OCTOBER, 1959 35 CENTS

PF REPORTER

PHOTOFACT

including **Electronic Servicing**

This Month's Highlights

Curing Brightness and Contrast Problems

Stock Guide for TV Tubes

Isolating Color TV Troubles by Symptoms

Servicing Medical Amplifiers

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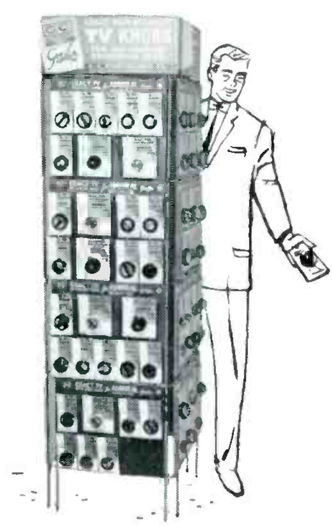

- 97 KNOBS TO CHOOSE FROM
- COVERS ALL 8 POPULAR TV MAKES
- REPLACEMENTS FOR ON-OFF, VOLUME, FINE TUNING, CHANNEL SELECTOR
- MODERN SKIN-PACK—PRICE-MARKED FOR YOUR TRADE

Whenever you run across a broken or missing knob on your TV service calls, you can supply an exact replacement that makes your customer happy, gives you extra money on that call. Your nearby G-C jobber is now showing the complete G-C TV Knob line . . . with each knob skin-packed, clearly identified, and marked with list price for the set owner's information. It's another great service for you from G-C and your G-C jobber.

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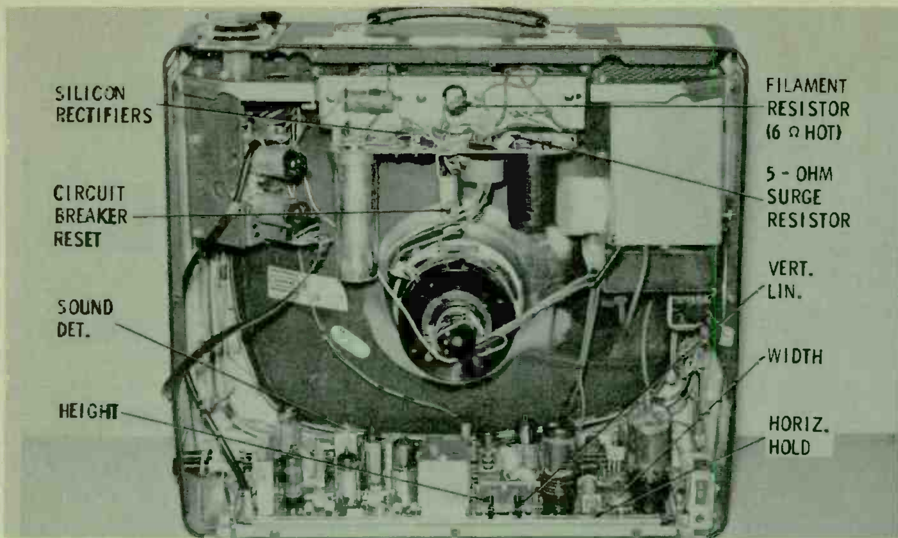
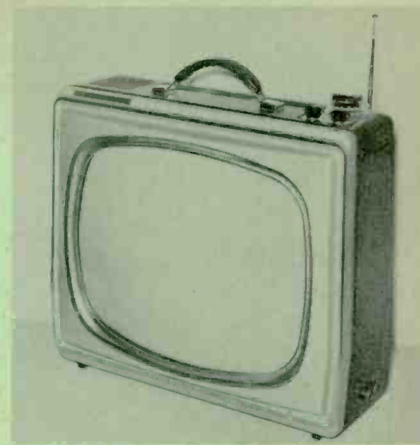
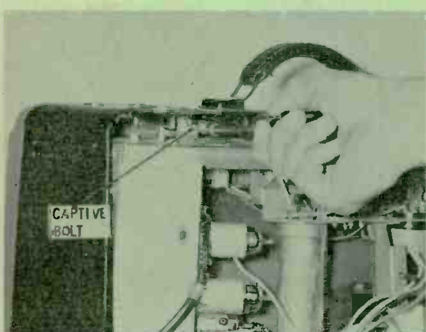
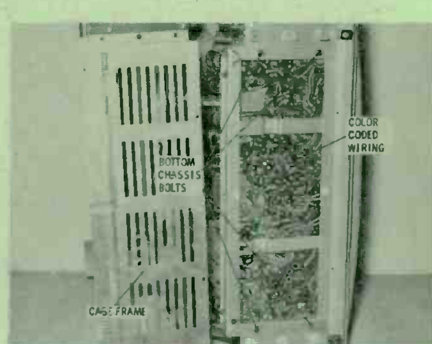
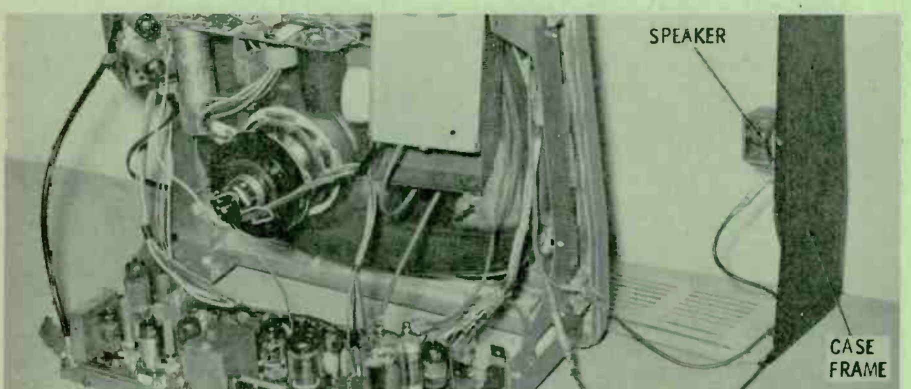


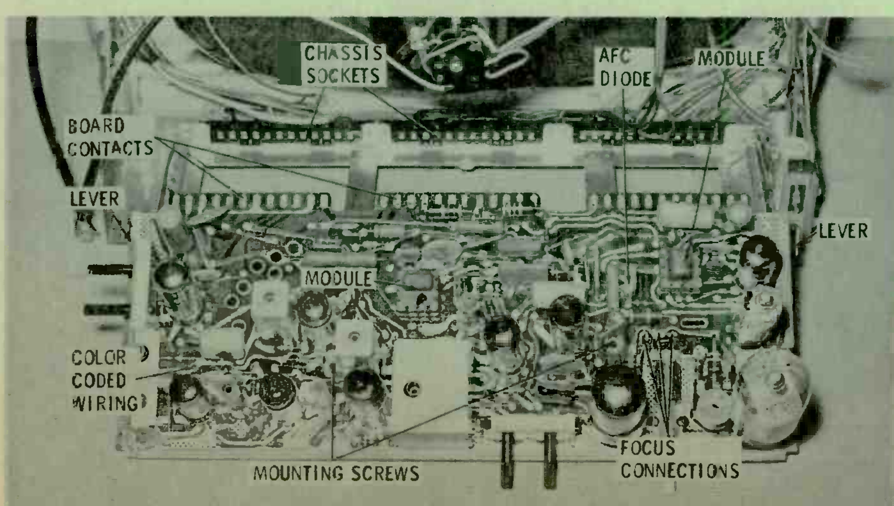


Motorola Model 17P6 Chassis TS-433









This is one of the new 1960 portables featuring a 17" 110° picture tube, telescoping antenna, and slim-styled carrying case. Top controls include channel selector, fine tuning, contrast, and volume with on-off switch. At the very bottom of one side, you'll also find control knobs for brightness and vertical hold.

The "hot" chassis is packed snugly around the 17DTP4 picture tube in a frame-like assembly; however, it should be considered as two different sections. The upper subchassis section contains conventionally-wired circuits of both the high- and low-voltage supplies, as well as a new switch-type tuner. The main section at the bottom contains all remaining circuitry, including the horizontal-output stage. This portion makes use of a unique plug-in type plated wiring board.

This portable was designed with serviceability in mind, for there are two fairly easy methods of disassembling it in order to reach certain test points on the plated board. One way is to take off the frame-like portion of the case, which is accomplished by removing the control knobs and loosening the two ¼" captive bolts shown at the top of the chassis.

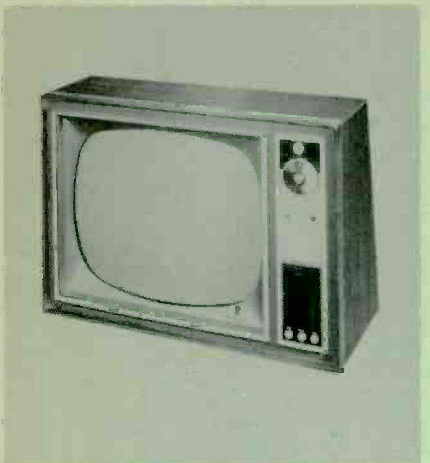
Then you remove eight ¼" screws securing the case at the bottom. Disconnect the speaker and remove the clip-on isolation network between chassis and side of case. Slip the frame off the chassis and picture-tube assembly from the rear. Remove the four 5/16" hex-head bolts from the bottom of the chassis.

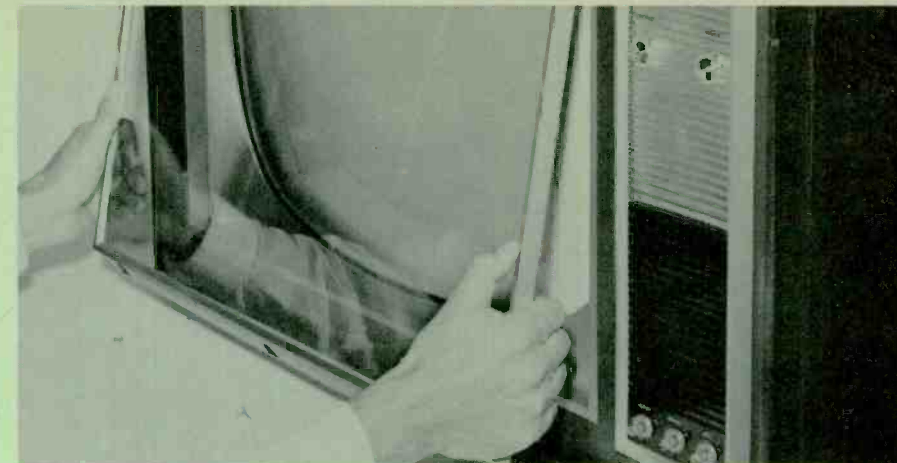
After freeing all wiring from retainers on each side of the chassis, pull the board assembly out away from the CRT. By making a simple connection to the speaker, the complete chassis is readied for bench servicing.

The plated board itself can also be removed from its plug-in chassis strip by removing the retaining rail on the back and taking out two mounting screws on top of the board and one at each end. Pressing down on the two levers shown in the photograph automatically unplugs the board.

TUBE COMPLEMENT

4ES8—RF amp	8BQ5—audio out
5EU8—conv	3BU8—sync sep/AGC
3BZ6—1st IF	7EY6—V out
3BZ6—2nd IF	5EA8—hor osc
6AU8—3rd IF/sound lim	12GC6—hor out
8EB8—vid amp/V osc	12AF3—damper
3DT6—sound det	DY87/1S2A—HV rect





RCA Model 210T195
Chassis KCS127A

You'll be able to identify this 21" table model by its wood cabinet with sloping back. The over-all depth at the base is a little less than 15". The control panel on the right includes channel selector, fine tuning, contrast, and volume with on-off. At the very bottom of the panel you'll also find horizontal hold, brightness, and vertical hold.

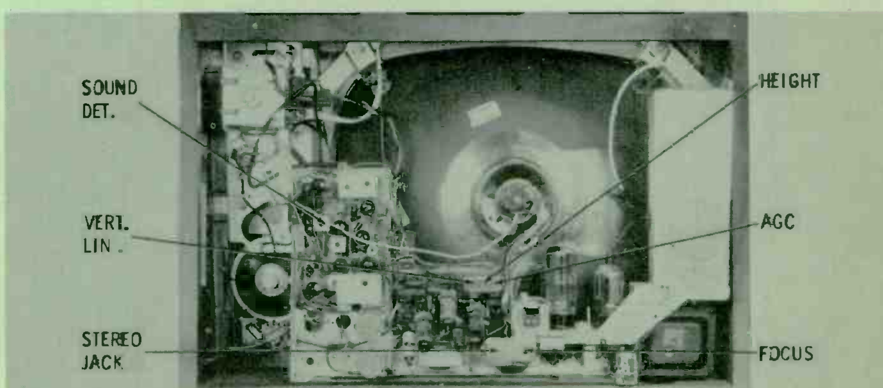
The safety glass on this set differs slightly from previous models. To remove it for cleaning, take out the three Phillips-head screws across the bottom of the front frame. The glass is kept in place only by this narrow metal frame, so hold it firmly when removing the screws. Pull out on the bottom and then upward to disengage two clips at the top. Remove glass and frame together as illustrated in the photo.

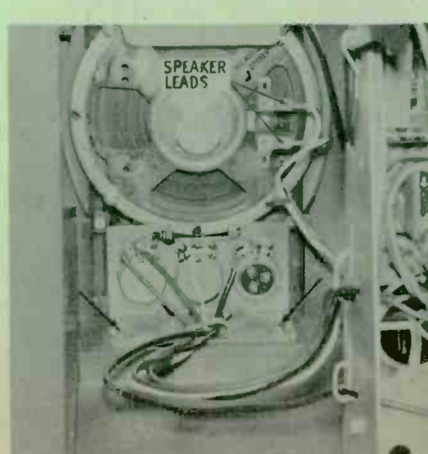
Although the transformer-powered chassis looks like a divided affair built around the 110° CRT, it consists of only two major sections; the main chassis, incorporating two printed boards, a power transformer, and a large high-voltage cage, is bolted to the bottom of the cabinet, while the tuner, controls, and speaker mount to the cabinet front. Some of the newer tube types to look for are a 6EW6 in the 3rd video-IF stage, a 6EB8 sync and video amplifier, a 6EM5 in the vertical-sweep circuit, and a 6DE4 damper.

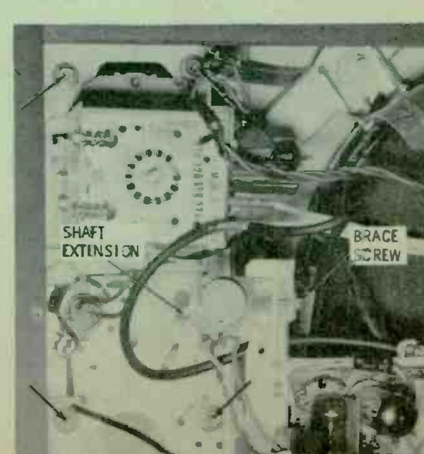
You'll find a surge-limiter fuse located on top of the chassis next to the low-voltage rectifier tube. This is a special 3/10-amp plug-in unit (part #945309-1) which protects both vertical and horizontal sweep circuits. Also shown on top of this section are drive and width adjustments. When pulling the chassis, be careful not to damage the width coil, which extends down under the chassis.

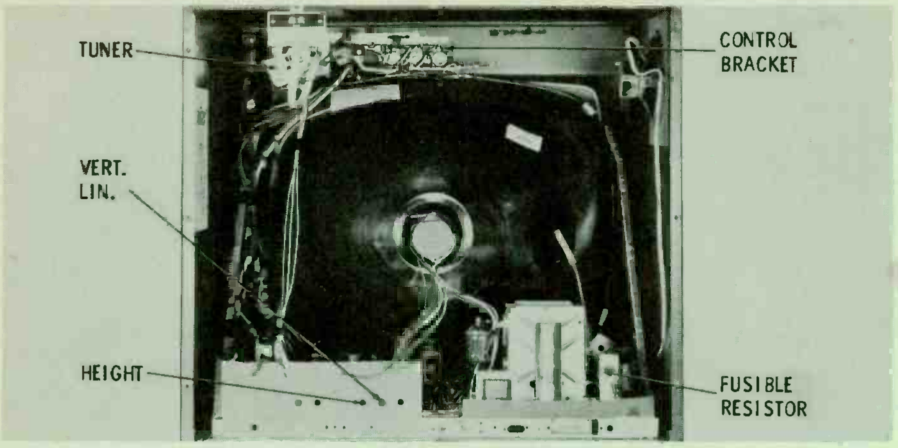
In the process of removing the chassis from the cabinet, you'll find it necessary to remove the two ¼" hex-head screws holding the lower control panel (see arrows in picture). The speaker leads can be disconnected by removing the clip-on connectors right on the speaker.

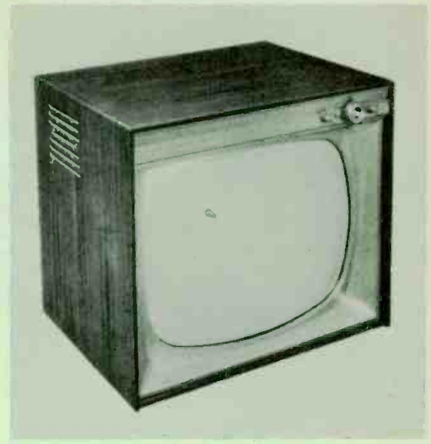
To slide out the main chassis, remember to remove the screw securing the front panel brace to the contrast-control bracket and to disengage the plastic shaft extension on the control. To pull the entire tuner panel, remove the four ⅜" hex nuts pointed out by large arrows in the photo.

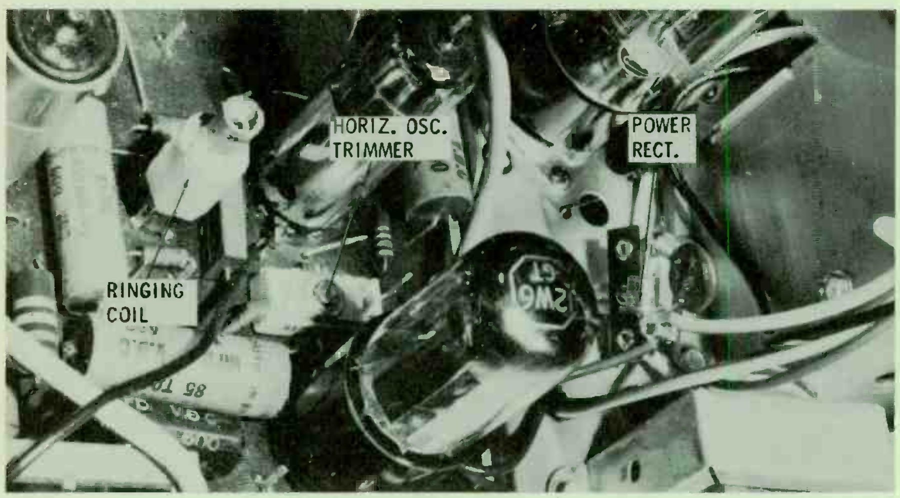


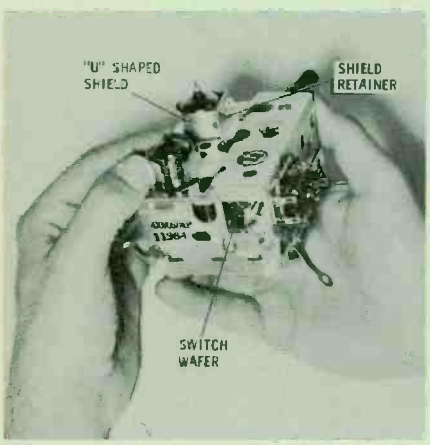


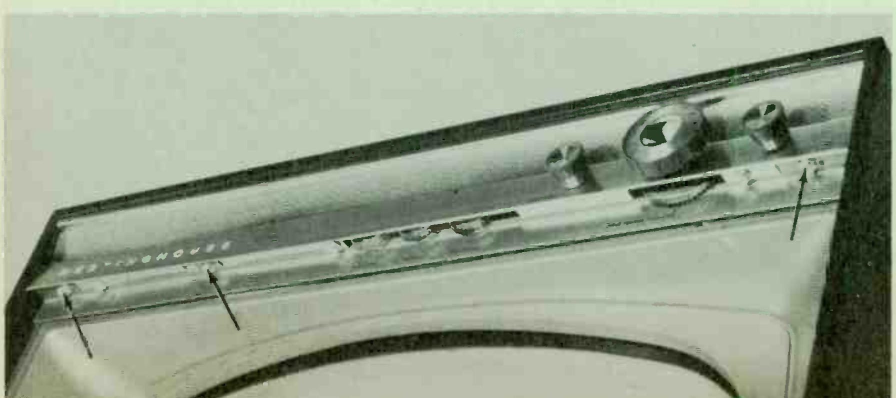












Westinghouse Model H21T263 Chassis V-2374-1

This table-styled metal cabinet houses a 21" 90° picture tube, a small VHF tuner, and a 5" PM speaker. Although knobs for the channel selector, contrast, and volume with push-pull on/off switch are in plain view, you'll find horizontal and vertical hold, brightness, and fine tuning adjustments up under the top trim strip on the front.

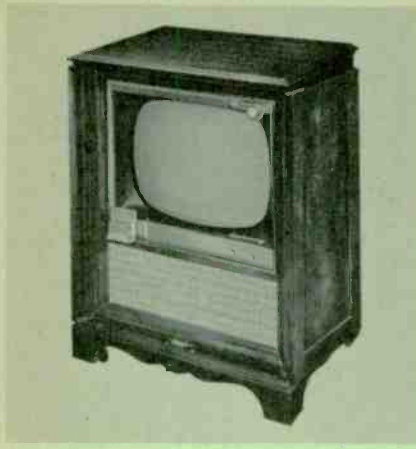
With the back removed, you'll find a shallow horizontal chassis at the bottom of the cabinet, two angled rails supporting the picture tube, and the tuner with control bracket at the top. Only two service adjustments are located on the rear—vertical linearity and height. The fusible resistor pointed out on the right side of the chassis is a 7.5-ohm plug-in component connected in series with the B+ supply. As for new tube types, a 3DK6 is employed in one of the video-IF stages, a 5CL8A functions as sound IF and vertical multivibrator, and a 12CU5 is used as an audio output tube.

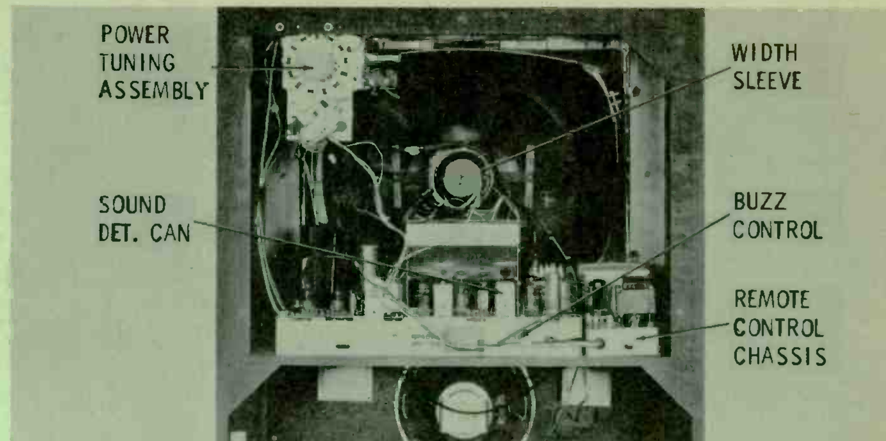
The "hot" chassis makes use of one large printed board which contains all circuit wiring except for the horizontal-output and high-voltage stages. Only one silicon diode is employed for power rectification. This unit is soldered to a small terminal strip just to the left of the high-voltage compartment. Incidentally, the shielded high-voltage compartment houses only the flyback transformer; the 1B3GT rectifier is located on the chassis in front of this cage. No horizontal drive or linearity controls are provided.

The VHF tuner in this set may be new to many of you. It's a small switch-type assembly which uses a 2CY5 RF amplifier and a 5AT8 mixer-oscillator. The tubes are shielded by small "U" shaped pieces of spring metal.

Removing the bottom shield from the tuner reveals the miniature printed board shown in the photo. Except for channels 2 and 7, which are individually tuned, a single adjustable oscillator coil is provided for every two channels. Adjustments are paired up for channels 11 and 10, 9 and 8, 6 and 5, 4 and 3.

The safety glass and screen on this model can be cleaned by removing the three screws pointed out on the front escutcheon. After removing the top retaining strip, tilt the glass forward and lift out.





Zenith Model C3014R Chassis 18C20Q

Here's one of the largest 21" consoles supplied with casters. The receiver features power tuning, remote control, and hi-fi tone controls. In addition, the cabinet is equipped with three speakers—two 3" electrostatic tweeters and a 10" PM woofer.

Equipped with *Space Command*, it uses a conventional hand-wired chassis, and all tubes and adjustments are within easy reach. The only adjustment you'll find on the rear apron of the chassis is a buzz control; all others are located behind a long control panel across the front. When making a call on this set, check your tube stock for a 6EB8, which is used in the video-amplifier and sound-IF stages, a 6CK4 vertical-output tube, and a 6BU8 for both sync and AGC sections. It's interesting to note that the tube socket for the 6CK4 is shock-mounted to lessen the development of microphonics in this section.

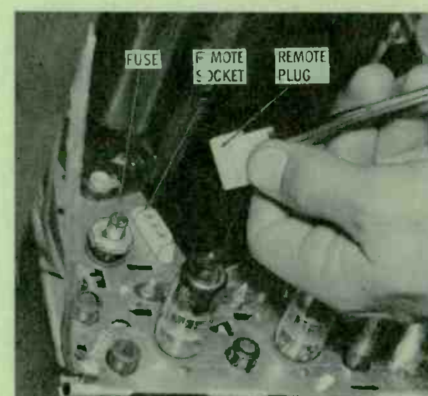
Behind the power transformer on the left side of the chassis, you'll discover a 700-ma slow-blow fuse and a special connector for the remote chassis. The fuse is connected in series with the B+ supply of the main TV chassis. The plug and socket shown is used for power to the remote receiver chassis positioned on the opposite side of the cabinet. To operate the TV without the remote chassis, you merely jumper the two socket connections which accept the black and gray leads from the remote chassis.

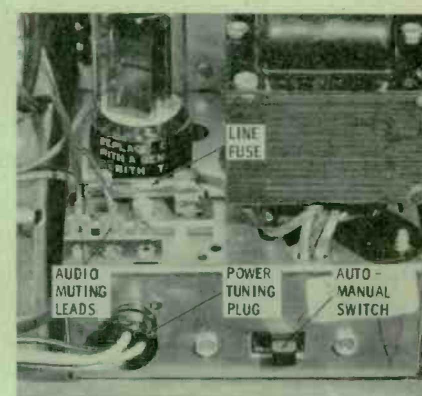
The line fuse near the back of the remote chassis is a ¾-amp slow-blow unit. The remote receiver uses three 6AU6's, two 6AL5's, two 6CM7's, and a 5Y3GT rectifier. A microphone pickup is attached directly to the front of this chassis.

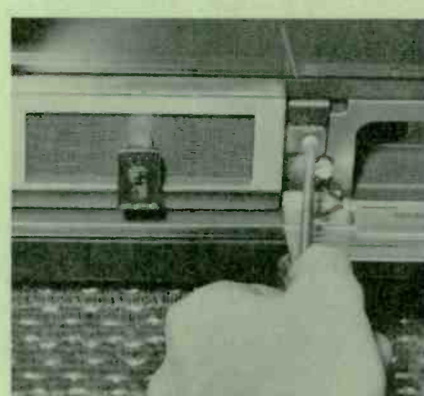
To clean the glass on this model, the bottom retaining strip must be removed; to accomplish this, you'll find it necessary to remove the remote transmitter holder. Flip the control panel down and take out the Phillips-head screw securing both the holder and the glass retainer at the left.

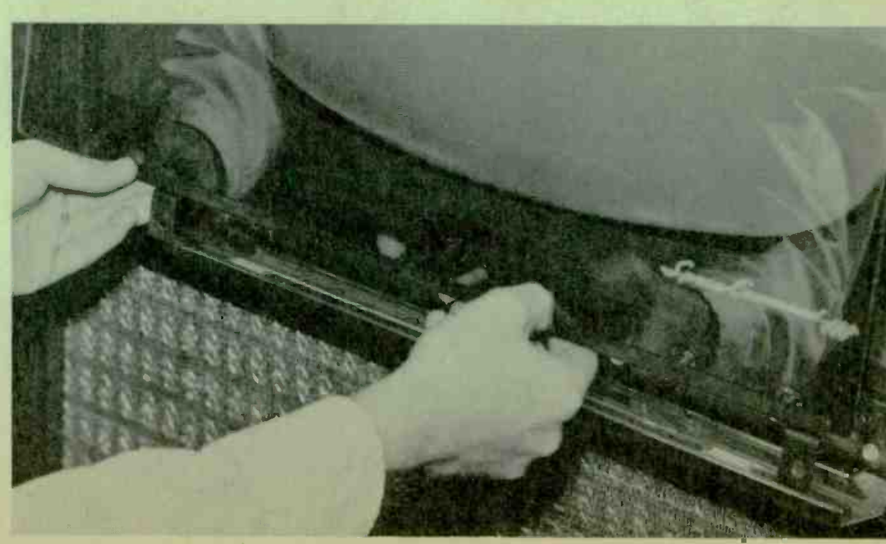
After removing the other Phillips-head screw, which holds the retaining strip at the far right, pull straight out on the transmitter holder as illustrated.

The retainer and glass are now free at the bottom and can be removed by pulling out and then down.









VIDEO SPEED SERVICING

Andrea

See PHOTOFACT Set 449, Folder 1

Mfr: Andrea **Chassis No. VR121**

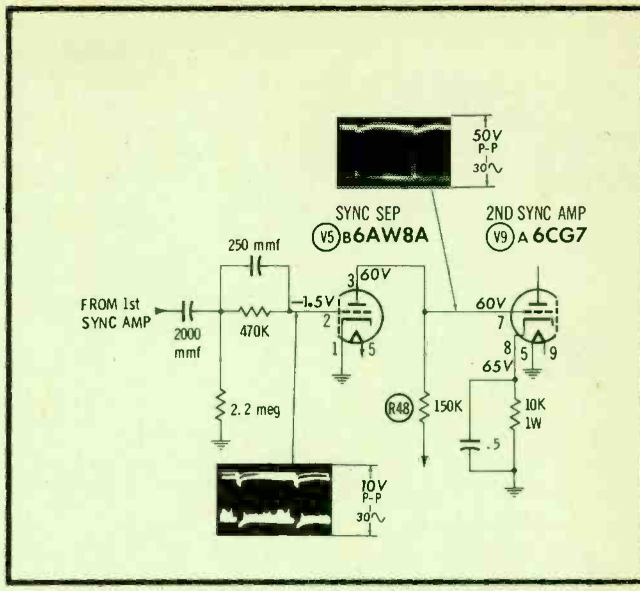
Card No: AN 121-1

Section Affected: Sync.

Symptoms: Vertical rolling and horizontal tearing.

Cause: Open plate-load resistor in sync separator circuit.

What To Do: Replace R48 (150K). Check V5 (6AW8A), sync separator-AGC keyer and V9 (6CG7), sync amp.



Mfr: Andrea **Chassis No. VR121**

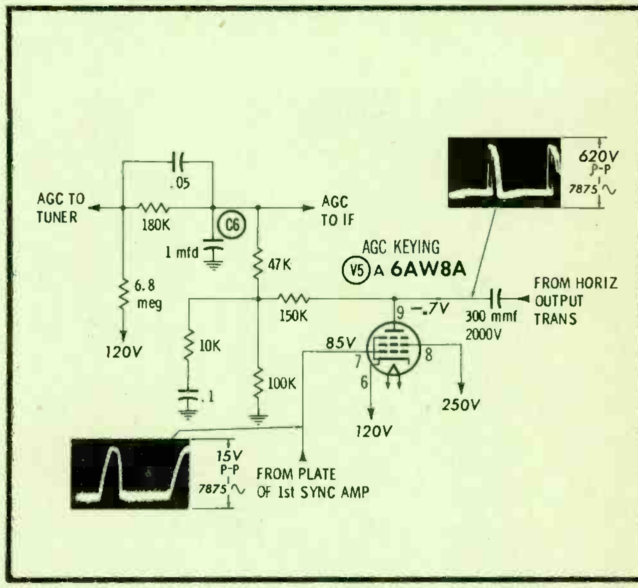
Card No: AN 121-2

Section Affected: Pix.

Symptoms: Severe video overloading.

Cause: Shorted AGC filter capacitor.

What To Do: Replace C6 (1 mfd—200V).



Mfr: Andrea **Chassis No. VR121**

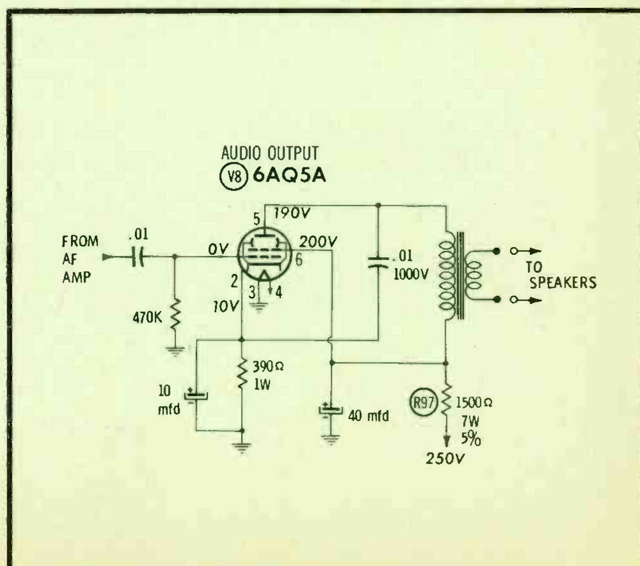
Card No: AN 121-3

Section Affected: Sound.

Symptoms: Crackling in audio, followed by complete loss of audio.

Cause: Defective B+ feed resistor in audio-output plate circuit.

What To Do: Replace R97 (1500 ohms—7W).



