11 instead of 4, 5, 6, 7, or 8. Not all *Compactrons* have 10 or more elements, however. A few types are single-function tubes in which the large T9 envelope is used simply to promote heat dissipation. These tubes have power ratings comparable to octal types, and also offer the advantages of miniature-style bases (smaller size, ease of mounting on printed-wiring boards, and lower cost).

Present TV design trends are causing an especially urgent demand for vertical output tubes and dampers with this combination of features. To obtain reliable vertical sweep with 110°-114° deflection angles, square-cornered picture tubes, and high voltage above 20 kv, several manufacturers have recently had to turn to octal types such as the 6EM7. However, miniatures would allow greater simplicity and flexibility in chassis construction. This also applies to damper tubes, which have not yet been miniaturized to any great extent.

Fig. 3. New Sylvania 6EW7 vertical sweep tube has a standard 9-pin base.

For this reason, the *Compactron* line includes a damper diode, the 6AX3 (Fig. 1). This tube is virtually a twin to the 6AX4GTB octal damper, except that the over-all height has been considerably reduced by substituting a 12-pin miniature base for the octal style. Two pins (4 and 10) are connected to the plate to increase heat conduction away from this element.

The 6FJ7, the tallest tube in Fig. 1, is a dual triode (with one low-power and one high-power section), designed to meet the current need for a more efficient vertical sweep tube. The output section has a plate-dissipation rating (design maximum) of 10 watts. This is the same as for the octal 6EM7, and well above the 7-watt rating of the 9-pin miniature 6DE7 used in many 110° vertical circuits.

General Electric is considering the use of even larger glass bulbs with the miniature 12-pin base, so we may see a *Compactron* horizontal output tube before long.

Big Tubes on Little Feet

Sylvania's 9-T9 tubes exemplify another way of solving vertical-circuit heat problems with a T9 envelope. Even though these tubes are as

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Plug this instrument into any 60 cps, 95/130 volt circuit and get a stabilized source of direct current, adjustable over a range from 0 to 45 volts DC, with current output 0/2.5 amperes. Filtered direct current output range 0/45 volts, 0/2.5 amperes is continuously adjustable and stabilized ±1% at any setting regardless of alternating current fluctuation. Voltage regulation is approximately 5% between full load and no load at full voltage setting.

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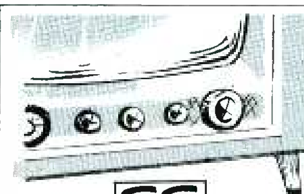
Acme Electric



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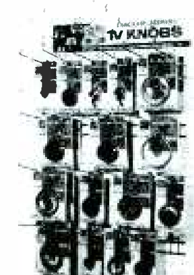
GC ELECTRONICS

CASH IN ON A TERRIFIC MARKET FOR EXACT REPLACEMENT TV KNOBS.



- THIS DEAL CONTAINS BEST KNOB SELLERS
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- PRE-PRICED AT FULL MARGIN MARK UP
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DIVISION OF TEXTRON ELECTRONICS INC.
Main Plant: Rockford, Illinois, USA
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large as some "GT" octals, they have a standard-sized 9-pin miniature base. One type, the 6-/10EW7 (Fig. 3), is a dual triode with a 10-watt output section. Another, the 6-/17HC8, is something new in TV-tube design—a vertical output *pentode* in the same envelope with a vertical discharge triode.

The newest 19" Philco sets contain a different type of vertical sweep tube with a 9-pin miniature base, T9 bulb, and 10-watt output rating. This type, the 6FD7, has the same base connections as the Sylvania 6EW7.

Jumbo Miniatures

Still another glass-based T9 design, the RCA *Novar*, looks like a magnified version of a typical 9-pin miniature. (See Fig. 4.) Tubes in this series are taller than average—some nearly 3". The base consists of nine wire pins in a .687"-diameter circle (wider than in conventional tubes), and the pins are longer than usual (.335"). Since the pins are spaced farther apart than on ordinary miniatures, relatively

12AT7 7868

Fig. 4. RCA Novar design features a large bulb, 9 wide-spaced base pins.

high pulse voltages can be applied between pins without arcing. This consideration is very important in the *Novar* series, since most of the first types introduced are heavy-duty dampers.