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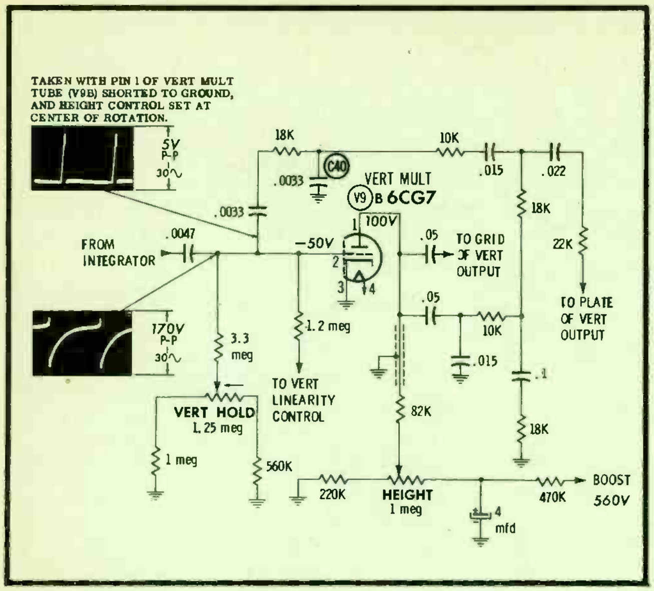
See PHOTOFACT Set 449, Folder 1



See PHOTOFACT Set 449, Folder 1

Mfr: Andrea **Chassis No.** VR121

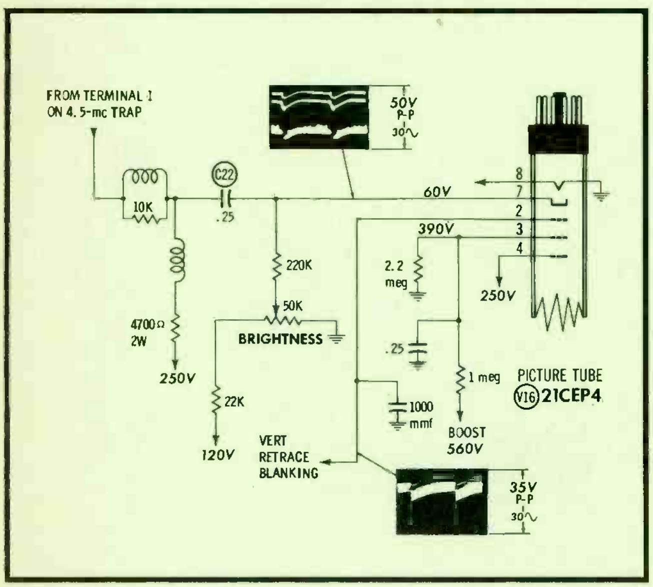
Card No: AN 121-4

Section Affected: Raster.

Symptoms: Vertical rolling after about an hour of play.

Cause: Leaky capacitor in feedback circuit of vertical multivibrator.

What To Do: Replace C40 (.0033 mfd—400V).



Mfr: Andrea **Chassis No.** VR121

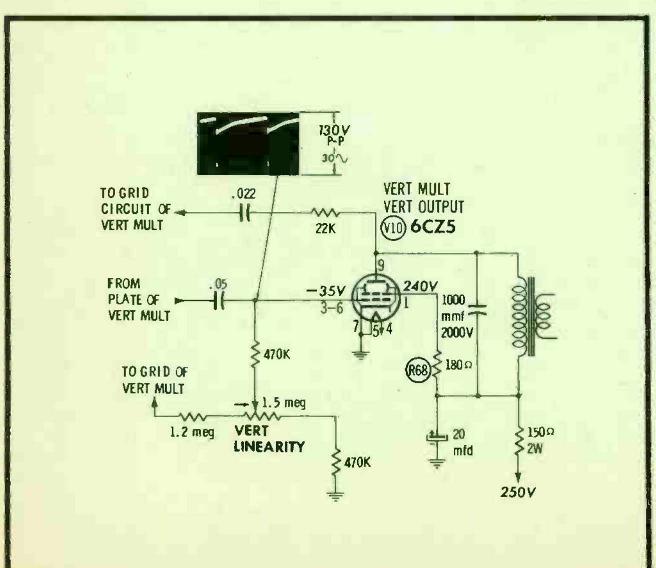
Card No: AN 121-5

Section Affected: Pix.

Symptoms: Pix flashes on and off intermittently.

Cause: Intermittently open video coupling capacitor.

What To Do: Replace C22 (.25 mfd—400V).



Mfr: Andrea **Chassis No.** VR121

Card No: AN 121-6

Section Affected: Raster.

Symptoms: Vertical sweep collapses a few times when set is first turned on, then remains normal.

Cause: Defective screen resistor in vertical output stage.

What To Do: Replace R68 (180 ohms—½W) with 2-watt unit.

See **PHOTOFACT Set 392, Folder 1**

See PHOTOFACT Set 392, Folder 1

Mfr: Magnavox **Chassis No. 24 Series**

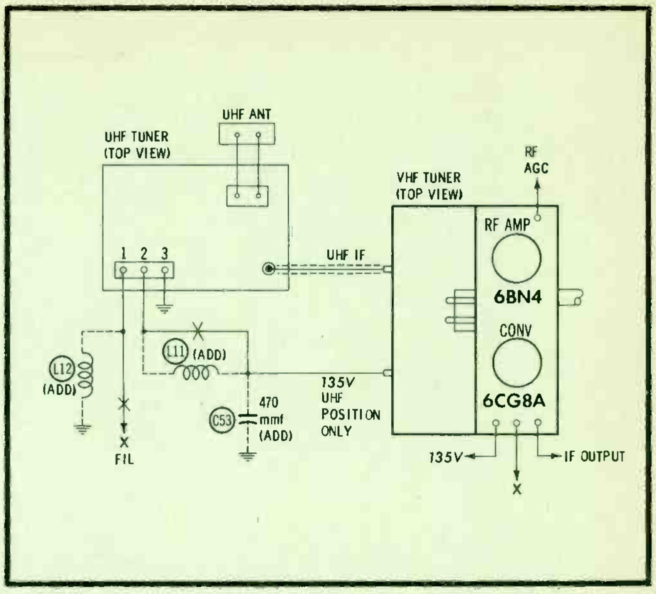
Card No: MA 24-1

Section Affected: Picture (on UHF).

Symptoms: Poor detail and video ringing.

Cause: Regeneration at UHF.

What To Do: Add L11 (Magnavox Part No. 360574-8), L12 (Part No. 360601-3), and C53 (470 mmf) as shown.
Note: This change has already been included in later-production receivers.



Mfr: Magnavox **Chassis No. 24 Series**

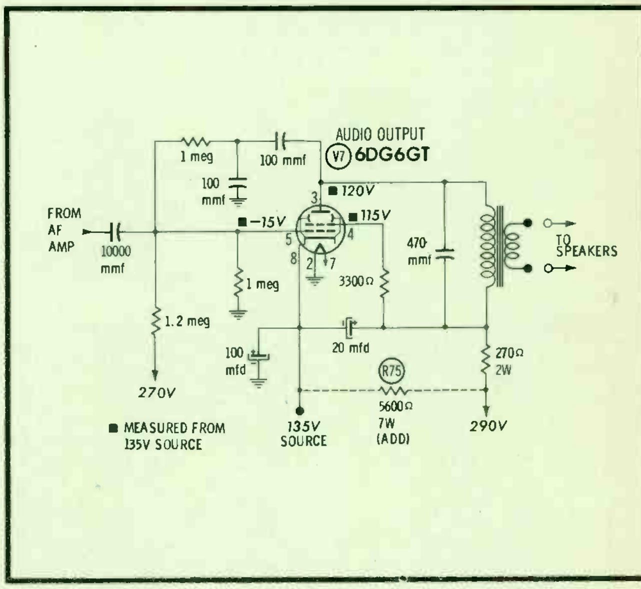
Card No: MA 24-2

Section Affected: Audio.

Symptoms: Repeated failure of 6DG6GT audio output tube.

Cause: Excessive 6DG6GT current.

What To Do: Add R75 (5600 ohms—7W, wirewound) from pin 8 of 6DG6GT to 290-volt B+ source.
Note: This change has already been included in later-production receivers.



Mfr: Magnavox **Chassis No. 24 Series**

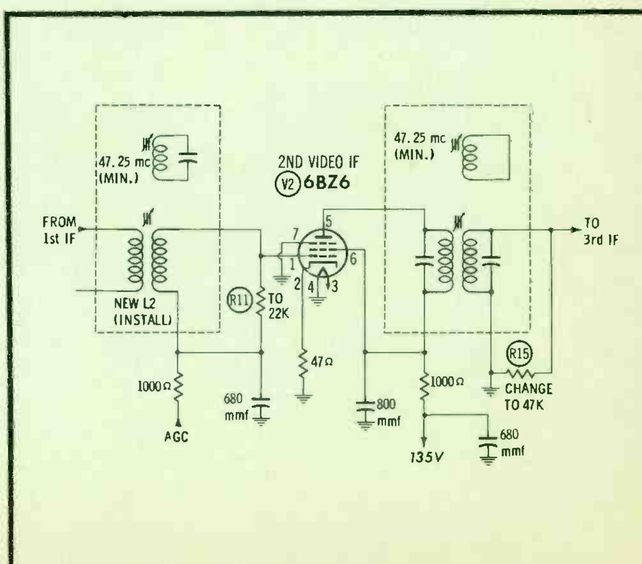
Card No: MA 24-3

Section Affected: Pix.

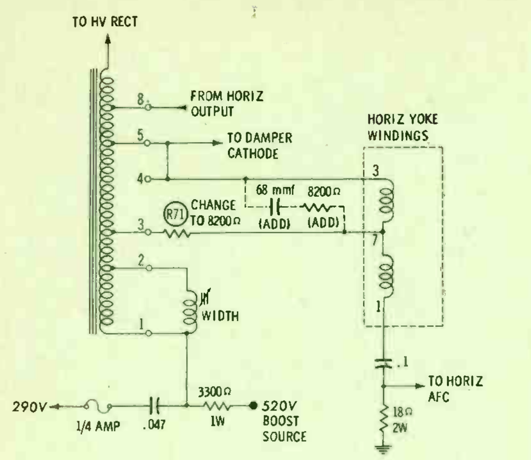
Symptoms: Adjacent-channel interference.

Reason for Change: To provide greater attenuation of adjacent-channel sound carrier in IF strip.

What To Do: Replace L2 (1st video IF transformer) with Magnavox part no. 360644-1, which includes a 47.25-mc trap. Change R15 from 86K to 47K and R11 from 82K to 22K. Check IF alignment.
Note: This change has already been included in later-production receivers.



See PHOTOFACT Set 392, Folder 1



See PHOTOFACT Set 392, Folder 1

Mfr: Magnavox **Chassis No. 24 Series**

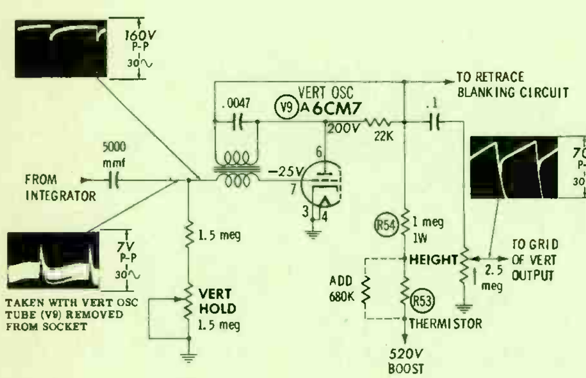
Card No: MA 24-4

Section Affected: Raster.

Symptoms: Ripples and lines in raster.

Cause: Yoke crosstalk.

What To Do: Replace horizontal output transformer with newer type (part No. 360700-2). Replace R71 (2700 ohms—½W) with 8200-ohm unit. Add an 8200-ohm resistor and a 68-mmf, 2000V capacitor in series between terminals 3 and 7 of the yoke.
Note: This change has already been included in later-production receivers.



Mfr: Magnavox **Chassis No. 24 Series**

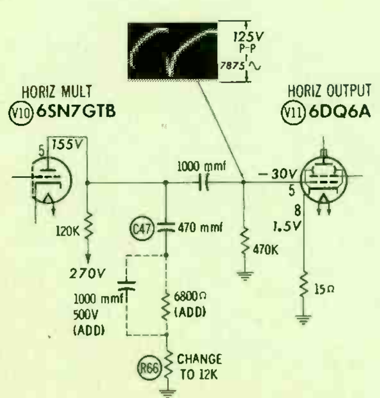
Card No: MA 24-5

Section Affected: Raster.

Symptoms: Height decreases after set has operated for some time.

Cause: Vertical sweep components change value due to temperature increase.

What To Do: Add 680K-ohm resistor in parallel with thermistor R53. If set being repaired has R54 (1 meg—1W) wired between R53 and boost B+ line, transpose positions of R53 and R54.
Note: This change has already been included in later-production receivers.



Mfr: Magnavox **Chassis No. 24 Series**

Card No: MA 24-6

Section Affected: Pix.

Symptoms: Picture size changes noticeably when horizontal hold control is turned.

Cause: Horizontal drive voltage is affected by hold-control rotation.

What To Do: Change R66 (4700 ohms) to 12K. Break connection between R66 and R47, and insert the parallel combination of a .001 mfd, 500V capacitor and a 6800-ohm resistor.
Note: This change has already been included in later-production receivers.

FUTURA TRIPLETS...

three models . . . superbly styled . . . covering a wide range of applications

ASTATIC'S FUTURA

SERIES DYNAMIC MICROPHONES

Most versatile performers in the microphone field are the Astatic Futura Series Dynamic Microphones—Models Metro 788, Tempo 888, and Vogue 988. Beautifully styled, encompassing the newest and most advanced principles in microphone engineering, each model is designed to outperform any other microphone in its price class.

Futura mikes are instantly convertible from hand to stand to lavalier use . . . offer many special features such as rugged, stable, fatigue-free Mylar diaphragm and, on the 888 and 988, the Cannon XLR-3 connector for instant detachment from cable ("Take the microphone to the cable.")

Model No.	Type	Response	Output	Impedance	Finish and Trim	Price
788	Omni-Directional	60-13,000 cps	-55 DB	Hi or 150	Black and Gold	$ 79.50
888	Omni-Directional	50-15,000 cps	-56 DB	50, 200, Hi	Black and Chrome	110.00
988	Omni-Directional	40-20,000 cps	-58 DB	50, 150, 250	Black and Gold	150.00

NOTE — Exclusive Astatic impedance selector permits instant choice of impedance without special tools.

All three microphones come complete with lavalier and belt clip, 360° swivel adaptor for ⅝ #27 thread.

Twenty-foot, two-conductor, shielded cable supplied with each microphone.

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BEAT HEAT AND HUMIDITY

New DIFILM Black Beauty Capacitors lead the way in tubulars! The operating temperature range of these new capacitors goes up to 105 C (221 F) *without voltage derating.* Capacitance tolerance is held to ± 10%.*

• The new dual dielectric used in DIFILM Capacitors combines the proven long life of paper capacitors with the effective moisture resistance of polyester plastic film capacitors . . . to give you performance that can't be beat.

• Here's the kind of performance you can expect from DIFILM: very high insulation resistance, low power factor, moderate capacitance change with temperature, excellent retrace under temperature cycling, and superior long-term stability . . . *all at regular prices!*

• This high performance is fully protected by HCX®, an exclusive Sprague hydrocarbon material which impregnates the windings, filling all voids and pinholes before it polymerizes. The result is a solid rock-hard capacitor section. These capacitors are further protected by an outer molding of humidity-resistant, non-flammable phenolic.

For complete technical information on DIFILM Black Beauty Capacitors, write for Bulletin M-759 to Sprague Products Company, 105 Marshall St., North Adams, Mass.

*From .001μF up

The major capacitor improvements come from

SPRAGUE®

world's largest capacitor manufacturer

SPRAGUE RESEARCH IS CONSTANTLY PRODUCING NEW AND BETTER CAPACITORS FOR YOU

PF REPORTER

Including Electronic Servicing

VOLUME 9, No. 10 *OCTOBER, 1959*

CONTENTS

ABOUT THE COVER

Oh, for the easy-going life of a TV serviceman (Hah!). And just when you were ready to show the housewife a nice picture on her set, too.

We're sure you'll take this "good clean fun in your stride, however (you were going to clean the glass, anyway—weren't you?)

Letters to the EDITOR

Dear Editor:

I just received my August issue of PF REPORTER and was shocked to read your answer to Mr. E. A. Ferguson's letter to the Editor.

Surely, you must be aware of what these part-time operators do. They have their regular job in a factory, and in the evening they go out with a bag full of tubes and pawn themselves off as servicemen. To them it is sort of a hobby, but to us full-time servicemen it is our bread and butter. I wonder what these "night crawlers" would say if the tables were turned and we went into their factories and forced them to take a cut in their pay checks? I assure you that they would scream to the high heavens—but yet, they think nothing of doing the very same thing to us full-time servicemen.

I personally resent your remarks, and I quote, "In our opinion it makes little difference if a man operates full-time or part-time." I would like to know just where you stand. I have always thought your magazine was directed to the professional serviceman, but your answer leaves grave doubts in my mind.

We here in Cleveland, through our shop owner's association and union, have been trying for years to improve conditions in this field. One of our biggest headaches is the part-timer.

I noticed that because of an error in "Video Speed Servicing" you received letters up to your eye level. For this answer, I hope you receive letters up to the ceiling and it takes a week to find you.

JOHN STANDEN
Wind-A-Meer Radio & Television Service
Cleveland 12, Ohio

P.S. May I live so long as to see this printed in PF REPORTER.

Dear Editor:

I read with interest all of the letters written to you, chuckling over some and boiling over others. I think you have a fine magazine as my October, 1963 expiration date will testify.

I concur thoroughly with the letter written by Mr. E. A. Ferguson relative to the beef about part-time servicemen. If these fellows, so full of indignation, would take inventory of themselves and their methods, they might find that people have reason to turn to someone upon whom they can rely. As for their charges of cheap work and mail-order parts, distributors with whom I deal will tell you that a good portion of their business is from part-time servicemen who rely on good parts and tubes, and who give just as good service as the regular full-time shops. Our instruments cost as much as theirs, being obtained from the same sources.

Sometime I would like to send you a snapshot of my shop, even though it's in the basement of my home. I am well equipped, and my work bears up under the testimony of my many customers. All this drivel about part-time servicemen taking away work from the full-time shops makes me sick. I, too, have had people tell me of their experiences with these "brainier-than-thou" guys, after which they become my customers.

Are we part-time men to blame for the indifferent attitudes and the other charges we hear, or are we damned because we dared to study and enter this sacred field to buck against the holy ones?

R. J. DENNIS
Binghamton, N. Y.

Hooray for you both and what you stand for. To Mr. Standen, a word of explanation, and a reminder. Explanation: We put it awkwardly, but we did say what you left out—that the part-timer was to be judged on the basis "that he practices sound business principles, and works toward giving his customers full value and improving his technical skills." Reminder: Many of today's most respected "full-timers" got their start as part-time servicemen.

Whatever the pros and cons may be on full-timer or part-timer, the real issue confronting our profession is the level of skill, integrity and honesty of the individual practicing it. To help provide a better understanding among all servicemen, we'll open these columns to anyone who has a burning desire to have his say on either side of the subject.—Ed.

Dear Editor:

I was very pleased with the position given Raytheon's September ad in PF REPORTER, announcing our Bonded Program, but notice that the ad is backed up with a valuable Service Shop chart of Common TV Troubles and Their Causes.

I fear that your readers will be faced with a difficult choice; either they can respond to our coupon, or they can utilize the fine PF REPORTER Service Shop Chart. They cannot do both. I am wondering how we might best solve this?

BILL GREY
Merch. Mgr., Distr. Products Div.
Raytheon Company
Newton, Massachusetts

Have no fear, Mr. Grey — free reprints of this chart (from the September "Shop Talk" column Developing a Modus Operandi) on heavier paper are available upon request from readers.

Further, for readers who find it more convenient, full information on Raytheon's Bonded Dealer Program and national ad dealer listings is available by checking item (411.) on the Catalog & Literature card bound in this issue.—Ed.

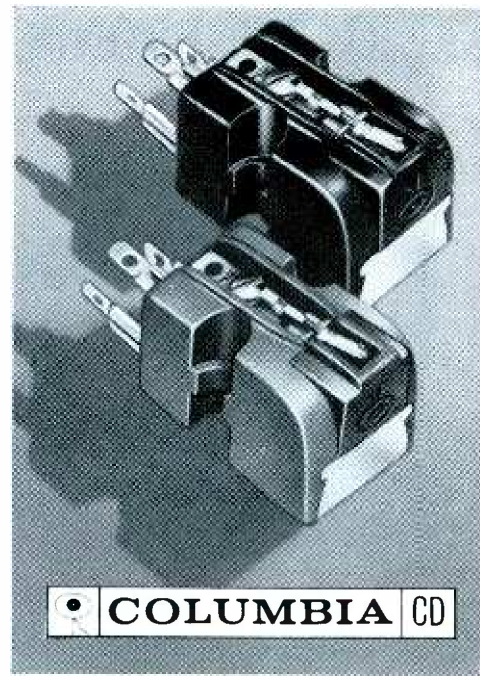
Dear Editor:

We have just seen the August issue of PF REPORTER and are delighted to see Admiral's 17" portable with wireless remote control featured on your amusing cover. Unfortunately, the negative was reversed and the set is shown with the controls on—of all places—the left side.

• *Please turn to page 22*

CBS Electronics adds Ronette to Cartridge Line

CBS-Ronette, the world's most popular cartridge

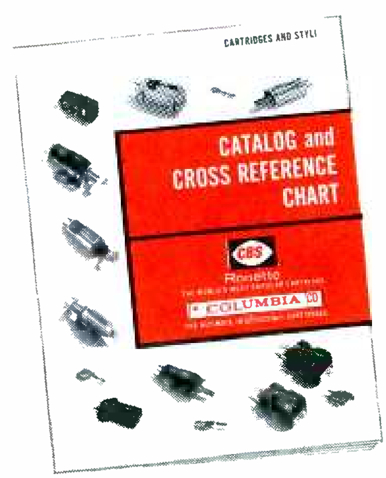


Columbia CD, the ultimate in stereo cartridges

CBS Electronics is proud to announce the addition of CBS-Ronette cartridges to its expanding product line. Independent service-dealers now have the convenience of its local distributors for this quality line of stereo and monaural cartridges widely used by manufacturers of phonographs and changers. Now your distributor offers you one dependable source for CBS-Ronette and Columbia CD cartridges and styli.

IMPROVE SERVICE...INCREASE PROFITS WITH THESE CBS-RONETTE ADVANTAGES

- Reduced inventory . . . 27 cartridges replace over 500.
- Exact replacements for over 6,000,000 cartridges in U.S.A.
- Made by largest cartridge manufacturer in the world.
- Painstaking craftsmanship: e.g., clip-on jeweled styli.
- Proven dependability to guarantee satisfied customers.
- Selection made easy by new CBS-Ronette and Columbia CD Catalog and Cross Reference Chart.
- Installation time cut by simplified instruction sheets.



This 8-page catalog makes cartridge replacement easier, faster, more profitable. It is free from your distributor. Ask for Bulletin PF-285 today.

CBS ELECTRONICS

Danvers, Massachusetts, U.S.A.

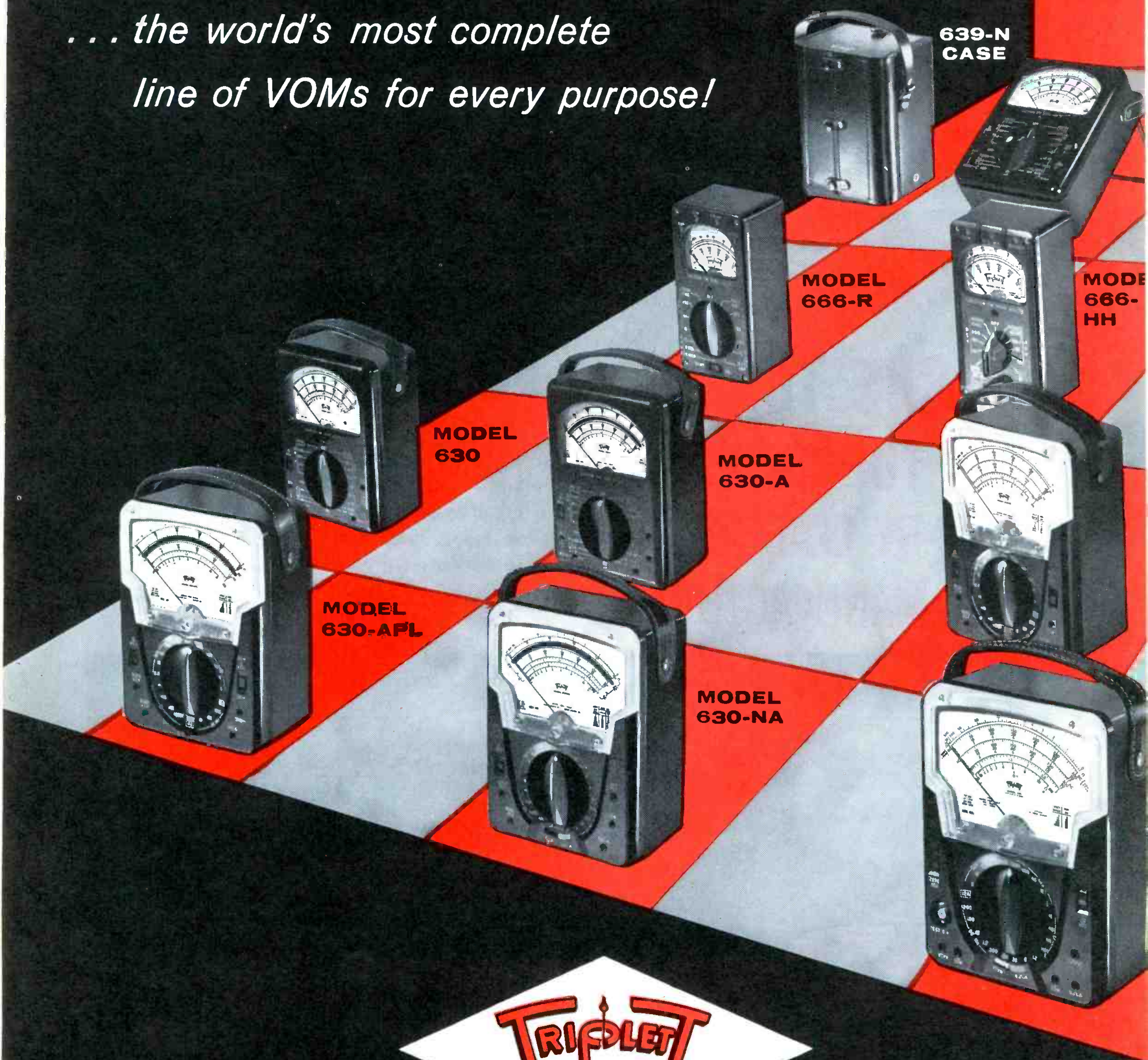
A Division of Columbia Broadcasting System, Inc.

Receiving, industrial and picture tubes • transistors and dioaes audio components • and phonographs

. . . the smartest move you can make

is to **TRIPLETT VOMs**

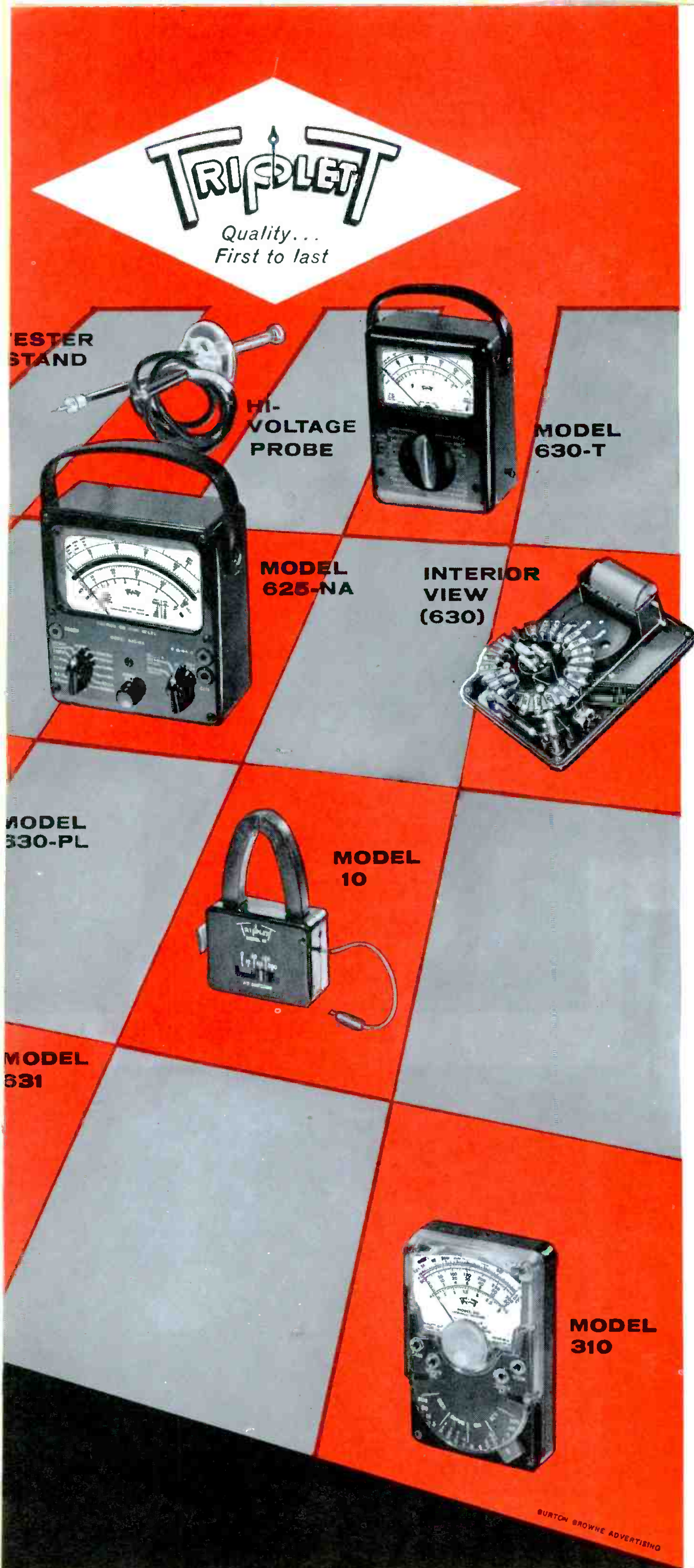
. . . the world's most complete
line of VOMs for every purpose!



TRIPLETT

Quality . . .
First to last

TRIPLETT ELECTRICAL INSTRUMENT COMPANY
BLUFFTON, OHIO



Model 639-N Case $9.50. Handsome, black cowhide leather. Center-cover flaps snap back for full view of scales and complete access to instrument without removal from case.

Model Pt. T-225-A-33 Tester Stand $0.50. Metal, holds tester in approximately 45° angle; facilitates easy reading.

Probe for High Voltage Testing $14.50. For models 630, 630-A, 630-PL, 630-APL, and 631. Completely insulated polystyrene; guard-type handle. 11¾" long; 48" hi-voltage wire lead with banana plug at tester end. Available in 0-12,000 AC or DC volts, and 0-30,000 AC or DC volts.

Model 630-T $54.50. Specially designed for telephone maintenance. 2% accuracy on DC. Fused protected circuit protects resistors and meter in ohms ranges. Special neck strap holds instrument, freeing both hands. Banana jack connectors eliminate all shock hazard. Completely insulated case protects from ground.

Model 666-R Pocket VOM $29.50. Hand size, ideal for electrical maintenance. With recessed range knob it fits easily into case. AC rectifier pre-calibrated unit for easy replacement. Banana jacks at panel top prevent leads falling over meter dial. Single king-size selector switch minimizes incorrect settings, burnouts. Molded case streamlined, fully insulated.

Model 666-HH Pocket VOM $27.50. Compact, hand-size; 3" meter integral with panel, adjusted to 400 microamperes at 250 millivolts. Only 3 jacks necessary for all ranges. 19 ranges.

Model 625-NA $54.50. Dual sensitivity for extra ranges; large mirror scale for super readability. 3-color meter scale 5" long. 6" instrument, 0-50 microamp. AC volts at 10,000 O/V for checking many audio and high impedance AC circuits usually requiring VTVM. 38 ranges. Molded insulated case.

Interior View showing advanced engineering features of all Triplett VOMs. Molded mounting for resistors and shunts allows direct connections without cabling. Eliminates shorts Longer life.

Model 630 $44.50. Popular, streamlined; long meter scales for easy reading. Outstanding linear ohm scale; low reading 1 ohm, high 100 megs. Single king-size selector-switch minimizes incorrect settings, burnouts. High sensitivity: 20,000 ohms per volt DC; 5,000 AC. Molded, fully insulated case

Model 630-A $54.50. Laboratory type; ½% resistors for greater accuracy. Long mirrored scale eliminates parallax. Banana jacks, low resistance connections; high flux magnet increases ruggedness. Single king-size selector switch minimizes incorrect settings, burnouts. Molded fully insulated case.

Model 630-PL $44.50. Instant-vision, wider spread scales; streamlined case; handsome modern design. Unbreakable window. Outstanding linear ohm scale; low reading .1 ohm; high to 100 megs. Single king-size selector switch minimizes incorrect settings, burnouts. 5 to 500,000 cps frequency response in AC measurements. DC Polarity Reversing switch High sensitivity: 5,000 ohms per volt AC; 20,000 ohms per volt DC.

Model 10 Clamp-On Adapter $14.50. Checks line loads with model 310 (can also be used with 6 other models). Instant, accurate, safe. No circuit breaking or work interruption Easy range switching. Available in 6 AC Ammeter ranges: 0-6-12-30-60-120-300. Clips around single wire to read AC Amperes direct. Use with adapter 101 to instantly divide 2-conductor cords. Molded case fully insulated, black plastic with engraved white markings.