Of the two series of damper diodes now available, the 6-/12-/17AY3 are the "milder" types. Heater current is 1200 ma for the 6-volt version, the PIV rating is 5000 volts, and maximum DC plate current is 175 ma. These figures correspond to the ratings of the 6DE4 octal damper, except that the 6AY3 requires less heater current. A more rugged *Novar* type, the 6-/17-/22BH3, draws more heater power (1600 ma at 6.3 volts, or equivalent), but has a higher PIV rating of 5500 volts and a DC current rating of 180 ma.

Another *Novar* tube, the 7868, is designed for audio output service with a maximum plate-dissipation rating of 19 watts. Two of these tubes can operate in a push-pull hi-fi amplifier with maximum signal-power output of 44 watts.

Testing

Suitable sockets and necessary setup data for checking the new glass-based T9 types are already provided in the latest models of tube testers, and plug-in adapters are also becoming widely available for conversion of older instruments.

As new sockets are added, old ones move aside to make room. The familiar octal socket seems destined to take its place among the loctal, 4-pin, 5-pin, and other "relics." ▲

TRUST YOUR **TV TUNER**
REPAIR and ALIGN to JW

24 HR SERVICE

VHF or UHF—ALL MAKES

VHF Tuners ....
UHF Tuners .... $9.50 net
UHF Converters ......
UHF-VHF Combinations $17.95

Prices are for service and unmutilated units. Missing, broken and damaged parts, defective tubes charged extra at LOW net prices. We ship C.O.D.

10 STEPS IN OUR GUARANTEED SERVICE

1. All tuners mechanically and electronically inspected.
2. All necessary parts replaced.
3. Contact surfaces correctly cleaned and lubricated.
4. First test run for intermittents and drift indication.
5. Fine tuning range checked on all channels.
6. Local osc aligned to correct frequency all channels—XTAL controlled.
7. RF alignment—all channels—XTAL controlled.
8. AGC check, all channels—cut off of RF amp checked.
9. Overall response all channels, shield covers in position.
10. Quality control FINAL CHECK ALL UNITS, UHF-VHF.

IMPORTANT: Ship complete. Include all broken parts. State model and complaint. Package well to avoid transit damage.

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SARGENT RED INSULATOR

Stops corona discharge and arcing. Waterproofs exposed wires and circuits. Impervious to moisture and temperature variations. Dielectric strength exceeds 20,000 volts. Excellent for use in printed circuit repairs. Laboratory tested and approved.

Giant 16.4 Oz. Can $1.29 Dealer Net

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Tuner Cleaner, Gear and Parts Cleaner, Degreaser, Clear Acrylic Plastic, Penetrating Oil, Squeak Stopper, Enamels, Lacquers, Metallics, Engine Enamels, Stop Rust, and other Specialties.

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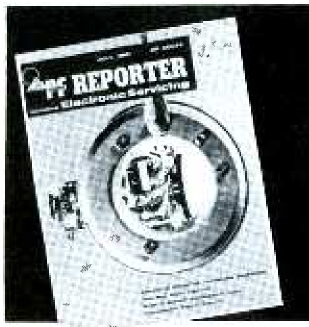


SWING-O-LITE FEATURED ON PF REPORTER COVER

To illustrate how magnification helps solve servicing problems of transistor radios, PF Reporter used Swing-O-Lite's famed "Inspector" lamp for their July cover. Especially designed for precision work, the "Inspector" will enable you to take full advantage of the lucrative transistor servicing market.

THE INSPECTOR

magnifying lamp for precision work

- 22 watt, shadow-free circline fluorescent lamp
- 5" dia. precision-polished magnifying glass 7" dia. available)
- Adjusts to any position
- Choice of arm reaches, colors and mounts
- Exclusive convenience electric outlet in base (optional)

NEW! GOOSENECK MODEL M-4 $27.00 list Less Bulb

Model M-1 45" Arm Reach $36.00 list Less Bulb

Dealer & Dist. Inquiries Invited

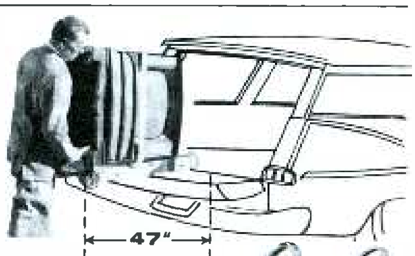
Write for literature on our complete line

Swing-O-Lite INCORPORATED

13 MOONACHIE ROAD HACKENSACK, N. J.

SAVES your back...

SAVES your time...



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FOLDING PLATFORM
$15\frac{1}{4}$" x $24\frac{1}{2}$" top.
Snaps on or off.
(Platform only)
$11.95

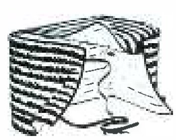
Designed for TV, radio and appliance men who make deliveries by station wagon or panel truck . . . the short 47 inch length saves detaching the set for loading into the "wagon" or pick up. Tough, yet featherlight aluminum alloy frame has padded felt front, fast (30 second) web strap ratchet fastener and two endless rubber belt step glides. New folding platform attachment, at left, saves your back handling large TV chassis or table models. Call your YEATS dealer or write direct today!

YEATS Model No. 5
Height 47"
Weight 32 lbs.

FURNITURE PAD

"Everlast" COVER AND PADS

YEATS semi fitted covers are made of tough water repellent fabric with adjustable web straps and soft, scratchless white flannel liners. All shapes and sizes — Write



TV COVER

YEATS APPLIANCE DOLLY SALES COMPANY

2103 N. 12th STREET MILWAUKEE, WISCONSIN

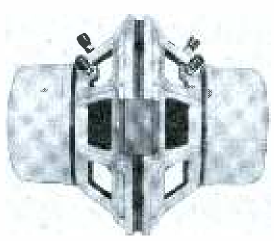
PRODUCT report

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

Redesigned Tube Tester (43F)

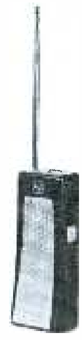
An improved version of the **Sencore** "Mighty Mite" tube tester checks RCA "nuvistor" and "novar," G-E "Compactron," and Sylvania "10-pin" tubes, plus all types that can be tested on the earlier model. In the new TC114 "Mighty Mite II," a friction device holds the mirror-equipped lid at any angle for convenience in making TV adjustments. The setup data booklet is printed in new, larger type. Dealer net price is $67.50.

Matched Stereo Speakers (44F)



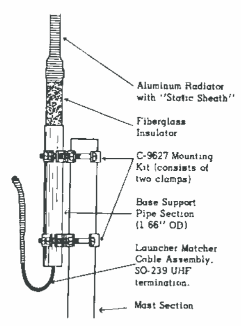
The two 8" speakers in the **Wilder** Model 808-A "Twin Speaker Stereo Set" are laboratory-matched to be as nearly identical as possible. Each speaker has an extended-range biaxial cone with a frequency response of 30-17,000 cps. Impedance is 8 ohms, power rating is 25 watts (continuous program material), and resonant frequency is 44 cps. List price is $98 per set.

Pocket CB Units (45F)



Weighing less than 1 lb. the **RCA** "Personal-Com 300" provides low-power two-way communications on the Citizens band, in compliance with part 15 of FCC rules. The transistorized circuitry is powered by an 11-volt mercury battery. Accessories include a leather carrying case, an earphone, and a factory-installed plug-in module for increasing transmitter power. (With the latter, the unit requires an operating license.) A slightly larger model, the "Personal-Com," is also available.

CB Base-Station Antenna (46F)



The Mark II "Super Beacon" antenna for 27-mc Citizens band base stations, manufactured by **Mark Mobile,** is a half-wave vertical radiator fed at the bottom high-impedance point through a "launcher-matcher" cable. The radiator is 19' long and has a "Static Sheath" (high-dielectric plastic coating) to prevent charged particles in the air from striking the metal surface and causing hiss interference.

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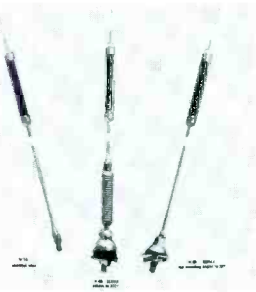
Compact CB Antennas (47F)

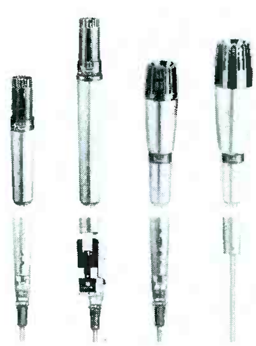


Wald center-loaded whip antennas for mobile Citizens band installations have an over-all length of 60". The loading coil, which is sealed in transparent plastic, is an integral part of the stainless-steel top section. Models are available with either standard or flex mounts, and also less mount (with universal adapter). A 54" or 144" coaxial cable is supplied with each antenna.