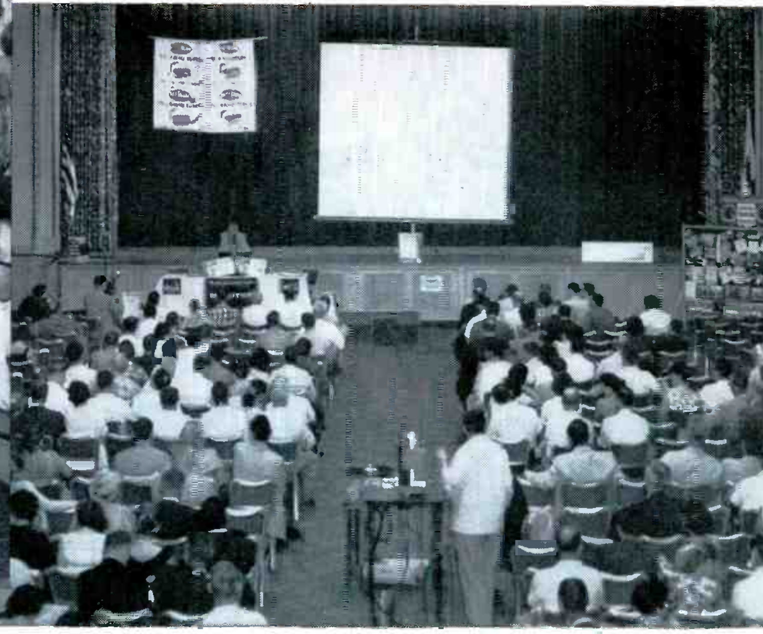
Model 630-APL $54.50. Laboratory type with ½% resistors, more accurate movement. Long mirrored scales eliminate parallax. Unbreakable window. Single king-size switch minimizes incorrect settings, burnouts. 5 to 500,000 cps frequency response in AC measurements. DC Polarity Reversing switch. High sensitivity: 5000 ohms per volt AC; 20,000 ohms per volt DC. Molded case fully insulated.

Model 630-NA $74.50. Super DeLuxe with 70 ranges—nearly double conventional types. Frequency compensated from 35 cps to 20 kc. Temperature compensated. Accurate within 1½% full scale reading on DC. Large open front meter easy to read. Unbreakable window. Mirrored scale. Meter protection against overloads. Molded fully insulated case.

Model 631 Combination VOM and VTVM $64.50. Two fundamental units at the price of a single tester. The No. 1 instrument for all electronic men. Battery operation assures VTVM stability and long life. Sensitivity PLUS. 1.2 volt (VTVM) range is equal to more than nine million ohms per volt. Large easy to read meter with unbreakable face. Single king-size selector switch minimizes incorrect settings, burnouts. Molded case fully insulated.

Model 310 $34.50. The only complete miniature VOM with 20,000 ohms per volt and selector range switch. Self-shielded against strong magnetic field. Rugged, high torque, bar-ring instrument. Unbreakable plastic meter window. Converts to common probe—frees one hand—by fitting interchangeable test prod into top. Standard sensitivity 20,000 ohms per volt DC, and 5,000 ohms per volt AC. Accuracy 3% DC. Molded fully insulated case.

Los Angeles, Cal.



Boston, Mass.

Boise, Idaho

Providence, R. I.

Philadelphia, Penna.

Portland, Ore.

Minneapolis-St. Paul, Minn.

Letters

(Continued from page 14)

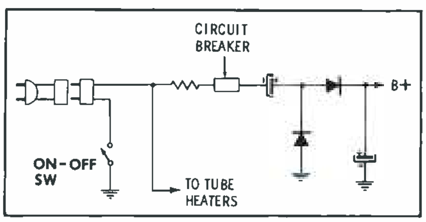
Our engineers take issue with your magazine's statement that the chassis of this portable receiver is "hot" (*Previews of New Sets*, August). We do admit to the high-voltage can, the cover over the IF strip, and the tuner being connected to one side of the AC line, but these do not constitute what is generally considered to be the chassis. I might also point out that the second paragraph of your coverage mentions an AC circuit breaker. The item referred to is actually a B+ circuit breaker.

MARTIN SHERIDAN
Admiral Corp.
Chicago, Ill.

We expected the orders for your special "southpaw" models to be pouring in by now! In all seriousness, our August cover picture was reversed on purpose for only one reason—to produce a more attractive cover layout.

As for our reference to the 15B3 chassis as "hot," we admit to having over-simplified our definition of a hot-chassis set. We've fallen into the habit of using this term to describe any set in which one side of the AC line is connected to any portion of the chassis.

We goofed on the circuit breaker. As shown in the diagram, it precedes the rectifier circuit, and will kick out when excessive drain occurs due to trouble in either the load or the power circuit itself.—Ed.



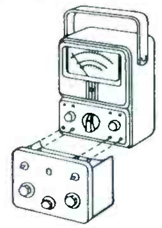
Dear Editor:

Please accept our sincere thanks for your participation as a speaker at our annual T.E.A. Clinic and Fair. It was a real pleasure to have you with us, and we look forward to seeing you again at future Clinics.

C. W. SCHERTZ
1959 Clinic Chairman
Texas Electronics Association

It was an honor to take part in your program. Incidentally, thanks to you and your group for the handsome plaque (see photo)—awarded exclusively to PF REPORTER *as the magazine providing most outstanding service to the industry.—Ed.*

New Simpson "Add-A-Testers"



Just plug it in

Converts your 260* into seven different testers!

Think of it! A small investment turns your 260 VOM into a whole array of testers—equipment with a quality that is found only in individual pieces of test equipment at much higher prices. The secret lies in combining an adapter with the *top-notch meter and circuitry* of your 260.

Each combination of Add-A-Tester unit and 260 is self-contained, self-powered. Each adapter goes on and off in a jiffy. No gadgets, no complicated connections. Furthermore, Add-A-Tester units require only 1/2 to 1/3 the storage space of individual testers. By reducing bench clutter, this compactness makes jobs go faster, raises shop efficiency. Make your 260 do double duty. Stop in at your Electronics Parts Distributor or write the factory for further information.

*Trademark

TRANSISTOR TESTER, Model 650 . . . . . . $26.95
Beta Ranges: 0-10, 0-50, 0-250, (F.S.)
Beta Accuracy: ±3%, with 260 ±5% nominal
Ico Range: 0-100 ua
Ico Accuracy: ±1%, with 260 ±3% (F.S.)

DC VTVM, Model 651 . . . . $32.95
Voltage Ranges: 0-.5/1.0/2.5/5.0/10/25/50/100/250/500
Accuracy: ±1%, with 260 ±3% (F.S.)
Input Impedance: greater than 10 megs all ranges

TEMPERATURE TESTER, Model 652 . . . . $38.95
Temperature Ranges: −50°F to +100°F, +100°F to +250°F
Accuracy: with 260 ±2° (nominal)
Three lead positions provided
Sensing Element: thermistor

AC AMMETER, Model 653 . . . . $18.95
Ranges: 0-0.25/1/2.5/12.5/25 amps
Accuracy: ±1%, with 260 ±3% nominal
Frequency Range: 50 cycles to 3000 cycles

AUDIO WATTMETER, Model 654 . . . . . . $18.95
Load Ranges: 4,8,16,600 ohms
Wattage: Continuous 25 watts (8,600 ohms)
50 watts (4,16 ohms)
Intermittent 50 watts (8,600 ohms)
100 watts (4,16 ohms)
Accuracy: ±5%, with 260 ±10% nominal
Direct reading scale from 17 microwatts to 100 watts

MICROVOLT ATTENUATOR, Model 655 . . $18.95
Ranges: 2.5 microvolts to 250,000 microvolts continuously variable in decade steps
Frequency: DC to 20 KC
Accuracy: ±1db

BATTERY TESTER, Model 656 . . . . $19.95
Checks all radio and hearing aid batteries up to 90 volts at the manufacturer's recommended load, or any external load.

Note: All Simpson 260 Adapters provide for normal 260 usage without disconnecting the adapter.

Simpson ELECTRIC COMPANY

5209 West Kinzie Street • Chicago 44, Illinois
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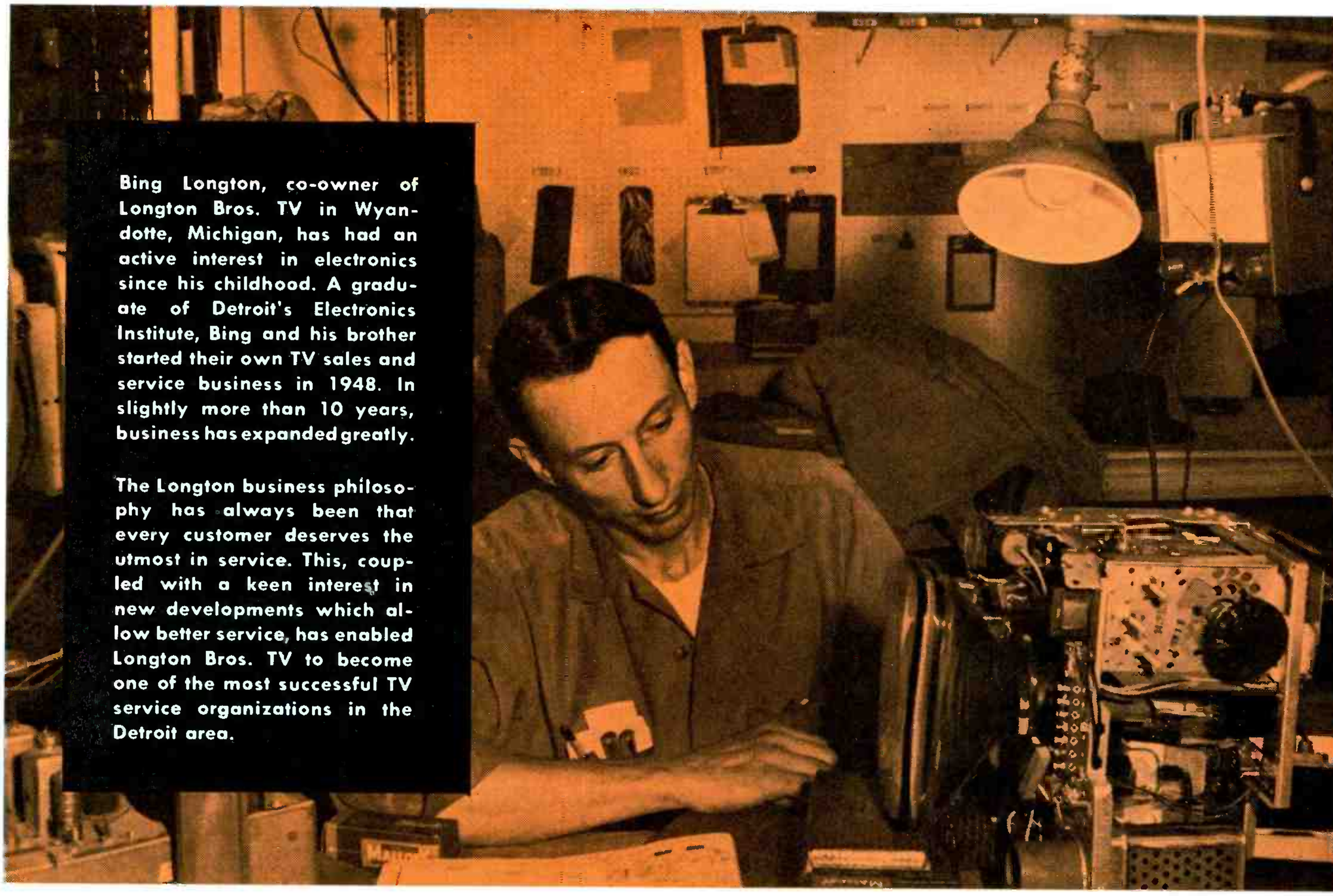
WORLD'S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT

TV Technician Bing Longton says . . .

"We Can't Gamble With Customer



Bing Longton, co-owner of Longton Bros. TV in Wyandotte, Michigan, has had an active interest in electronics since his childhood. A graduate of Detroit's Electronics Institute, Bing and his brother started their own TV sales and service business in 1948. In slightly more than 10 years, business has expanded greatly.

The Longton business philosophy has always been that every customer deserves the utmost in service. This, coupled with a keen interest in new developments which allow better service, has enabled Longton Bros. TV to become one of the most successful TV service organizations in the Detroit area.

Put an end to call-backs with these quality Mallory products . . .

GEMS

5 rugged, moistureproof, Mallory "Gem" tubular capacitors in an easy-to-use dispenser that keeps your stock fresh and clean—easy to find—no more kinks in lead wires. They're your best bet for outstanding service in buffer, by-pass or coupling applications.

RMC DISCAPS®

Are a product of the world's largest producer of ceramic disc capacitors. Long the original equipment standard, Mallory RMC Discaps are now available for replacement. They come in a handy 3" x 5" file card package . . . easy to stock, simple to use.

®A registered trade mark of Radio Materials Company, a division of P. R. Mallory & Co. Inc.

FP ELECTROLYTICS

The Mallory FP—the original 85°C. capacitor—now has improved shock-resistant construction and leakproof seal. Its etched cathode construction—standard in all FP's—assures hum-free performance. High ripple current ratings fit the toughest filter circuits.

Satisfaction . . . We Use Mallory Components for Replacement"

"Customers demand quality repair service, and at Longton TV the customer is *king*. We figure the best way to keep him happy . . . and protect our own profits, too . . . is to prevent complaints before they happen. So we give him the best in service and the best in replacement parts—that means MALLORY components. We've used them ever since we started in business, because we know we can always depend on MALLORY."

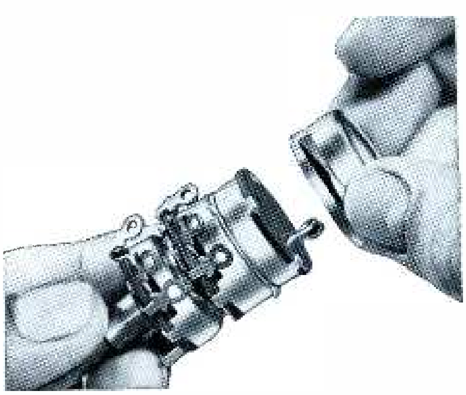
Whether you need capacitors, controls, resistors, silicon rectifiers or batteries, you get the highest quality components at sensible prices. The Mallory line is the widest in the industry, and Mallory "service-engineering" assures you fewer call-backs and more satisfied customers. See your Mallory distributor for a full selection of the parts you need.

Get TC capacitors at your distributor from this handy merchandise display.

P.R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA



STA-LOC* CONTROLS

New Sta-Loc design enables your distributor to custom build, in just 30 seconds, any of 38,000 combinations—eliminates waiting for out-of-stock controls. You can replace the line switch by itself, without unsoldering control connections.

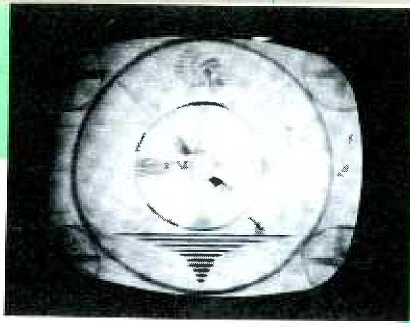
GOLD LABEL* VIBRATORS

On critical auto radio servicing, use the Mallory Gold Label Vibrator. It gives longer, trouble-free service life. Mallory Gold Label Vibrators feature Mallory exclusive buttonless contact design.

**Trade Mark*

TC TUBULAR ELECTROLYTICS

Economically priced electrolytic filter capacitors with a reputation for doing an excellent job. They have been proved in performance and are backed by years of Mallory experience. Also special TCX type available for −55°C.



What you can do about those TV pictures with that "tattle-tale gray" look.

by George D. Philpott

BRIGHTNESS AND CONTRAST

Trying to get a good picture on a TV set with deficient brightness is like trying to write a neat letter on the wrappings left over from lunch. Conversely, you have about as much chance of writing legibly with a nail dipped in ink as you have of obtaining a clear TV picture when the set has poor contrast.

Yet, servicemen often have trouble in diagnosing brightness and contrast defects, let alone repairing them. The main problem, aside from the fact that brightness and contrast controls interact to a great degree, is the sad truth that no particular setting of either control can be considered "correct." Light conditions in the viewing area have a fairly definite effect on the choice of settings, but different viewers' personal preferences in this matter seem to be completely unpredictable. What the serviceman may call "excessive contrast" (Fig. 1), the set user may consider a "good clear picture." Thus, either the user or the serviceman — or both — may fail to recognize a brightness or contrast problem.

In order to make a fair judgment of picture contrast, you must first determine whether or not the available brightness is ample for the existing room light. Of course, you can always produce an apparent increase in contrast by lowering the brightness level; however, this practice will not effectively improve the picture even though it results in a correct *ratio* between brightness and contrast.

The first step in evaluating picture quality, therefore, is to make sure you can obtain plenty of screen brightness — enough to produce clear highlights in the picture even in the daytime. An abnormally dim screen can be caused by any of the following conditions:

1. Defective low-voltage power supply.
2. Defective high - voltage power supply.
3. Weak horizontal sweep stage.
4. Misadjusted or weak ion trap.
5. Dirt on safety glass and face of picture tube.
6. Low heater voltages throughout receiver.
7. Low emission or other defects in picture tube.

The first three cases all lead to the same end result, a deficiency in high voltage applied to the anode of the picture tube. Even when the high-voltage rectifier is working normally, it will not produce its rated output if it does not receive input pulses of sufficient amplitude. A weak signal at the rectifier cap may be caused by either an ailing horizontal output tube or a defect in the flyback circuit; then again, it may be due to a general "listlessness" of *all* circuits, resulting from lower-than-normal B+ voltage.

You might assume that a poorly-operating horizontal sweep stage would result in a narrow raster as well as in decreased high voltage, but don't count on it. When the value of high voltage goes down, less electromagnetic force is required to deflect the electron beam by a given amount; therefore, full sweep can often be achieved by an abnormally weak yoke-driving signal. This combination of symptoms is related to *blooming,* a change in raster size caused by variations in the value of high voltage.

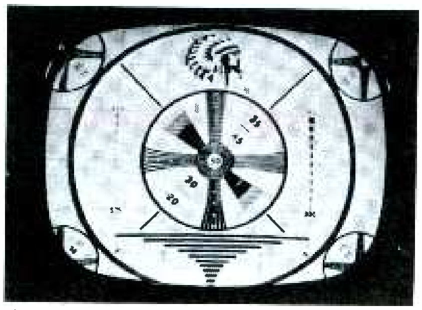


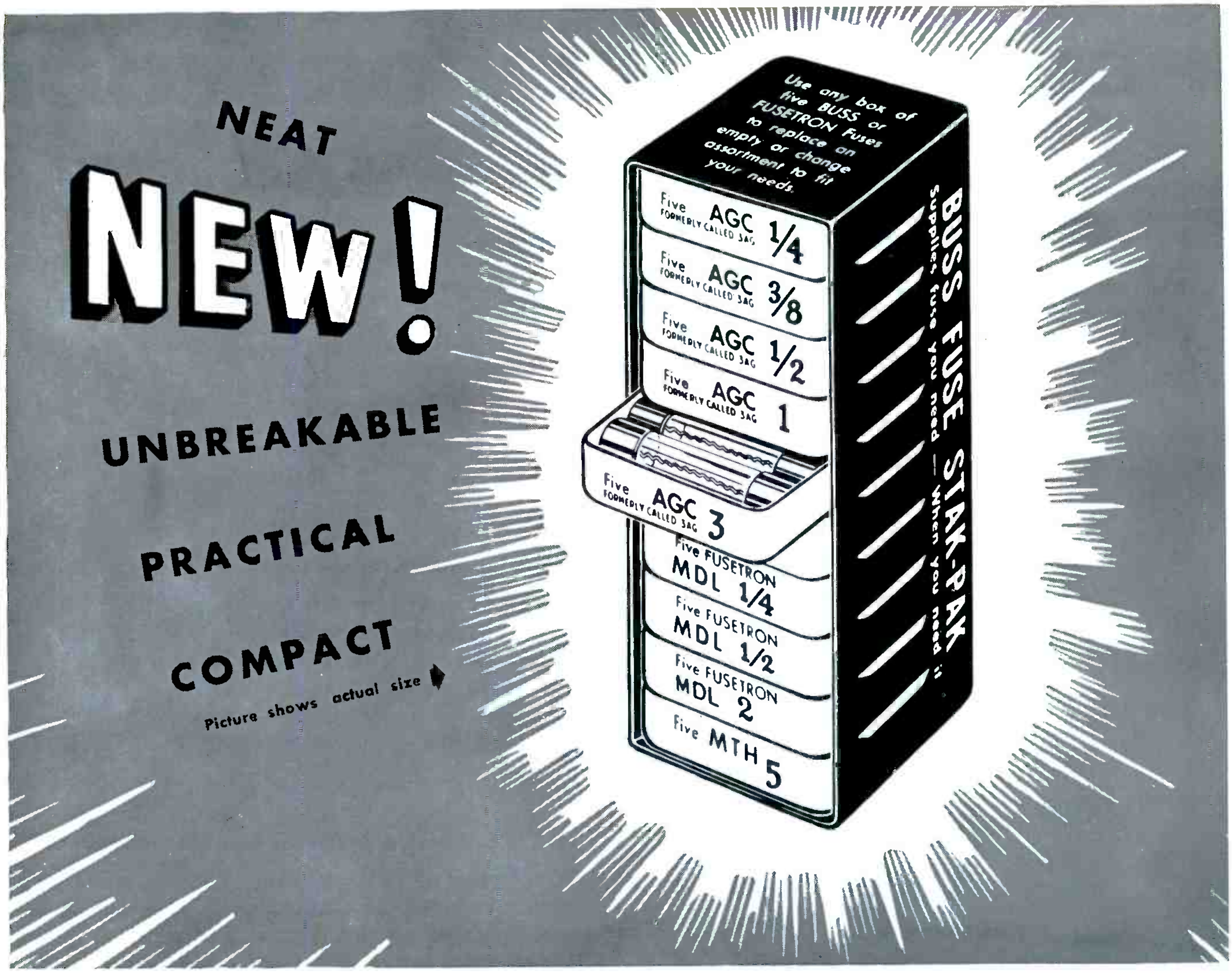
Fig. 1. Excessive contrast causes the TV picture to have harsh appearance.

Ion-trap magnets are on the way out, thanks to the straight-gun, short-neck design of the latest picture tubes; but quite a few of these tricky little gadgets are still at large. They sometimes cause confusion by appearing to give equally good performance at two different positions on the neck of the tube. You might reason that either position is correct; unfortunately, this is not the case. The position *nearer the base* of the tube, well away from the influence of the yoke's magnetic field, is the proper one to utilize. Even if the ion-trap magnet finally comes to rest on the Bakelite base instead of the tube neck, don't worry about it; what really counts is the interaction between the magnet's field and the electron beam, not the location of the trap itself.

A demagnetized ion trap might better be called a picture tube salesman with a spring on it. Before finally condemning a picture tube several years old, it is often advisable to try a substitute magnet; one should be kept on hand for this purpose.

Have you ever been guilty of readjusting the ion-trap magnet to eliminate dark corners in the picture caused by "neck shadow"? When you encounter this problem (Fig. 2), you should rely entirely on the centering adjustments, yoke positioning, and possibly the focusing device, to restore a full raster. The ion-trap magnet should be used strictly for the purpose of obtaining maximum brightness. While adjust-

• *Please turn to page 76*



BUSS Fuse STAK-PAK

An On-the-Job Fuse Assortment
Supplies the Right Fuse When You Need It

The BUSS Fuse STAK-PAK offers the service man a new, convenient way to carry fuses.

It contains fifty of the most popular fuses, in ten different sizes and types. Five fuses to a box, ten boxes in all.

It's NEAT — no loose fuses scattered about in the tool box.

It's COMPACT — the most fuses in the smallest space — takes less space than any other type of assortment.

It's UNBREAKABLE — sturdy metal — not fragile plastic.

It's PRACTICAL — to replace fuses or to change assortments just slide in tray of any BUSS or FUSETRON five-in box.

Serviceman can make assortment fit his local needs

The beauty of the STAK-PAK is that empty boxes can be replaced with same fuses — or assortment can be changed to fit the service-man's local needs.

Never any need for the serviceman to carry a lot of "slow-moving" fuses around with him.

If more fuses are needed the service-man just picks up another STAK-PAK and arranges it to suit himself.

"PICK A PAIR OF STAK-PAKS"

Two Assortments Available to Supply Practically All Service Needs.

Standard Fuse Assortment supplies fuses most in use on popular TV sets. *Order Number SP-1.*

C & N Fuse Assortment supplies the popular sizes of these fuses that are especially designed for TV. *Order Number SP-2.*

While you think of it, make a note to *"pick a pair of STAK-PAKS"* at your distributor.

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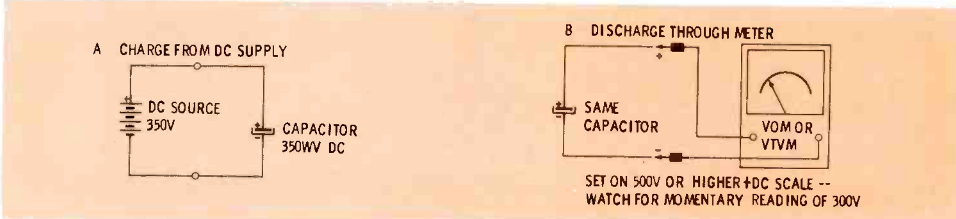
SPECIAL USES FOR YOUR

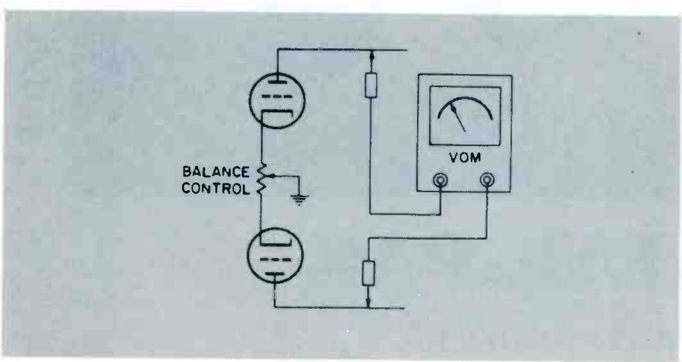
Many of us fail to realize the extent to which we can utilize our everyday servicing instruments because we forget to apply basic theories learned early in our training. To give you a simple example, suppose you want to know the amount of current flowing through a resistor, but you don't want to break the circuit. Why not use a voltmeter and an ohmmeter and put Ohm's law to work?

While the following examples are somewhat more complex in application, they will permit you to make many tests you may not be making now.



To Check an Electrolytic or Large-Value Paper Capacitor for Leakage

Apply working voltage or near working voltage to the capacitor (be sure to observe polarities). Disconnect the voltage source, wait five to ten seconds, and then connect a voltmeter across the capacitor. Note the initial reading of the voltmeter. A good capacitor will initially give practically the same voltage reading as the source. A poor capacitor will give a low or zero initial reading. Note that small-value capacitors cannot be tested satisfactorily because the input resistance of the voltmeter discharges the capacitor too rapidly.



To Check a Push-Pull Amplifier for Balance

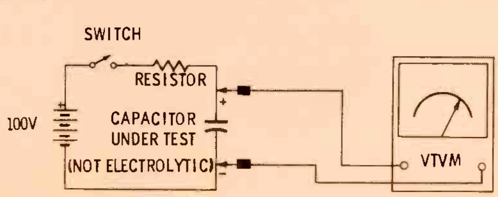
Connect a VOM as shown, and adjust the amplifier balance control (or controls) while observing DC voltage readings. The amplifier is properly balanced when the VOM reads zero. As proper balance is approached, switch the meter to the lowest DC voltage range in order to obtain maximum sensitivity.

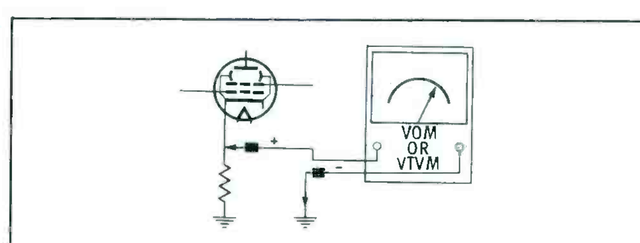
Note: This test cannot be made satisfactorily with a VTVM because both sides of the circuit are "hot"; use of a VTVM requires that one side of the circuit be grounded or at nearly ground potential.

To Measure Capacitance Values with a DC Voltmeter

Connect battery, resistor, and the capacitor under test as illustrated. Close the circuit and note the time required for the capacitor to charge to 63.2% of the battery voltage.

Suppose we use a 100-volt battery in the test. At the end of X number of seconds, the capacitor should have charged to 63.2 volts. We then divide the number of seconds (X) by the value of the resistor to obtain the value of the capacitor. For example, if a 100-volt battery and a 1-megohm resistor require 40 seconds to charge a capacitor to 63.2 volts, the capacitor has a value of 40 mfd. Or, if a 100-volt battery and a 100K resistor require 4 seconds to charge a capacitor to 63.2 volts, the capacitor has a value of 40 mfd. (This test is accurate only for capacitors having high insulation resistance.)

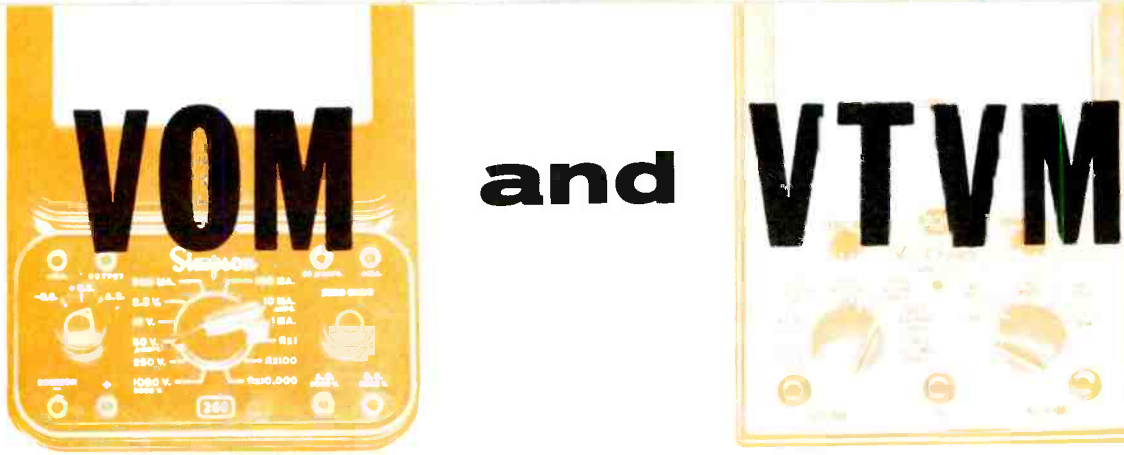




To Measure the Cathode Current of a Horizontal Output Tube

Connect a voltmeter across the cathode resistor of the stage. Adjust the horizontal-drive control for minimum current while maintaining full sweep width without drive lines. Adjust the horizontal-linearity coil for a current dip or for minimum current without distortion. The meter indicates average cathode current. (Tube manuals give maximum ratings for both peak and average currents.) The 6BQ6 is rated for a maximum of 110 ma cathode current; 6CD6, 200 ma; 6DQ6, 140 ma.

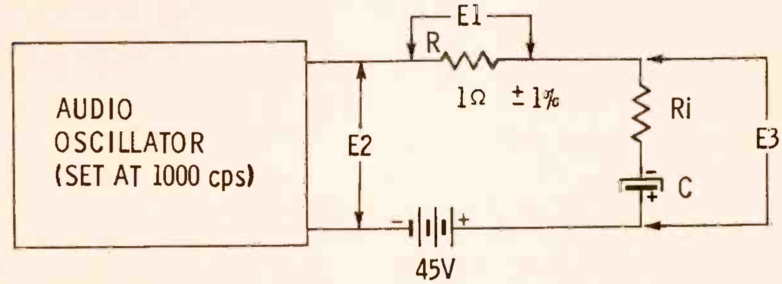
VOM and VTVM

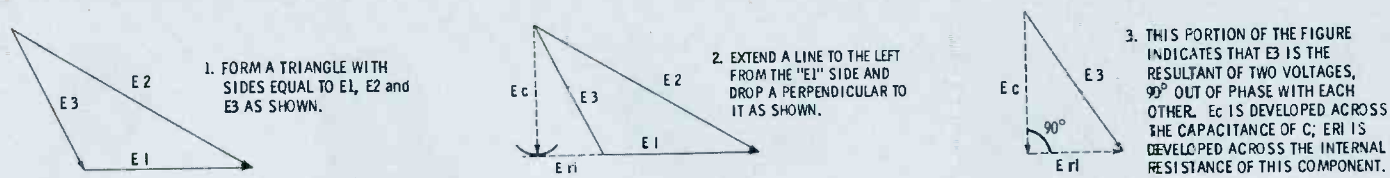


Adapted from the recent Howard W. Sams publication, "101 Ways to Use Your VOM and VTVM" by Robert G. Middleton.

To Measure the Value of an Electrolytic Capacitor

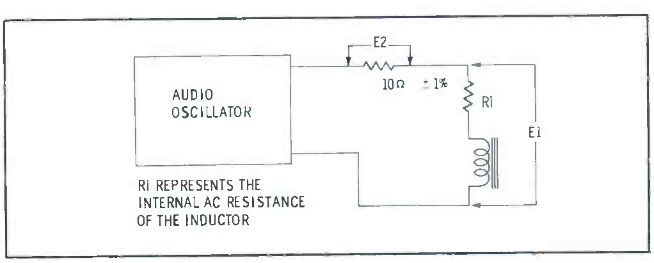
Connect a battery, audio oscillator, and 1-ohm precision resistor as shown. (The 45-volt battery supplies the polarizing voltage.) Set the audio oscillator to 1,000 cps and note the AC voltage readings obtained across the audio-oscillator output, across the resistor, and across the capacitor. Plot a scale drawing as shown, letting a certain length be equal to one volt. The capacitance value is found from the formula: C=E1/6280Ec.





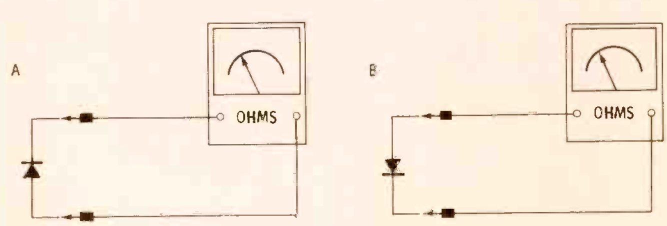
To Check a Semiconductor Diode

Connect an ohmmeter across the diode terminals, and set the range selector for readable scale indication. Observe the reading obtained; then reverse the ohmmeter connections. To obtain the front-to-back ratio, divide the smaller reading into the larger. The most useful evaluation is obtained by comparing the measured front-to-back ratio with that of a same-type diode known to be good, using the same ohmmeter set to the same range.