Transistor Kits (48F)

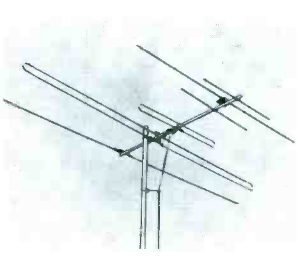
The newest kit of American-made replacement semiconductors marketed by **Semitronics Corp.** (No. 5PT) contains five power transistors designed to replace more than 100 types used in auto radios. Other kits in the "Popular-Quick" series are No. 8JP, with replacements for Japanese and other foreign transistors and diodes; 9TK, with nine popular PNP transistors and diodes; 10SP, with 10 silicon power rectifiers; and 5GP, with five glass-cased germanium diodes. Each kit contains replacement and interchangeability charts.

Dynamic Microphones (49F)



A series of plug-in adapters extends the usefulness of the six **University** "Modular Microphones." Any model can be used with or without Cannon plugs, with either slide-on or threaded stands, and with or without a thumb-operated on-off switch. Models 401 and 402S are omnidirectional, while Models 501 and 502S have a cardioid pickup pattern. The "S" versions feature internal shock mounting. Also available are Models 404L and 403L—small and extra-small lavaliers.

Medium-Gain Antenna (50F)



A six-element, all-channel VHF antenna designed for peak performance in areas of intermediate signal strength, the **Channel Master** Model 309 "Commuter," has separate driven dipoles for the low and high bands. Since all elements lie flat, this antenna can be installed even in a low-roofed attic. List price is $10.56.

Replacement Transistors (51F)

A kit of nine transistors, designed to replace hundreds of other types in specific stages of radios, is available from **Sylvania** semiconductor distributors. NPN types are as follows: SYL 101, converter-mixer-oscillator; SYL 102, IF amplifier; SYL 103, AF amplifier-driver; and SYL 104, AF power amplifier. PNP types include the SYL 105, converter-mixer-oscillator, SYL 106 IF amplifier, SYL 107 AF amplifier-driver, SYL 108 AF output, and SYL 109 auto-radio power output. Supplied with the "Big 9" kit are a replacement guide and a coupon worth $12.50 toward enrollment in a correspondence course on transistor servicing.

"MORE EFFICIENT CLEANING IS POSSIBLE!"

...thru the use of

INJECTORALL TUNER CLEANER

CLEANING . . . our formulation gets contacts sparkling clean. **LUBRICATION** . . . our spray leaves a lubricant as a protective coating. **NEEDLE APPLICATOR** . . . the 6 inch Injectorall Needle is made of stainless steel, with a special fitting to prevent the needle from blowing out of the can.

Non-toxic, non-inflammable.
6 oz. spray can with needle . . . **$1.95** net.

INJECTORALL COMPANY
Brooklyn 14, New York

Service Dealer Program
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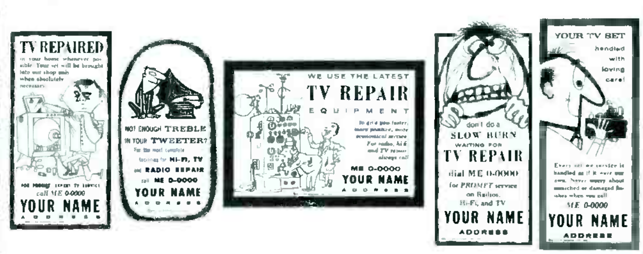
All 5 ads only

$1.00 for glossy proofs

$1.75 for ad mats



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INDEX TO ADVERTISERS

September, 1961

Latest Jackson Tube Test Data

MODEL 648

Tube Type	Fil.	D	E	Plate Test
2GK5	2.5	A234	A57	22 YZ
3AW3	3.0	12	9	39 XZ
20EZ7	Set line to 75% mark			
	19.	AC145	AC28	26 WX
	"	A456	AC79	26 WX
35HB8	35.	127	B689	26 V
	"	125	A34	15 XZ
50FK5	50.	C123	467	60 VW

SUPPLEMENTS LATEST ROLL CHART 648-24

MODEL 598

Tube Type	A.	B.	C.	Fil. Cont.	D.	E.	F.	G.
2GK5	2.5	3YZ	7	4	5	2		48
3AW3	3.0	2	1358	7	0	Z		81
20EZ7	Set line to 75% mark							
	19.	1	3	2	6	5		47
	"	1	3		7	8		47
35HB8	35.	4Z		5	7	9	6	41
	"	4Z			3	1		38
50FK5	50.	3Z	5	4	7	2	6	38

SUPPLEMENTS LATEST ROLL CHART 598-3

MODEL 658

Tube Type	Sec.	Heater	Circuit H-K	Circuit P-G	Plate	Grid Test	Heater Current
2GK5	T	2.5J	123	a57	21R	5WY•	A10.6H Z600
3AW3	D	3.0L	12	0	14U	VX	
20EZ7	T	22.D	C145	ac28	33Q	5XY•	
	T	"	456	ac79	"	5XY•	
35HB8	P	38.F	127	b689	84R	45VY•	
	T	"	125	a34	56R	7WY•	
50FK5	P	50.K	123	467	17R	20WY•	

SUPPLEMENTS LATEST ROLL CHART 658-4

"For further information, see Tube Test Data in PHOTOFACT Folder No. 548"

CATALOG AND LITERATURE SERVICE

ANTENNAS AND ACCESSORIES

1F. *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 TV antennas, mounts, masts, *Mardi Gras* TV tables, accessories. *See ad page 63.*

2F. *JERROLD*—Special bulletin on determining *system noise figure,* for use in eliminating snow from TV pictures; also new literature on transistorized *Powermate TV-FM Preamplifier. See ad 2nd cover.*

3F. *R-COLUMBIA*—Complete literature on new, time-saving strapless chimney mount. *See ad page 83.*

4F. *TACO*—New literature setting forth the importance of *tuned* antennas for FM stereo (multiplex).

5F. *WINEGARD*—Information on transistorized Model AT-6 *Booster-Pak* home TV-signal amplifier. *See ad pages 12-13.*

AUDIO AND HI-FI

6F. *CLAROSTAT* — Illustrated flyer on *Panel-Juster* extension bushings and audio controls on which they can be used. *See ad page 49.*

7F. *NORTRONICS* — Information on converting tape recorders to four-track operation and replacing worn tape heads. *See ad page 18.*

8F. *QUAM-NICHOLS*—Catalog 61, listing complete line of replacement, public-address, and high-fidelity speakers. *See ad page 73.*

9F. *SWITCHCRAFT* — New 12-page, two-color *Audio Accessory Catalog No. A-401,* featuring selector switches, couplers, adapters, plugs, jacks, connectors, and cables; includes guide for selecting proper microphone mixers and cables. *See ad page 42.*

10F. *UNIVERSITY*—*Informal Guide to Component High Fidelity* (16-page booklet), 12-page microphone guide and catalog; 16-page PA speaker catalog. *See ad page 39.*

COMMUNICATIONS RADIO

11F. *SONOTONE*—Flyer on CM-30 series of microphones for use with mobile communications systems and tape recorders. *See ad page 69.*

12F. *TEXAS CRYSTALS*—New 8-page catalog, No. 961, covering all types of quartz crystals; includes oscillator circuits. Also CB directory giving crystal information on 64 of the most popular transceivers.

COMPONENTS

13F. *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 65.*

14F. *GENERAL ELECTRIC*—Capacitor catalog and interchangeability guide (No. ETR-2600). *See ad pages 34-35.*

15F. *MERIT*—Catalog sheet giving specifications and prices for new line of input, interstage, and output transformers for transistor circuits. *See ad page 44.*

16F. *J. W. MILLER*—Literature on RF, IF, and TV-sound transformers designed as exact replacements for popular original parts of eight major radio-TV manufacturers. *See ad page 20.*

17F. *SPRAGUE*—Catalog C-457 of capacitors, printed-circuit components, and wire-wound resistors (designed to hang on wall). *See ad page 10.*

18F. *TRIAD*—Replacement-parts catalog TV-62; also Bulletin PTM-4 in *Service Aids for the Professional Television Man* series.