To Measure the Impedance of an Inductor

Connect a precision 10-ohm resistor and the inductor to be measured in series with the output from an audio oscillator. Adjust the audio oscillator to the desired test frequency, such as 60 cycles, 400 cycles, or 10,000 cycles. Then observe the AC voltage readings across the inductor and resistor separately. The 10-ohm resistor drops 1 volt for each 100 ma of current; consequently, the current equals .1 X E2. The voltage divided by the current gives the impedance of the inductor: Z=E1/0.1E2.



How to choose and use MICROPHONES

For two-way communications, a microphone having high sensitivity and extreme ruggedness is essential. A wide frequency response is not necessary, and reasonable amounts of nonlinearity and noise are not objectionable as long as the message is intelligible; thus, either a carbon or crystal microphone does the job very well.

Recently, ceramic mikes have been developed to the point where they may eventually be used to a greater extent than either the carbon or the crystal type. As to basic construction and operation, the ceramic mike is identical to the crystal type except that a ceramic slab is used instead of the Rochelle salt crystal.

Ceramics are usually made of barium titanate, which becomes piezoelectric after being polarized by a very high electrostatic potential for a few minutes. The dielectric constant of ceramic is higher than that of crystals, and changes very little with temperature or age. (Part of the reason for this is that ceramic materials do not pick up moisture so easily.) Both are high-impedance units, and both cost about the same. Although ceramic mikes have somewhat lower sensitivity, they still have greater output than dynamic, ribbon, or condenser types, and response is smoother than for crystal units.

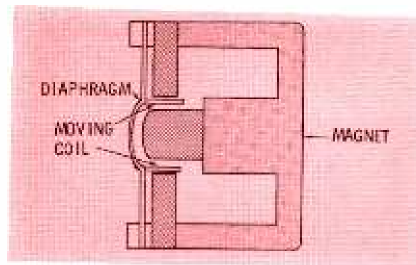
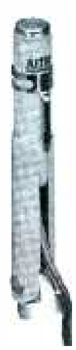


Fig. 1. Dynamic or moving-coil mike is basically similar to a loudspeaker.

Dynamic Microphones

Basic construction of a dynamic, or moving-coil microphone, is shown in Fig. 1. It consists of a coil to which a diaphragm is attached, and mounts on a permanent magnet frame. As sound waves strike the diaphragm, both it and the coil move back and forth. As the coil moves in the magnetic field, signal voltages corresponding to the sound waves are created by induction. Signal out-


Altec Model M20—condenser
Frequency response: 20-15,000 cps
Output level: -59, -53, -49, -44 db
Impedance: 30/150/600/10K ohms
Pickup pattern: omnidirectional


American Model D-12—dynamic
Frequency response: 70-12,000 cps
Output level: -57 db
Impedance: low or high
Pickup pattern: omnidirectional

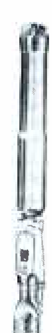

American Model D-10—dynamic
Frequency response: 50-11,000 cps
Output level: -57 db
Impedance: 50 or 40K ohms
Pickup pattern: omnidirectional


Argonne Model AR-3—dynamic
Frequency response: 80-10,000 cps
Output level: -70 db
Impedance: 50K ohms
Pickup pattern: omnidirectional


Argonne Model AR-309—dynamic
Frequency response: 50-11,000 cps
Output level: -55 db
Impedance: 50K ohms
Pickup pattern: omnidirectional


Astatic Model D-104—ceramic
Frequency response: 30-7,500 cps
Output level: -47 db
Impedance: high
Pickup pattern: cardioid


Astatic Model M-150
Frequency response: 30-10,000 cps
Output level: -44 db
Impedance: high
Pickup pattern: semidirectional


E-V Model 636—dynamic
Frequency response: 60-15,000 cps
Output level: -55 db
Impedance: 150 ohms or high
Pickup pattern: omnidirectional


E-V Model 926—crystal
Frequency response: 60-8,000 cps
Output level: -60 db
Impedance: high
Pickup pattern: omnidirectional


RCA Model BK-1A—dynamic
Frequency response: 60-10,000 cps
Output level: -52 db
Impedance: 30, 150, or 250 ohms
Pickup: non- or semidirectional

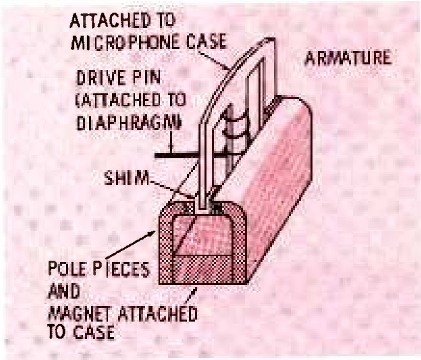


Fig. 2. Diaphragm is connected to center leg of armature in magnetic mike.

put is obtained from leads connected to the ends of the coil.

Dynamic mikes resemble loudspeakers in both operation and construction. (In fact, an ordinary speaker doubles as a microphone in some communications systems.) The moving coil is most often made of aluminum to reduce weight and thus improve sensitivity and response. The diaphragm is metallic, so its over-all construction makes it rugged and able to withstand extremes of temperature and humidity. It also has good response and fairly high sensitivity, making it an excellent choice for any except the most exacting applications.

Dynamic mikes are low-impedance units, often 50 ohms, which is an advantage where a long connecting cable is necessary, or where high-frequency losses and noise pickup are important factors.

Essentially, dynamic units are nondirectional when pointing upward, but they become directional when positioned as in Fig. 1. This behavior affords some degree of flexibility in directional characteristics. Furthermore, with proper case design, a cardioid response pattern can be obtained.

Dynamic mikes can be used to replace crystal units when certain characteristics are desired. Direct replacement, however, even with a matching transformer, usually results in "bassy" response. Response of crystal mikes is governed by the size of the loading resistor, and in order to extend the low-frequency response, a grid resistor of one megohm or larger must be used. However, value of the grid resistor has virtually no effect on the response of a dynamic mike. The "bassy" quality can be decreased by using a coupling capacitor between the mike and the grid input. Response at low frequencies is reduced as the size of this capacitor is increased; and while the nominal value is usually about 1,000 mmf, trial and error may produce best results.

The recently developed magnetic or variable-reluctance mike, which has a stationary coil, is quite similar to the dynamic type. Signal is induced into the coil by changing the reluctance of the magnetic circuit. The coil is wound around the center leg of an armature which is attached, at the top, to the frame of the unit. A drive pin connects the center leg to the diaphragm as shown in Fig. 2. The outer legs of the armature are spaced equidistant between the poles of the magnet, and are held in place by nonmagnetic shims. When the diaphragm is at rest, the center leg of the armature is also held midway between the pole pieces. Therefore, the magnetic lines from north to south pole follow a path directly across the gap through the ends of all the legs. The pressure of a sound wave causes the center leg of the armature to move toward the north pole piece. This causes a concentrated flow of magnetic lines through

• Please turn to page 81

RCA Model 77-DX—ribbon
Frequency response: 50-15,000 cps
Output level: -53 db
Impedance: 30/150/250 ohms
Pickup pattern: polydirectional

Reslo "Avon"—ribbon
Frequency response: 20-15,000 cps
Output level: -58 db
Impedance: low, medium, or high
Pickup pattern: super-cardioid

Reslo "Symphony"—ribbon
Frequency response: 18-15,000 cps
Output level: -58 db
Impedance: low, medium, or high
Pickup pattern: bidirectional

Ronette Model B110—
Frequency response: 30-13,000 cps
Output level: -55 db
Impedance: high
Pickup pattern: semidirectional

Ronette "Ronomike"—crystal
Frequency response: 30-10,000 cps
Output level: -55.4 db
Impedance: high
Pickup pattern: semidirectional

Shure Model 55S—dynamic
Frequency response: 50-15,000 cps
Output level: -54, -55, -57 db
Impedance: 30-50/150-250/35K
Pickup pattern: ultra-cardioid

Shure Model 315—ribbon
Frequency response: 50-12,000 cps
Output level: -59, -60, -57 db
Impedance: 30-50/150-250/high
Pickup pattern: bidirectional

Telex Model 100—dynamic
Frequency response: 50-5,000 cps
Output level: -52 db
Impedance: 10 ohms
Pickup pattern: omnidirectional

Turner Model 201C—ceramic
Frequency response: 60-10,000 cps
Output level: -60 db
Impedance: high
Pickup pattern: nondirectional

Turner Model 250—dynamic
Frequency response: 100-10,000 cps
Output level: -54 db
Impedance: high
Pickup pattern: omnidirectional

USING A Scope

We all know the guy who's convinced he's better than the design engineer, or who simply gets tired looking for the trouble and tries a few part substitutions to "compensate" for the circuit difficulty. Unfortunately, the real fault still remains and, although a repair seems to be effected, after three or four callbacks everybody is in a stew. The usual result is the serviceman loses not only time and money, but the customer as well.

I had two of these circuit substitution jobs in the shop recently. One—a power supply problem—wasn't too difficult once I put the DC scope to work. The second case was much more stubborn, since the condition was intermittent, and evaluation of waveforms and DC voltages weren't at all conclusive. In this instance, there was nothing to do but dig until I had located the fault.

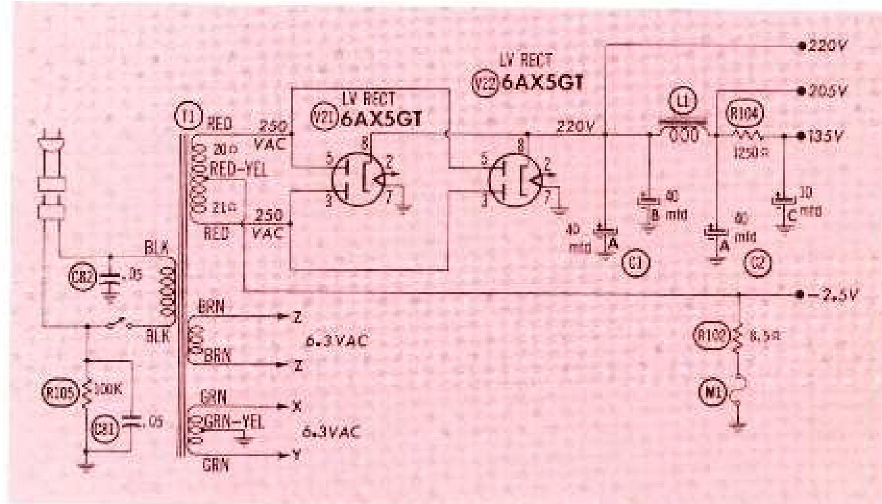


Fig. 1. Power-supply circuit used in the Emerson 700 series TV receiver.

Emerson Series 700

This receiver was brought in with an intermittent horizontal-hold condition and insufficient width. I was told by the customer that all tubes had been checked and that I wouldn't find any bad ones because she had just paid $35.00 in a neighboring town to have the receiver put in A-1 condition. She was sure her present difficulty was "just some little thing." I immediately asked if she was willing to have the set carefully gone over and thoroughly repaired, since "little things" usually add up to a considerable amount when reconditioning begins in earnest. She hesitated for a moment and then, *because I had handled her mother's set for 7 years,* agreed.

Six tubes, four capacitors, and three resistors later, I felt the horizontal oscillator could now stand a scope alignment, and that the receiver was in reasonably good operating condition. Sure enough, the circuit responded—as any good pulse-width horizontal oscillator will—to careful alignment, and the receiver seemed ready to go. One look at the picture, however, immediately convinced me otherwise. There was a tell-tale 120-cycle ripple, and, although the oscillator stayed in sync through complete rotation of the horizontal-hold control, the figures on the screen writhed slowly like a hypnotized cobra. Looking at the schematic (Fig. 1), I noted the power supply consisted of dual 6AX5 rectifiers in a full-wave rectifier circuit. A small negative voltage is taken from the center tap of the power transformer to supply grid bias for the video output tube. Taking a quick check of DC supply voltages, the 205-volt supply seemed to be missing; only the 220 and 135-volt sources remained. Using the oscilloscope, I investigated the signal available at the 205-volt source. The waveform looked like that in Fig. 2—approximately 4 volts of miserable, weaving 120-cycle ripple.

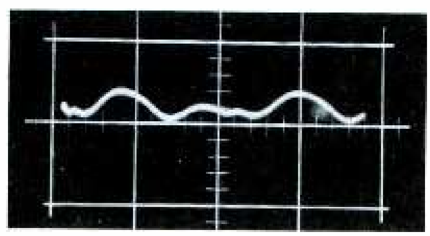


Fig. 2. Waveform at the 205-volt source had 120-cycle ripple, 4 volts p-p.

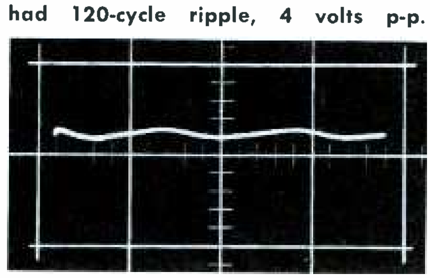


Fig. 3. Normal appearance of the signal waveform on 205-volt supply line.

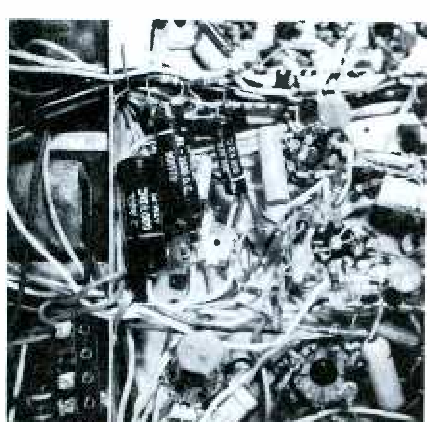


Fig. 4. Appearance of the Olympic vertical circuit when brought to the shop.

My first thought was of open filter capacitors, but then I realized they couldn't be at fault since the 220-volt supply was okay. Looking again at the schematic, I decided to trace across L1. Here, indeed, was the trouble. In trying to relieve this receiver of 60-cycle ripple, caused by heater-to-cathode leakage in the sync separator tube, the out-of-town

FOR TV TROUBLESHOOTING

by Stan Prentiss

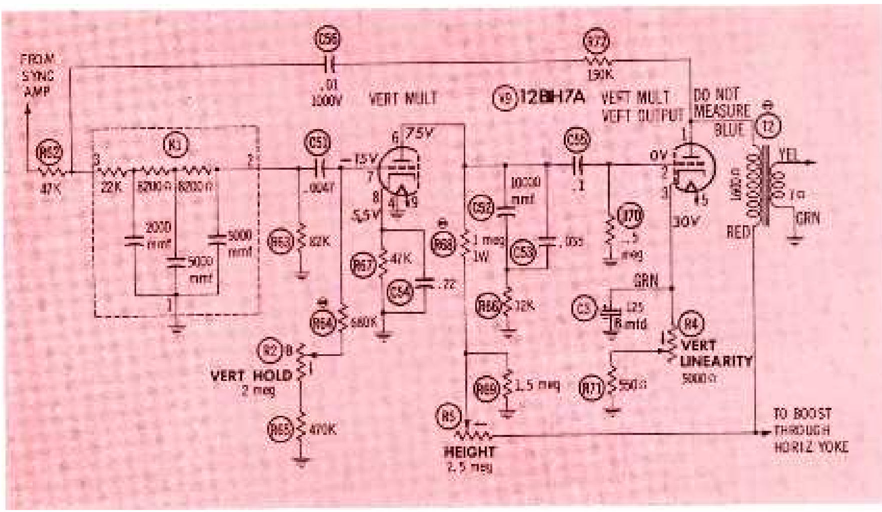
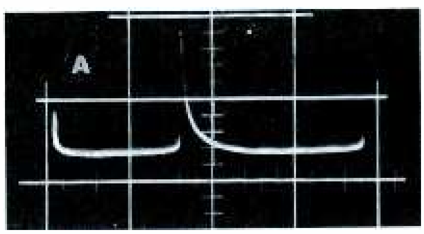


Fig. 5. Schematic of the vertical multivibrator used in the Olympic GD chassis.

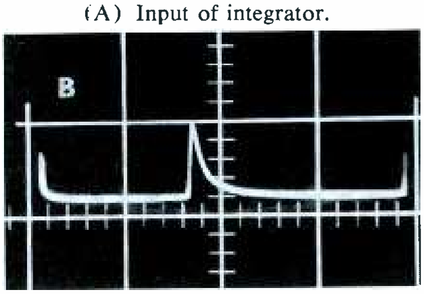
shop had disconnected R104 from the output end of the choke and tied it securely to C1B. Without L1 in the circuit, the ripple was at least four times what it should have been (see Fig. 3). Of course, after simple reconnection, everything returned to normal. Mr. Emerson 700 was working well again.

Olympic Chassis GD

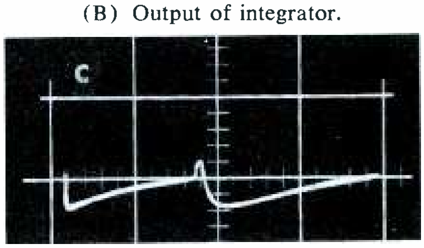
This was a bit of an odd-ball to begin with since I couldn't find the model number. It was in an ornate Chinese black-lacquer cabinet, and the only clue I had to follow was the "GD" chassis. Fortunately, it was conveniently listed in the PHOTOFACT index, and I was able to begin hunting for the receiver breakdown without further difficulty. The fault was in the vertical circuit, and as shown in Fig. 4, it was easy to see what had gone before. The .01-mfd, 1600-volt buffer and the .004-mfd capacitor immediately made me suspicious. Buffers are relatively expensive oil-filled capacitors, and really have no place in this circuit. The .004-mfd unit is an odd value not often used these days; .0047 mfd is the regular off-the-shelf value. The third capacitor, a .1 mfd, was obviously a recent replacement because of its overly large size and shiny black case.



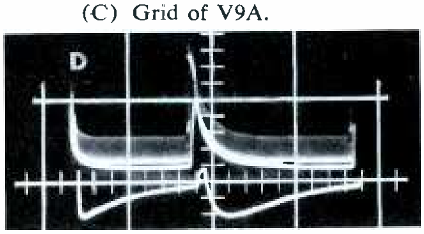
(A) Input of integrator.



(B) Output of integrator.



(C) Grid of V9A.



(D) Simultaneous display.

Fig. 6. Signal waveforms at multivibrator input before repairs were made.

The customer complained the receiver would operate for a period and then flip, losing vertical sync. The vertical-hold control would produce picture lock-in at only one extreme setting. On making further receiver-to-schematic comparisons, I traced the entire vertical multivibrator circuit (Fig. 5). In addition to C51 having been changed, grid resistor R64 was 470K instead of 680K, and voltage-divider R65 off the end of the vertical-hold control was missing entirely (the control went directly to ground). These changes affected the conduction time of V9A. The buffer had replaced C56, the 1000-volt feedback capacitor from the plate of V9B.

The problem now was twofold: Return the circuit to normal by installing the proper value components, and discover the original cause of the trouble. After inspecting the video-amplifier and sync-circuit waveforms for both shape and amplitude and finding them to be normal, I knew the difficulty had to be confined to the vertical multivibrator itself. To preserve them for possible use in this column, I photographed the three waveforms at the junction of R62 and K1 (the input of the integrator network), the junction of R63, C51 (the end of the integrator network), and the grid of the vertical multivibrator. These are all shown in Fig. 6. I also recorded the waveforms at the plate and cathode of the vertical multivibrator (Fig. 7). Then I replaced C51, C55, C56, R64, and R65 with the components listed on the schematic.

Now came the unpleasant task of uncovering the real culprit. At this point, I knew approximately where the trouble was located. It had to be in the feedback circuit from the output plate of V9B, or in the DC supply to the plate circuit of V9A. Checking at the arm of height control R5, I found adequate boost voltage, and the plate voltage of 75 volts was well within the allowable tolerance. Next, I checked the tube

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Kit WV-77E(K)
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FREE when you purchase 425 RCA Tubes*
WEATHERPROOF
LANTERN
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(a new one) in a reliable tube checker and found adequate Gm and no interelement leakage. Now there was only one promising suspect left, and that was the vertical hold control (Fig. 8). I unsoldered both R64 and R65 and checked the control with an ohmmeter. Instead of the rated value of 2 megohms, the control had risen to more than 2.5 megohms and apparently was headed even higher.

Now, this may not seem like much of a change, but remember that the value of the control was measured when it was cold. I suspect that as the set warmed up, the small current through the control further increased its value and changed the triggering time of the multivibrator. It could have been that the old vertical multivibrator tube had a grid-to-cathode short which damaged the hold control (since it returned directly to ground in the modified circuit). At any rate, the control was the underlying cause that undoubtedly prompted replacement of the various grid and plate components of V9.

Note the small difference between the waveforms of Figs. 6 and 9. Other than being a little sharper and cleaner, the "afters" are essentially the same in shape and amplitude as the "befores." On the other hand, there's a more noticeable difference between the waveforms of Figs. 7 and 10. The cathode waveform is about the same; however, the plate waveform not only became sharper and better formed, but also changed its DC level. The moral to this story is that there are times when you have to keep digging until you've located whatever has been causing the fault. In borderline cases like this, I've sometimes been forced to check every capacitor and resistor in the circuit until I found the offender. Remember, however, that you must first localize the difficulty to a single circuit, so you won't spend needless time on sections that are in good working order. This is why the shapes and amplitudes of waveforms are so important.

You must be sure there is no clipping or amplitude loss of the incoming sync information before tackling the oscillator. Thereafter, it's simply a question of locating the defective component or components by standard voltage, resistance, and capacitance checks. ▲

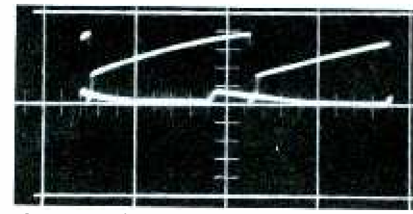


Fig. 7. Multivibrator plate and cathode signals before repairs were completed.

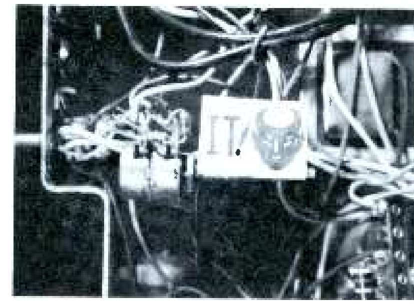
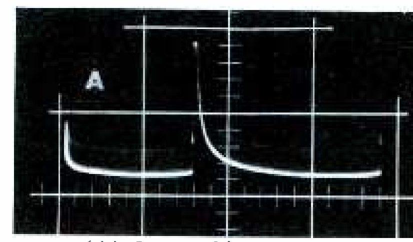
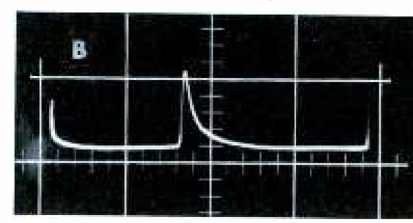


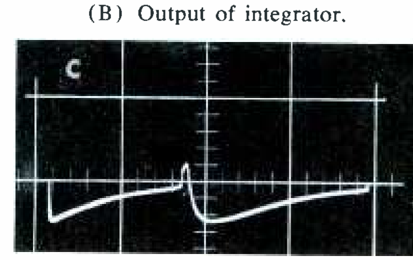
Fig. 8. No more devil horns for this dilemma. "IT" was a bad hold control.



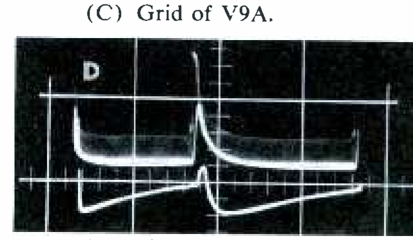
(A) Input of integrator.



(B) Output of integrator.



(C) Grid of V9A.



(D) Simultaneous display.

Fig. 9. Signal waveforms at the multivibrator input after repairs were made.

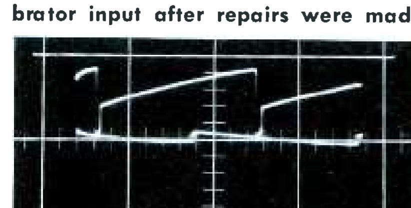
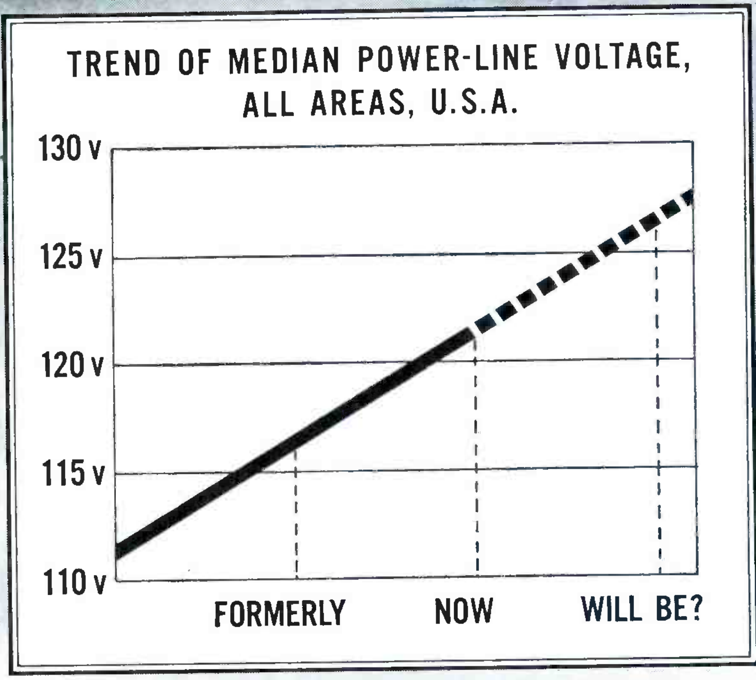
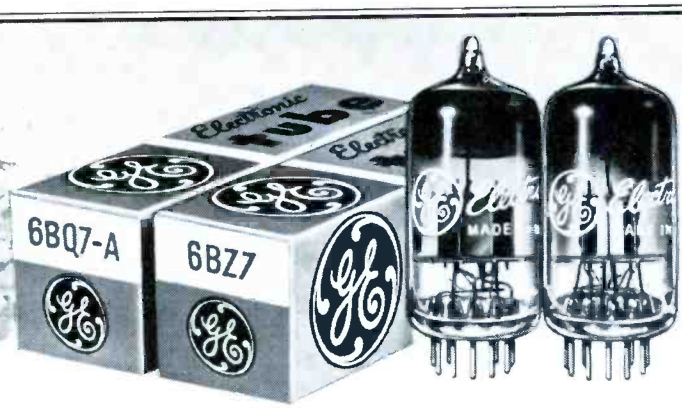


Fig. 10. Multivibrator plate and cathode signals after repairs were made.





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The vertical linearity is in poor shape on an Emerson Chassis 120123-B. The bottom of the raster looks about normal, but the top is stretched so far that the test pattern looks like an egg standing on end. Checking with a VTVM, I found only -2 volts on the grid of vertical output tube V12 instead of the normal -6 volts. When I started hunting for the lost voltage, I found readings of +7 and +6 volts at pins 8 and 7 of the first video amplifier tube V7B. PHOTOFACT Set 109, Folder 3 calls for -1.5 and -1.9 volts at these pins. Are the PHOTOFACT readings correct? The circuit of V7B looks as if it would normally operate with slight positive voltages on the grid and cathode.

LES EASTEP
Springfield, Ill.

You were hot on the trail of the defect when you measured the voltages on V7B, but you were probably misled by the polarity markings on C6. The top plate of this capacitor is positive with respect to the bottom plate, but not with respect to ground. The vertical output and video amplifier stages, as well as the audio output tube, receive their bias voltage from a B- power supply which operates independently of the B+ rectifier. Since this circuit is not labeled as such on the schematic, and is seldom seen in newer receivers, you probably didn't recognize it.

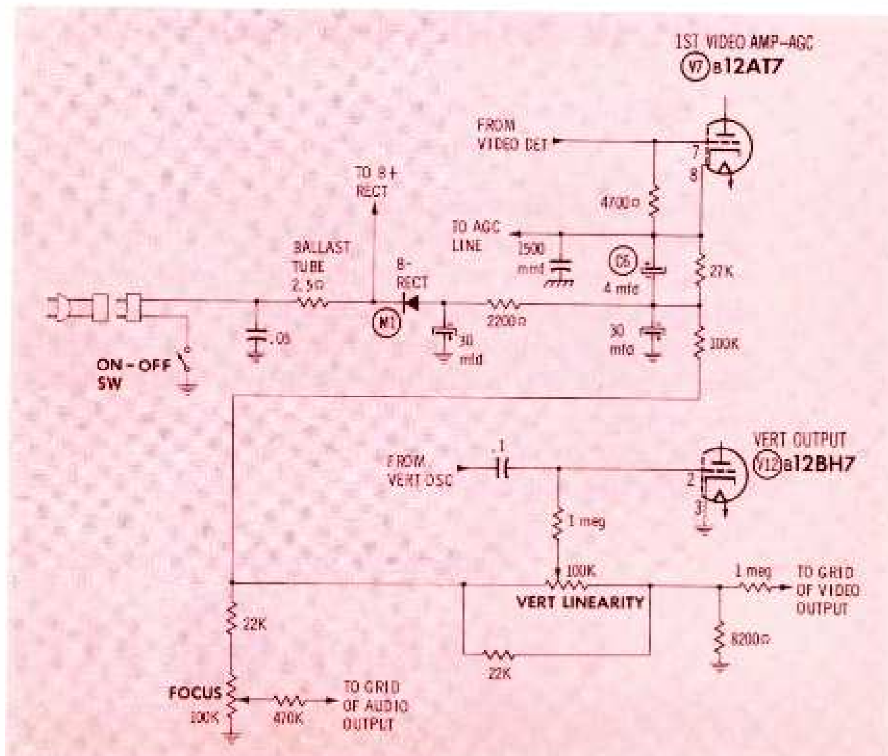
Failure of the B- rectifier M1 or its related filter components would remove the negative bias voltage from the above-mentioned stages. Since the AGC system is also tied into the B- network, be on the lookout for any defect which might neutralize B- by placing a positive voltage on the AGC line.

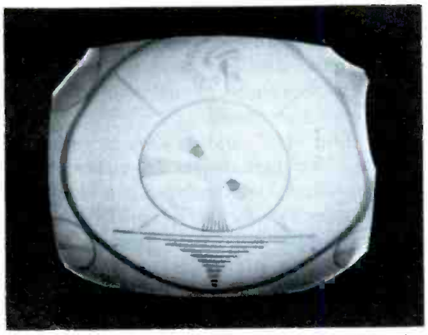
Mice?

When a General Electric Model 17T15 is turned off for a few seconds and then switched back on, the raster takes 10-15 seconds to expand all the way into the corners of the screen. It has a scalloped appearance at first, and the light gradually "crawls" out to fill the corners.

A. L. PAYNE
Arlington, Texas

Under some conditions, a negative elec-





trostatic charge is produced on the internal aquadag coating of the picture tube by the collapse of high voltage when the set is turned off. If this charge is still present when the receiver is turned on again, the electron beam will be repelled as it tries to approach the edges of the screen; thus, you will see scalloped corners in the raster. This effect is not serious, since the charge is harmlessly dissipated by operation of the high-voltage rectifier within a short time.

Poor contact between the outer aquadag coating and the CRT grounding spring has been known to cause this symptom. You might try repositioning the spring or "repainting" any defective spots in the coating. If the scalloped effect persists, you might consider the possibility that some of the internal aquadag coating has flaked off and left certain areas isolated from the high-voltage supply. A negative charge would tend to remain on such isolated areas for a long time after the set is turned off. The latter condition could be cured only by replacing the CRT, but a tube old enough to develop this defect is probably ready for replacement anyway.

New Scene—No Sync

I have an RCA Chassis KCS83 which loses horizontal sync only on commercials or on camera changes at the studio. Somewhere in PF REPORTER, as I recall, there is an article on this subject; but I can't find it. Can you help me out?

G. H. RAYBORN

Nocatee, Fla.

You are probably referring to an item in this column in the September, 1958 issue. That hint would not be of any direct help to you, since it referred to multivibrators instead of the pulse-width type of circuit employed in your set.

The most likely cause of unstable sync in an RCA receiver is misalignment of the horizontal frequency, waveform, and locking-range adjustments. Try going through a realignment of the sweep section before getting involved too deeply in other circuit tests. If this touch-up doesn't help the situation, one of the following faults may exist:

1. The natural frequency of the oscillator could be far enough from 15,750 cps to be almost at one end of the AFC control range. One symptom of this condition would be an excessively high or low cathode voltage on the AFC tube. The most probable cause would be an off-value or defective component in the oscillator grid circuit.

2. *The AFC stage itself could be defective. A thorough check of voltages, waveforms, and resistances would probably be necessary to uncover the exact source of the trouble.*

3. *The AFC input signals might be faulty. This idea could be either proved or disproved by examining the shape and amplitude of the AFC grid waveform with a scope, and then proceeding to a study of the oscillator plate and sync-amplifier stages if necessary.*

This Doubler Is Full-Wave

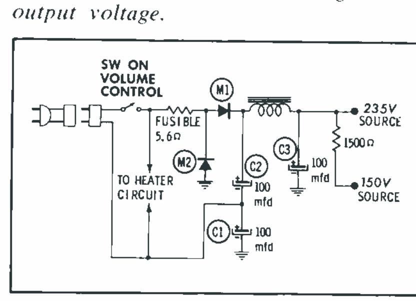
I'm having trouble understanding the operation of the low-voltage power supply in the Truetone Model 2D2312A. Although I can tell it's some kind of voltage doubler, I'm wondering how much it differs from the circuit which has an input capacitor wired between the fusible resistor and the junction of the two rectifiers.