SERVICE AIDS

19F. *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 52.*

20F. *CASTLE*—Leaflet describing fast overhauling service on television tuners of all makes and models. *See ad page 79.*

21F. *G-C ELECTRONICS* — 400-page combined catalog FR-62 of all electronic components and service aids, including chemicals, hardware, test equipment, antennas, communications gear, audio accessories, microphones, etc. *See ads pages 78, 84.*

22F. *MERCURY TV TUNER*—Information sheet describing immediate tuner-exchange service, 24- to 48-hour tuner repairs, and additional services; states prices and announces new seven-month warranty. *See ad page 58.*

23F. *PRECISION TUNER*—Information on repair and alignment service available for any type of TV tuner. *See ad page 60.*

24F. *TENSOR* — Literature on portable, swivel-arm *Fold-Away* Model 6975 utility lamp which produces concentrated, high-intensity beam.

25F. *YEATS* — Literature describing *Appliance Dolly* and padded delivery covers. *See ad page 86.*

SPECIAL EQUIPMENT

26F. *ATR*—Information on inverters for operating standard 110-volt AC PA systems in mobile applications; an example is Model 12U-RHG which delivers 150-watt, 110-volt continuous output from 12-volt storage-battery source. *See ad page 14.*

27F. *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 84.*

28F. *EMCEE* — Complete planning kit on HVF translators for extending TV service into difficult reception areas.

29F. *STANDARD ELECTRICAL* — 40-page catalog of *Adjust-A-Volt* variable transformers, with illustrations, descriptions, electrical ratings, specifications and dimension diagrams.

30F. *VIRGINIA*—Data sheet on *Classroom TV Stand* — a rack with tubular metal frame, mounted on casters, which holds TV set approximately 5' off floors for viewing in schools, hospitals, institutions, and industry.

TECHNICAL PUBLICATIONS

31F. *GRANTHAM* — Booklet entitled, "Careers in Electronics," outlining training courses available. *See ad page 19.*

32F. *HOWARD W. SAMS*—Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics servicing. *See ads pages 47, 54, 66.*

TEST EQUIPMENT

33F. *B & K*—Catalog AP18-R, giving data and information on *Dynamatic* 375 *Automatic VTVM, V O Matic* 360, *Dyna-Quik* tube testers, Model 1076 *Television Analyst,* Models 1070 and A107 *Dyna-Sweep Circuit Analyzers,* Model 610 *Test Panel,* Model 440 CRT *Cathode Rejuvenator Tester,* Model 160 transistor tester, and Model 960 *Transistor Radio Analyst. See ads pages 51, 55, 59.*

34F. *EICO*—New 32-page catalog of test equipment, kits and wired equipment for stereo and monophonic hi-fi, Citizens band transceivers, ham gear, and transistor radios. Also, "Stereo Hi-Fi Guide," and "Short Course for Novice License." *See ad page 62.*

35F. *HICKOK* — Literature on Model 656 NTSC-standard color-bar generator and other color television test equipment. *See ad page 45.*

36F. *JACKSON* — Bulletin MK-61 on new Socket Modification Kit that enables Model 658 and 648R tube testers to check any of the newest types of tubes. *See ads pages 61, 88.*

37F. *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 60.*

38F. *PACOTRONICS*—12-page catalog with specifications and illustrations of *Precision* test equipment for radio-TV servicing. *See ad page 15.*

39F. *PRECISION ELECTRONICS*—Specifications on Model 202 aural-visual signal tracer, *Television Clarifier* for rejecting interference and Grommes *Little Genie* series of hi-fi kits. *See ad page 76.*

40F. *SECO* — Pocket-sized folder describing complete line of radio, TV, transistor, and communications test equipment.

41F. *SENCORE*—New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter,* plus brochure on complete line of *time-saver* instruments. *See ads pages 41, 43, 80.*

TUBES

42F. *SAMPSON*—*Hitachi* receiving-tube manual, giving extensive specifications, basing diagrams, and outlines for complete tube line; also catalog sheet with color photos and descriptions of *Hitachi* broadcast-band and two-band transistor radios. *See ads pages 72, 75.*

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HOW SILVERAMA BECOMES "SILVER"

High-Vacuum Aluminizing Assures Sharpest TV Picture Possible

Here RCA Silverama picture tubes become "silver" at the aluminizing station on our Marion, Indiana, production line. In a burst of light, aluminum is vaporized in a high vacuum and is deposited over the entire inner surface of the tube. Then the operator, with an RCA-designed electronic gauge, checks to be sure the aluminum film is of proper thickness. If it is not, the tube is rejected.