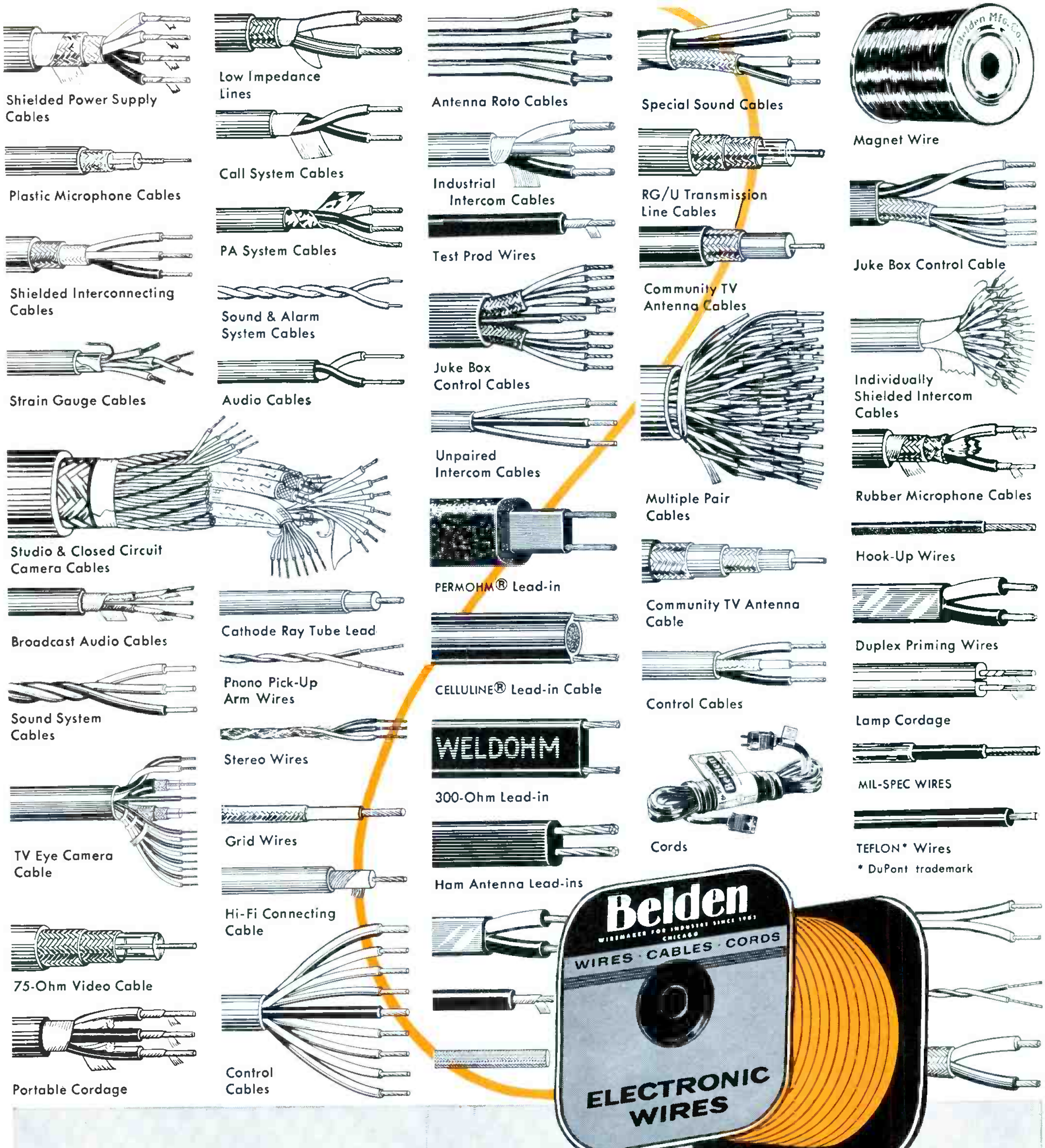
EDWARD J. GOMEZ
St. Bernard, La.

The circuit in question is a full-wave doubler. This arrangement, which has not been too widely used in TV power supplies, is definitely different from the common half-wave voltage doubler; however, its operation is not difficult to understand. Here is a brief account of the action which occurs when AC line voltage is fed to the circuit:

On the first half-cycle of AC input, when the upper prong of the line plug is negative with respect to the lower one, M2 conducts. AC current passes through the fusible resistor, down through M2 to ground, and back up through C1 to the other side of the line. As a result, C1 is left charged (in the polarity shown) to almost the peak value of the line voltage. On the next half-cycle of AC, current enters through the lower prong of the line plug, passes up through C2, proceeds through M1 (which conducts at this time), and returns through the fusible resistor to the AC line. This second half-cycle of operation charges C2 to nearly the peak value of the line voltage. The charges on C1 and C2 are maintained by alternate conduction of the rectifiers on following cycles of AC, and an output voltage is tapped off across the charged capacitors in series. Under no-load conditions, the output of the circuit is about 300 volts; with load, it declines to as low as 225 volts.

Full-wave doubler circuits frequently include a transformer between the AC line and the rectifiers. Besides isolating the AC line from chassis ground, this transformer usually provides a slight step-up which results in a higher DC output voltage.





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8-3-9

STOCK GUIDE
for tv tubes

The tube types listed on this page should account for well over 90% of your tube stock requirements. To keep the chart down to a manageable size, nearly 100 of the rarest type numbers have been omitted; however, we will keep you informed on these rare types and where they are found. Look for this information in *Previews of New Sets,* and also in special coverages like the article "Keeping Posted on TV Tubes" in the June, 1959 issue.

Two columns of figures are listed along with the type numbers in the chart. The first column is purely a matter of statistics. Here's the meaning of the figures: If you took a cross-section sampling of 1,000 tubes from all TV sets now in service, you could expect to find the stated number of tubes of each type in this sample. (To avoid omitting many types which are only moderately popular, we have listed a figure "1" for each type with a usage frequency of at least once per 2,000 sockets.)

This column of figures, as it stands, is naturally not a suggestion to stock the exact number of tubes listed. The statistics should be combined with your own experience to produce information tailor-made to your own needs. Here are three factors to be considered:

1. Relatively high failure rate of certain types such as cascode RF amplifiers and power output tubes.

2. Specialization in certain makes of sets, such as regional brands. (As a national publication, PF REPORTER necessarily gives nationwide averages based on all brands of receivers.)

3. Average age of those sets which contain a particular tube type.

The second column of figures marked "Caddy Stock" is a suggested stock of 350 tubes to be carried on home calls—either in two medium-size caddies or one "king-size" caddy. This list attempts to strike a balance between having enough different types and having a sufficient stock of widely-used types to meet most contingencies.

Keep yourself informed of trends toward increased or decreased use of various tube types. This is easy to do by comparing the current *Stock Guide* with previous editions, which appear in the April and October issues.

*Note: *indicates a 450-ma series-string tube.*

TUBE TYPE	USE PER 1,000	CADDY STOCK	TUBE TYPE	USE PER 1,000	CADDY STOCK	TUBE TYPE	USE PER 1,000	CADDY STOCK	TUBE TYPE	USE PER 1,000	CADDY STOCK	TUBE TYPE	USE PER 1,000	CADDY STOCK
1AX2	1	1	5CZ5	1	1	6BH8	2	1	6CY7	1	1	*9AU7	1	1
1B3GT	38	6	5EA8/5U8	1	1	6BK5	2	1	6CZ5	2	1	9BR7	1	1
1G3GT	4	1	5J6	1	1	6BK7A/-B*	7	2	6DA4	1	1	10DE7	2	1
1J3	2	1	5T8	2	1	6BL7GT	4	2	6DB5	1	1	12AF3	1	1
1K3	1	1	5U4GB	38	6	6BN4	2	1	6DE6	4	1	12AT7	7	4
1S2A/DY87	1	1	5U8	6	3	6BN6	7	2	6DE7	1	1	12AU7/-A	24	6
1V2	1	1	5V3	1	1	6BN8	1	1	6DG6GT	1	1	12AV5GA	1	1
1X2A/-B	9	4	5X8	1	1	6BQ5/EL84	1	1	6DK6	1	1	12AV7	1	1
2BN4	2	1	5Y3GT	2	2	6BQ6GT/-B	14	3	6DN7	1	1	12AX4GTA	8	3
2CY5	2	1	6AB4	1	1	6BQ7A	13	5	6DQ6A	9	4	12AX7/ECC83	4	2
3A3	1	1	6AC7	3	1	6BR8A	1	1	6DS5	1	1	12AZ7A	1	1
3AL5	1	1	6AF3	1	1	6BS8	1	1	6DT5	1	1	12B4A	1	1
3AU6	4	2	6AG5	4	2	6BU8	3	1	6DT6	4	2	12BH7/A	10	3
3BC5	1	1	6AG7	1	1	6BW8	1	1	*6EA8/6U8A	2	1	12BK5	1	1
3BN6	3	2	6AH4GT	2	1	6BX7GT	1	1	6EB8	1	1	12BQ6GTB	1	1
3BU8	3	2	6AH6	4	2	6BY6	3	2	6EM5	1	1	12BR7	1	1
3BZ6	15	4	6AK5	2	2	6BY8	1	1	6ER5	1	1	12BY7/-A	11	3
3CB6	11	3	6AL5	44	4	6BZ6	13	4	6EW6	1	1	12C5/-CU5	3	1
3CS6	2	2	6AM8/-A*	4	1	6BZ7	3	2	6FV6	1	1	12CA5	2	1
*3CY5	1	1	6AN8/-A*	5	2	6C4	5	2	6J5	2	1	12CU6	1	1
3DK6	1	1	6AQ5/-A*	18	4	6CB6/-A	94	9	6J6	16	4	12D4	2	1
3DT6	4	2	6AR5	1	1	6CD6GA	2	2	6K6GT	5	2	12DB5	2	1
4BC8	2	2	6AS5	2	1	6CF6	3	1	6S4A	1	1	12DQ6A	8	4
4BQ7A	2	2	6AS8	1	1	6CG7	25	6	6SL7GT	1	1	12DQ7	1	1
*4BU8	1	1	6AT6	2	1	6CG8/-A*	3	2	6SN7GTB	48	8	12DT5	1	1
*4BZ6	1	1	6AT8/-A*	2	2	6CH8	1	1	6SQ7	2	1	12L6GT	3	2
*4CB6	1	1	6AU4GTA	6	2	6CK4	1	1	6T8	11	3	12R5	1	1
*4CS6	1	1	6AU6/-A	72	6	6CL6	2	1	6U8/-A*	16	6	12SN7GTA	2	2
*4DT6	1	1	6AU8	3	2	6CL8/-A*	1	1	6V3A	1	1	12W6GT	1	1
5AM8	2	1	6AV5GA	2	2	6CM6	1	1	6V6GT/-A*	11	3	*13DE7	1	1
5AN8	1	1	6AV6	11	3	6CM7	4	2	6W4GT	13	2	*17D4A	1	1
5AQ5	5	2	6AW8A	12	4	6CN7	2	1	6W6GT	8	2	*17DQ6A	1	1
5AS4	1	1	6AX4GTA	15	6	*6CQ8	3	1	6X8	6	2	19AU4GTA	3	2
5AT8	2	1	6AX5GT	1	1	6CS6	3	2	6Y6G	1	1	25AV5GA	1	1
5B8	1	1	6BA6	5	2	6CS7	1	1	7AU7	3	2	25AX4GT	1	1
5BK7A	1	1	6BA8A	2	2	6CU5	1	1	*8AW8A	1	1	25BQ6GTB/		
5BR8	1	1	6BC5	4	2	6CU6	2	4	8BQ5/XL84	1	1	-CU6	3	2
5CG8	3	2	6BC8	2	2	*6CU8	1	1	*8CG7	1	1	25CD6GB	1	1
5CL8	2	1	6BE6	4	2	6CX8	1	1	8CX8	1	1	25DN6	1	1
5CQ8	1	1	6BG6GA	3	2	6CY5	1	1	8EB8	1	1	25L6GT	3	2

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WHY TEST TUBES IN THE HOME?

by Calvin C. Young Jr.

The question, "Why test tubes in the home?" was unresolved in my own mind until I had spent several weeks using a tube tester on home service calls. This article is a result of the experiences I had during this test period.

In my opinion, all service calls should be made according to a three-step plan. The first involves carefully questioning the customer about the failure and the exact nature of the complaint. A lot of helpful information can be obtained by so doing, especially if you make it a practice to carefully analyze the comments made by the customer. The second step is to apply power (unless the customer's comments dictate otherwise) and note the effect on the trouble symptoms when adjusting the various controls associated with the "afflicted" section of the set. Armed with this information, I now either check or make substitutions for the tubes in the malfunctioning circuit.

When to Check and When to Substitute

Tests of certain tube types will not always yield conclusive results. For instance, some power rectifiers are required to pass 250 ma or more in normal service, and, if the tester checks them with a load of 100 ma or less, any such test is inconclusive. Likewise, horizontal-output and damper tubes are required to operate under high-pulse voltage conditions, and few testers generate these pulse voltages. For these reasons, I prefer to check suspected power rectifiers, dampers, power amplifiers, and high-voltage rectifiers by substitution—even when my tester gives them a clean bill of health.

If a trouble symptom points to a possible defect in the video, audio or sync portions of a TV receiver (and this includes the tuner and IF sections), a good tube tester is most helpful. Tube substitution usually proves to be more time-consuming than running tests. If the tester is of the multiple-socket type, it is possible to check all of the aforementioned tubes in a very short time.

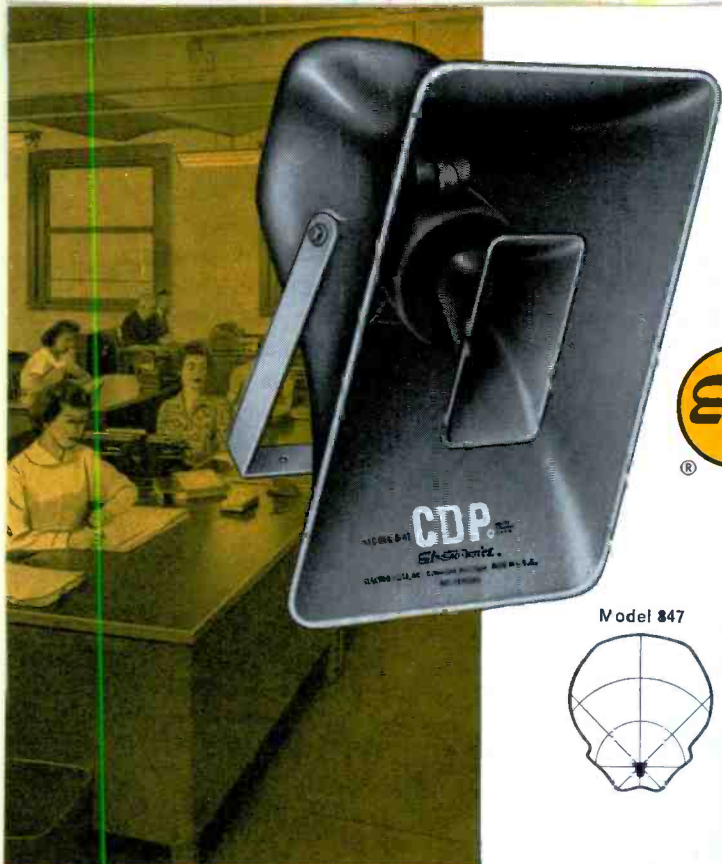
How to Test Tubes

Tube testing in the home can be helpful only if the tubes are tested correctly. In fact, failure to do a complete job of testing (and accurately evaluate the results) will lose time instead of saving it. For instance, a value test alone is of almost no benefit. Shorts, leakage and gas are the most troublesome defects; therefore, prime requisites in any tube tester are provisions for sensitive shorts-leakage tests and accurate gas-content checks.

Tube testing in the home should be performed according to the following sequence (and this is in order of importance):

1. Shorts
2. Interelement leakage
3. Gas content
4. Gm or emission
5. Loose elements

The test for the last condition should be made during the value test. If the tube is tapped with a pen-



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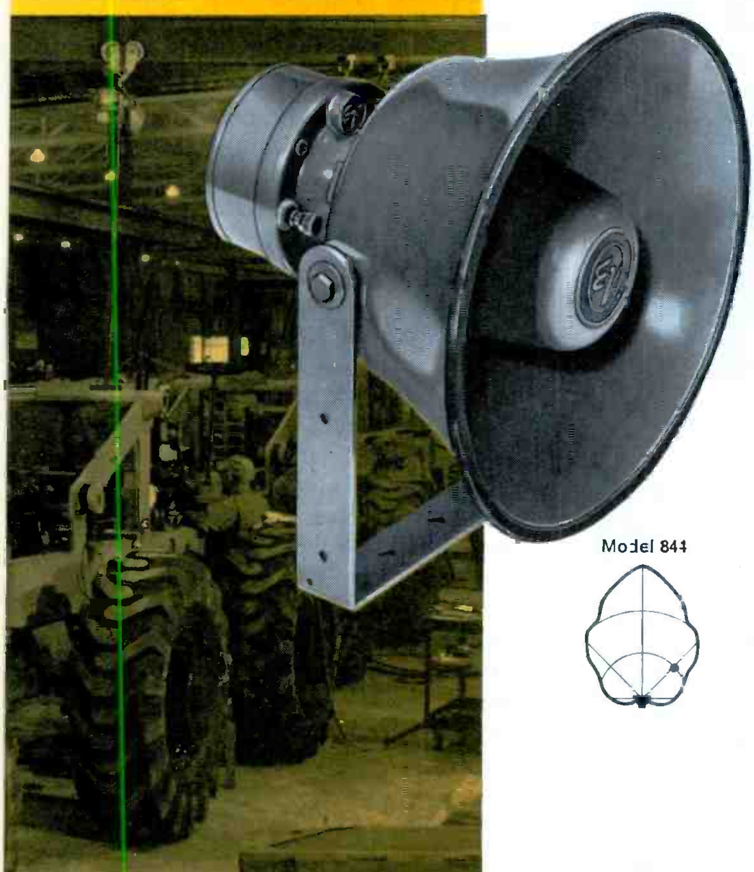

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Model 847-45 CDP with 45-ohm voice coil for intercom applications. List Price, $47.83

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cil eraser, loose elements will be indicated by an erratic movement of the value indicator.

Evaluation of Test Results

After the tubes have been tested, the next step is to evaluate the results and try to determine any connections they might have with the complaint. If, for instance, the trouble symptom is 60-cps hum modulation in the picture, and the only defect found during the tube test is a slightly weak tube, you know it isn't causing the trouble. However, if the test revealed that one of the video IF tubes had internal leakage, you could logically assume it was the source of the trouble.

When using a tube tester as a troubleshooting assistant, the best procedure is to replace all tubes that fail to check good. If the set then operates normally, tubes that tested okay except for being slightly weak could be reinstalled if the customer has indicated the repair should be completed at the lowest possible cost. However, make it a point to indicate this on the job ticket, and inform your customer that you cannot guarantee performance of the weak tubes. You should, of course, guarantee all newly-installed tubes and parts for the standard period.

Tubes which have interelement leakage or gas are troublemakers and should never be left in any set. To do so is to invite a callback. A slightly weak tube, on the other hand, could conceivably operate for years, but the decision of whether or not to replace it should be left strictly up to the customer (unless, of course, its use has a noticeable deteriorating effect on receiver performance). This places the responsibility for future failures on the customer, and eliminates the necessity of making a free callback to replace a tube that checked "doubtful" in the first place.

In addition to the callback-insurance feature, you'll find an increase in your tube sales per call. If this causes worry about the increased cost of your services, consider that it also deters your customer from testing and buying those same tubes at a drug store. Chances are, he won't be tempted to test them even as much as three months later if you impress him with the accuracy and completeness of your test procedure. In the long run, the customer will save money, and you will get more of it.

Even more important than the added sales feature is the customer confidence you inspire by the thoroughness you display in completely testing his receiver. This is especially true since tube testing and replacement may locate and cure some minor defects the customer has noticed, but either forgot to mention or just wasn't sure represented trouble. For instance, you find a leaky 6T8 and a gassy video IF tube; replacements eliminate that trace of audio buzz and the picture bend that's been troubling him for a long time. This will always impress him.

Still a third advantage of tube testing is that it will locate troubles caused by simultaneous defects in more than one tube, thus resulting in more prompt correction of such troubles. I have encountered sets in which AGC defects were cured only after both tuner and all video IF tubes were replaced. (All checked leaky and/or gassy in the tube tester.) Another time, a most discouraging horizontal jitter was eliminated when I tested the various tubes and replaced a gassy video output tube.

Possible Consequences

Naturally, a tube tester can't do your thinking for you, and it won't help you find troubles that don't occur during the troubleshooting procedure. Thus, you run into those sticky occasions when, after you've left, the customer will call to complain, "The serviceman put three tubes in my set and it's still doing the same thing." This can happen if one of the new tubes fails, or if the trouble is intermittent. In either event, the serviceman is obliged to make a recall, fix the set, and calm the customer. Generally, the customer should pay for additional parts or tubes required to repair the set. He should even pay the standard shop fee if the set has to be taken in for repair. However, you are going to have to explain things so that the customer knows he isn't paying twice for the same job.

I've always used this system with excellent results:

1. Inform the customer in detail about shop fees and labor charges.
2. Explain that the money paid for the original call will be credited toward the final repair.
3. Give a 10% labor discount to make up for customer inconvenience.

You may or may not want to use this last step; however, the $2 or $3 reduction in profit will be returned ten times over in customer good will. Most people seem to feel that this little discount is a sure sign of your interest in their set, and of an honest desire to do the right thing.

Handy New Tool

No, the tool shown in Fig. 1 wasn't left in a serviceman's stomach! You're looking at the new Xcelite "Seizers," which are made of stainless steel and patterned after surgical forceps. These hardy pliers, feature a sturdy two-position lock joint, and are available in both straight-and curved jawed versions. The locking feature makes these

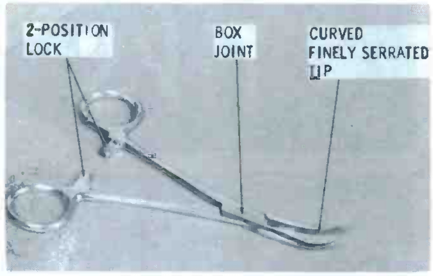
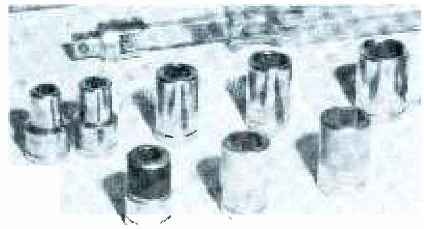


Fig. 1. Xcelite's new Seizers are self-locking and have strong, box-type joint.

pliers ideal for use as a heat sink when soldering transistors, diodes and other delicate components. They are very useful as a third hand in tight soldering operations like those encountered when replacing components on printed wiring boards. This is especially true when installing or removing diodes or transistors, since the "Seizes" can be clamped onto a lead to act as a "hands-off" heat sink.

TV and FM tuners are other ploces where the small mass and long, skinny jaws of these pliers come in handy. The jaw teeth are very fine and made accurately, permitting them to grasp and securely hold even the very fine wire that slips through the jaws of standard tools. ▲

TIPS for TECHS

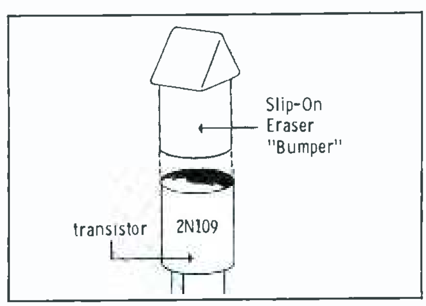


Color-Code Your Wrench Sockets

If you believe that every second of your servicing time is valuable (and what money-making service technician doesn't?), you will see the advantage of color-coding tools for easier selection of different sizes. For instance, you can mark your more frequently - used socket wrenches with bands of colored plastic tape. You'll be better able to select the needed size from the rest of the group at first glance.

Socket Aids Tube Testing

When you want to check a tube's filament for continuity with an ohmmeter, plug the tube into a spare socket from your parts box. You'll find that it is a lot easier to touch the test prods to the socket contacts than to the tube pins themselves. Also, there is less chance of accidentally touching the prods to the wrong pins or getting a false reading due to poor electrical contact between pins and prods.



Transistor "Bumper"

Transistors are often mounted in chassis locations that make them especially vulnerable to damage. Many kinds of transistors can be protected by pushing a slip-on pencil eraser down over the case as shown in the drawing. The rubber eraser serves as a "bumper" to ward off mechanical blows that might damage the component internally.

Aluminum Soldering Aid

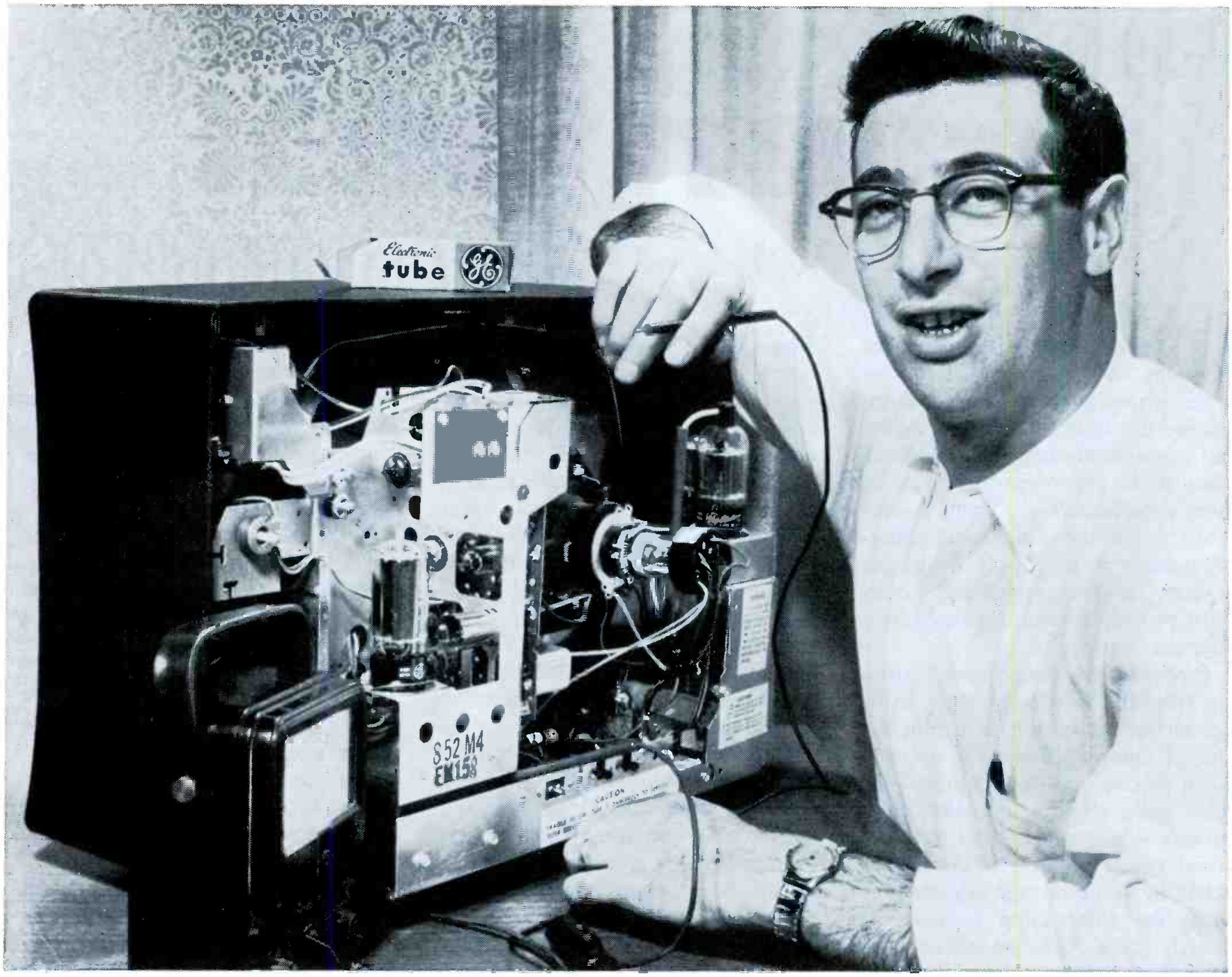
In your electronic servicing work, how many times have you attempted to solder a wire to an aluminum chassis, only to find that the solder just wouldn't stick? Thanks to a newly developed aluminum solder called *Chemalloy,* this vexing problem is solved. This new fluxless solder is derived primarily from zinc blended with other metals that have been cleansed with muriatic acid and homogenized while still in a molten state. It's available in 10" triangular rods and will stick to aluminum like magic.

Plastic Box Protects Mirror

To keep your inspection mirror from becoming broken when stored in a tool box among other tools, take one of those small plastic parts boxes and file a hole in one corner large enough to accept the neck of the mirror. Put the mirror inside and snap down the lid. Then you won't find your mirror broken the next time you have occasion to use it.

Lead-In Identification

When an antenna installation includes separate lead-in wires for VHF and UHF, and heavy-duty twin-lead is used for both, it's not easy to tell them apart after they enter the house. To make them readily identifiable, put a narrow strip of tape around one or the other near the terminals and use ink to label it VHF or UHF. This will help you out on future service calls and will also save the customer a lot of confusion if he ever finds it necessary to disconnect the antenna leads from his TV set.



"IT'S A SNAP to get at the chassis in a 'Designer'"

says Norm Murkoff, Service Manager of Rocket Stores, Inc., Poughkeepsie, N. Y.

"The minute you take the back off any General Electric 'Designer' TV receiver the chassis is right in front of you and it's a snap to get at it," says Norm Murkoff, Service Manager of Rocket Stores, Inc., in Poughkeepsie, New York.

"Rarely do you ever have to pull the chassis on this set to replace parts or circuit trace so we do 9 out of 10 repairs in the home.

"Because of the higher home completion rate we find we can make more calls and this, of course, means we make more money.

"Another thing we like about the 'Designer' is that we can get at both sides of the printed circuitry while the chassis is still in the cabinet.

"Also, the tubes are directly replaceable, fuses are accessible, and you easily get at the key check points. Another thing: the painted schematic on the boards helps us find our way around very quickly."

Precision Etched Circuitry is the name General Electric gives to its circuitry and it is used in all sets. This circuitry is reliable and uniform so that when you've serviced one you never have to puzzle over the next one.

"Designer" TV—called the easiest-to-service set in television! General Electric Company, Television Receiver Department, Syracuse 8, New York.

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isolating COLOR TV TROUBLES by symptoms

In a practical sense, color service problems only *seem* more troublesome, primarily because of the increased difficulty in chassis handling and troubleshooting. In general, many of the failures are the same as those experienced in a monochrome receiver, and the same troubleshooting procedures will apply. There are failures, however, which are strictly color problems requiring an entirely different approach.

Probably the most difficult trouble, from the standpoint of the average service technician, is a complete loss of color. Although it narrows down to one of three sections—the color sync, chroma, or color killer circuits—the problem area is rather broad (see Fig. 1). For instance, a defect in the color sync circuits may cause the color killer to react as though there were an absence of color signal and cause the killer to block the chroma channel. On the other hand, a defect in the color killer may result in color killing action even though color signals are present. To further complicate things, a breakdown in either the bandpass amplifier or demodulator driver could prevent the chroma signal from reaching the demodulators, and only a monochrome picture would be displayed; but the same symptom could be exhibited because of a defective color killer!

Considering only defects that affect color reception, symptoms can best be divided into the following categories: Complete loss of color; intermittent color; no color sync; and incorrect colors. Each of these defects can usually be localized to the chrominance section or the color picture tube.

Complete loss of color can be definitely established with use of a color-bar generator, or by checking local color programs. Before assuming that the trouble is a tube or circuit defect, check the fine tuning control for misadjustment. An incorrect setting will cause the higher video frequencies to be attenuated, which will in turn result in a lack of chrominance signal. Also check the setting of the saturation control (sometimes labeled "chroma"), and the setting of the color killer threshold control; an incorrect adjustment by the set owner may be the difficulty. (Early color sets used a manual color-killer switch to remove the screen voltage from the chroma demodulators, and later models used a manual switch in addition to the threshold control, so also check this possibility.)

If the 3.58-mc subcarrier oscillator is of the type which does not require a color signal for activation, it is possible, even before going inside the cabinet, to determine whether or not it is functioning properly. Turn the color killer control to its minimum setting, and tune in a monochrome signal. Adjust the fine tuning control while watching the picture for streaks or blobs of color-noise. If none is present, it usually means a dead subcarrier oscillator.

Other than testing or replacing all the tubes in the color section, very little else can be done in the customer's home. On the bench, you can quickly check out the chroma circuits by measuring the bias voltage (color killer voltage) on the bandpass amplifier (see Fig. 2). If it is sufficient to cut the tube off, return the set to normal operating condition by disconnecting the cathode

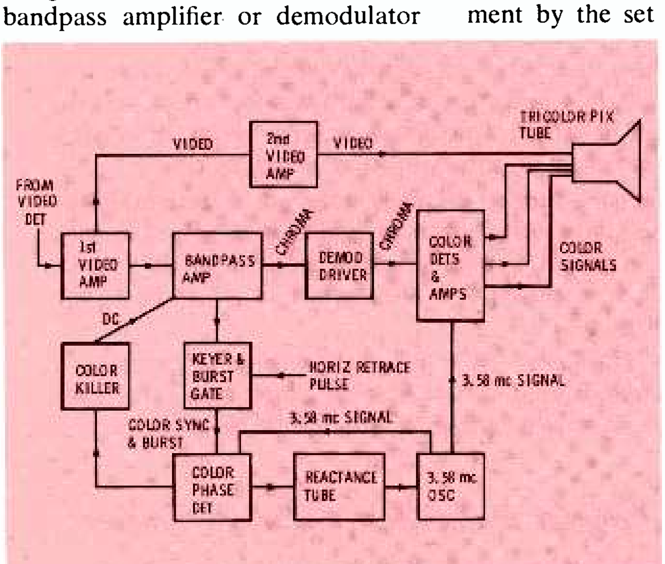

Fig. 1. Block diagram of the video sections of a color receiver, including the circuits which control them.

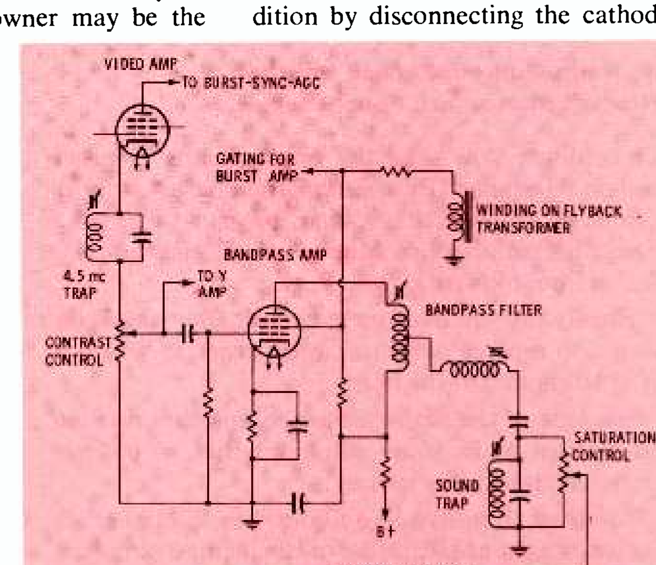

Fig. 2. Common bandpass amplifier circuit used in modern color receiver. Killer voltage is fed to screen grid.

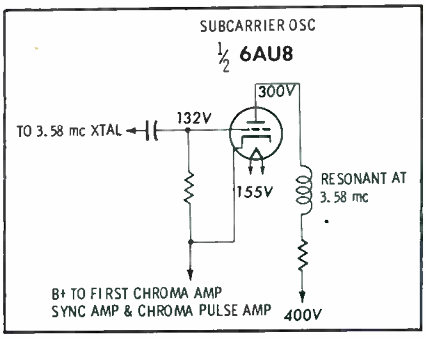

Fig. 3. Basic diagram of 3.58-mc oscillator which also serves as B+ divider.

lead of the color killer, or by shorting out the killer voltage.

If the chroma section is not defective, color of sorts will be evident in the picture, although it won't be synchronized. If color does not appear, a defect in the bandpass amplifier or demodulator driver may be indicated. A wide-band scope check for video up to the bandpass amplifier, and then for chroma through the bandpass amplifier to the demodulator driver, will localize the failure. Bad tubes and open, shorted, or leaky coupling capacitors are usually the source of troubles in these stages.

If color appears in the pattern when the color-killing voltage is removed, check the 3.58-mc subcarrier oscillator. A quick and definite check of oscillator output can be made by taking a measurement across the secondary of the oscillator output transformer with a VTVM and RF probe. If there is no output, replace the tube first, because interelectrode leakage in this stage can simulate practically all circuit defects. Also replace the reactance control tube, since it may be loading the oscillator, and check all oscillator voltages.

In some receivers, the subcarrier oscillator is used as a B+ voltage divider in a circuit arrangement similar to that of audio output stages in conventional monochrome receivers. The basic circuit is illustrated in Fig. 3. The oscillator tube is located between the low-voltage rectifier output and the +155-volt line. Failure of the oscillator tube would result in a loss of B+ on the first chroma amplifier, burst amplifier, and the sync amplifier. When the tube becomes weak, the trouble developed depends mostly on circuit details. On our illustration, where the tube also serves as a voltage divider, the sync action of both

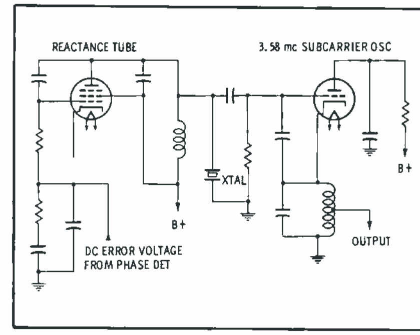

Fig. 4. Simplified crystal-controlled 3.58-mc oscillator-reactance tube stage.

color and monochrome signals may be affected; the weaker the tube, the poorer the sync action. In circuits where the tube is used strictly as an oscillator, the color in the picture will become very weak. An extremely weak tube will cause intermittent color.

In areas where line-voltage regulation is poor, the subcarrier oscillator is a frequent source of intermittent color reception. A simplified diagram of the popular crystal-controlled oscillator-reactance tube circuit is shown in Fig. 4. Gm of the tube is very important to the proper operation of most oscillators of this type, and several new tubes should be substituted before assuming that an under-the-chassis component is faulty. One particular circuit used in later color sets, and described in a previous issue of PF REPORTER, is very critical in this respect (see *Quicker Servicing*, November, 1957). Adjustment of the oscillator coil L1 in Fig. 3 is also very critical; if tuned too close to resonance, intermittent operation results. The easiest way to tune it, and still maintain a high degree of stability, is to approach resonance from the high-frequency side. Remove the burst amplifier tube to prevent spurious indications, and connect a VTVM to the plate of the color phase detector feeding the color killer grid. Tune the coil for maximum meter deflection, and then back off to give approximately 1.5 volts less than the maximum obtainable. The output voltage of the oscillator is then great enough to drive the color phase demodulators, but the tuned circuit is still far enough from peak resonance, and drift won't intermittently cut off the oscillator with line-voltage fluctuations.

In cases where erratic oscillation cannot be cured by replacing the tube or retuning the coil, increas-

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ing the amount of feedback may solve the problem. In the circuit of Fig. 4, oscillation is sustained by feedback through the interelectrode capacitance of the tube and a small parallel capacitor (C1) between grid and cathode. This unit is generally on the order of 2.2-mmf; increasing it to 3.3 or 4.7 mmf and retuning L1 should clear up any feedback difficulties.

Another subcarrier oscillator circuit encountered occasionally is the shock - excited crystal - ringing type. It is also referred to as a 3.58-mc crystal filter. This is one of the simpler circuits, but is not as widely used as the crystal-controlled reactance tube circuit because of its unsatisfactory operation on weak color signals. Failure of this circuit in most cases is due to a defective limiter tube, resulting in a nonuniform voltage to the chroma demodulators during the horizontal scan interval. The voltage starts at a high level at the beginning of the forward trace, and ends at a low level, causing the colors in the picture to be fully saturated at the left side but desaturated on the right.

The next logical step in troubleshooting a color receiver should be to check the keyer circuit (see Fig. 5). A view of the input and output waveforms will disclose any discrepancies. A lack of keyer pulse or a pulse of inadequate amplitude may be the difficulty, stemming from an open or shorted keyer winding or, more likely, leakage from the keyer winding to the core of the horizontal output transformer. The pulse is distorted or weakened by leakage; consequently, a weak burst is applied to the color AFC diodes. The weakened DC output voltage of the diodes results in a partial or complete

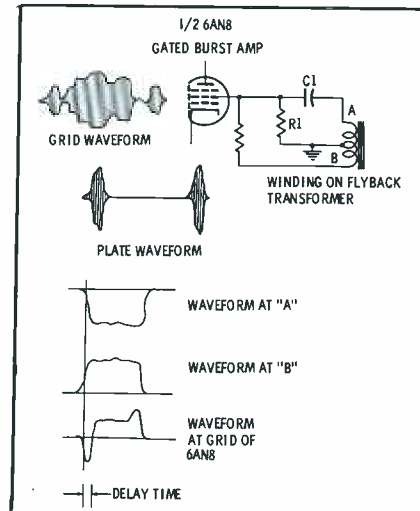

Fig. 5. Burst-gating circuit arrangement used in certain Motorola receivers.

loss of control on the color killer, and the killer keeps the bandpass amplifier cut off even in the presence of strong chroma signals. It is possible for color to appear on strong signals with an open keyer winding, in some sets, but contrast is very poor and sync is nonexistent.

One difficulty which seems to be very common to this section is arcing in the flyback winding. This is especially true of older color receivers. The amplitude of the keyer pulse falls off considerably whenever arcing occurs, causing a wide variety of troubles ranging from poor color sync and weak color contrast to an intermittent or complete loss of color.

Other scope tests which should be made in the area of the keyer circuit include a check for color signal input, color burst output, and a check for the color burst signal on the diodes of the burst phase detector. *(The second part of this coverage will appear in the December issue.)* ▲

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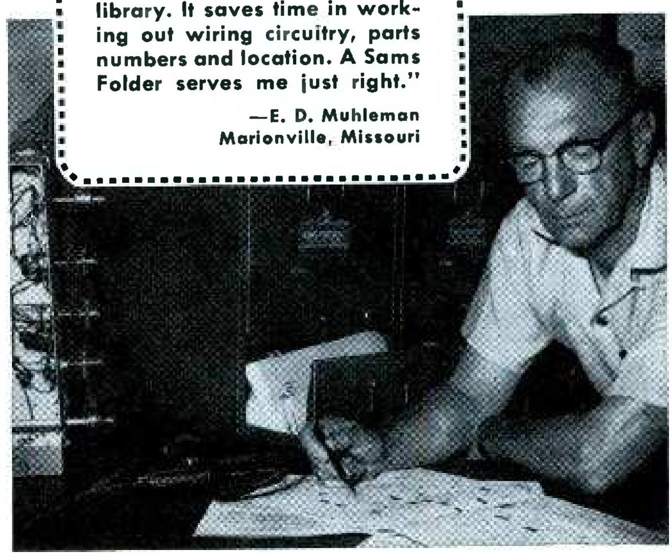

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Reading Between the Lines

Proper schematic interpretation involves more than just knowing what the symbols mean.

by Robert G. Middleton

There is more to a schematic diagram than meets the eye! Much of the circuit-action data is implied, since it is impractical to show other than the conductive paths. When we learn to read between these paths, or lines, we are in a position to get the most out of a schematic diagram.

R-F Ground Paths

When is a ground not a ground but, instead, a coupling circuit? Fig. 1 shows a typical IF amplifier circuit with various ground returns. When we replace IF components, we can't use "just any" ground point. We find that one ground point works okay, while another results in poor picture quality. If we happen to cross input and output ground points, feedback or lower gain is likely to develop.

These facts come clearly to light in conventional alignment work. For example, when we use the circulating ground-current method of marker injection (Fig. 2), we are utilizing the principle of high-frequency ground impedance. From the simple conductive circuit drawing, we might assume that the marker-generator output cable is short-circuited. However, we know the real reason we get markers on the response curve is because the marker ground current couples into the mixer-ground circuits.

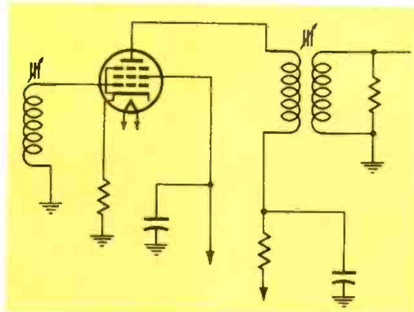

Fig. 1. Physical ground-point location is critical in IF amplifier circuit.

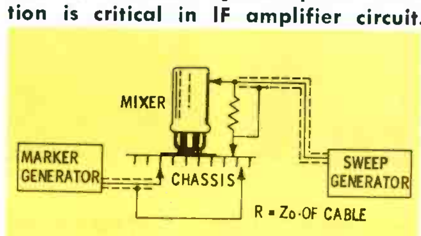

Fig. 2. Method of marker injection that utilizes circulating ground current.

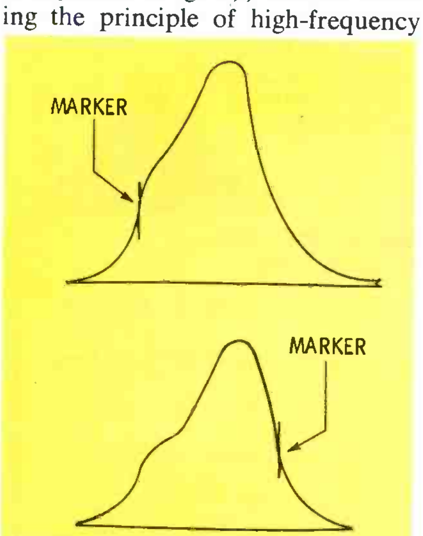

Fig. 3. When marker output cable acts as a resonant stub, marker size may vary greatly according to its frequency.

High-Frequency Leads

All high-frequency leads have impedance. Merely a little extra length can give choking action to RF or IF currents. Shielded cables can act like tuned coils when improperly used or installed. Consider Fig. 2 again, in which the shielded marker-output cable is "shorted" to ground. In varying the tuning dial of the generator to run the marker along the curve, we often observe that the marker is extremely large on one side of the curve and extremely small on the other side.

This unexpected action results because the output cable is approximately a shorted stub in this application. At one frequency, the cable input *looks like* a series-resonant circuit, and we get high currents in the chassis ground circuit. On the other hand, the cable *looks like* a parallel-resonant circuit at another frequency, and we get much weaker ground currents.

Again, consider the properties of an IF output lead from an RF tuner to the grid of the first IF amplifier tube. If you have ever made the mistake of trying a substitute tuner, using a clip lead for output coupling instead of the short cable, you will recall the erratic action or lack of response which results. The clip lead has excessive series impedance, and depending upon its relation to surrounding metal, also acts as a crude transmission line and filter.

Stray Capacitances

Conductive paths shown in circuit diagrams all have stray capacitance to ground and to other leads.

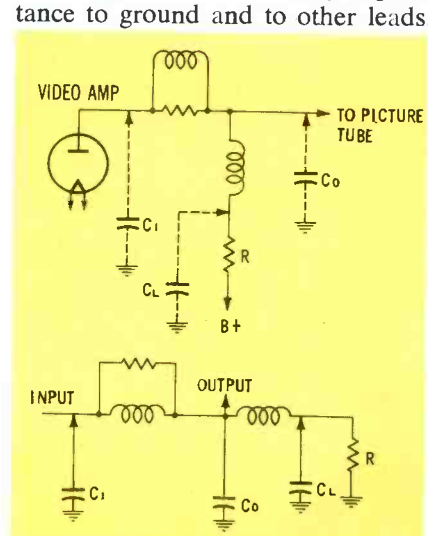

Fig. 4. Conventional schematics show conducting paths but not capacitances which make circuit a low-pass filter.

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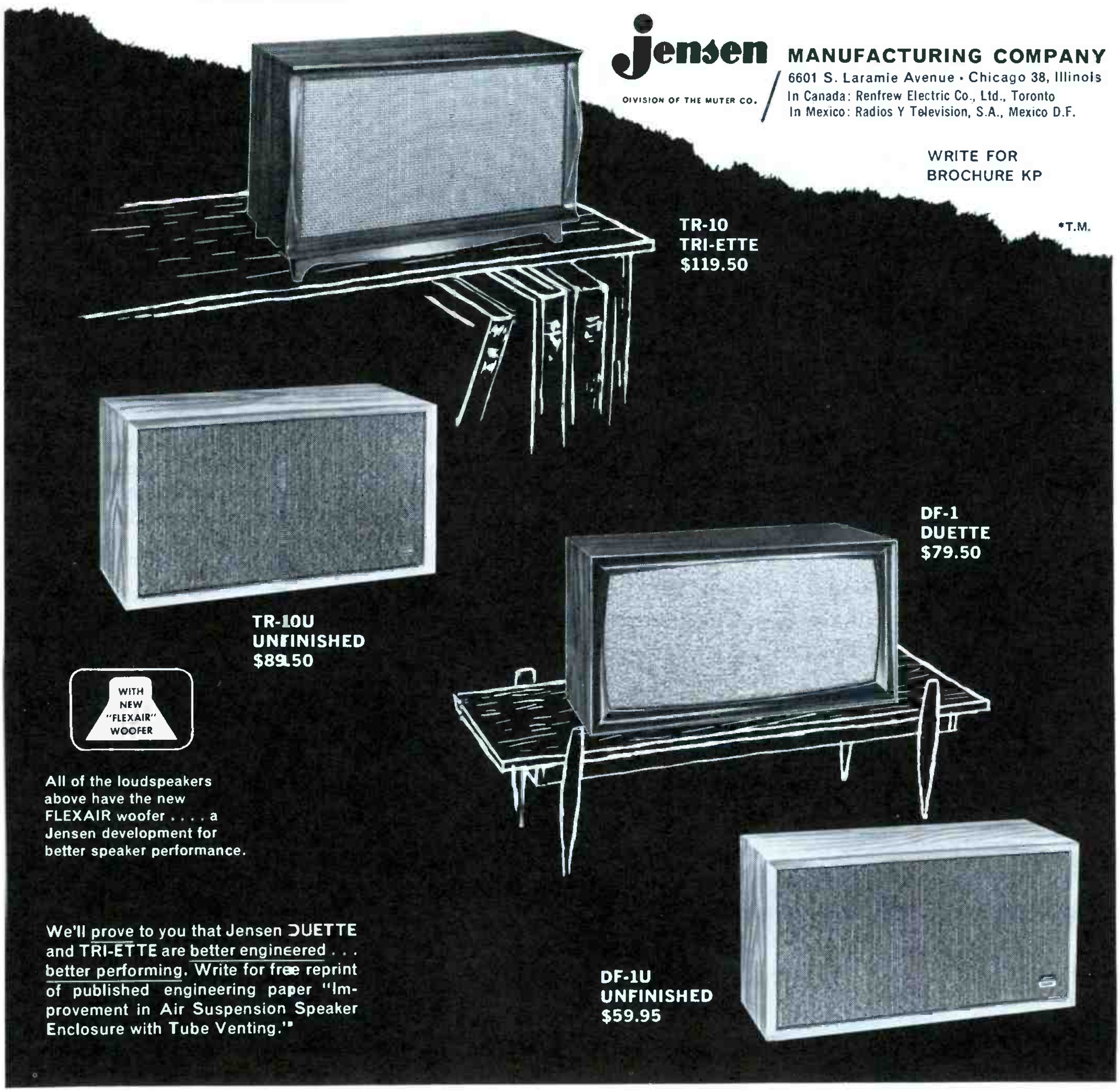


In normal receiver layout, stray capacitances may be negligible, as in a power-supply circuit. On the other hand, they may be an essential to proper operation of the circuit, as in a video-amplifier stage. For example, the peaking-coil circuit in Fig. 4 includes input capacitance C_I, output capacitance C_O, and load capacitance C_L. By putting the circuit components in line, we have a rather simple form of low-pass filter, with two sections. The input of the filter is tuned by C_I, the mid-band section is tuned by C_O, and termination is fulfilled by load resistor R and stray load capacitance C_L.

The cutoff frequency and uniformity of response depend on correct capacitor values in the low-pass filter circuit. If we take the picture tube out of the receiver cabinet and mount it several feet away, we must lengthen the picture-tube leads. C_O increases with lead length, making an improper termination for the filter, and high-frequency response suffers. As a result, the picture looks blurry and fuzzy.

There are three ways to use a remote picture tube without introducing a change in the value of C_O. The first is to use the long leads (hot and ground) as a line, properly terminated as shown in Fig. 5. The value of R must equal the characteristic impedance of the line, which is determined primarily by the spacing between the leads. Then, the input to the leads is purely resistive, and the line no longer affects the value of stray capacitance across the video-amplifier output. Fig. 6 shows the characteristic impedances of various lead spacings and wire sizes. Sometimes we can use the required value of R in the circuit, and at other times we cannot.

Another way to use long leads from a video amplifier without increasing C_O is to use an RC compensating network such as illustrated in Fig. 7. When R and C have correct values, there is no frequency distortion and the circuit can be arranged so that C has the same value

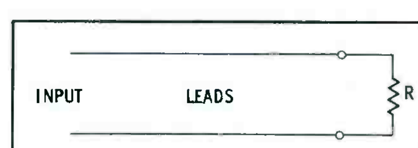


Fig. 5. If R has proper value, it makes no difference how long the leads are.

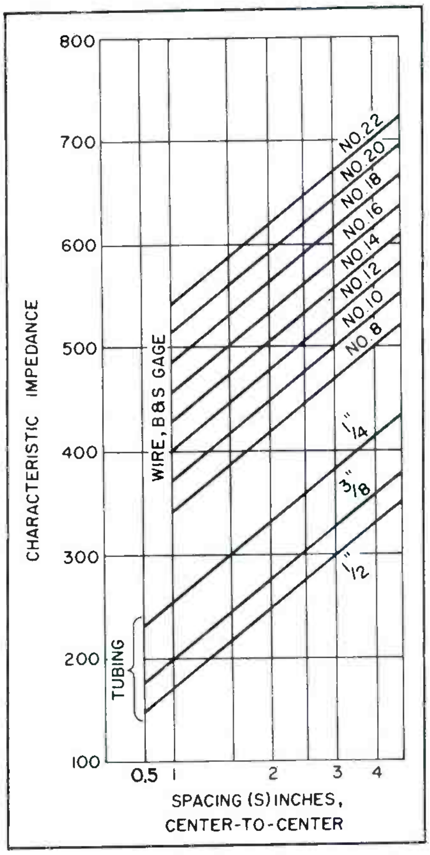


Fig. 6. Various lead spacings and sizes of wire give different impedances.

as the input capacitance of the picture tube (at its socket terminal). However, this method results in a reduction of signal voltage, and the amount remaining must be ample to drive the picture tube. Hence, this method of controlling stray capacitance may be practical in some cases, and impractical in others.

The third method involves use of a cathode follower, as shown in Fig. 8. This method is most generally applicable, but has the disadvantage of requiring an extra stage. In any case, one of the three methods must be used to maintain the correct value of stray capacitances.

Capacitors Can Act Like Coils

An electrolytic or large paper capacitor looks like a simple capacitive element in a schematic diagram; however, such components often are physically constructed in a manner which makes them inductive. Such phenomena may cause trouble in

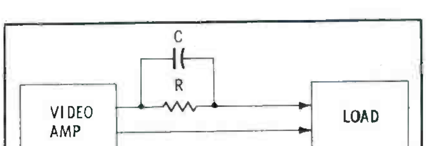


Fig. 7. Suitable values of R and C leave Co unchanged and prevent distortion.

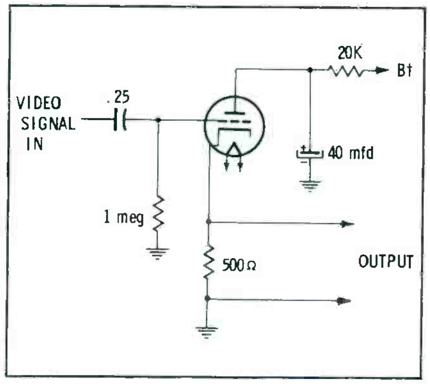


Fig. 8. A cathode follower isolates the low impedance of the output lead from the high-impedance input circuit.

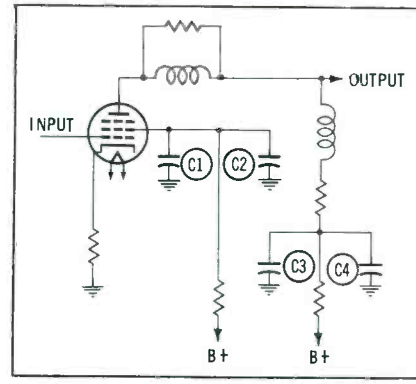


Fig. 9. Inductance in C1 and C3 at high frequencies can be counteracted by shunting them with .002 - mfd mica units.

wide-band circuits such as video amplifiers.

If an electrolytic or paper capacitor is used in a video-amplifier circuit, it is usually shunted by a much smaller capacitor, as shown in Fig 9, to offset the inductive reactance introduced by the larger unit. Plate areas and physical construction of smaller capacitors introduce little or no inductive reactance.

If the type of capacitor used in screen-bypass and plate-decoupling circuits has appreciable inductance at 4 mc, there will be degenerative action in the screen and impaired load response in the plate circuit. However, a .002-mfd mica capacitor shunting the larger capacitor provides the needed bypassing and decoupling action.

Bypassing Long Supply Leads

Since a long lead has appreciable impedance at high frequencies, it is not sufficient to bypass the lead at only one point. Consider the AGC bus shown in Fig. 10. If we were to rely upon the large delay capacitor C_D for bypassing action, and did not utilize capacitors at each high-frequency point along the line, we would have a feedback circuit instead of a DC supply line. The series impedance of the bus is not shown as part of the conductive path in the circuit diagram—yet, it is there. Unrecognized, it can give rise to perplexing problems.

The Miller Effect

Most of us are more or less familiar with Miller effect, which can take place because of the interelectrode capacitance between grid and plate of a tube—something that doesn't appear on a circuit diagram. Miller capacitance causes feedback from plate to grid, and affects the response of tuned circuits.

The value of Miller-effect capacitance depends on grid bias; it is greater when stage gain is higher. Accordingly, the shape of a response curve can change when AGC bias goes down. This is used to advantage in some receiver designs by arranging the circuits to place the picture carrier higher up on the response curve when the signal is weak (grid bias low).

Miller capacitance can be controlled in two ways. In an IF stage, an unbypassed cathode resistor of 40

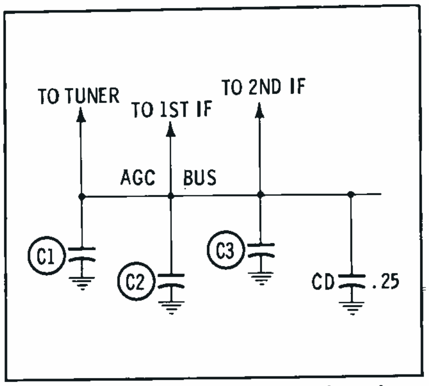


Fig. 10. Since the AGC lead is long and CD is large, C1, C2 and C3 are needed as a shunt for high frequencies.

to 60 ohms can be used to cancel out the effect of Miller capacitance. Degenerative voltage across the resistor nullifies regenerative voltage developed by Miller capacitance. Of course, an incorrect value of cathode resistance results in either incomplete cancellation, or over-cancellation.

In a mixer stage using a triode tube, an LC neutralizing circuit is often connected between plate and grid. The value and phase of voltage fed from plate to grid by the LC circuit neutralizes or cancels the regenerative voltage developed by the Miller capacitance. Hence, although the Miller capacitance is not shown in a schematic diagram, it is present, and able to cause trouble.

Stray Resonances

Stray resonances are present in inductive components such as flyback transformers and yokes. It is not shown in circuit diagrams, but it is essential for proper circuit operation. At the end of a horizontal scan interval, the flyback circuit must shock-oscillate at correct frequency—to get the beam back to the left side of the screen in the allotted time, as well as to generate an inductive surge to operate the damper-boost and high-voltage rectifier circuits.

If we should try to rewind a flyback transformer using a different winding pattern, such as simple layer windings, we would find that none of these circuits work. The changed values of stray capacitances would no longer resonate the inductive circuit as required.

These few examples clearly show us the necessity for recognizing elements not shown in circuit diagrams. We must learn to read between the lines! ▲

Circuit descriptions and servicing techniques for equipment used in the medical profession. by Ed Bukstein

servicing MEDICAL AMPLIFIERS

The rapidly increasing use of electronic apparatus in the medical field has created new opportunities for the service technician. With the exception of a set of spare tubes and the ingenuity of a general maintenance man, most hospitals and clinics have no facilities for servicing their electronic devices. Because returning the equipment to the factory for repairs means that the doctors will be deprived of its use for a length of time, it is more logical to call in a local technician when certain repairs are needed.

Many of the medical-electronic instruments in common use are recording voltmeters. These are used to produce chart recordings of potentials picked up by metal electrodes strapped to a patient's body. Included in this category are such instruments as the electrocardiograph (ECG) used to record potentials developed by the heart, the electroencephalograph (EEG) used to record brain waves, and the electromyograph (EMG) used to record muscle potentials. The equipment represented by these impressive names generally consists of a

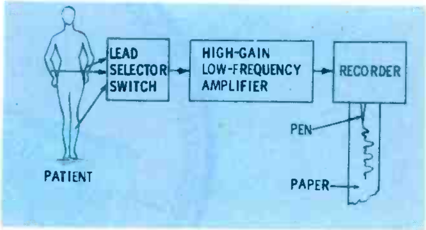


Fig. 1. Block diagram shows the basic electrocardiograph operation principle.

high-gain, low-frequency amplifier whose output is used to deflect a pen across a paper chart.

Fig. 1 illustrates the use of the electrocardiograph. Metal electrodes, moistened with an electrically-conductive paste, are strapped to the arms and left leg of the patient. Voltage waveforms generated by the beating heart are picked up by these electrodes and applied to the amplifier. After sufficient amplification, the signal is used to drive a recording pen across a moving strip of paper. The recorder is, in effect, a mechanical oscillograph. The electroencephalograph is used in a similar manner, except that the electrodes are placed against the scalp to pick up the brain potentials. In electromyography, the electrodes are positioned over the muscle to be studied. Multiple-channel instruments are commonly used so that more than one waveform can be recorded at the same time. Such instruments are similar to the one represented in Fig. 1 except that they have additional amplifiers and pen mechanisms.

Servicing electromedical apparatus is basically no different than servicing a television receiver or a hi-fi amplifier. An open filter capacitor, for example, will produce hum in an electrocardiograph just as certainly as it does in a table model radio. A leaky coupling capacitor in a brain wave machine produces the same symptoms as a similar defect in a video amplifier. There are, however, certain special considerations of interest to the serviceman who wishes to extend his operations into the medical field.

Gain and Frequency Response

Medical amplifiers are characterized by their high gain and extended low-frequency response. These features are dictated by the characteristics of the waveforms to be record-

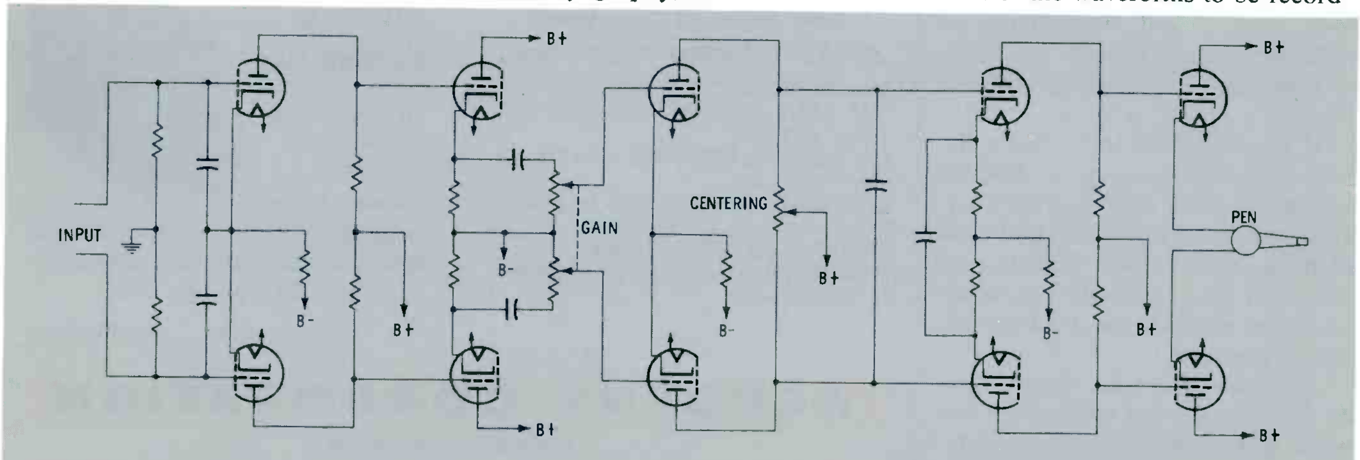


Fig. 2. The electrocardiograph amplifier uses direct coupling for extended low-frequency response. Push-pull stages are used throughout to reject in-phase pickup such as noise and power-line radiation.

ed. The signal obtained when taking an electrocardiogram, for example, usually has a peak amplitude of one millivolt and a fundamental frequency of about one cycle per second (the heart beat rate). High-frequency components of this waveform do not extend much above 100 cps. Brain wave potentials average about 50 microvolts, and components of clinical importance have frequencies under 60 cps. In terms of low-frequency response, the medical amplifier leaves off where many audio amplifiers begin. High-frequency response is not only unnecessary, but undesirable, because it is disadvantageous to preserve gain at frequencies involving more noise than signal. Rejection filters and bypass capacitors are therefore commonly used in medical amplifiers to reduce response above a few hundred cycles per second.

To achieve the required low-frequency response, amplifier stages are either direct-coupled (for response down to zero cycles per second), or coupled by large-value capacitors (for frequency response down to a fraction of a cycle per second). Coupling capacitors as large as 4 mfd are not uncommon.

The over-all voltage gain factor of a medical amplifier generally ranges from 500,000 to 2,000,000; thus, 60-cycle hum and noise pickup become problems of first magnitude. For this reason, differential (push-pull) stages are almost invariably used. Since hum and noise voltages are in phase at the input grids, they are cancelled in the push-pull stages. Further reduction of stray pickup is accomplished by extensive shielding both inside and outside the instrument. In some applications, the room in which the equipment is used is completely enclosed with copper-screen shielding. Although this extreme is not always required, it is helpful when the instrument is operated in the vicinity of X-ray apparatus, electric motors, or other noise-producing equipment.

A commercially available electrocardiograph is pictured in the head photo; a schematic showing its basic circuitry appears in Fig. 2. As mentioned previously, push-pull stages are used throughout to promote cancellation of stray pickup. The two gain controls are ganged, and control the signal level at the input of the third stage. The centering control in the plate circuit of the third stage compensates for lack of balance in the push-pull stages. This control is used to center the pen on the recording paper.

In the design of a direct-coupled amplifier, special considerations are taken to prevent base line drift. Since the response of a direct-coupled amplifier extends down to zero cycles per second, thermally-produced changes in component values will cause the recording pen to gradually drift away from its center position. The input stage is particularly critical in this respect because small changes will be amplified by the succeeding stages, causing a considerable shift in the position of the recording pen. In the circuit of Fig. 2, this problem is avoided by the use of capacitive coupling between the second and third stages, effectively isolating the last three stages and the recording pen from minor DC voltage changes at the tube elements of the first stage. Stability of the amplifier is further improved by the use of voltage regulator tubes in the power supply.

The last stage in Fig. 2 is a cathode follower, matching the amplifier to the low impedance of the recorder. The recorder is essentially a meter movement which drives a lightweight pen instead of a pointer.

Hum, Noise and Microphonics

Special precautions must be taken to reduce 60-cycle pickup from the heater circuits. Such pickup, particularly in the early stages of the amplifier, will cause a 60-cycle component to be superimposed on the recording. In some instruments, the heater wiring is run through metal tubes to reduce radiation. In other instruments, heaters of the first two or three stages are DC powered. Another commonly used technique involves the use of an RF oscillator to provide heater power for the input stage. Since the frequency of this oscillator is above the frequency response of the amplifier, its signal introduces no interference.