Such extra care in manufacture is an important reason why the Silverama you install today is free from "picture-spoiling" dark centers caused by an excess of aluminum deposited on the tube face. This extra care is the reason, too, why Silverama delivers the brightest, sharpest picture your customers' sets can produce. Obviously, Silverama picture tube service is the surest way toward satisfied customers, repeat business, favorable word-of-mouth advertising for you—plus freedom from call backs and costly in-warranty failures.

Equally important is the fact that RCA is a picture tube manufacturer. This means that your customers can take advantage of the latest innovations in picture tube design and manufacture when they buy RCA Silverama. It is made with a precision electron gun, the finest parts and materials, plus a reused envelope.

Final checkout before shipment. Here Silverama tubes receive final focus check before being shipped to customers.

Packing for final shipment. Before it can go into this box, RCA has made certain this Silverama is the best picture tube modern science and technology can produce.

RCA ELECTRON TUBE DIVISION, HARRISON, N. J.

RCA ®

The Most Trusted Name in Television.

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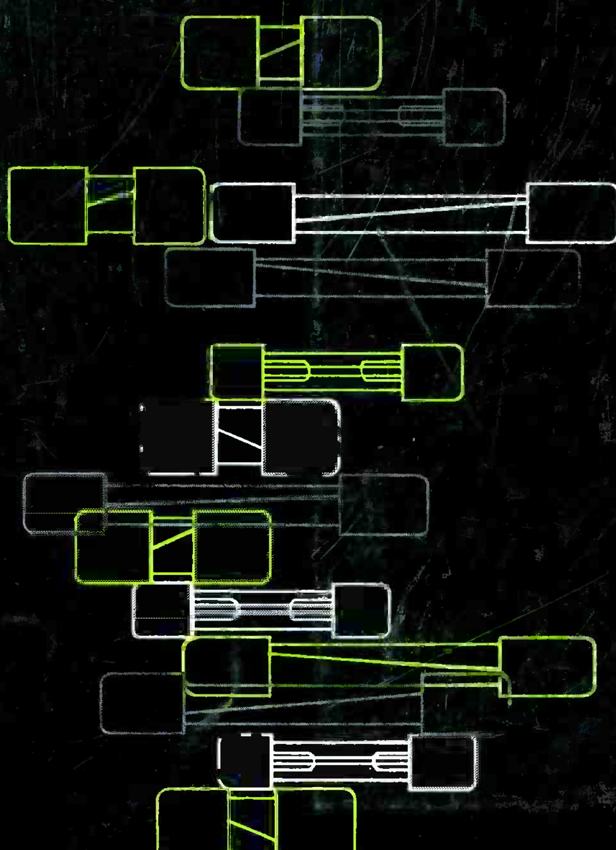
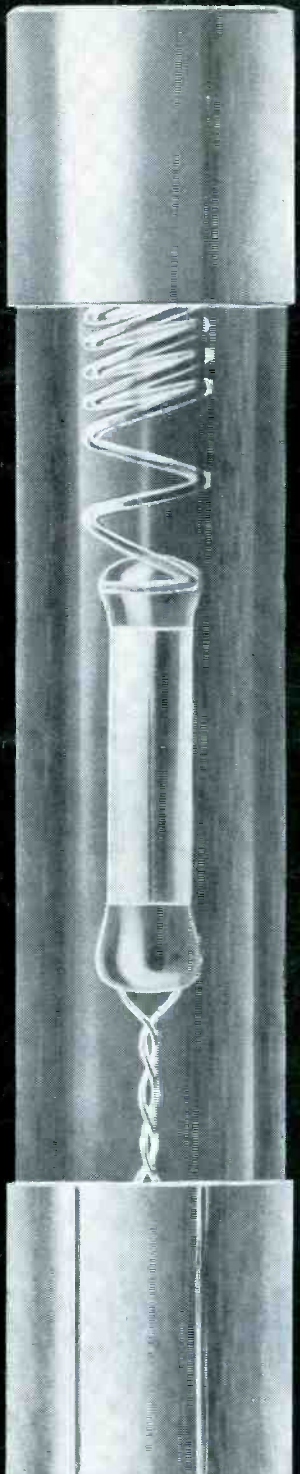
WHAT'S IN A FUSE?

Only a fuse element, glass & caps? No! Every fuse carries with it the skill and quality of its manufacturer. You can't reach out and touch or taste this, you can't even be sure it will do its job when needed except by purchasing from a company that has the know how of 30 years of manufacturing fine fuses.





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