Individually selected industrial grade tubes are usually used in medical amplifiers, particularly for the input stages. Tubes are selected for low noise, minimum heater-to-cathode leakage, and low microphonic characteristics. The input stage is often shock-mounted on rubber supports to further reduce microphonic tendencies, and the tube itself is sometimes encased in sponge rubber for the same reason. Depending on design tolerances, it may be necessary to hand-pick matched tubes for the push-pull stages.

Calibration Circuit

Recordings such as the electrocardiogram and the electroencephalogram are useful because they can be compared to "standard" waveforms. Such comparisons form the basis of diagnosis because specific physical defects produce recognizable changes in waveshape, frequency, and amplitude. The paper on which the pen mechanism writes is generally marked with evenly spaced lines or coordinates. Using these as references, and knowing the speed at which the paper passes through the recorder, a doctor can determine the frequency of the waveform. Some instruments even contain a timing device which marks the paper

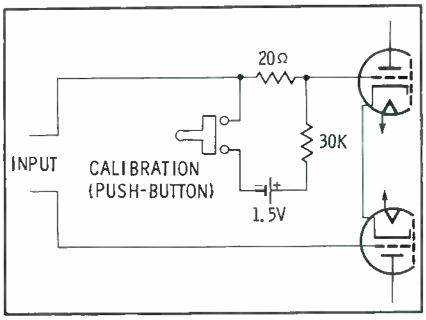


Fig. 3. Calibration circuit used to provide amplitude standardization pulse.

once every second. The frequency can then be determined by counting the number of cycles between consecutive marks.

The amplitude of the recorded waveform is determined by comparing it to a calibrating pulse. This "standard" pulse can be recorded as frequently as desired by pressing a button on the front panel of the instrument. As shown in Fig. 3, the calibration button connects a battery across two resistors. The voltage drop across one of these resistors is applied to one of the input grids and causes the pen to be deflected. In the electrocardiograph, resistance values are selected to produce a 1-mv standardization pulse. In the electroencephalograph, 5, 10 and 50-mv pulses are commonly used.

Recorders

At one time, optical-photographic recorders were frequently used in electromedical instruments. Basically, they consisted of a D'Arsonval meter movement having a small mirror cemented to its moving coil. The mirror was illuminated by a light source and reflected a small spot of light onto a moving strip of photographic film or paper. Current variations through the meter movement caused the spot of light to sweep back and forth across the photographic film, tracing out the waveform. The obvious disadvantage of this type of recorder is the necessity of processing the film before the waveform can be studied. Most modern instruments are of the direct-writing type. In these, the moving coil of the meter actuates a lightweight pen riding on a motor-driven strip of paper. Because of the mass of the pen and the friction between pen and paper, the frequency response of the direct-writing recorder is not as good as that of the optical-photographic type. This is not a serious disadvantage because of the low frequency of most physiological potentials, and from a clinical point of view it is desirable to have the recording immediately available for analysis.

Direct-writing recorders are of two basic types—those that write with ink and those that write with heat. In the ink-writing type, the pen is a thin, hollow tube connected to an ink container through a length of flexible tubing. Gravity and capillary action maintain a flow of ink to the pen. In the heat-writing type, the pen is heated by current from a transformer winding; principle of operation is similiar to that of the soldering gun. This pen rides on a chemically-treated paper which changes color at the point where it is contacted by the heated pen.

The paper-drive mechanism is mechanically straightforward. A constant-speed motor, acting through a gear train, pulls the paper past the pen mechanism. More elaborate instruments have gear-changing arrangements to provide a range of paper speeds.

Service Techniques

Most manufacturers of medical equipment supply instruction and service manuals with their instruments. The service manual usually contains the circuit diagram, a brief description of circuit theory, a parts list, photographs identifying the parts by number, disassembly instructions, and special precautions to be observed when using or servicing the instrument. Although well-designed and expertly constructed, medical instruments do, of course, break down occasionally. The three most common complaints are (1) inoperative, (2) noise, and (3) hum.

Inoperative

The instrument is considered inoperative when it produces no recording at all. As in the case of other electronic devices, this defect is often attributable to a lack of B+ voltage. A burned out rectifier tube is the most common cause.

The pilot light, of course, immediately indicates whether or not the instrument is receiving AC power. Medical instruments are almost invariably fused, and multiple-channel instruments usually have a separate fuse for each channel. A blown fuse always suggests the possibility of a short somewhere in the instrument. As an aid to localization of the short, the rectifier tube should be removed from its socket before a new fuse is installed. If the new fuse blows under these conditions, the short must be ahead of the rectifier —possibly in the power transformer or the heater wiring. If the new fuse doesn't blow with the rectifier removed from its socket, the short is on the load side of the rectifier—possibly a shorted filter capacitor.

If the recording pen is pulled over to one side, and the centering control has little or no effect, one of the tubes in a push-pull pair is likely to be defective. A good localization technique is to measure all plate voltages. In each push-pull stage, the two plates should be at approximately the same potential. In multiple-channel instruments, tubes from one channel may be substituted in another as an aid in locating the defective tube.

Another common cause of an inoperative instrument is lack of heater voltage for the input stage. Heater power for the first stage (the first two or three stages in some instruments) is often obtained from batteries, a rectifier operating from a low-voltage secondary winding, or an RF oscillator. These sources should be checked for proper operation.

Only high quality parts of similar characteristics should be used as replacements in a medical amplifier. Wire-wound resistors, for example, are often used in the input stage; they should not be replaced with carbon resistors which may generate enough noise to make the pen quiver erratically. When replacing a tube, it may be necessary to try several before one with sufficiently low noise, hum and microphonics can be found.

The power supply and the amplifier are often on separate chassis interconnected by a cable. The recorder likewise is cable-connected to the amplifier. These cables should be inspected, and both plugs and sockets should be cleaned if necessary.

The recorder itself sometimes becomes inoperative. When this is due to an open coil, the mechanism should be replaced with a new unit of the same type. Great care should be exercised in handling the recorder. As in the case of a loudspeaker, it should be kept away from metal objects and iron particles which may be attracted by the powerful magnetic field.

The recording pen sometimes becomes clogged with dried ink. The pen can be cleaned by slowly pushing a thin, stiff wire through it. Pipette cleaners, sold by medical supply houses and used in all medical laboratories, are ideal for this purpose. In the case of heat-writing instruments, failure of the pen to write may be due to an open transformer secondary in the pen's heating circuit. A variable resistor, identified as a heat control, is usually connected between the transformer and the pen. This resistor should also be checked for a possible open.

Noise

Noise generated either inside or outside the instrument will cause an erratic quivering of the recording pen. In localizing the cause, the gain control of the instrument should be turned all the way down to zero. If noise is still present in the recording, it is obviously being introduced at some point in the circuit beyond the gain control. Some common causes of noise are poorly soldered connections, dirty contacts in switches or cable connectors, and noisy tubes. Noise generated externally and picked up by the input leads of the instrument is often caused by electric motors or other electrical equipment being operated in the vicinity.

Medical amplifiers require a good earth ground connection. A three-wire power cable is sometimes used, the third wire connecting the instrument to the electrical conduit. A poor ground connection should therefore be considered as a possible source of noise.

Hum

Stray 60-cycle pickup may cause the recording pen to vibrate violently, a condition often referred to as pen thrashing. Turning the gain control to zero will be helpful in determining whether the interfering signal is being introduced before or after the gain control. Heater-to-cathode leakage in one of the tubes is a common cause of hum. If this is the case, tube substitution will locate the offending tube. Broken leads, poor connections and inadequate grounding are other common causes of hum.

Another condition, which is not hum in the strict sense, is sometimes described as such by hospital personnel. The high-gain medical amplifier may act as a receiver and pick up a local broadcast station. In this event, the recording pen will attempt to record the audio signal of the station. When this happens, all ground connections should be checked; then, if necessary, the equipment should be relocated in another part of the room. In extreme cases, it may be necessary to move the instrument to a completely shielded room to eliminate the unwanted pickup. ▲

(Editor's Note: A word of caution—when servicing medical electronic instruments, remember that the results obtained from their use may well affect human lives. Make doubly sure that any unit returned to service is in perfect operating condition.)

by Les Deane

New Signal Seeker

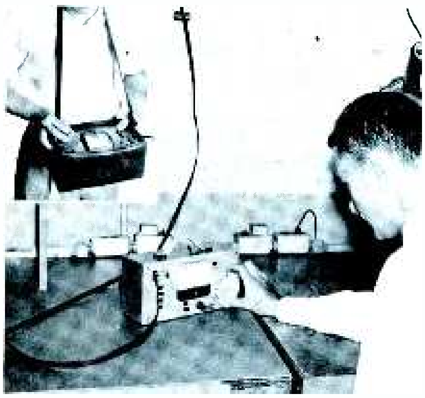


Fig. 1. Jerrold's field-strength meter gives readings directly in microvolts.

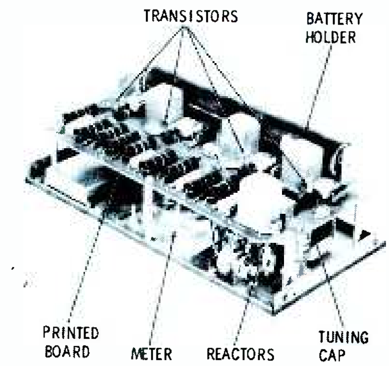


Fig. 2. The TMT has transistor circuits mounted on a printed wiring board.

The transmitted signal from a TV station is something we can't see or touch, but it is all-important to television operation. Thus, it's quite natural that a device which can distinguish between different transmitted signals, and also measure their magnitudes, should become a part of the serviceman's basic stock of test equipment.

One of the latest instruments in this category is the Transistorized TV Field-Strength Meter pictured in Fig. 1. The Model TMT is a direct-reading instrument produced by Jerrold Electronics Corp. of Philadelphia.

With size and weight to match that of the average vacuum tube voltmeter, yet completely self-powered, the TMT is mighty handy on calls that require checking signals from rooftops, vehicles, and other locations where portability is a must. The meter comes complete with instruction manual, batteries, and 72-ohm connector. A weatherproof carrying case with neck strap is available as an accessory.

Specifications are:

1. *Power Requirements—four self-contained 1.5-volt cells, operating life approximately 200 hours, standard Size "C" replacements available, battery calibration mark on meter scale.*
2. *Frequency Range — continuously tuned for VHF channels 2 through 6 and 7 through 13, channel indicator knob on front panel; meter detects video carrier strength.*
3. *Sensitivity—from 100 microvolts at 75 ohms to 2.0v full scale; 2 meter scales and 3 attenuators provide 8 microvolt ranges plus separate db scales; accuracy ±3 db on any range.*
4. *Input—either 75-ohm coaxial or 300-ohm balanced line.*
5. *Size and Weight—10½" x 5½" x 4½"; 4½ lbs.*

The most impressive feature of this new Jerrold unit is its compact, portable design. To me, an instrument of this size, capable of accurate direct readings, represents an engineering accomplishment. (The term "direct reading" means the meter has been calibrated to indicate actual signal strength rather than relative readings.)

After removing the TMT chassis from its case (see Fig 2), I discovered that a single printed board employing four transistor circuits contributes to its compact design. The tuned input circuits, which accommodate both 75- and 300-ohm leads, couple the signal through a switch-attenuator network to the RF-mixer section. Four stages of amplification follow, each employing a 2N185 plug-in transistor. After amplification, the signal is then detected and applied to the panel meter. AVC voltage from the second detector is also fed back to the RF-mixer stage to stabilize gain.

When checking out the antenna distribution system in our lab, I found the instrument's operating procedures relatively simple.

The first step called for a calibration and battery check. I turned the meter on and held the BAT. CAL. switch, located directly below the meter, in its CAL position. I then manipulated the small knob at the left of the switch until the meter needle came to rest over the red CAL line on the lower arc of the scale.

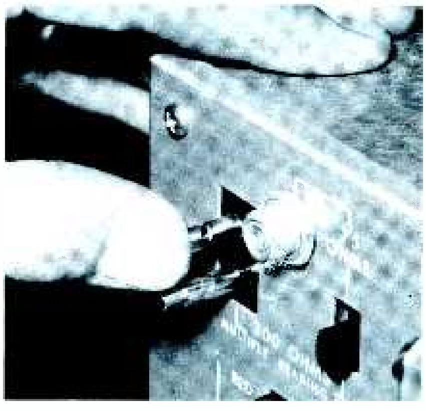
With the instrument calibrated to available battery voltage, I set the input for minimum sensitivity by placing all three attenuator switches in their ON or X10 positions. The METER SCALE switch, also located on the front panel, has two positions. One is labeled RED and the other BLACK, corresponding to separate red and black scales on the meter. The red scale represents a range of 0 to 300, while the black has a full-scale indication of 1000. Placing this switch in the BLACK position, I was then ready to connect the signal line.

Since I was using a conventional 300-ohm lead, I flipped the input impedance switch to the 300-ohm position and connected the line to the two convenient terminals on the front panel. To do this, you merely press in on the end of each terminal as shown in Fig. 3, place the wire in the notch, and release. Incidentally, when the input switch is in the 300-ohm position, all meter readings must be multiplied by 2. This is not the case, however, for 75-ohm inputs.

To pick up the transmitted signal for each active channel, I placed the high-low band switch (labeled 2-6/7-13) in its proper position and slowly rotated the large tuning knob until I noticed a deflection. When I was unable to obtain a deflection on certain channels, I removed the attenuators one at a time until the signals produced usable readings. Aside from microvolt measurements, the meter also features a separate db scale for comparison purposes. (Zero db equals 2 mv across 300 ohms, or 1 mv across 75 ohms.)

As I became more familiar with the Model TMT, I was able to determine direct microvolt readings immediately. I simply took three factors into consideration simultaneously: the position of the meter scale switch (red or black), the times-2 factor for 300-ohm inputs, and the settings of the X10 attenuation switches. Actually, this mental calculation is much simpler than it sounds.

Many servicemen associate a field-strength meter only with antenna installations, but it's surprising how many applications there are for this instrument in isolating causes for such troubles as snowy pictures, overloading, lack of signal on certain channels, ghosts, weak picture or sound, poor sync, and interference of various descriptions.



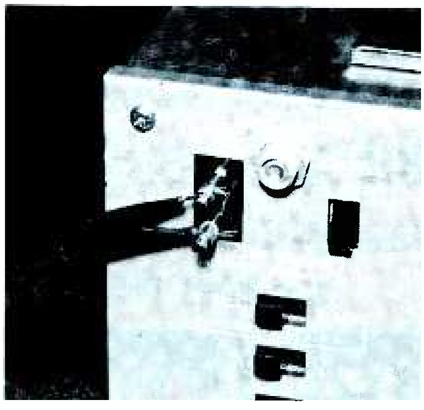


Fig. 3. Spring-loaded 300-ohm input connectors securely hold twin lead.

When working with the Jerrold instrument in the lab, I noted that an accurate reading could not be obtained if the meter was in close proximity to an operating TV receiver. The unit is very sensitive to the horizontal synchronizing signal, and therefore readily picks up any horizontal sweep radiation. This factor can be used to good advantage, for by placing the Model TMT near a set, you can determine whether or not the horizontal sweep circuit is functioning. If the circuit is operative, the meter needle will deflect to some degree regardless of the position of the meter's channel-tuning knob.

VTVM With Transistor Test

The Model 470 Electronic Volt-Ohmmeter, manufactured by Hickok Electrical Instrument Co. of Cleveland, is being used in Fig. 4. In addition to voltage and resistance ranges well suited for radio and TV troubleshooting, the 470 has a special low-voltage range for measuring sensitive bias potentials used in typical transistor circuits. The instrument comes complete with battery and AC-DC probe.

Specifications are:

1. *Power Requirements — 105/125 volts, 50/1200 cps; power consumption 15 watts at 115 VAC; one self-contained 1.5-volt battery.*
2. *AC Voltmeter — rms ranges of 0 to 1.5, 5, 15, 50, 150, 500, and 1500 volts; peak-to-peak ranges of 0 to 4, 14, 40, 140, 400, 1400, and 4000 volts; input impedance 3 megohms shunted by 150 mmf; frequency response from 30 cps to approximately 3 mc.*
3. *DC Voltmeter—ranges of 0 to 1.5, 5, 15, 50, 150, 500, and 1500 volts plus a special 0 to .5-volt range; input resistance 10.5 megohms; zero-center scale, isolation probe, and polarity reversal switch provided.*
4. *Ohmmeter—ranges of R x 1, 10, 100, 1K, 10K, 100K, and 1 meg; center scale 10; zero- and ohms-adjust controls on front panel.*
5. *Size and Weight—7" x 6½" x 3¾"; 5½ lbs.*

Fig. 4. Hickok 470 has .5-volt range to check transistor-radio bias voltages.

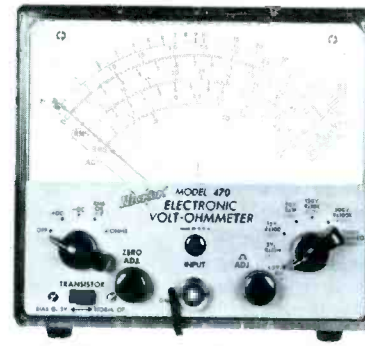


Fig. 5. Meter face of new VTVM extends over almost entire width of case.

The outward appearance of this VTVM suggests somewhat of a new look in meter design for this company. Small in size, and wider than it is high, the unit is housed in a black phenolic case with a leather carrying strap at the top and four hard rubber feet on the bottom.

You can see from the photo of Fig. 5 that the scales are well spread out, forming a large easy-to-read face across the entire top half of the meter. The control panel is a gold-colored metal plate which occupies the lower section. All lettering and trim is in black except for peak-to-peak scale markings and range values, which stand out in bright red. In the lower center of the panel, you'll find a screw-on type connector for the input cable, and a ground lead which is permanently attached to the instrument.

Taking a close look at the meter face, I noted that scale functions are identified at the left end of each arc, while full-scale indications for multiple ranges are shown in small boxes at the right end. These notations leave no doubt as to which scale to read when any range is selected.

Last, but not least, you'll find a simple slide-type switch labeled TRANSISTOR in the lower left corner of the front panel. Before reading the manual, you might

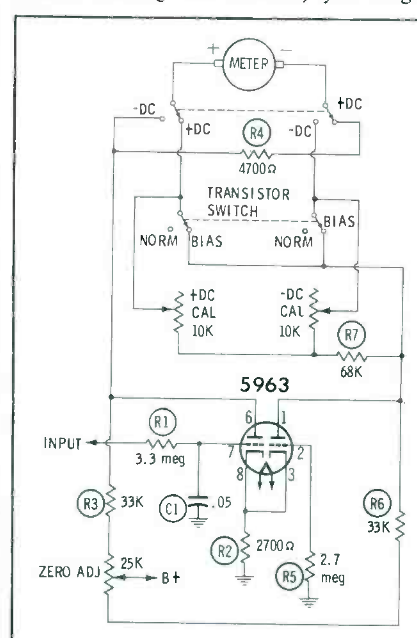


Fig. 6. The DC circuit of Model 470 includes a special *transistor* switch.

wonder as I did—is it a transistor checker, too? Well, I'll say this much, it can certainly help you locate troubles in a transistor circuit.

When the switch is moved from NORM to BIAS position, the sensitivity of the lowest DC range is increased by converting the full-scale deflection from 1.5 volts to only .5 volts. On this extra-low range, each division of the DC scale represents only 1/100 of a volt. Thus, transistor bias potentials which fall in this range can be measured very accurately with little or no interpolation.

The DC measuring circuit associated with the TRANSISTOR switch is shown in the partial schematic of Fig. 6. Under normal conditions, with the range selector in its lowest position, one of the DC calibration controls (depending on the polarity chosen) and R7 are connected in series with the meter resistance at all times. With the transistor switch in its BIAS position as shown, however, the CAL. controls and R7 are shorted out and the meter movement is three times more sensitive.

Although the range selector remains in the 1.5V position for this operation, you must refer to the 0 to 5 volt scale and divide the measured indication by 10. When actually using this feature of the 470, I noted that random pickup often produced a slight amount of meter deflection, due to the high sensitivity involved. To overcome this condition, I found it necessary to short the input probe to the ground lead and use the ZERO ADJ. to zero the meter before taking any measurements.

Pocket-Size Generator

The small unit in the foreground of Fig. 7 is the Model HG104 Harmonic Generator, a new addition to the line made by SENCORE, of Addison, Ill. Especially designed for troubleshooting transistorized and printed-board sets, the instrument is essentially a noise generator with an output satisfactory for signal tracing RF, IF, audio, and video circuits. With the TRC4 Transistor Checker and PS103 Power Supply, this unit rounds out Sencore's line of transistor-radio servicing equipment.

Specifications are:

1. *Power Requirements—two self-contained 1.5-volt batteries, standard Size "C" replacements available; on-off switch provided on panel.*
2. *Output Frequency—fundamental of approximately 1000 cps with harmonics representing RF, IF, and audio ranges; RF and IF signals effectively modulated by 1000-cycle note; RF-audio frequency compensation switch provided.*
3. *Output Level—variable by separate output control on front panel; output test leads attached.*
4. *Test Applications — signal-tracing transistor radios as well as conventional and auto radios, hi-fi systems,*

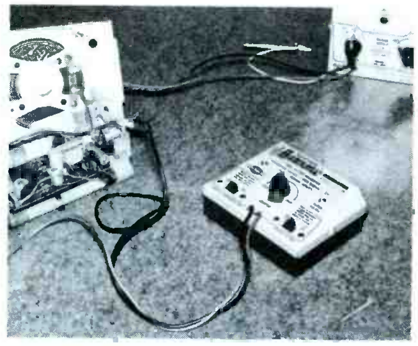


Fig. 7. Troubleshooting portable radio with the aid of the Sencore HG104.

and AF amplifier and picture circuits of TV receivers.

5. *Size and Weight—4½" x 3½" x 1¾"; 13 oz.*

In my examination of the Harmonic Generator, I put it to several tests by actually trying to isolate simulated troubles in a number of portable radios. Starting at the speaker, you merely inject the generator output into each stage as you proceed toward the front end. If the 1000-cycle note heard in the speaker drops out or weakens, the stage following the test point is defective.

When working on small printed-wiring boards such as those used in transistor radios, I found it convenient to clip the "hot" generator lead to one end of a soldering aid. This made it much easier to probe these delicate wiring jungles. I also noted in some cases that it's best to short out the radio antenna by wrapping a piece of solder around the loopstick.

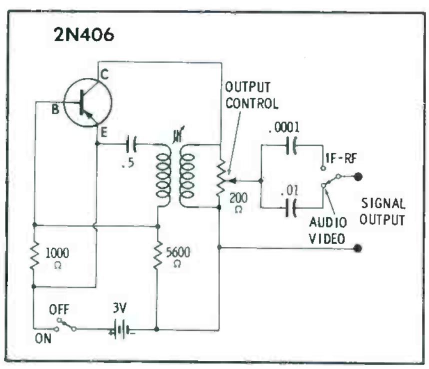


Fig. 8. Complete schematic of Sencore Transistorized Harmonic Generator.

This tends to kill any antenna pickup from the generator, and permits a more accurate point-to-point check in the RF or oscillator circuits.

When I used the unit to signal-trace the video stages of a TV receiver, I discovered that its output signal produced a number of dark horizontal bars on the screen—provided, of course, that the circuits were functioning. By adjusting the vertical hold control, I noticed that the bar pattern could be made stationary, thus forming a test pattern for checking linearity. Although the FM sound detector of a TV receiver shows little response to the Harmonic Generator's signal, I found that I could signal-trace from the output side of the detector to the speaker with the HG104.

After proving out some of these sug-

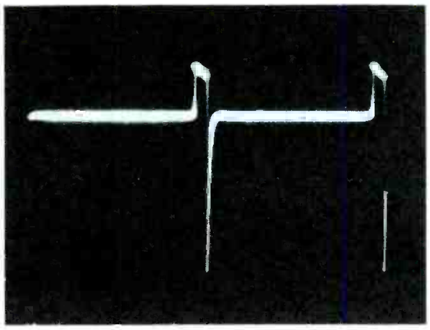
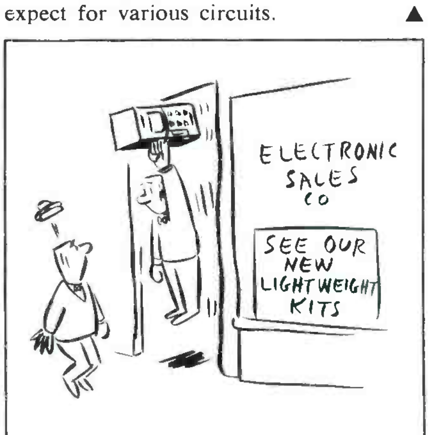


Fig. 9. The output signal of the HG104 has this unusual-looking waveshape.

gested applications, I decided to investigate the instrument's theory of operation. The unit itself employs a 2N406 transistor in a simple blocking-oscillator circuit (see Fig. 8), and is powered by two "C" size flashlight cells. The base or fundamental frequency of operation, which is not critical, is somewhere in the vicinity of 1000 cps. (When I made an accurate measurement of this primary signal for the particular unit I was examining, I found it to be 720 cps.) Although the core of the small transformer is adjustable, changing the tuned circuit is not advised. The waveshape of the fundamental is as pictured in Fig. 9. During the sharp rise and fall periods, bursts of RF energy are generated. These so-called groups of harmonics occur during every cycle of the base frequency, and effectively represent mixed audio, IF, and RF signals.

Since the output signal contains a high degree of odd and even harmonics, the signal will be passed by all amplifiers, tuned or otherwise. The 200-ohm control across the transformer varies the output amplitude, while the two capacitors serve to govern the output frequency ranges. With the output selector in the AUDIO-VIDEO position, the .01-mfd capacitor permits the entire signal to develop across the output; however, in the IF-RF position, the 100-mmf capacitor limits the output to the higher-frequency components.

The main advantage in using a portable generator like the HG104 is that it permits quick and easy localization of troubles by signal-tracing. The operating instructions for the instrument include a simplified chart which tells you how to set up the generator and what results to expect for various circuits. ▲



Brightness and Contrast

(Continued from page 26)

ing it, keep the brightness control at a low setting so that you can more readily gauge your progress in "peaking" screen brilliance.

After making any repairs which result in a significant change in boost or high voltage, be sure to check the ion-trap adjustment; a slight shift in the magnet's position may brighten the picture to a noticeable degree.

A dirty screen might seem to be a rather obvious trouble to be included in the above list, but many people underestimate its effect on picture brightness. One good way of spotting a filthy safety glass is to look at it from almost directly overhead while the receiver is operating. The thickness of the grime in mid-screen can be judged by comparison with the borders of the glass panel, which tend to remain fairly clean in most receivers. Enough film may have accumulated to reduce the transparency of the glass by as much as 50%!

Item 6 on the list of possible brightness - stranglers (low heater voltage throughout the set) is most

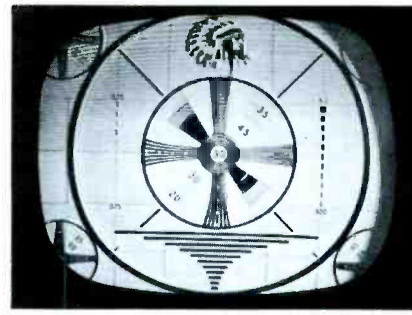


Fig. 2. Eliminate neck shadow with centering adjustments—not with ion trap.

likely to attack series - string receivers, and can usually be traced to a stubborn dropping resistor in the heater circuit. All too often, this bad actor will cook along for several months before finally making up its mind to burn out. The receiver will make a vain effort to continue operating, but the picture will constantly grow sicklier in appearance.

At last we come to the fateful situation where you must decide whether or not all the available electrons (except for a few stragglers) have finally been wrung out of the tired filament of an aging picture tube. Among the usual signs of approaching doom are (1) extreme slowness in reaching full brightness, and (2) a tendency of the whitest areas in the picture to wash out — i.e., lose detail and tend to darken — as the brightness control is advanced. But since these symptoms are not *always* due to approaching CRT failure, you'll be doing the customer a favor by testing the tube just to make sure it *is* bad.

How's the Contrast?

Once you are convinced the set has normal brightness — and a simple turn of the brightness control may be enough to settle this question to your satisfaction — you can proceed to find out if contrast is normal.

The degree of contrast is directly determined by the peak-to-peak amplitude of the video signal applied to the picture tube. If a change from "white" to "black" in the picture information causes a great enough voltage swing to drive the picture tube from saturation to cutoff, the strength of the video signal is just right for full, normal contrast. Any further increase in signal amplitude merely causes distortion in the picture, usually recognized as a blurring together of detail in both the brightest and darkest areas. Of course, insufficient signal strength results in a weak, "all-gray" effect in the picture. Not much can be done about this latter condition in fringe areas, where the available RF signals are too feeble.

A novice, when trying to remedy a lack of contrast, will often replace the contrast control as the first step in troubleshooting. More experienced technicians are apt to sneer at this naive approach, since they know how many other faults can cause the same symptom. But the novice occasionally has the last laugh! Contrast controls are known to go bad every now and then. The resistive element need only be dirty or pitted to cause trouble; the dirt can produce arcing and intermittent loss of contact, thus creating flashes in the picture. This effect is close kin to the popping and scratching produced by a dirty volume control in the audio section.

In many receivers, the contrast control is required to carry 15 or 20 milliamperes of current. If this load is carried by a relatively minute-sized portion of the control's total range (as is the case in some sets when the control is habitually kept in the "wide-open" or minimum-resistance position), the control may actually burn out after a few years. More often than not, however, the control is found to be in perfectly good condition even though it apparently isn't doing its job. Then it's time to find out why the video amplifier isn't behaving as it should.

A typical video output stage is somewhat like a glorified audio amplifier, but it has the special ability to handle an extremely wide range of signal frequencies. In view of its wide-band requirements, the video circuit has an impressive stage gain; an input signal of only a few volts peak to peak is amplified 10 to 25 times to provide the necessary drive for the picture tube. Many sets have the contrast control located in the cathode circuit of the video amplifier, so that the DC bias on the stage can be varied in order to regulate gain. In a well-designed circuit, the output tube operates on the linear portion of its characteristic curve throughout the useful range of the control; this means signal amplification without distortion.

Other sets have a fixed-gain video amplifier — running full blast all the time, so to speak —and the contrast control is series-inserted in the plate circuit to tap off a variable percentage of the total signal for feeding the picture tube.

Many a case of poor contrast is due to some defect which cuts down the gain of the video output stage. Among possible troubles are a weak tube, deficient plate voltage, or an increase in the value of the screen resistor (resulting in lowered screen voltage). On the other hand, the output stage may put out a weak signal because it is being starved for sufficient input. This circuit seldom has enough reserve gain to compensate for abnormally low signal amplitude at the grid. Thus, you can often save a lot of time by using a scope with a calibrator to measure both input and output signal amplitudes. Divide output by input to obtain the stage-gain figure.

You may find that the video output circuit is working as hard as it can, but the detector isn't delivering enough "raw material." This is usually not the detector's fault. A more likely possibility is that one of the RF or IF stages could be lying down on the job. The trouble might even be due solely to a defect in the AGC system.

There's more to this business of AGC than you might realize — unless you've already come face to face with a tough trouble involving this circuit. After all, AGC is one of the major factors which determine the amplitude of the detector-output signal. Actual defects (such as weak keying tubes, leaky AGC filter capacitors, and changes in the values of RF-AGC delay resistors) can be repaired easily enough; but what do you do when all components and voltages check normal, yet you still suspect that the AGC bias voltage is incorrect for existing conditions?

Well, you can check to see if the AGC circuit contains a control, switch, or other device for regulating the strength of AGC output. No matter whether the control influences the operation of the whole circuit or whether it merely varies the bias of the RF stage, it must still be adjusted properly to suit local reception conditions. Just as in the case of the contrast control, there is no absolutely correct setting which will automatically result in an excellent picture. There *is* a fairly narrow range of satisfactory settings, with limits determined by the strength of signals available to the receiver. At the upper limit (too much AGC voltage developed), the weakest station signal will produce a washed-out or a snowy picture; at the lower limit (not enough AGC), the strongest incoming signal will overload the IF's and produce such symptoms as picture bending and sync buzz. Somewhere between these extremes is the optimum operating point for the AGC circuit.

Even when no means of adjustment is provided, it is sometimes to your advantage to "optimize" the AGC system by slightly changing certain component values. This technique is not recommended as a general practice, but it occasionally becomes necessary as a last resort when you are repairing an older set.

When stuck with a subtle AGC problem, be sure to check all available production-change information applying to the model on which you are working. Slight alterations have been made to quite a few chassis designs during the production run

— usually to improve sync under difficult conditions, but sometimes also to improve the contrast range.

The suggested changes can be tried out, and some or all of the alterations permanently made if they seem to result in improvement. Blindly installing all possible changes is not a wise procedure, because it can lead to unforeseen complications. As a case in point, listen to the recent history of a 17" Westinghouse Chassis V-2216 of about 1952 vintage. About two years ago, when the set was in the shop with a vertical sweep defect, the serviceman had considerable difficulty in obtaining positive action of the vertical hold control. He checked the production-change information and found an extensive list of alterations, including a major change in the integrator and one in the cathode circuit of the AGC keying tube, for the purpose of improving sync. These two modifications had the desired effect on vertical hold, so they were left in the set.

This year, the picture tube in this receiver (the original unit!) was finally replaced. The set produced plenty of brightness on the new CRT, but contrast was not quite up to par. In the course of checking for defects, it was discovered that the IF tubes were receiving an AGC bias potential of -2 or -3 volts even on unused channels! The various incoming signals caused -4 to -7 volts to be developed on the IF grids, and such behavior seemed definitely abnormal in view of the low to moderate signal levels present at the shop site. Then the dawn came: This is the set with the modified AGC circuit! Could the keying tube be working overtime as a result of the production change?

Checking the schematics, the serviceman found the situation as shown in Fig. 3. The alteration had consisted of juggling the values of R51 and R53 in the voltage divider, which determines the value of the AGC cathode voltage. In the original circuit (Fig. 3A), the cathode was maintained at 105 volts above ground. Since the grid was at only 80 volts, this meant 25 volts of bias on the tube under no-signal conditions—evidently too much to permit adequate conduction in response to input signals. With a chronic shortage of AGC voltage, the set in its original form probably had a tendency toward sync clipping under some circumstances.

The resistors in the later-production circuit (Fig. 3B) were rearranged so as to decrease the cathode potential to about 90 volts; thus, the bias on the keying tube was reduced to 10 volts. In this particular set, the cure seemed to be about

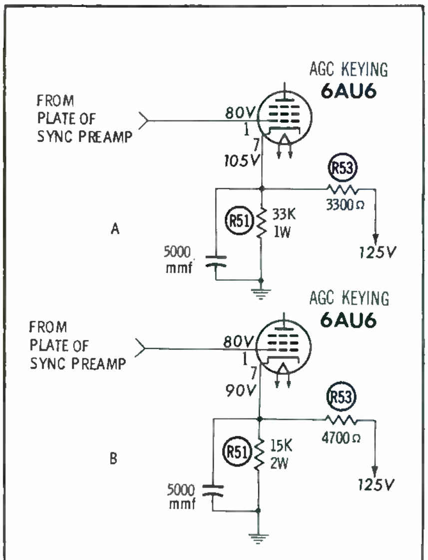


Fig. 3. Production change in AGC circuit of Westinghouse Chassis V-2216.

as bad as the ailment. You might say the tube became too eager to conduct when an input signal (even random noise) was applied to the grid. As a consequence, there was an oversupply of AGC bias voltage which led to a slight deficiency in contrast.

The serviceman recalled that the set had originally been equipped with *half* of the AGC-circuit change; R51 was 15K (as in the late version), but R53 was 3300 ohms (as in the early version). When the circuit was restored to this hybrid condition, the cathode voltage rose to 95 volts. Noticeably better contrast was obtained in this way, without any sacrifice of sync-signal quality and also without a great deal of effort. In a set this old, the serviceman was content to let well enough alone!

When a contrast trouble like the one above is being investigated, the importance of considering the available signal strength cannot be overestimated. The following is a case history which illustrates how a misunderstanding can arise between the serviceman and the customer over a contrast problem:

Soon after a set was serviced in the shop to correct a sweep trouble, the customer called back to complain of low contrast. As things turned out, this particular shop was in an area of high signal strength and had a rather—er—ah—shall we say *informal* antenna setup. The bench technician had noticed that the picture wasn't perfect, but he attributed this to the usual flaws in reception which were characteristic of the location. Consequently, he overlooked the trouble. But he caught it during the set's second trip to the shop! A series peaking coil on the output side of the video detector had opened. In parallel with this unit was a resistor which permitted a fair amount of video and sync information to reach the output tube. Since signals were plentiful (but rough) in the shop, the technician never even suspected the detector-circuit defect; but it quickly showed up when the set was operated in the customer's home at lower signal levels.

Why didn't the man who returned the set notice this fault during the post-delivery check? Bet he's still explaining this to his boss! ▲

Microphones

(Continued from page 31)

the center leg, following the path of least resistance, and through the outer legs to the south pole. On the next half-cycle, the center leg is moved closer to the south pole. Magnetic flow is then up through the outer legs and down through the center to the south pole, reversing the direction of flow through the center leg. These changes of reluctance cause the signal to be induced into the coil.

Because the coil is stationary, it may be wound for either low or high impedance. Its main advantage, however, is ruggedness. The variable-reluctance design was developed during World War II for use by the armed forces. Its fidelity is comparable to that of average dynamic types, but it lacks the wide-range response of the more expensive dynamics. Some recorder manufacturers are beginning to furnish magnetic mikes with their equipment instead of crystals.

Ribbon Microphones

The variations in pressure above and below normal form the pressure components of a sound wave. Most microphones respond to these changes, and are thus pressure-operated. As the air particles move back and forth between the low and high pressure points, they have direction and speed. These motions, called velocity components, are the forces to which a ribbon or velocity mike responds.

Ribbon mikes cost more than most other types but are worth it if linear, wide-range response is desired. Basic construction is shown in Fig. 3, where a lightweight, corrugated *Duralumin* ribbon is suspended, with almost no tension, between the pole pieces of a magnet. As sound waves strike the ribbon, it moves back and forth in the magnetic field and causes a signal voltage to be induced. Output is taken from the ends of the ribbon.

A ribbon mike has low impedance and relatively low output signal, but good frequency response. It is not affected by temperature, humidity, or changes in atmospheric pressure. Two reasons for its superior response are that it has no diaphragm to add weight, and that the case is open in construction, freeing the unit from resonances which would create annoying response peaks. The ribbon has its own resonant frequency, but this is designed to be lower than the normal audio range.

Bass response is usually quite strongly accentuated when the mike is placed less than about 18″ from the sound source. Some models contain a two-position switch marked VOICE and MUSIC, with the bass response attenuated in the VOICE position. Ribbon mikes are bidirectional,

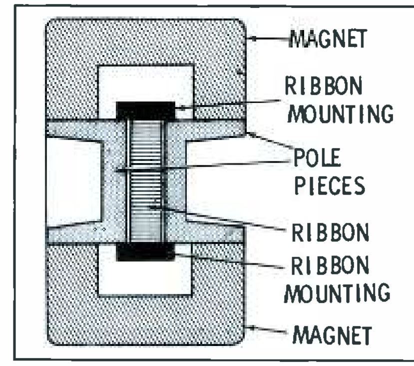


Fig. 3. Lightweight ribbon, vibrating in a magnetic field, produces signal.

response being almost exclusively from directions perpendicular to the flat sides of the ribbon; however, a unidirectional pattern can be obtained by closing in one side of the case.

Ribbons are essentially indoor mikes — not because they won't function outside, but because there are too many precautions to be observed. They are fragile and are not suitable for portable use. Wind can easily damage the ribbon; in fact, it is possible to cause damage merely by breathing directly into the unit. This brings up an important consideration for all mikes: Do not blow into the mike for testing. It is much better to speak into it, or to tap the case lightly with a pencil.

Condenser Microphones

Condenser mikes will be found only in the most discriminating applications. They have the best response of all, but their extremely low output requires the use of a preamp, usually built into the case itself. This also necessitates a power supply, making the condenser mike the most expensive of all. Basic construction of a condenser mike is illustrated in Fig. 4.

It is actually a capacitor, comprised of a fixed light-metal plate and a much heavier movable plate, with DC voltage applied across the whole unit. Sound waves cause the moving plate (the diaphragm) to vibrate, varying the distance between the plates. With a fixed DC voltage applied, the changes in capacitance cause extremely small charge and discharge currents to flow. These currents develop the desired output signal across a resistance connected in series with the applied voltage. An increase in pressure on the diaphragm causes the capacitance of

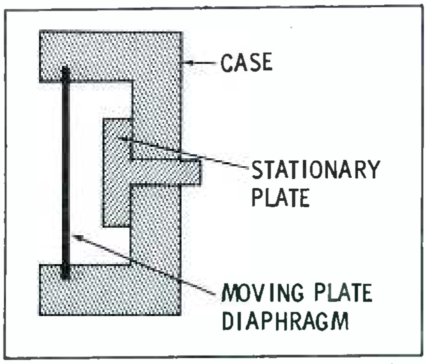


Fig. 4. Output is developed by varying capacitance of condenser microphone.

the mike to be increased, and the voltage to be decreased, according to the formula $E = Q/C$ (Q remains the same). Even with a large load resistor, the output is very small; thus, amplification is needed so that sufficient signal-to-noise ratio will be obtained at the amplifier input.

In the early days of radio, condenser mikes were extremely bulky. Today's units are much smaller, which greatly adds to their usefulness. Many of the very small mikes developed for TV work are of the condenser variety.

Mike Placement

Placement of microphones is a subject in itself, and in professional recording and broadcasting much time is devoted to it. For communications work, PA systems, and nonprofessional recording, we usually do not have the time nor the facilities for extensive experimentation. However, by following a few simple rules, very good results can be obtained with minimum effort.

One thing we should remember is that a microphone responds to all sound waves, since it has no way to differentiate between speech (or music) and noise.

Best results are obtained when there is only a small amount of reverberation (echo), but this effect should not be eliminated entirely because reproduction then sounds dull and flat. Acoustic tile, draperies, carpeting, and even people absorb sound waves instead of reflecting them, and thus decrease the echo. Where reverberation cannot be controlled, a unidirectional mike is probably best because of its discriminating pickup pattern. It is also an asset in eliminating crowd noises at public gatherings. For outdoor pickups, a directional mike may reduce traffic and crowd noises, as well as interference from wind. Mikes should always be used in such a way that the wind does not blow against the diaphragm. This precaution decreases noise pickup and also the chances of damaging the mike. With PA systems, acoustic feedback occurs when the sound waves from the speaker re-enter the mike, giving an objectionable howl or whistle. Use of a directional mike greatly reduces the effect.

Distance from the sound source is also important to mike placement and, as would be expected, output increases as the distance to the source is lessened. For some applications, we should speak directly into the mike at close range. This is especially true when using carbon and crystal mikes in any of the communications services, where the best possible signal-to-noise ratio is supremely important. It also applies to the use of PA systems under certain circumstances. For quality in music and speech, however, greater distances should be used—the actual distance depending upon the program material. Some bidirectional and unidirectional types tend to emphasize low frequencies at close range. Others have variable response, depending on the angle at which sound waves strike the diaphragm. All of these factors should be taken into consideration when setting up microphones.

Some installations may require more than one mike. Here, too, a few rules may help. Always use as few mikes as possible in order to minimize complexity of the installation and interaction between mikes. Again, a directional mike may help, this time in decreasing the possibilities of sound waves actuating two mikes at slightly different times. Where it is possible to do so, several mikes can be fed into a mixer circuit with a separate fader for each input. Through proper control, the sound balance of the signals can be adjusted with respect to each other. Also, any mike not being used can be switched out to reduce noise and interference. Naturally, the final arrangement will be dictated by the equipment available.

Impedance Matching

In most cases, the input impedance of an audio amplifier is high, so any high-impedance microphone can be connected directly into it. However, the connecting cable cannot be as long as for low-impedance types, because, for a given length of cable, a low-impedance mike provides better high-frequency response and reduced noise and hum pickup. On the other hand, low-impedance types develop a low-voltage, high-current signal. If this signal is fed directly into the high-impedance input circuit of the amplifier, virtually no output will be produced.

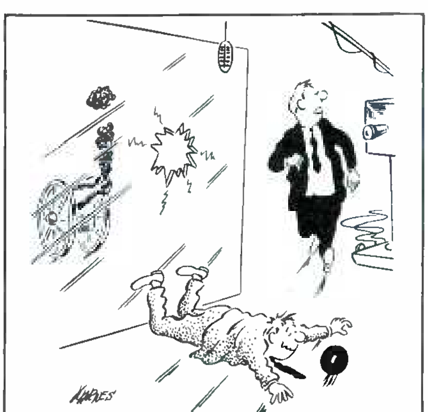
Normally, a step-up matching transformer is used to furnish the voltage drive required by the amplifier grid circuit. For example, the output of a 50-ohm mike is fed into a transformer with a turns ratio of, say, 100 to 1. The impedance ratio of a transformer is equal to the turns ratio squared, so a secondary impedance of 100 squared times 50 (or 500,000 ohms) is obtained. Since voltage step-up is numerically the same as the turns ratio, the signal voltage actually applied to the amplifier grid is 100 times as great as the microphone's output voltage.

A larger turns ratio would provide more voltage, but the impedance might then be too high and could work with the input capacitance to reduce high-frequency response. A high-impedance secondary would also have high inductance, which could resonate with the input capacitance at audio frequencies. For best results, dynamic units should be worked into an impedance of about 250,000 ohms.

Condenser and crystal mikes have high impedances, so they can usually be connected directly into the amplifier grid circuit. Both act as capacitances, so to eliminate any possibilities of resonance, they should not feed into a transformer. High-resistance loading gives best results. Resonant peaks, with any type of microphone, can often be minimized by shunting the transformer secondary with a resistance. It should be small enough to even out the response, but large enough to prevent excessive signal loss.

Mike Connections

When connecting the microphone to the amplifier, always use shielded cable to minimize stray pickup. Two types of cable are available and the one used depends upon the actual installation. Most systems use a shielded, single-conductor cable where the shield serves as the grounded side of an audio line feeding an unbalanced amplifier input.



"I knew they'd carry that 'Invisible Shield' thing too far."

More expensive systems use a shielded, two-conductor balanced line and a balanced amplifier input. Audio is carried by the two conductors, and the shield is grounded at the center tap of the amplifier input transformer. Advantages of this system are less danger from shock, and reduced pickup of hum, noise, and interfering signals.

Most microphones and their mounting stands are metallic, and they may be a source of shock hazard if not properly grounded. The usual ground path is through the shield of the connecting cable, which connects to both the frame of the mike and the ground at the amplifier input. Separate grounds at the mike and the amplifier should be avoided because hum may possibly be created by the potential difference between the two.

In some systems, reversal of the power plug may reduce the shock hazard, as well as hum and extraneous pickup. A special hazard may exist when two separate sound systems are used, because touching both mikes simultaneously may result in a shock. Reversal of one power cord may reduce this risk.

Microphones should be treated with extreme care if they are to do their job dependably. They should be stored in dustproof containers when not being used. They should not be jarred, dropped, allowed to get wet, or exposed to magnetic fields. And they should be mounted on a stand or some other device in order to minimize the possibilities of damage. Unless the owner knows what he is doing and has the proper equipment, microphones should be repaired only by a company set up for that express purpose, or by the manufacturer. ▲

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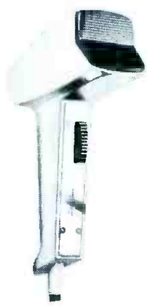
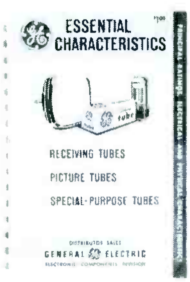
Dynamic Microphone (42 I)



A hand-held, omnidirectional dynamic microphone intended for communications and public-address applications, the American Microphone Model D-11 has a frequency response of 50 to 11,000 cps and an output level of −57 db with reference to 1 milliwatt at 10 dynes/cm². Output impedance is high but becomes low with the change of a connector pin. A thumb switch offers "press-to-talk" or detent action. Price is $39.50.

Tube Manual (43 I)



The latest edition of General Electric's *Essential Characteristics* tube data handbook (260 pp.; $1) lists specifications for 399 types of picture tubes as well as 1392 receiving and special-purpose types. Nearest American equivalents of 95 foreign tubes and standard prototypes of ruggedized "Five-Star" types are also given. Maximum screen wattage ratings are included in data listings where applicable.

Solderless Terminals (44 I)

Plastic insulating sleeves on Vaco solderless terminal connectors are color-coded to indicate the range of wire sizes suitable for use with each connector. A total of 21 types are manufactured. A dollar's worth of connectors, all of the same type, may be bought in a plastic *$ Pak*; also obtainable is a $4.25 kit including assorted lugs, a crimping tool, and a plastic carrying pouch.

High-Temperature Silicon Diodes (45 I)

A silicon diode rectifier, able to operate at ambient temperatures up to 70° C, is now available from International Rectifier for use in small-screen portable TV sets or in any other equipment which may tend to "run hot." Two versions are supplied—No. 2E4 (200 ma) and No. 5E4 (350 ma)—both with PIV of 400 volts. The units are insulated and also sealed against humidity.

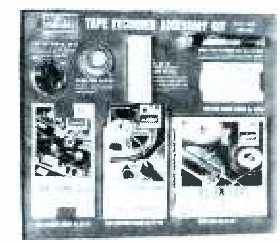
Transistorized PA Amplifier (461)

The Bogen Model BT25 transistorized public-address amplifier produces 25 watts of audio power. At full output, the current drain from a 12-volt battery power supply is 3 amps. Two individually-controlled input circuits are provided, and the input signals can be mixed. Case dimensions are 6⅝" x 3¾" x 4⅜"; weight is 3½ lbs.; list price is $120.

Ceramic Cartridge for Stereo (471)

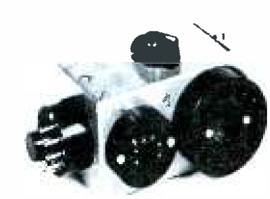
The Sonotone "8T" ceramic stereo cartridge has been redesigned to obtain greater compliance (now 3×10^{-6} cm/dyne) and lower tracking force (now 3 gm for professional-type tone arms and 4 gm for changers). The new model, designated 8TA, costs $14.50 with 0.7- and 3-mil or dual 0.7-mil sapphire styli, and $19.50 with 0.7- and 3-mil diamond tips.

Tape Accessories (481)



Eight items are included in the Audiotex No. 30-148 *Tape Recorder Accessory Kit:* A *Kleen-Tape*, which cleans the recorder heads while playing through the machine; *Tape Threading Leaders*; reel labels; cueing tabs which fasten to tape; a vial of recorder oil; tape-splicing device; supply of splicing tape; and clips for holding end of tape on reel.

Adapter for CRT Tester (491)



A new CA200 *Color Adaptor*, designed for plugging into the Vis-U-All Model V200 *CRT Tester-Reactivator*, provides the necessary facilities for testing three-gun color tubes and flexible-pin 110° tubes. A three-position switch selects individual color guns or different 110°-tube filament voltages (2.5, 6.3, or 8.4). Dealer net price is $13.50.

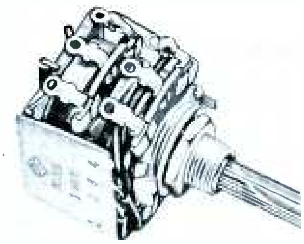
Record Cleaning Kit (501)

Antistatic cleaning fluid deposits a protective film on the surfaces of phonograph record grooves. To produce an exceptionally thin and evenly spread film (considered desirable for best results on stereo discs), Duotone has developed a new cleaning formula. A spray can of this fluid is packaged in a record-cleaning kit with two deep-pile applicator pads.

Citizens' Band Radio (511)

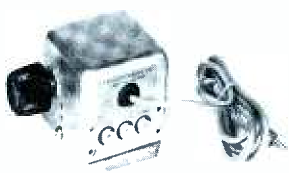
A fixed-tuned transmitter-receiver for the new 11-meter Citizens' Radio Service band, the Utica Communications' *Town & Country*, can operate on 117 VAC or from a 6- or 12-volt battery. These units cost $149.50 each, complete with microphone and whip antenna. Mounting brackets, headsets, and other accessories can also be supplied.

Tone-Compensating Volume Control (52 I)



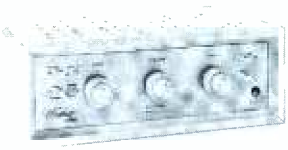
Dual, ganged Centralab *Compentrols* can be installed in a stereo amplifier to provide automatic compensation for the Fletcher-Munson effect (progressively poorer response of the human ear to low- and high-frequency sounds as volume level is decreased). Two values—500K and 1 megohm—are furnished as direct replacements for ganged pairs of regular volume controls.

Stereo Gain Control (53 I)



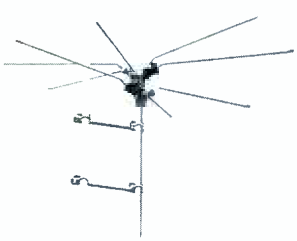
A plug-in master gain control is being manufactured by B & M as an accessory item for use with stereo amplifiers not already equipped with ganged volume controls. The device is connected between the preamp and power amplifier stages by means of phono patch cords. Its metal case measures 2⅛" square by 2" high and may be mounted in any position.

(Dual-Channel) Amplifier (54 I)



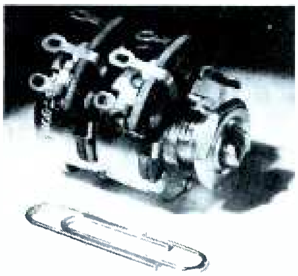
The Shell Electronics Model 1010P *Westbury* stereo amplifier is a self-contained unit including dual-channel 10-watt amplifiers, low-level preamp stages with concentric bass, treble and volume controls, and a full-wave power supply employing a 6CA4/EZ81 tube. Output impedance is 8 ohms. Both power amplifiers can be placed in parallel for monophonic operation.

FM Antennas (55 I)



The 8-element JFD *Stereo-Cone* FM radio antenna is said to have a fully omnidirectional polar pattern with no "blind spots." Two styles are available—an "Attach-It" unit (No. AFM150, $13.95 list) for side-mounting on an existing TV antenna mast, and a complete kit (AFM100, $15.95) including all accessories needed for a separate installation. Both styles have a gold-anodized finish.

Stereo Balance Controls (56 I)



Here's a "reverse twist" on the idea of ganged controls for stereo. Clarostat Type AD47 units are tandem-mounted pairs of identical Series 47 carbon controls, simultaneously driven by one shaft so as to increase the resistance of one section while decreasing that of the other. This arrangement is useful for equalizing (balancing) signal or bias voltages in the two stereo channels.

$100.00 CASH REWARD

. . . for the location of any of the following stolen receivers:

Admiral, serial No. 6855-926, 6621-425, 5920373, and 6436720; GE, serial nos. 2407583582, and 423905; Philco, serial nos. 20560, C562865, BB71172, EE421052, AC65298, and AA36315; RCA, serial nos. 9358440, 4614228, and A962946; Sylvania, serial nos. 520100173259, 54131342146, 54130113822333, 537306932049, and 180691; Muntz, serial no. 24972.

Contact by phone or wire, Carl C. Schmidt, Inspector of Detectives, Indianapolis Police Dept., Indianapolis, Ind.

INDEX TO ADVERTISERS

OCTOBER, 1959

Latest Jackson Tube Test Data

TUBE TYPE	FIL.	MODEL 648 CIRCUIT D.	E.	PLATE TEST	SEC.	MODEL 49 A.	B.	C.	D.	CATH. SHORTS	E.
6EA5	6.3	A234	AC156	18XZ	P	6.3	3	2X	156	7	30
6EB5	6.3	235	7	65X	D	6.3	3	-	2X	5	47
		C123	4	65X	D	6.3	3	-	7X	5	47
6ES8	6.3	123	A45	16YZ	T	6.3	4	9X	12	3	28
		127	A89	16YZ	T	6.3	4	9X	67	8	28
6FV6	6.3	A123	AC456*	70V	P	6.3	3	2X	156	7	31

TUBE TYPE	SEC.	HEATER	MODEL 658 CIRCUIT H-K	P-G	PLATE	GRID TEST	HEATER CURRENT
6EA5	P	6.4J	124	ac356	32R	10WY	
6EB5	D	6.4J	123	4	17U	WX	
	D	6.4J	125	7	17U	WX	
6ES8	T	6.4J	127	a89	20S	15WY	
	T	6.4J	123	a45	20S	15WY	
6FV6	P	6.4J	124	ac356	35S	15WY	

Latest Chart Form 648-21, 49-5, 658-1

CATALOG AND LITERATURE SERVICE

ANTENNA SYSTEMS

1I. *AMPHENOL*—Folder on redesigned line of amateur antennas for the "ham" bands. *See ad page 60.*

2I. *JFD* — New 24-page catalog of UHF, VHF, FM, and indoor TV antennas and accessories, plus hi-fi speakers and TV accessories. *See ad pages 9-10.*

3I. *MOSLEY*—Material for servicemen's use in promoting TV-FM flush-mounted wall plate outlets. *See ad page 74.*

AUDIO & HI-FI

4I. *ASTATIC*—Catalog 33-3 containing complete listing of cartridges, microphones, pickups, and needles. *See ad page 11.*

5I. *ELECTRO-VOICE* — Bulletin No. 255, "How to Choose and Place Stereo Sound Equipment for the Home," explains what you should know about stereo. *See ad page 47.*

6I. *PICKERING* — Service File of helpful, informative data on audio and hi-fi. *See ad page 82.*

7I. *RCA*—"Microphone-Select-a-Guide," with information to help you choose the right unit for any job. *See ads pages 34-35, 61, 3rd cover.*

8I. *SWITCHCRAFT* — 8-page catalog S-590 describing molded cable assemblies, adapters, and connectors, plus microphone and audio mixers for hi-fi and commercial sound applications. *See ad page 22.*

CAPACITORS

9I. *MALLORY*—New 28-page capacitor catalog in step-down wall-chart form. *See ad pages 24-25.*

CARTRIDGES & NEEDLES

10I. *CBS*—Cartridge catalog and cross-reference chart, PF-285. *See ads pages 15, 16-17.*

11I. *SHURE*—Replacement manual #59 covering phono cartridges and magnetic recording heads. *See ad page 50.*

12I. *SONOTONE*—Cartridge reference chart, cartridge replacement manual, hi-fi products catalog, and rechargeable flashlight battery flyer. *See ad page 53.*

COMPONENTS (MISC.)

13I. *SPRAGUE*—17-page Printed Circuit Replacement Manual. *See ad page 12.*

FUSES

14I. *BUSSMANN*—Completely new television fuse chart describing proper fuses to use, how they are mounted, and which circuits they protect. *See ad page 27.*

POWER SUPPLIES

15I. *ELECTRO PRODUCTS* — Short form catalog sheet describes complete line of DC power supplies. *See ad page 56.*

SERVICE AIDS

16I. *CHEMTRONICS* — Flyers describing complete line of electronic servicing chemicals, including *No-Arc* high-voltage insulator. *See ad page 86.*

17I. *E-Z-HOOK*—Convenient reference sheet titled, "How to Build the Five Most Useful Scope Probes," with schematics, mechanical component layouts, etc. *See ad page 86.*

18I. *R-COLUMBIA*—16-page illustrated catalog No. 59 containing data on a compound to stop slipping turntables, heavy-gauge steel strobe disc, magnetic-base lamp, new speaker cone cement, replacement clock-radio shaft, and many other service aids. *See ad page 74.*

19I. *ROGERS* — Literature describing new *Tel-A-Turn* TV service cradle. *See ad page 86.*

20I. *SUPEREX*—Information on new detergent lubricant for tuners and controls, new replacement flat loopsticks for Japanese radios, and TV couplers and accessories. *See ad page 22.*

SEMICONDUCTORS

21I. *PYRAMID* — Specification sheet on the S1-500 silicon power rectifier for radio and TV replacements. *See ad page 54.*

22I. *SYLVANIA*—20-page booklet with up-to-date information on line of semiconductor diodes, including characteristics and interchangeability; also a replacement guide, Form No. SD-10. *See ad pages 44-45.*

SPECIAL EQUIPMENT

23I. *ATR* — Brochure describing customized *Karadios* for small import cars and compact American cars. Eight models available. *See ad page 14.*

24I. *BULLDOG*—Catalog #EH-100 describes *Electrostrip* multiple AC outlet assembly. *See ad page 48.*

25I. *MIRATEL*—Technical specifications and prices for line of TV monitors designed for industrial, educational and other closed-circuit applications.

26I. *TERADO*—Catalog sheet on line of full-wave 6- and 12-volt battery chargers for boats, planes, autos, etc. New model plugs directly into cigarette lighter.

TECHNICAL PUBLICATIONS

27I. *HOWARD W. SAMS*—Descriptive literature on all Howard W. Sams publications covering servicing of radio, TV, hi-fi, etc. Includes data on latest books, "Video Speed Servicing, Vol. 3," "Electronics Reference Data, Vol. 2," "How to Save Time Analyzing and Tracing TV Circuits," "Basic Electricity and an Introduction to Electronics," and "Record Changer Manual, Vol. 12." *See ads pages 57, 80, 84.*

TEST EQUIPMENT

28I. *B & K*—Bulletin ST-24-R gives helpful information on how to save time and work, and make money with point-to-point, signal-injection, direct-viewing Model 1075 Television Analyst, Models 550 and 650 dynamic mutual-conductance tube testers, Model 675 automatic tube tester, and Model 440 CRT cathode-rejuvenator tester. *See ads pages 43, 67.*

29I. *DOSS*—Information on the latest in test equipment, including the *Pioneer 250* Horizontal Systems *Quantalyst. See ads pages 56, 62, 68.*

30I. *EICO*—20-page 1959 2-color catalog describes 65 models of professional test instruments, hi-fi, and "ham" gear in both kit and factory-wired form. Shows how to save 50%. Also, 4-page 2-color stereo hi-fi guide. *See ad page 38.*

31I. *HICKOK*—New 4-page brochure describing the Model 121 *Cardmatic*, the card-programmed automatic tube and transistor tester. *See ad page 49.*

32I. *SENCORE*—4-page brochure on complete line of time-saver instruments. *See ads pages 77, 79, 81, 83.*

33I. *TRIPLETT* — Catalog 39-T, with new listings on radio, television, electrical and electronic test equipment. *See ad pages 18-19.*

34I. *VIS-U-ALL* — Catalog #59A contains complete description of business-building test equipment. *See ad page 75.*

35I. *WATERMAN*—Brochure giving technical specifications and prices for complete line of oscilloscopes and accessories, including several *Pocketscope* models and the professional-type wide-band, high-sensitivity *Craftscope.*

36I. *WINSTON* — Flyers describing complete line of instruments, including an AGC circuit analyzer, intermittent condition analyzer, induced waveform analyzer, rainbow generator, dot generator, sweep circuit analyzer, and audio system analyzer. *See ad page 87.*

TOOLS

37I. *BERNS*—Data on the 3-in-1 picture tube repair tool that crimps pin and element lead to make a solid electrical connection; can also be used as screwdriver and channel selector. *See ad page 85.*

38I. *ESICO* — Information on the GUN-CHOKE, a simple and inexpensive device for reducing the tip temperature for soldering on printed-circuit or laminated boards. *See ad page 82.*

39I. *HUNTER*—Folder on an ultra-fine hole driller for drilling small holes in steel. *See ad page 82.*

40I. *VACO*—New catalogs on nut drivers and Allen-type screwdrivers, plus newly developed hand tools. *See ad page 88.*

TUBES

41I. *RAYTHEON*—Full information on the company's Bonded Dealer Program including free merchandising kit, free 90-day Repair Bonds, and dealer listings in national display ads. *See ads pages 20-21.*

How to keep your profits from going to the "dogs"!

AVOID CALLBACKS DUE TO PREMATURE TUBE FAILURE...

...when you replace a defective horizontal output tube check operating cathode current.

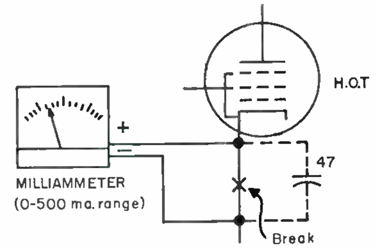
Premature horizontal output tube ("H.O.T.") failure can be caused by excessive cathode current—*higher than recommended by the manufacturer*—due to misadjustment or defective components in the horizontal output stage. Whenever you replace the "H.O.T.", protect your profits with these precautions: (1) measure "H.O.T." cathode current; (2) if excessive, find the trouble and fix it; and (3) adjust Horizontal Drive, Width, and Linearity.

Keep your hard-earned profits to yourself. Take time to check "H.O.T." cathode current. And, do as most successful service technicians do: always replace defective horizontal output tubes with *power-to-spare* RCA tubes. They pay off in fewer callbacks, finer reputation, and bigger profits.

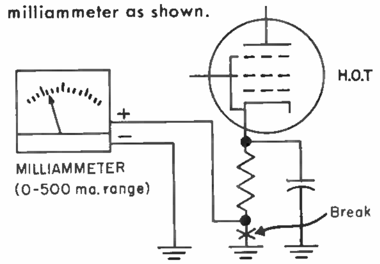
RCA-6DQ6-A—typical of RCA's excellent tube quality. Mount structure is designed to give maximum heat dissipation, prevent "hot spots" on the plate, allow cooler operation of the grids—help cut callbacks! Available at your RCA Tube Distributor.

RADIO CORPORATION OF AMERICA
Electron Tube Division **Harrison, N. J.**

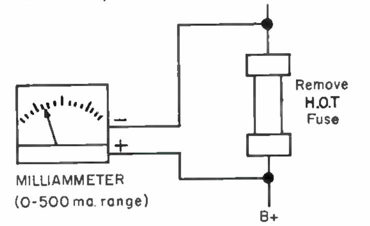
4 SIMPLE WAYS TO MEASURE "H.O.T." CURRENT



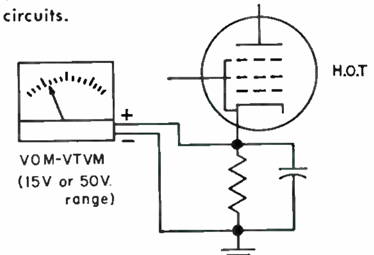
Disconnect cathode circuit at the "H.O.T." socket. Connect 0.47 μf capacitor and dc milliammeter as shown.



If "H.O.T." circuit has bypassed cathode-bias resistor, connect milliammeter as shown.



Remove "H.O.T." circuit fuse. Connect meter across fuse holder as shown. Indicated current will be slightly higher than actual cathode current because it includes boosted "B" current to vertical oscillator and/or other circuits.



Measure dc-voltage across "H.O.T." cathode-bias resistor. Voltage should not exceed value shown in service data for the set. Compute cathode current by dividing the voltage by the resistance.

TYPICAL RCA "H.O.T." TYPES	AND MAX.▲ DC CATHODE CURRENT (MILLIAMPERES)
6AU5-GT	110
6AV5-GA	110
*6AV5-GT	110
*6BG6-G	110
6BG6-GA	110
*6BQ6-GT	110
6BQ6-GTB/6CU6	112.5
*6CB5	200
6CB5-A	220
*6CD6-G	200
6CD6-GA	200
6DQ5	285
6DQ6-A	140
12AV5-GA	110
12BQ6-GTB/12CU6	112.5
12DQ6-A	140
17BQ6-GTB	112.5
17DQ6-A	140
*19BG6-G	110
19BG6-GA	110
*25BQ6-GT	110
25BQ6-GTB/25CU6	112.5
25CD6-GA	200
25CD6-GB	200
25DN6	200

*Discontinued RCA Type—Replaced by RCA "A" or double-branded version.

▲Values shown are measured with the receiver operating at a line voltage of 117 volts, 60 cycles.

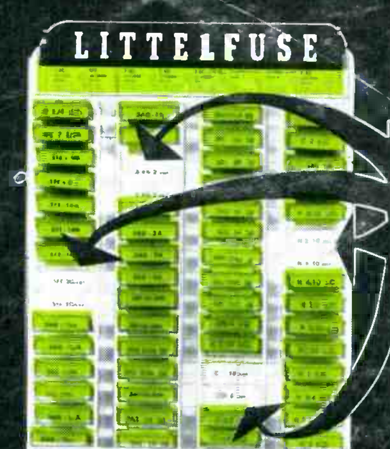
dealer-serviceman's fuse rack . . .

. . .for wall mounting

most needed

most wanted

. . . the FUSEMASTER!



dealer-serviceman's fuse requirements at a glance